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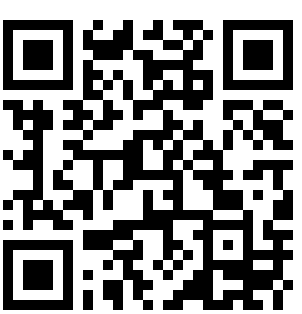

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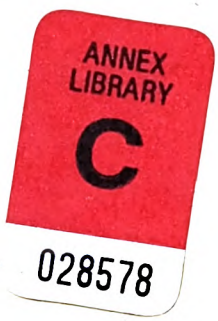

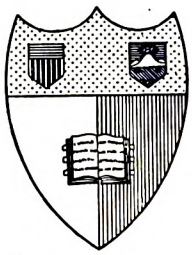

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Electrical World

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and Its Practical Applications

Volume LXXIII

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Electrical World

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The Outlook in Electrical Industry

THE rôle of the prophet is a very unsafe one and never more perilous than now when the world is emerging, gasping for breath, from the raging whirlpool of a colossal war. The Central Powers at the moment present no government with which any permanent peace can be made, nor any immediate prospect of such a government as will not be imperiled or overthrown by counter-revolutions to the utter demolition of its international agreements.

As a feature of the industrial outlook the fact arises that the world generally has been indulging in a wild orgy of monetary inflation. Each country, with Germany in the lead, has in effect pyramided in its finances, so that the net result is not very different from what would have been reached by the issue of very large amounts of irredeemable paper in quantity bearing some unknown and irregular relation to the funds which have been raised. Our own country, while more conservative than some others, has become a victim of the general tendency, with the result that prices of commodities and especially of labor have reached planes hitherto undreamed of, even in the wildest speculative days of the Civil War, when gold was on the rampage with quotations between 200 and 300. With the approach of peace and the return of millions to civil life or employments unconnected with war, the period of stabilization must necessarily be a hazardous one.

Under these circumstances the thing to be asked regarding the electrical industries is whether they are likely to ride on the crest of the wave or wallow in the trough. Our judgment, on the whole, is that the outlook is good rather than bad, for the fundamental reason that with all the changes in conditions electrical supply, which is the basis of the demand for electrical goods of every sort, has become steadily more and more necessary to whatever forms of industry may at any time be dominant. The mere fact that fuel prices are likely to remain high for a long time, and perhaps never sink to the pre-war plane, points to the growth of electrical supply in bulk as the remedy for high power costs. Throughout the course of the war the central stations have very generally been called on for output up to the limit of their production, output indeed demanded largely by war industries, but for this purpose withdrawn from its ordinary course of distribution. So far as electrical supply goes, it is the total quantity demanded which in the long run counts rather than any special distribution of this demand. Unless, therefore, there is a general collapse of industry, the supply stations will merely find that the character of their load will change without any serious shrinkage.

Another important matter is that war conditions have forced a great development of electrical supply in bulk and through the medium of widely extending interconnected networks. The establishment of supply in such wise brings with it an increasing opportunity for large and profitable use of electrical energy. As one of the by-products of war conditions, too, there has been a necessary slackening in general building operations. The stress now having been removed, builders will begin even at present prices to make up for lost time, bringing with their activities renewed electrical demands. And beyond all this there is the broad fact that anything which has the large and well-established economic value of electrical supply does not, even in hard times, suffer to the extent of industries less necessary in the world's affairs.

For some time there will be no inconsiderable opportunities for export trade in electrical equipment, because the element of time in deliveries will overweigh to a considerable extent the added costs of production in this country. Material must be had to reëstablish the equilibrium of the world's manufacturing, and when it cannot be obtained from one source it will be from another, even at added expense. For the larger use of electrical material therefore we have little fear.

Looking at the whole matter in a large way, it seems to us that the electrical supply industry, with all the ramifications of manufacture which that implies, is likely to push steadily ahead in spite of sudden upheavals in industrial life, at a good rate of progress. Now if ever is the time for commercial and engineering departments to busy themselves with adaptation to a change of requirements. All the multifarious branches of electrical manufacture which depend upon the central stations' prosperity are likewise due to advance with just the same qualifications here expressed. Only here and there will there be found lessened demand caused by changes that come with impending peace. These unfavorable situations will, on the whole, we think, be less numerous and serious than in most branches of manufacture. The safe course to pursue in the electrical industries at large is to drive along steadily on the theory that a greater need than ever for electrical help has been fully demonstrated, that rapid shifts in the nature of the demand may be fully expected, and that in this particular it is the spirit of quick adaptability that wins out—an adaptability which has never been lacking in electrical enterprises and will not be.

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Reawaken the American Mind

Need of Clear Vision with Our Thousandfold Increase of Responsibility in World Affairs—Let Us Demand Such a Degree of Excellence from Schools and Colleges as We Have Demanded in Industrial Achievements

BY B. A. BEHREND
Consulting Engineer, Boston

AMERICA is the country of achievement. It is perhaps more than a mere epigram to say that, while from England and France we have obtained ideas and inspiration, from the Germans methods, America has been the field of achievement. It is idle to repeat, as every one constantly sees the numerous superlatives in our industrial life—the greatest railroads, the greatest water-power development, the greatest power-transmission lines, the greatest electric generators, the greatest steel mills; but we may well add to it that in this war now at an end we have proved our warlike powers of achievement and we have raised a gigantic army in a stupendously short time, and an army of quality and individuality and manhood which it is the writer's firm conviction was not only the equal but the superior of other armies in the field.

America thus stands essentially for the idea of achievement and accomplishment of great tasks and problems, be it the achievement in popular government inaugurated by the founders of the Union and tested through the fires of civil war and again recently in a foreign war, or be it achievement in the industrial field.

We are told now that the world has entered upon an era of reconstruction, and it is probably only too true that Europe has crucial years to pass through; but it is not at all clear that such a period of economic reconstruction is at hand in this country. On the contrary, it is hard to see that the name of reconstruction can be justly adapted to the conditions before us. We have to make a shift from a country organized in an incredibly short time as a huge war machine to a country adapted to the pursuit of industry and trade.

So far as the author of this article is concerned, it seems to him that there is only one great issue which the country should carefully ponder, and this issue is not an industrial issue so much as it is the thought which, through an attitude of introspection, might suggest itself to a spectator.

On the founding of the great Johns Hopkins University in Baltimore in 1876 a great and brilliant Englishman was asked to deliver an address. From this address of Thomas Henry Huxley we quote the following lines:

> To an Englishman landing upon your shores for the first time, traveling for hundreds of miles through strings of great and well-ordered cities, seeing your enormous actual and almost infinite potential wealth in all commodities and in the energy and ability which turn wealth to account, there is something sublime in the vista of the future. Do not suppose that I am pandering to what is commonly understood by national pride. I cannot say that I am in the slightest degree impressed by your bigness or your material resources as such. Size is not grandeur, and territory does not make a nation. The great issue, about which hang a true sublimity and the terror of overhanging fate, is, What are you going to do with all these things?
>
> What is to be end to which these are to be the means? You are making a novel experiment in politics on the greatest scale which the world has yet seen. . . . Truly America has a great future before her—great in toil, in care and in responsibility, great in true glory if she be guided in wisdom and righteousness, great in shame if she fail. I cannot understand why other nations should envy you or be blind to the fact that it is for the highest interest of mankind that you should succeed; but the one condition of success, your sole safeguard, is the moral worth and intellectual clearness of the individual citizen.

"What is to be the end to which these are to be the means?" This is the question Professor Huxley asked, and it is, two score years later, the question which we all must ask. With the tremendous powers for good and evil which the people of this country possess, having been the arbiters of the world in the great war just at an end, it is a matter of the utmost importance that their vision be as clear and dispassionate as it is possible for the human mind to be, and such clear vision can be obtained only through the best possible instruction in our schools and colleges. In other words, as our capacity for achievement is greater than the capacity of achievement of any other country in the world, not even excepting Great Britain, our instruction and our intellectual clearness should be, to say the least, the equal of those of Great Britain.

If we apply this standard to the teaching in our universities in the particular field with which I may humbly feel acquainted, and in regard to which I may possibly utter competent judgment, one's verdict un-

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fortunately cannot be so favorable as it has been in regard to our power of achievement. No better minds, no greater individual energy, no greater assurance and capacity for digestion of learning exist anywhere in the world than in this country, and it is perhaps largely due to these great qualities of our people that we have so far been able to get along with methods of education and limitations of teaching which might have sent almost any other country to the poorhouse. As Lord Viscount James Bryce remarks in his "American Commonwealth," in speaking of Congressional finance, "Her wealth is so great, her revenue so elastic, that she is not sensible of the loss. She has the glorious privilege of youth, the privilege of committing errors without suffering from their consequences."

But our period of youth is not eternal, and our responsibility in world affairs has increased a thousandfold. The time may come, if it has not yet come, when we shall have to give a more thorough and sound training to our engineers in the advanced branches of science and engineering, not to mention the equally important branches of philosophy, history and law; when we must be able to point to American teachers in our universities of the caliber of Henry Bouasse, André Blondel, Paul Appell, Sir George Greenhill, Sir J. J. Thomson, John Perry, Horace Lamb, H. S. Hele-Shaw, A. E. H. Love—in short, that great host of brilliant French and English teachers to whose works we must constantly refer if we would understand our art and our science and make proper use of the great opportunities at our hand.

It is perhaps, as Prof. Vladimir Karapetoff once remarked to the author, asking too much to have embodied in one nation the greatest power for achievement and the leadership of science, but such a vision seems perfectly possible, and to all those who appreciate that possibility it becomes a passionate desire to see the names of American scholars and the authors of American works of science placed in the front rank with those of other nations for the safe guidance of this greatest of all commonwealths and for the glory of America, our country.

In this sense alone may we speak of reconstruction. Reconstruction with us is to be, outside of the adaptation to peace conditions with their consequent problems, a reawakening of the American mind to the tremendous obligations that for the next century America's holding of the balance of power in the world imposes upon American citizens and American statesmen. Let us turn to our schools and colleges and demand a degree of excellence such as we have demanded in our industrial achievements on the largest scale imaginable, with unparalleled and unexampled results.

Then, and then only, may we face the future calmly; thus, and thus only, can we merit our place as the arbiters of the world.

Planning for the Nation's Future

Place of the Pathfinders Is All-Important—Problem of Socialistic Institutions in a Democratic Society Is Yet Unsolved—Government Functions Should Be Evolved and Not Made Suddenly

BY W. L. R. EMMET
Consulting Engineer General Electric Company

THE war has caused an unprecedented manufacturing activity, mainly on lines very different from those of peace, and mainly conducted with very little reference to degrees of economy which could compete in peace times. The stoppage of this production—and much of it must be promptly stopped—will necessarily cause some idleness and confusion, and the high standards of cost which have been established will tend to discourage construction and to reduce the foreign demand for our goods. European nations, impoverished by the war and with depreciated currency, will produce for costs which on a gold basis are relatively very low, and thus forces will work to equalize the financial burden which the war has put upon others more than upon us.

Nevertheless, the channels of normal production have been dammed for two or three years and the pulses of our national energy have been stimulated by the activities of the war, so that it seems probable that we shall quickly return to a vast productiveness. To those who know the resources of science and mechanics reasons to justify a production beyond the scope of our population are always apparent. Every new accomplishment changes the balance, and economy constantly demands that old constructions should be replaced by new and that the scale of activities should be augmented.

It is in this pressing demand for progress that the engineer finds his inspiration, and the better the engineer the greater will be his belief in an endless need for the best engineering. Even bad engineering must

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be used because there is never a sufficient supply of good. To many all engineering looks good, and there are few people who receive more undeserved commendation than engineers. In reality much money and labor are unwisely spent on engineering activities and much is left undone which would be very profitable if wisely planned.

Science is always progressive, and progress brings joy and hope to mankind. The institutions and ideals of our country have, more than in other nations, stimulated men of imagination and given them ready opportunity in all walks of life. In our plans for the nation's future we should never lose sight of the need for constant progress or forget that in the bewildering demands of national life mere industry will not suffice, and that the function of the pathfinders is all-important.

The demands of the war have suddenly made necessary a vast increase of governmental activities. The railroads, the wires and the ships have been taken over. All the channels of trade have been controlled and directed, the food supply has been apportioned, and facilities for doing these things have in a few months been created and put into use. To those who have brought themselves to a belief in the socialistic idea of governmental operations of industry these are doubtless matters of confident satisfaction, but to those who believe that governmental operation is in the long run fundamentally uneconomical and unprogressive the situation presents grave problems. But whatever our beliefs may be, a little thought must convince us that, in peace as well as in war, the nation faces many great needs which far overreach the scope or desire of private investment and organization.

Great undertakings demand authority and resources, and for some of our requirements the national government constitutes the only adequate source. It should, however, be remembered that if the government plans and makes secure the financing of certain large enterprises, arrangements might be made by which construction and operation could, under suitable direction, be safely and profitably intrusted to private industry. The belief is quite common that government work is well done and efficient, and much is being published at the present time for the purpose of giving this impression. Credit for the products of private thought, invention and organization are constantly being claimed for the army and navy. Their efficiency is being offered and accepted as an argument for great extensions of government activity.

To those who know government service and private industry the fallacy of such ideas is apparent. Governmental service may have the advantage that it eliminates much that is wasteful in competition, but its great evil is that it largely eliminates the unrestricted competition of individual abilities, and this is the mainspring of progress. Government service, to be safe and honest, must be disciplined and regulated by law, while private industry is governed by trust between man and man, the only natural means through which scope and authority can be effectively apportioned to those who have the force, judgment and knowledge to accomplish and inspire confidence, not in the public, but in the few directly informed of the matter in hand.

Discipline is a great power, but it is distinctly blighting to the imagination, and if we would follow our democratic destiny to its fulfillment, we should use it sparingly and only for purposes where it is necessary.

The socialistic state which is being advocated by many who think themselves democrats is in reality the maximum of government, while true democracy is the minimum. The only success of the socialistic method has been in Germany, backed by an uninterrupted imperial appointing power and all the forces of caste and authority. The idea that it has been truly efficient there is in many respects very incorrect, and we should remember that it has materially helped to lead to the greatest national mistake of history.

The problem of socialistic institutions in a democratic society is as yet unsolved, and governmental functions should properly be evolved and not made suddenly out of the whole cloth. No one is wise enough to embark a nation safely on radically new courses.

These matters are at the present time of vital interest to the engineer. If the government confines its activities to planning, promoting and helping to organize the great activities for which there is such demand, opportunities will be expanded. If, as has been announced by some of its highest officials, it is to own, operate and appoint to the exclusion of private enterprise, America will no longer afford the field for the engineer and inventor which it has in the past. Fortunately, we have good reasons to believe that the American people will in such a great matter do what is wise and expedient, and it may be hoped that, notwithstanding great governmental activities in the regulation of our national affairs, we shall continue to be the most individualistic people in the world. The aim of the socialistic idea is shelter for the incompetent, and that of the individualistic is opportunity for the able. Can we doubt which will best conduct to the advance of a democratic state?

OUT of the war necessity there came a new application of efficiency in dealing with national affairs. As we now face another transitional period—the period of demobilization and reconstruction—we must as a nation prepare to meet its problems in the same intelligent manner in which we dealt with mobilization. We shall need federal administrative agencies to plan industrial return from a war to a peace basis, to direct the order and the progress of the transition. The way in which we meet this problem will determine our progress in the years to come. Great economic advantage awaits the nation that can quickly enter the world's markets with the products of normal commerce. The nation that succeeds will be the nation that wisely directs return to peace production and that avoids friction between labor and capital. Friction can be minimized by providing such standards of working conditions as will insure understanding and coöperation between all persons concerned in the processes of production.—*Grant Hamilton, Director-General of the Working Conditions Service, Department of Labor.*

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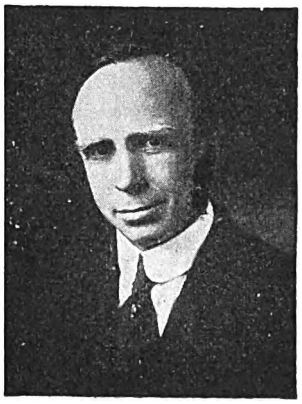
Manufacture of Power Apparatus in 1919



Desirability of Close Co-operative Working Relationship with Government—Need of Foreign Outlet—Efficiency of Labor Should Increase—No Reduction Expected in Electrical Apparatus Prices Until Raw Materials Are Cheaper

BY CLARENCE L. COLLENS, 2D
President Electric Power Club

THE War Industries Board has proved during the past year the practicability and desirability of a close coöperative working relationship between government and organized industry. Fortunately, the lessons learned will not be entirely lost, and a further opportunity to demonstrate the advantages of such a relationship will be afforded in the Department of Commerce under the plans announced by Secretary Redfield at the recent war emergency and reconstruction conference at Atlantic City. Secretary Redfield has appointed fourteen men from the organization of the War Industries Board to become his personal industrial advisers and to assist in continuing and further developing close coöperative relations between industry and government.

It is hoped that this new coöperative relationship will develop along economic lines, such as continuing the work of conservation and standardization, which has been so efficiently handled by the Conservation Division of the War Industries Board, and will also promulgate policies which will assist in fortifying business in this country against foreign competition in world markets.

The results obtained by organized industry during the last two years are also bringing an enlightened public opinion toward trade organizations in general and the desirability of close coöperation between business men under government supervision. Much can be done by coöperative effort and concerted action on the part of competitors, which is in the public interest and produces economic benefit to all concerned. Eliminating unnecessary styles, sizes, types, finishes, etc., is a good example of economic benefit both to the consumer and to the manufacturer. I do not believe that the American public will long be satisfied without some modification of the Sherman anti-trust law which will permit, under proper government supervision, concerted action and agreements among manufacturers or business men to the extent that such action is in the public interest, will stabilize business, eliminate destructive, wasteful competition, remove unnecessary financial risks, conserve labor, materials or capital employed, and promote giving the greatest service in the most efficient, most economical manner.

During the next year this country faces extensive liquidation in almost every line of endeavor, and close coöperation between organized industry and government will be necessary to reach equitable solutions. The government now has on hand, and will not require, machine tools purchased at high prices which aggregate four years' normal output. We have developed our productive capacity in this country up to a point where in four months we can produce what is necessary for home consumption, and in order to utilize fully the plant capacity and labor available we must find an output in foreign markets for the additional eight months' output. We cannot do this without a merchant marine, and yet the merchant marine which we are now building is costing $200 per dead-weight ton, as compared with a cost of $50 to $70 per dead-weight ton in other countries. Our seamen's laws require American crews, which means operating costs many times that of other nations. In order to maintain itself, a merchant marine must be able to justify itself from an economic standpoint, and we shall be unable to do this without material liquidation in the first cost of the ships and a revision of the existing seamen's laws.

The government has purchased the entire stock of raw wool in this country at from 60 to 70 per cent higher prices than are now being quoted. Moreover, the government is under moral obligation to purchase the entire wheat crop, which is the largest in the history of our country, at $2.25 per bushel, whereas foreign wheat, of which there seems to be a considerable supply, is being now quoted at $1.40 per bushel. All of these items mean heavy losses which must be assumed by the government and which must finally be absorbed by taxation.

In the field of electrical apparatus no reduction in prices can be made until there is some change in the rate of wages paid and the cost of raw materials used. It is exceedingly doubtful whether any material reduction in these factors can be expected for some time. Since 1914 the price of electrical apparatus has increased approximately 70 per cent, whereas the rate of wage and the cost of the principal raw materials used has practically doubled. Labor has decreased,

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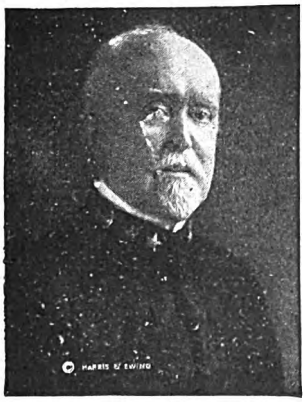
rather than increased, in efficiency during the period of the war. The labor turnover has increased very materially. Provided that business is maintained, the present labor turnover will easily permit each organization to absorb the men who were drafted into the service, which will automatically eliminate some of the present shifting, inefficient labor. Any change in the rates of wages will be a last resort and can only be equitably effected with material reductions in the cost of living. Every effort will doubtless first be made to offset present wages by increased efficiency.

The price of copper, one of the principal raw materials, has been under government control, and has not decreased with the release of that control.* The iron products used have also been largely under government control, and it is only necessary to remember where prices were before government control to judge whether with business above normal for the year 1919 any reduction in the cost of raw materials can be expected. Many projects are at the present time being held off for lower prices, and in certain fields of manufacture lower prices can certainly be expected where there has been inflation during the period of the war out of proportion with the increased cost. In the case of electrical apparatus, however, no reduction can be expected until there are material reductions in the cost of raw materials, but for the reasons stated this seems exceedingly doubtful.

Electric Propulsion on the New Mexico



REAR ADMIRAL GRIFFIN

Rear Admiral Griffin of the Navy Department Says that the New System of Driving Warships Is Adopted as a National Policy, and that Great Britain and France Will Probably Follow the American Lead

BY WINGROVE BATHON
Washington Representative ELECTRICAL WORLD

INTERESTING details concerning the system of electrical propulsion in use on the new battleship New Mexico have been furnished to the writer by Rear Admiral R. S. Griffin, chief of the Bureau of Steam Engineering of the United States Navy, in a recent interview in Washington, and as a result of the standardization trials of the warship, held off Rockland Breakwater late in December, Admiral Griffin predicts that the navies of Great Britain and France will follow the American lead in propulsion in future warships. Admiral Griffin also formally announced in this interview that ten other capital ships of the United States Navy now appropriated for will be electrically propelled.

"Great Britain and France," Admiral Griffin said, "have not yet tried electric propulsion in their navies, but when Sir Eric Geddes and his party, representing the British Admiralty, were here recently they were very much interested in the New Mexico, and after they saw the ship in operation they were much impressed, although the British are conservative and have always been cautious in taking up new ideas. The French have been much interested too. I do not, of course, know the naval policies of those countries, but I do not see how any one can fail to realize the great advantages electric propulsion of warships offers, and I predict that both countries will adopt the new system."

In the annual report of the Secretary of the Navy, recently quoted in the ELECTRICAL WORLD, it was stated that it was to the vision and wisdom of Admiral Griffin and his assistants that the world owes "this successful revolution in the propulsion of the biggest fighting ships." In Admiral Griffin's mind, and in the minds of his assistants, following the building and operation of the electrically propelled collier Jupiter, there has never been the slightest doubt as to the success of electrically propelled fighting ships. Questions of speed and maneuvering enter into the building of fighting ships which do not enter into the building and operation of colliers, and on the question of speed alone, when the New Mexico was put through her standardization trials off Rockland Breakwater, Dec. 18, 1918, she made 21.33 knots, although it was only guaranteed that she should made 21 knots. In Admiral Griffin's office it was afterward naïvely remarked:

"Every one expected the ship to make more speed than required. If she had not made more speed than required, she would have been a failure."

As a result of the success of the New Mexico, there are to be, now appropriated for and without taking future naval programs into account, six battleships and five battle cruisers equipped for electrical drive. The battleships are to have a guaranteed speed of 21 knots and the battle cruisers a speed of 35 knots. Both classes will do more, it is expected, than required. Including

*Since this was written by Mr. Collens the Copper Export Association, Inc., has fixed the price of 23 cents a pound for export copper, from Jan. 1, 1919.—Eds.

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the New Mexico and excluding her sister ship, the Idaho, which is not to be electrically propelled, so as to offer opportunity for comparisons, the following are to be the new electrically propelled battleships: New Mexico, built at the New York Navy Yard; Tennessee, building at the New York Navy Yard; California, building at the Mare Island Navy Yard; Colorado, building at the yards of the New York Shipbuilding Corporation; Washington, building at the same yards; Maryland, building at the yards of the Newport News Shipbuilding & Dry Dock Company. The electrically propelled battle cruisers and their builders are: Lexington, Fore River Shipbuilding Corporation; Constellation, Newport News Shipbuilding & Dry Dock Company; Ranger, the same yards; Saratoga, New York Shipbuilding Corporation, and Constitution, Philadelphia Navy Yard.

MACHINERY TO BE MODEL FOR OTHER SHIPS

In general it may be stated that the machinery of the New Mexico will be used as the model for the machinery for the other ships. The New Mexico has two turbo-generators, good for 11,000 kw. each, and four 7000-hp. induction motors. These motors are arranged for pole-changing, with a twenty-four-pole arrangement at high speed and thirty-six for anything below 15 knots. The generators are arranged for 4442 volts when running with both generators and 3000 volts when running with one generator. A double-throw switch is provided so that a high-voltage or low-voltage connection can be made depending or whether two or four motors are being operated. The generators are two-phase, high voltage being obtained with a square arrangement of winding and low voltage with a parallel or diametrical connection. The latter gives increased current rating of the generator when running four motors. When the ship is running with one generator feeding all four motors at low speed high voltage is not wanted; but, on the other hand, when each of the four motors is receiving current from the same generator a large current capacity is required, and this condition is met by the described change in the windings, which arrangement is said to be ideal, because under it there is given a desired reduction of voltage as well as increased current capacity at the same time.

The main turbo-generator sets are installed in rooms outboard of and alongside of the center engine room. The two outboard motors are in rooms just abaft the generator rooms. The two inboard motors are in the center engine room, just abaft the switchboard.

Most of the switching is mounted on one structure in the center engine room. The exceptions are the generator disconnecting switches and the generator field switches. The generator disconnecting switches are installed on the two bulkheads of the center engine room, and the generator field switches are installed on the direct-current exciter switchboard, also in the center engine room.

The switches on the structure in the center engine room are the pole-changing switches for the motors, the reversing switches for the motors and the disconnecting switches for the motors. The disconnecting switches are simple knife switches at the top of the board and are not intended to open live circuits. They are only there in order to cut out a motor in case the room should become flooded from torpedo or mine attack. The generator field is always opened and the current allowed to die out before opening any of these switches. The bus-tie switch, which allows one generator to operate all four motors, is the same type of switch and is installed at the top of the switching structure in the center. The pole changing and reversing switches and the field and speed and steam-limiting switches are all in front of the switchboard structure and constitute the operating gear.

The reversing and pole-changing switches are capable of opening live circuits, but, owing to the method of operation, they are normally opened and closed on circuits with very little current in them. The reason for this is that before any switches are moved the field of the main generator is opened, thus allowing the current to drop in the main circuits, and none of the operating switches are moved until the current in the system has dropped to a predetermined amount which is determined by an underload current relay.

The speed adjustment, aside from changing from low speed to high speed, which is accomplished by pole changing, is effected by regulating the speed of the turbine, or, in other words, by changing the frequency of the generator. When it is desired to vary this speed the setting of the governor is altered by the speed lever on the front of the switchboard. For each setting of the governor there is a corresponding setting of the steam-limit lever, and this limits the amount of steam that the turbine can take for any setting of the governor. This steam-limit lever is necessary for use in connection with turning the ship. When the ship turns, if the governor were allowed to keep the turbine running at the same speed, an enormous increase in power would be required; but the steam-limit lever will allow only a certain maximum amount of steam to go into the turbine, and after this amount has been reached further demands for power are met by the turbine automatically slowing down.

Excitation for the main generator field is furnished by two 300-kw. non-condensing sets which exhaust into either the fifth or the eighth stage of the main turbines, with a by-pass to the main condenser for use in starting up, or when all power has been taken off the main turbine. This field current is supplied through a small booster set which is used to vary the voltage of the 300-kw. machines, thus giving the desired current in the generator field.

The remaining power of the 300-kw. machines is used for running the main engine auxiliaries and ventilator blowers for the main motors. All of the main engine auxiliaries and the 300-kw. exciters are in the center engine room.

The electrical equipment of the New Mexico was manufactured by the General Electric Company, which proudly terms the war vessel its "baby ship."

TEN MORE CAPITAL SHIPS TO BE EQUIPPED

The success of the New Mexico's machinery, and the fact that electrical propulsion machinery for ten other capital ships is now about to be built under the direction of the Bureau of Steam Engineering, has given rise in Washington to the idea that there should perhaps be created a separate bureau in the Navy De-

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partment to deal with electrical matters, or, if not, that the word "electrical" should be incorporated in the title of the Bureau of Steam Engineering.

Approximately $20,000,000 was expended by the bureau for electrical purposes during the past year, and no annual report of any bureau or department in Washington contains as many details concerning electrical machinery, material and personnel as that of Admiral Griffin. The field of expenditure and invention under Admiral Griffin has comprised generators, lighting systems, telephones, searchlights, electrical installations in submarines and naval aircraft and the development of all electrical anti-submarine and anti-aircraft devices, including detection devices. The electrical fire-control systems on all battleships and smaller ships, as well as electrical communication systems for the service of guns on ships, have been remodeled and improved during the past year, and Admiral Griffin's bureau has been responsible for more than 4000 radio installations. More than 100 graduates in electrical engineering were enrolled under the bureau during the past year and have been serving as reserve officers.

Outlook for Jobbing in New England

Prospects Give Reason for Optimism—Buying Power of the General Public Greater than Ultra-Conservatives Appreciate, and Civilian Business Should Increase Steadily as Government Consumption Declines

BY HANSON M. SAVAGE
Wetmore-Savage Company, Boston, Mass.

THE outlook for the new year in New England jobbing circles gives reason for optimism. With the war behind us, the manufacturers in better condition than for many months to meet the requirements of the civilian market, and the jobbers well prepared to handle a large business on the basis of immediate deliveries in many lines of material, trade ought to do well in 1919. Stocks of lamps, motors, wiring material and electrical conveniences are in excellent shape, and the buying power of the general public is greater than many ultra-conservatives appreciate.

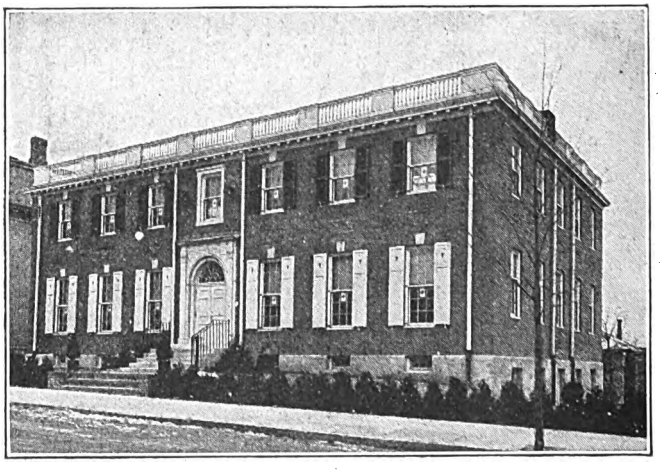
The expectation is that the amount of government business placed in the hands of the jobbers will fall off rapidly this year and that civilian business will increase month by month. Whether prices fall materially or not, a large trade must be handled to supply the needs of the 110,000,000 people of this country, including the extension of electrical service in both old and new fields. Whether prices change much or not, jobbers will be in the market in the near future to replenish stocks at present short or to replace material which will soon be called into use by the demand for increased electrical service.

Active canvassing of the New England territory is under way (some of the more progressive houses have kept their field forces at work all through the war period), and intensive solicitation of new business is the order of the day. It does not seem likely that the central stations long can defer the extension of their lines into many hitherto unoccupied fields. Deliveries are showing considerable improvement as the new year begins, and it is expected that this favorable condition will continue, barring occasional delays in shipment and transit due to winter interruptions of rail or water service. I have already referred to the fact that the manufacturers are in excellent shape to meet domestic orders. The contractors are being called upon more and more to prepare estimates for construction work, which is a good sign.

While high prices of labor and material tend to hold back building construction at this time, it looks as though there would be a gradual increase in such work even in the face of high prices, and the electrical industry will accordingly share in the benefits of this.

A word as to the services of the jobbers during the war. The electrical supply jobbers have performed patriotic and efficient work; their coöperation has been most helpful in speeding up deliveries of supplies needed in the production of war material and in observing the priority requirements. Without the jobbers' help many war plants would have been badly handicapped in reaching a mass production basis, and it is not too much to say that the jobber was an important factor in the successful termination of the war in 1918. Our men are being welcomed back from the service into an industry bright with promise and based on fundamental necessities of civilization.

A Well-Conceived Utility Office Building



Architecturally harmonious with its surroundings, the recently completed general office building of the New England Power Company, Worcester, Mass., occupies a site on a fine old residential street within a couple of blocks of the business district. The new home of the company is 70 ft. long by 45 ft. wide, comprises two stories and a basement and houses about seventy persons. It includes offices for the general manager, engineering and operating officials, a drafting room, blue-print room, meter laboratory, and quarters for the accounting, legal and other departments.

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New Multiplex System of Telephony

Developed After Several Years of Effort, It Will Increase Manyfold the Message-Carrying Capacity of Long-Distance Telephone and Telegraph Wires—Suggestive Value of Earlier Undertakings in This Field

A NEW multiplex system which marks an epoch in the development of long-distance telephony and telegraphy is the most recent practical application of the work of the technical staff of the Bell system, and was announced on Dec. 11, 1918, by Theodore N. Vail, president of the American Telephone & Telegraph Company.

The new system of multiplex telephony and telegraphy has been invented and developed after several years of intense effort, and by its use it is now possible to increase manyfold the message-carrying capacity of the long telephone and telegraph wires. The system has been in actual use between Baltimore and Pittsburgh for more than two months now with entirely satisfactory results.

On Dec. 9 Mr. Vail, accompanied by a party of distinguished government and telephone and telegraph officials, made an inspection of the system at Baltimore and a test of the service provided by it between Baltimore and Pittsburgh. The party was unanimous in its appreciation of the skill which had been shown in developing the new system and of the success of its operation.

Permits Five Conversations on One Circuit

The new multiplex system permits four telephone conversations to be carried on simultaneously over one pair of wires in addition to the telephone conversation provided by the ordinary methods. That means that over a single circuit a total of five telephone conversations are simultaneously transmitted, and in each the service is as good as if the circuit was carrying, in the ordinary way, a single conversation.

A number of years ago the Bell engineers developed the "phantom-circuit" arrangement by which telephone circuits are obtained from two pairs of wires. This is an improvement and has been extensively used, but heretofore it has been impossible to carry over a single pair of wires more than one telephone conversation.

Now it is possible by the multiplex method to utilize a single pair of wires for five conversations, while two pairs of wires, which heretofore had a maximum of three conversations with the aid of the "phantom," may now be multiplexed to carry ten simultaneous conversations. This amounts to an increase of more than threefold in the telephonic carrying capacity of the wires as compared with the best methods previously known to the art, and an increase of fivefold in the capacity under conditions where the phantom circuit just alluded to is not employed.

The new multiplex system makes use of alternating currents whose frequencies occupy a range between the frequencies of the ordinary telephone currents, which are those of the human voice, and the lowest frequencies which are used in wireless communication. This frequency range has not heretofore been commercially used. It is interesting to note that under favorable conditions the whole range is audible to many and the lower part of the range is audible to any one with normal hearing. It is found that frequencies within this range are high enough to be used as "carriers" of ordinary telephone currents and yet with proper arrangements can be transmitted over long telephone lines without the large transmission losses and large interference between circuits which would be brought in by higher frequencies.

Each additional circuit in the new system makes use of some frequency within this range. At the sending end of each circuit the ordinary telephone currents are made to modulate this "carrier" frequency so that the amount of carrier frequency sent out on the line varies with the amplitude of the ordinary telephone currents. At the receiving end the carrier current is put into a demodulating circuit which then gives out the original telephone current.

The different circuits are kept separate at each end by inserting in each circuit a combination of impedances which make up an electrical "filter." This transmits the range of frequencies peculiar to that circuit and stops all other frequencies. An important difference should be noted here between this system and wireless systems in that in wireless working it has been generally sufficient to send and receive in "tuned" circuits. In the multiplex system, however, tuned circuits would not be sufficient since each telephone channel occupies a range of frequencies of about 2500 cycles and any circuit tuned to these comparatively low frequencies would be too selective to receive such a range in the proper manner.

Vacuum tubes are used in the modulating and demodulating circuits and are also used as amplifiers in the transmitting and receiving branches and at intermediate points along the line where necessary to prevent the currents from becoming too highly attenuated.

Illustration of the Underlying Principle

The underlying principle may be illustrated by considering a composite photograph of five individuals. Given such a composite photograph of the ordinary kind, it would obviously be impossible to derive from it the picture of each of the five individuals going to make it up. If, however, the composite photograph had been made up in five different colors, the picture of each individual being in a different color—say, one red, one blue, one green, one yellow and one violet—it would then be possible by looking at the picture through colored glasses to see any one picture separate from the others. If red glasses were used, the picture printed in red only would be seen, if blue glasses the picture in blue, etc., although when looking at it in the ordinary way all of the pictures would be seen together and only the combination would appear. As the tint of each picture serves as a means of differentiating it from the others, so the frequency of the carrier currents serves to dif-

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ferentiate each of the conversations in the new telephone multiplex.

Sensational results have also been attained in telegraphy by the new multiplex system. A single pair of wires combined into a metallic circuit of the type used for telephone working will, by the application of the Bell system's new apparatus and methods, have an enormously increased capacity for transmitting telegraph messages.

As applied to high-speed printer systems the engineers find they can do eight times as much as is now done, and as applied to the ordinary duplex telegraph circuit in general use, they can do ten times as much. These increased results are attained without in any way impairing the telegraph working.

Moreover, the nature of the developments permits the same wires to be used partly for telephone and partly for telegraph purposes. This means that a pair of wires is available either for five simultaneous telephone

MAJOR-GENERAL SQUIER

conversations or for forty simultaneous telegraph messages, or partly for one and partly for the other.

The technical staff of the Bell system has acted as an organization in working out these developments, which are the outgrowth consequently of combined inventive and engineering skill of hundreds of scientific men. It is impossible to name any one man who is even entitled to the major part of the credit for the work. However, without detracting from the credit due to any one, there are a few whose contributions are more distinctive. They are O. B. Blackwell, G. A. Campbell, H. S. Osborne, J. R. Carson, Lloyd Espenschied, H. A. Affel and John Davidson, Jr., of the engineering department of the American Telephone & Telegraph Company, and E. H. Colpitts, H. D. Arnold, B. W. Kendall, R. A. Heising, H. J. Vennes, E. O. Scriven and H. F. Kortheuer of the engineering department of the Western Electric Company, the manufacturing division of the Bell system.

The work was under the executive direction of Col. John J. Carty, chief engineer, and Bancroft Gherardi, acting chief engineer of the American Telephone & Telegraph Company, and Frank B. Jewett, chief engineer of the Western Electric Company.

There have been numerous attempts by inventors, scientists and engineers from the earliest days of both the telegraph and the telephone to develop methods for the multiplex transmission of messages. Dr. Alexander Graham Bell was working on the problem of multiplex telegraphy when he had his first conception of the structure of the original telephone. It is significant that the Bell system organization, which has been and is working continuously to perfect the telephone and extend its usefulness, has accomplished not only multiplex telephony but multiplex telegraphy, Dr. Bell's unsolved problem of forty years ago.

BENEFIT FROM EARLIER INVESTIGATIONS

Notwithstanding the fact that there were no conclusively practical results from the early efforts in this direction, it is nevertheless true that some of the undertakings of the earlier workers in this field have been of suggestive value at least in the working out of the problem. As an instance, there is a suggestion made by Major General George O. Squier, Chief Signal Officer of the United States Army, about ten years ago which attracted very general attention. Likewise, Dr. Lee De Forest, working in entirely different fields and with a different objective, a number of years ago invented a wireless device known as the audion, which by the improvements and adaptation of the Bell system engineers has been made an important part of the system.

While the new multiplex system is physically adaptable to short lines, from the nature of the apparatus and methods employed it is not practically advantageous on lines of much less than 100 miles. On longer lines its application will be extended immediately, but its introduction must necessarily be gradual on account of the nature of the apparatus required and the rearrangement and adaptation of the lines themselves and their associated apparatus to the new methods of working.

The new multiplex system as it is now applied to the telephone is a means of increasing or multiplying the transmitting capacity of long lines, requiring no change in the subscriber's telephone or in the terminal switchboard operation. It is quite as applicable to transcontinental lines as to any other long-distance service.

I AM quite certain that it would be improper for America even to consider the proposition of contributing to the world police a number of units smaller than that contributed by the greatest other power. It seems to me that this is obviously the American duty and that the other nations of the world would be justified in regarding us as shirkers if we failed to accept the burden of it cheerfully and turn to the performance of it with an unexampled earnestness and high efficiency. It would be contrary to all our traditions and all our ideals to assume that in the planning of a new and mighty navy America could be animated either by fear or by the intention of aggression.—*Secretary of the Navy Daniels.*

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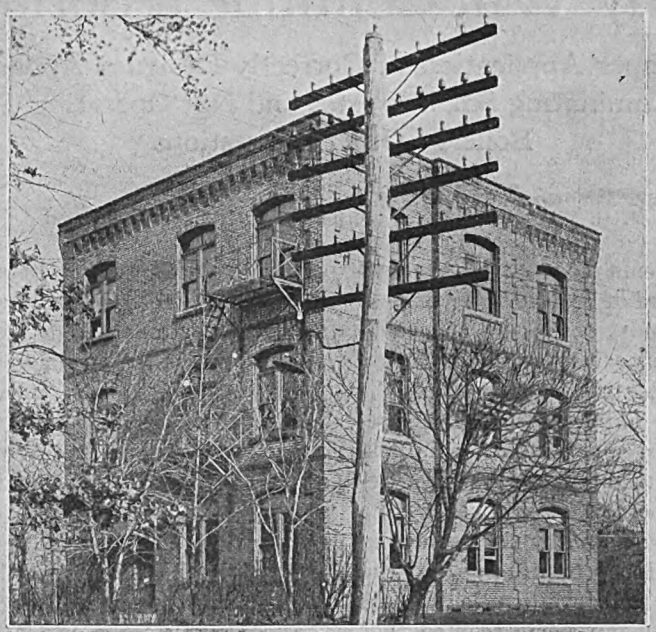
Left to Right Standing–

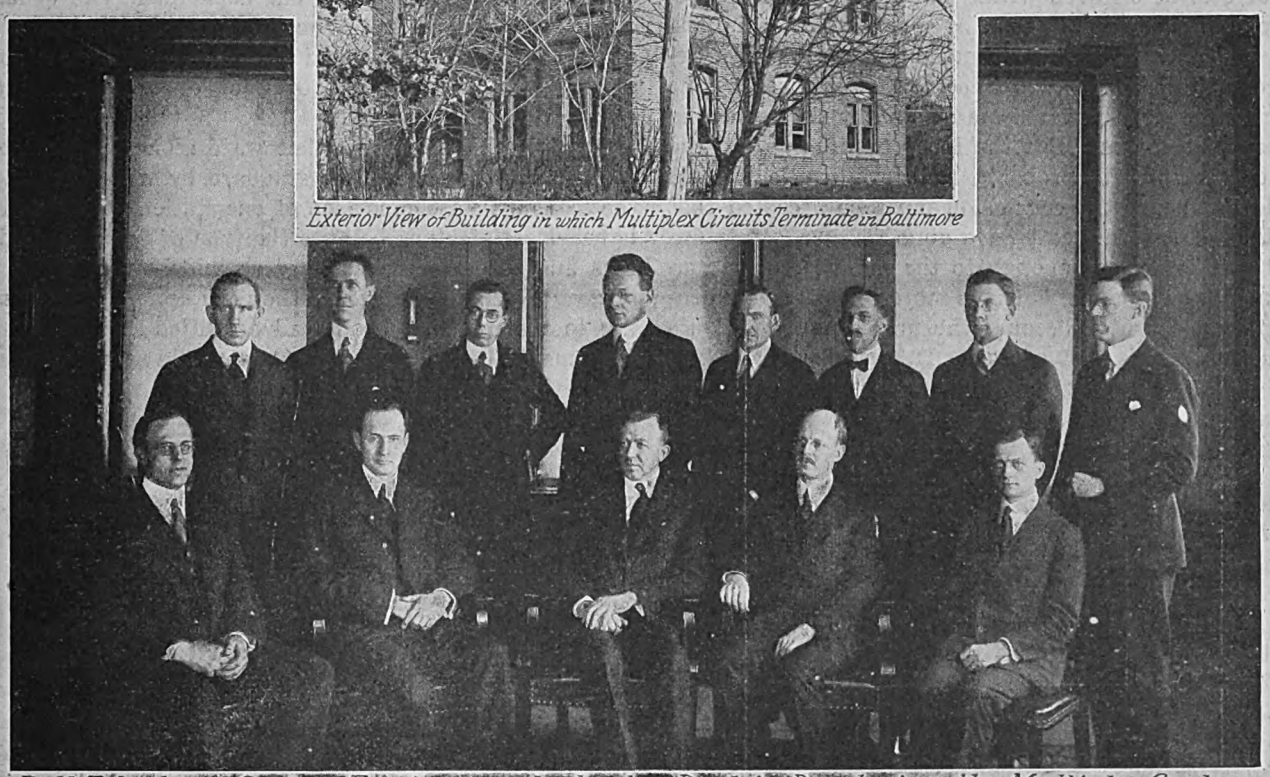
H.J. Vennes,
E.O. Sciven,
Lloyd Espenshied,
H.A. Affel,
H.F. Kortheuer,
J.R. Carson,
R.A. Heising,
John Davidson.



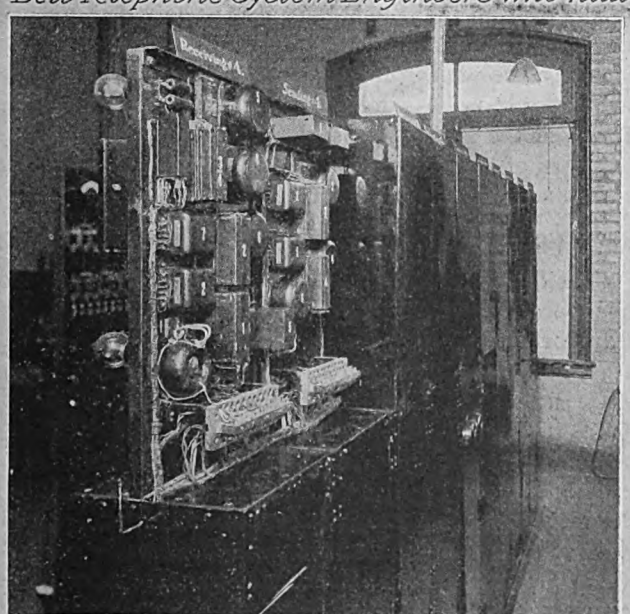
Exterior View of Building in which Multiplex Circuits Terminate in Baltimore

Left to Right Seated–

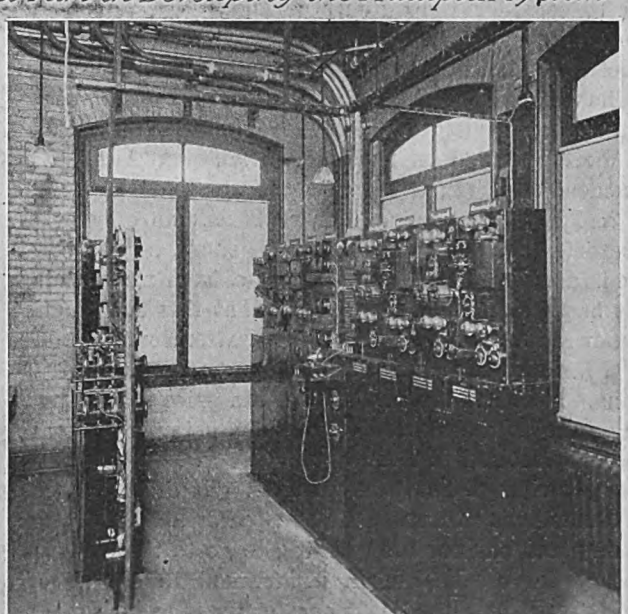
H.D. Arnold,
O.B. Blackwell,
E.H. Colpitts,
B.W. Kendall,
H.S. Osborne.



Bell Telephone System Engineers who had a Part in Developing the Multiplex System



Back View of Multiplex Rack with Covers Removed



General View of Multiplex Apparatus

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Fuel Economy Will Continue a Serious Problem

Can Be Improved by Proper Application of Correctly Designed Apparatus, Maintaining High Vacuum, Eliminating Small Wastes and Not Operating Too Many Boilers—Other Suggestions

BY W. A. SHOUDY
J. G. White Engineering Corporation, Mechanical Division

ONE of the serious problems confronting the central stations in this period of readjustment is that of fuel economy. The most optimistic of prophets do not expect to see in the near future a reduction of fuel cost that will be sufficiently great to bring the cost of coal or oil even within hailing distance of prewar prices. That there may be some reduction is possible, since the excessive demands upon the fuel resources of the country will be somewhat lessened by the reduction of strictly war demands and by the reopening of European mines. But the labor of mining and the cost of freight will probably never return to the old standards; hence the conclusion must be accepted that the days of low fuel cost have gone forever. This unusual cost is serious enough to the manufacturer generating his own power, but it is more serious to the central-station operator because the major portion of his production cost is that of fuel. If, therefore, power is to be sold at low rates, the fuel cost must be reduced or the margin of profit wiped out.

Fuel Waste a National Crime

The small attention that has been paid to fuel economy in the past years, with the resulting excessive waste of fuel, has been a national crime. Fortunately the central station carries less blame than do the other users. Such attention as has been paid to the subject has been principally in this industry—first, because fuel cost has been so large an item in the total, and, second, because those in charge have been more conversant with the subject and therefore could give it more careful attention. The manufacturer has steadily refused to consider the subject seriously and has been content so long as the cost did not rise and so long as production was not lessened. The design of his power plant has usually been based upon minimum first cost, and his operating engineers have been chosen as if they were merely skilled laborers and often paid less. He has seldom encouraged them in the study of improvement and has spent money for replacements only as a last resort, and then grudgingly. In short, he has considered fuel cost a necessary evil of a fixed magnitude, and it has seldom entered his head that this evil might be somewhat mitigated by intelligent attention.

To a limited extent this is also true of some central stations. Fuel has been cheap and the price stationary. An increase in the station output or an improved load factor has resulted in a lower cost per kw.-hr. Because this slight change has been in the right direction the management has assumed that no further attention was necessary and has not been willing to go to the expense necessary for establishing a department in charge of economy until increased cost has forced it to do so. It has lost sight of the fact that the cost of such a department is fully justified even though the station has been generally well managed, because the highest economy can never be reached without such help and the fact that such a department exists acts as a stimulus to the operating force. Stations of very small capacity can seldom justify a department for each station, but by grouping a number of small stations one department can usually effect great economies. When such small units are separately owned and operated the employment of a consulting engineer is the equivalent of establishing an economy department.

Possibly this false attitude toward economy exists because there is generally no standard by which to judge the economy. A comparison of one station with another is never satisfactory because the type of equipment differs and load conditions vary so widely that there is always the chance to excuse the poor economy by pointing to the unusually bad load conditions or inefficient equipment. In fact, some stations would soon lose their reputation for economy if it were known how far from their true standard they had strayed.

The first step toward economy is to use correctly designed apparatus, but even with this the degree of economy obtainable is determined by the care with which the equipment is applied. Once installed the apparatus will give the best results only if the following rules are observed:

1. Maintain as high a vacuum as conditions permit.
2. Carry no more boilers on the line than continuity of service demands.
3. Watch for the small, generally neglected wastes.

The three foregoing rules are much more important than they may appear on first reading because for the efforts exerted the benefits are largest and because work along these lines may be started before standards of economy are set. Furthermore, observance of the first two rules can be easily checked by the management. To reach the highest pinnacle of economy some goal or standard of economy must be set toward which to work and to serve as a gage of results.

Relation of Fuel Economy to Successive Processes

Considering the three steps in the generation of electric power by steam—(1) generation of steam, (2) transformation of the steam energy into mechanical energy, and (3) conversion of the mechanical energy into electrical—there is little opportunity of effecting economies in the third step in an existing station. This is so because the efficiency of electrical generators is not greatly affected by changes in operating conditions. In the second step, however, careless operation may seriously affect economy, and in the first the opportunities for waste are so vast that they must be watched with the greatest care. The electrical end may therefore be passed by in this discussion and attention confined to the turbine and boiler rooms.

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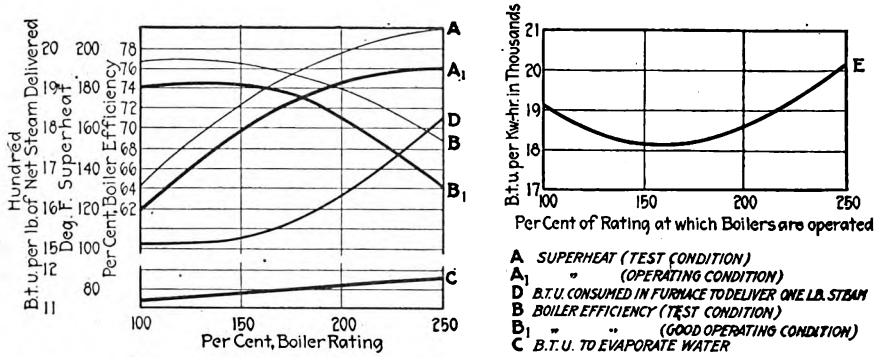
In the turbine room there is comparatively little that can be done to improve economy except to keep the apparatus in repair and properly distribute the station load over the several units. If these units and their auxiliaries are in good condition and the load properly distributed, there remain but three items that may affect the economy in this depatment, viz., steam pressure, superheat and vacuum.



FIGS. 1 AND 2—RELATIONS BETWEEN SUPERHEAT, BOILER EFFICIENCY, B.T.U.'S PER POUND OF STEAM AND PER KILOWATT-HOUR AND THE PERCENTAGE OF RATING AT WHICH BOILER IS OPERATED

The steam pressure seldom needs special attention because the operators have become accustomed to keep a constant watch on the pressure gage and permanent records can be easily kept with a simple recording gage. It is often given too much attention since such variations as are likely to occur in a modern plant are so small as to be negligible. So long as the minimum pressure is that for which the turbines are designed, a variation of 10 lb. or 15 lb. will not affect the economy as much as a variation of 0.25 in. (6 mm.) in the vacuum. However, it is advisable to give the steam pressure some attention because of the psychological effect. Carelessness in this respect may affect the whole morale of the operating force.

In existing turbine stations the highest superheat that is economically obtainable from the equipment is desirable inasmuch as it has a direct effect on the steam consumption of the turbine and steam-driven auxiliaries. Unfortunately the degree of superheat is not readily controlled because American superheaters are built into the boilers and are not independently fired. Hence the degree of superheat varies with the rate of forcing the boilers. If the superheaters are clean and in good repair, about the only means of varying superheat is by varying the boiler loading. To maintain a constant superheat the boilers must be operated at a fixed rating. Since the station load varies widely, this can only be done by cutting boilers on and off the line as the load varies. However, an increase in superheat is not an unadulterated benefit because the increased temperature is obtained at the cost of a reduction in boiler efficiency due to operating at high overloads. The slight saving arising from a constant degree of superheat is offset by the necessity of carrying banked boilers and the concomitant loss of fuel through banking.

When the time for great refinement has been reached it may be advisable to operate the majority of boilers at a fixed rating, the balance being used to carry the fluctuations of the station load. There may also be the possibility of automatically bypassing some of the furnace gases so the superheat is maintained constant. This can only be determined by careful investigation of each station. Such an investigation should also include a study of the effect of high ratings upon the life of the boiler and setting. Unless the feed water is pure, the setting properly designed and the draft condition correct, the increased maintenance charges are likely more than to offset the saving due to higher superheat obtained by operating at higher ratings. This point is illustrated graphically in Fig. 1, the data for which were obtained from tests on a 500-hp. water-tube boiler equipped with abundant superheating surface and operated under good conditions. The boiler is equipped with a six-retort underfeed stoker using coal at about 13,500 B.t.u. In determining these figures allowance has been made for the steam required to drive the stoker and blower, assuming that each boiler has its own stoker and blower engines. It will be noted that curve C rises slowly with the increase of boiler rating because the resulting higher superheat requires slightly more heat per pound to evaporate the water and supply the superheat. Curve D rises very rapidly after 175 per cent of rating because it includes boiler efficiency, which drops rapidly beyond this.

The effect of increase of superheat on the economy of a 10,000-kw. turbine operating at three-quarters load is illustrated in Fig. 3. The increased heat input necessary for higher superheat is offset by the decreased quantity of steam required to produce a kilowatt-hour. However, if the increased superheat is obtained by forcing boilers, there is a point reached when further superheat shows no gain but rather a loss because of the lower boiler efficiency. This is shown by Fig. 2, which is a graph of the heat that must be removed from the coal to deliver one kilowatt-hour when the boilers are operated at various ratings. The variation is so small between 125 per cent and 175 per cent of rating as to be negligible. The usual station maximum is of such short duration that the lower economy at such times cannot affect the gross economy as much as will the

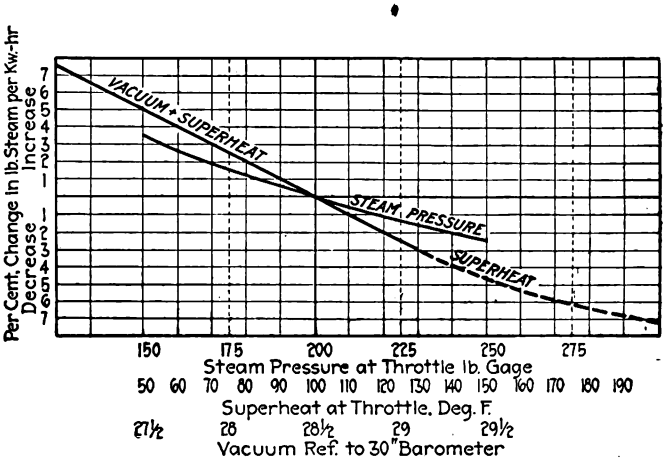


FIG. 3—CHANGE OF TURBINE WATER RATE WITH VARIATIONS IN STEAM PRESSURE, SUPERHEAT, OR VACUUM

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waste of fuel during banking hours if additional boilers are carried to avoid the lowered economy at the peak.

While the figures referred to are for specific equipment, they may be considered typical. If fewer retorts or a different type of stoker were used, the results would be similar but the limits different.

The effect of variation in steam pressure, superheat and vacuum on the steam consumption of a 10,000-kw. turbine at three-quarters load is shown in Fig. 3. At other loadings the results are similar. It shows that an increase in vacuum of ¼ in. (6 mm.) results in as great a decrease in steam consumption as is obtained by 24 lb. (1.7 kg.) increase in pressure or by a 13-deg. Fahr. (7 deg. C.) increase in superheat. The influence on fuel consumption is even greater because the increase in steam pressure or superheat is only obtained by an increase in fuel consumption to produce the higher temperature or pressure. This is the reason for placing high vacuum as one of the three requirements necessary for fuel economy.

The statement is sometimes made that it does not pay to operate a turbine at a higher vacuum than that for which it is designed. However, these curves, which are based on the performance of a turbine designed for 28½ in. (723 mm.) vacuum, indicate that a higher vacuum gives an attractive economy. There are times when purchasing new equipment when the higher cost of a high-vacuum condenser is not justified by the resulting fuel economy, but the highest vacuum obtainable with given equipment is always justifiable. The care of the vacuum is therefore the principal point to be observed in the turbine room.

The number of boilers carried on the line is the next important point. The influence of forcing boilers on the economy is illustrated in Figs. 1 and 2. If only sufficient boilers are operated to carry the peak (with a reasonable margin of safety in case of the loss of one boiler by accident before and after the peak period), they will operate in the region of their highest economy and at low loads not much below. If more boilers are carried, the number of boilers to be banked will be increased and the additional coal burned in banking hours will be a dead loss.

The result of attention to the first two requirements stated at the outset may be entirely wiped out if the third is forgotten. The small usually neglected wastes are the worst enemies of economy. Carelessness in these things soon breeds carelessness throughout the entire station, and the operators can never be expected to do their best unless the importance of small things is impressed upon them. There is nothing too small to merit attention in the central station, and until this attitude is insisted upon efforts at economy are wasted. It is impossible to catalog all items which should be watched. However, among them are leaky blow-off cocks, traps, joints and valves, carelessly banked and carelessly cleaned fires, unnecessary blowing of safety valves, etc.

The connecting link between the boiler and turbine rooms is the auxiliaries. These do not admit of much alteration in existing plants; the most that can be done is to keep them in repair, operate them as they are designed to be, and never to use two when one is enough. First look at the feed-water temperature, then look at the exhaust outlet to the atmosphere. If the feed-water temperature is low and there is plenty of exhaust, get after the feed-water heater. If there is still an excess of exhaust, reduce it if possible; if not, make the best of a badly designed station.

The bulk of the work has now been done, and the time for testing instruments has arrived. The number that can be justified depends upon the size of the plant. There are some instruments that should be in all stations: A vacuum gage, with barometer if possible, a feed-water meter, a feed-water thermometer and some means of recording the quantity of fuel used. Nothing can be done without these. Other instruments should be added only when they will receive attention. A high-grade efficiency instrument out of order for some days will destroy the operators' confidence so completely that its usefulness is lost for perhaps months. It seems best therefore to add instruments only as rapidly as the crew can be trained to use them with complete confidence.

The task now becomes that of setting a standard for the station and this means a careful and extensive series of tests of nearly all apparatus and finally a series for the station as a unit. These need not be conducted with the accuracy required in the laboratory. Many approximations may be made if investigators are experienced. The testing corps need not be large and may be recruited from the other employees. The generating unit should be tested if possible. If an old unit, this is important; if a new one, the builder's guarantee may be used as a standard. The steam used by the various auxiliaries may be determined by measuring the water passing through the feed-water heater and its inlet temperatures and the exhaust steam calculated by the rise in the water temperatures. If there is an excess of auxiliary exhaust, a part may be diverted and measured at another time under similar conditions. The operating efficiency of the boilers may next be determined and compared with those that may be reasonably expected. These tests should show the efficiency during operating conditions and also should be carried over banking periods to determine the net efficiency including banking losses. With these three values—the steam used by the turbine, that for the auxiliaries and the over-all efficiency of the boilers—a standard fuel consumption may be set as a mark to be reached ultimately.

The series of tests made on the equipment will give sufficient data for setting a standard for each item in the weekly or monthly report. If these are plotted with the station records, the progress is not only recorded but the reasons for progress or the reverse are shown graphically.

With the standard set, the test then becomes one of unceasing "plugging" to determine better methods of operating and to train the operators into these methods. It is a hard task, but with a standard set progress can be shown and encouragement for better work obtained.

To the manager the writer would say, Don't hurry your economy man. Pick him with great care. He must know his job, he must like work and by all means be endowed with tact and diplomacy. Then turn him loose and let him alone for a few months, for he has a mass of detail ahead of him and must have time to work it out. If results come quickly, you may be sure that you have assigned him to a plant in poor condition. In a well-operated plant his results will show only after months of effort.

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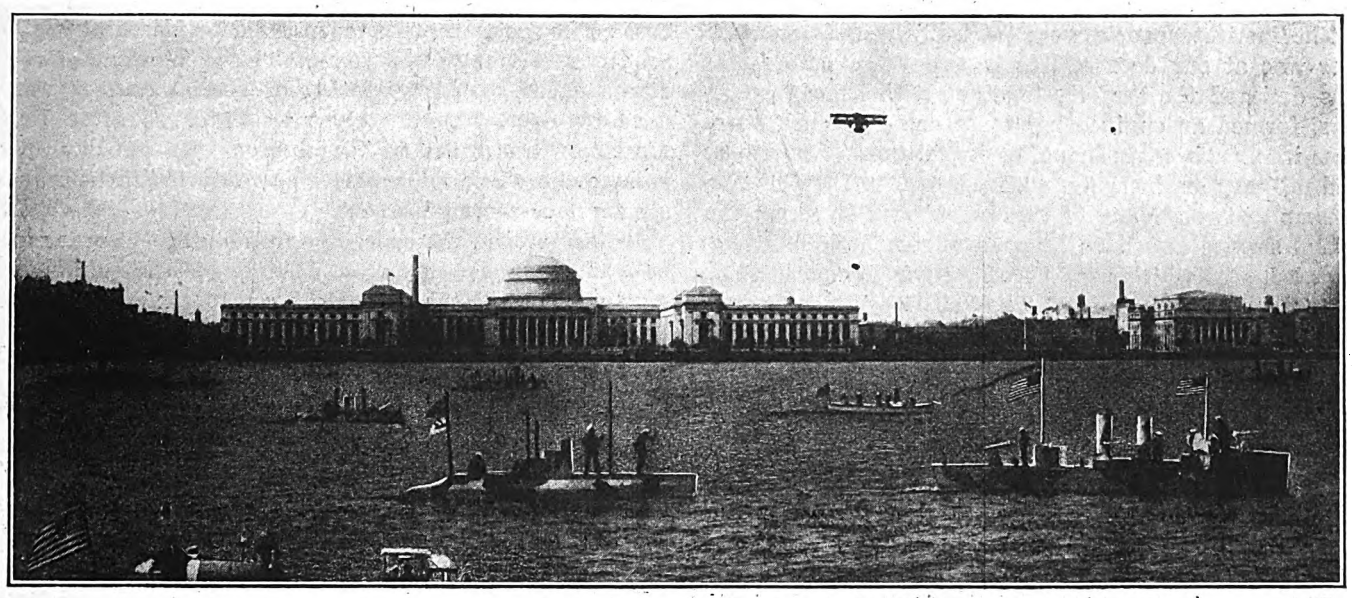

A Close-Up View of the S. A. T. C.

If We Are to Profit by the War Experience, This Is the Psychological Moment to Discuss and Formulate Rational Co-operation in Education Between Academic Institutions and Military Forces

BY JOHN RITCHIE, JR.

IT IS true that the Society for the Promotion of Engineering Education agreed at its recent meeting in Boston to consider only the larger questions of engineering education; still, there was very noticeable the undercurrent of question with reference to the Students' Army Training Corps and its effects on the colleges. This broke out at the last session when one college president plainly asked where his institution stood.

In two previous addresses President Maclaurin of the Massachusetts Institute of Technology had referred to the matter. One was at a students' mass meeting, when he used the phrase "enjoyed the S. A. T. C." in a sense that every one present understood and turned immediately to draw the lesson of how much better the men would feel for having patriotically done their bit. Later, before the meeting of the Association of American Universities, he stated directly that it was impossible to draw any conclusions from the brief trial. At the S. P. E. E. Dr. C. R. Mann referred to the difficulties, agreed with Dr. Maclaurin about the futility of trying to draw conclusions, and emphasized the splendid work of the great coöperative machine—the army. But at the same time there was hardly one of the professors present who had not reached his own conclusions with reference to the success of the short attempt at coöperative education between the army and the colleges.

At the Massachusetts Institute of Technology it is an open secret that there was much dissatisfaction, and even before the announcement that the S. A. T. C. was to be given over steps had been taken to release the academic portion of the Institute from its military partner. The same action was taken at other colleges.

It may be true that in the comparatively slow advance of technical education from Plato's day to ours and from decade to decade there are no lessons to draw; but, on the other hand, there are hundreds of overworked professors who gave the best that was in them toward a serious coöperative effort and who know that their work was thrown away.

There are also thousands of students, volunteering to help their country in the way that should have been most effective, who realize that they have wasted a school term. They will not become soldiers, on the one hand, and their academic work has suffered so much that to a considerable extent they will repeat the studies.

From the beginning the relationships of the army with technology have been those of unpreparedness and uncertainty. When the school for aviators was established the M. I. T. was obliged to furnish dormitories, beds and bedding, meals, instructors and apparatus. The army had practically no officers for the school, so the cadet officers of the institute's battalion were given commissions and cared for the school.

When the first school of military aeronautics was really well under way, with its courses determined and instructors well posted in their work, the army whisked it away and substituted a school of another character, and this again was later removed or discontinued and a school for aviators returned. It was the institute and not the army that solved the various problems in connection with the administration of the schools in matters not strictly military, and this at considerable inconvenience and disadvantage.

Now, the Massachusetts Institute of Technology was in every way fitted to be a school for training military engineers. This had been evident for a number of years to the professor of military science, Major E. T. Cole, U. S. A., retired, and he endeavored to convince Washington of the fact. He failed in his efforts till war was actually declared.

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The institute people were perfectly well aware that war was at our doors. Nearly two years before war was declared the seniors, together with some instructors, formed an engineering corps and put much spare time into radio engineering, electrical work, topography and military engineering, with practice in the field and a camp or two. Many of these men have since been in actual service and have been advanced through special knowledge of which they here laid the foundations.

When war was declared the War Department sent a commission of officers to look the institute over and see where it fitted in in military engineering. The report of this commission is one of the most complimentary indorsements that the institute has ever received. The commission reported in effect that with a selection of courses already in the regular curriculum, with the addition of one hour a week of military exercises, the graduates would be practically prepared for commissions.

This was in May, 1917, and the faculty of the institute prepared the outline of a four-year military option based on the findings of this commission. The outline was virtually accepted by the War Department, but delay was necessary to determine details. The opening of the school in October found no option accepted by the government, and to meet in part the enthusiasm of its students, who were anxious to be doing something, Technology formed an advance battalion suitable for the men ready to take the military option. By the time this was well started the War Department arranged some details, and two units of the Reserve Officers' Training Corps were formed and the advance battalion was given up.

A Great Coöperative Plan

With an experience like this and the absence of a well-defined policy some of the members of the faculty regarded the plan of the S. A. T. C. with some misgivings. The whole matter was a sudden move. In the middle of the summer President Maclaurin was called to Washington, and there, in extraordinarily short time, he with his war education committee outlined a plan of coöperation between the military and academic forces that was admirable. This made the commandant a member of the faculty and left the control in the hands of the president. It was adapted with rare skill so that each college should help by giving to the young men the studies it was best fitted to impart. Meanwhile they were to receive a judicious schooling in matters military. The planning of this great piece of coöperation was one of the most patriotic bits of work that have been done in this country.

In 400 to 500 colleges the faculties worked like beavers through the heat of the summer molding their studies into form acceptable to the army, while the members of the committee oscillated between torrid Washington and their homes.

For an example of what changes were made there is the new curriculum at the M. I. T. Instead of four years with two terms each of fifteen weeks, the terms were shortened to twelve weeks and four of them were packed into the fifty-two weeks of the year. This involved excision—the humanities largely had to go—rearrangement and compression. From it young men would become engineers with all the essentials of the usual education, and these men could be placed at their country's service in two years. The great work of rearrangement with preparation of special courses was done by Sept. 30, only eight weeks or so after Dr. Maclaurin was called to Washington. On the day appointed the whole machinery was ready to start—truly a marvelous accomplishment.

In the interim the colleges were obliged—in order to be ready—to make important changes in their buildings. At the M. I. T. it meant accommodations for 1600 S. A. T. C. men, with mess hall, kitchen, stores and utility houses, which cost many thousands of dollars.

Obstacles That Arose

Meanwhile legislative and other destructive agents were busy making holes in the plans of the war education committee. It had been the intention to induct the young men into the army and then release them on furlough for the period of their studies. Apparently after it had set the S. A. T. C. in motion the War Department found that the furlough idea could not legally be carried out. The students were therefore placed in the status of enlisted men with no guarantee that they would be allowed to remain in college after other men in the same age group were called. They were soldiers and must be under the control of their officers. This disposed of any amicable sitting in of the commandant at the faculty meetings.

As soon as the S. A. T. C. was started it became evident that some of the officers considered the colleges merely as recruiting grounds. One group of young men at Technology who registered Monday were detailed on Thursday to Fort Monroe. One of them had been at the institute only two days, it is said, a brief time indeed for a young man to study at the school of his selection. It is, of course, true that they went away willingly, but that it was possible for them to go at all in such short order exposes the absurdity of the system from the viewpoint of technical education.

When such facts became known there were some changes in the officer group at some colleges, but the rigidity of the military system was felt everywhere. At this moment there is no college in the land whose faculty does not breathe freer now that the S. A. T. C. has gone by. It is perfectly true that they are most of them wondering to-day how they are to be reimbursed for the actual cash paid for improvements that are of no value or perhaps a hindrance now that the corps is demobilized. The War Department realizes that there are some difficulties. Every one agrees that the colleges ought not to be out of pocket for their patriotic acts of national assistance, but the legal considerations that could prevent the holding of selected officer material, or which say that the War Department can pay for no education in times of peace, are likely to create difficulty in meeting moral obligations.

The experiences with the S. A. T. C. at the Massachusetts Institute of Technology, represented to be less serious than in some other institutions, were not encouraging, although Colonel (formerly Major) Cole used every endeavor to give fair play to the educators. He encountered the fact that there was little appreciation among the army officers for academic education or else little ability to disregard the niceties of legal quibbling and cut red tape.

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Some of the things that happened are almost worthy of vaudeville setting. The soldier after having lost his lectures through guard duty is transferred to another company and saddled with repetition duty without credit for his past. The hours for study are the same no matter what the mental capabilities of the student. Procrustean study periods they proved to be.

The absurdity of study periods at the end of a sixteen-hour day crammed with military exercise, calisthenics, studies and lectures became patent very early in the game, and students asleep through real fatigue were common in the academic work. What with the cessation of the lecture at the stroke of the clock whether the sentence was complete or not, the robbing of the student of the chance to get a word of explanation from the professor after his exercise, the delay for roll-call at the beginning of the lecture—twenty-two minutes, some one whispered, in one case from a period of fifty minutes—it is not difficult to realize the demoralization which the S. A. T. C. experiment effected. The students were discouraged, for they knew they could not make up the losses due to military duty that conflicted with academic exercises, and the instructors realized that so far as the studies were concerned they were a joke. The academic work was the tail of the military kite and met the fate of instability that befalls all tails of all kites. But, like good soldier material as they were, the students did their best and had no complaint; only through words of gossip were their real feelings made known, while the professors stood by their guns and patriotically did their best.

Discouraging as the experiment has been, it has a silver lining. It has opened the eyes of 25,000 college professors and 180,000 students. It has shown the advantage which military training depends upon—namely, discipline—although it condemns absolutely any such law-bound, ill-balanced attempt at coöperation as that which has passed. There is the greatest need of discipline in colleges—it is the American man's greatest need. The future of the country demands the avoiding of any such condition of unpreparedness as that which has characterized our past. Discipline and preparedness can be effected through the colleges, and now is the psychological moment in which to discuss and formulate a rational coöperation in education between the academic and the military.

Problems of Turbine Design*

Reliability and General Operative Excellence, Efficiency and Cost Constitute the Principal Considerations—Compromises Required in Low-Pressure Stage—Single Versus Multiple, Unit Versus Tandem Sets

BY J. F. JOHNSON
Engineer Turbine Department, Westinghouse Machine Company

Experience with several large steam turbines, ranging from 30,000 kw. to 70,000 kw., was related in the Dec. 28, 1918, issue of the ELECTRICAL WORLD to show that reliable large units can be built, that they are not a fad and are advisable for large systems, and that no problems have been encountered within the commercial limits so far reached that cannot be solved by accurate analysis of conditions. This leads to a consideration of some of the most important problems of large steam-turbine design and their solution, which will be discussed in this article.

MANY conflicting factors are encountered in large turbine design that must be judiciously combined in order to secure the best evenly balanced design and one which will serve its purpose most satisfactorily. Reliability and general operative excellence must stand out as the dominating characteristics; second to this comes efficiency, and third comes cost.

The first and perhaps the greatest single problem is suggested in the theoretical design, viz., that of providing areas suitable to accommodate the enormous increase in volume of the steam while passing through the turbine. With steam supplied at the throttle at 250 lb. gage pressure and 150 deg. Fahr. superheat, the volume when exhausting to 28½-in. (724-mm.) vacuum is 166½ times, and when exhausting to 29-in. (952-mm.) vacuum is 241 times as large as it is at the entrance. This means that if the mean diameter and exit angle of all the rows of blading be the same and the ratio of blade speed to steam speed be the same in each, and if the height of the blades in the first stage be taken as 1 in. (2.54 cm.), the last row would have to be approximately 14 ft. (4.2 m.) if designed for 28½-in. vacuum and 20 ft. (6 m.) if designed for 29-in. vacuum. Here is where the combining of conflicting factors begins. In the first stages the areas and blade heights should be kept large in order to reduce the losses, and in the low-pressure stages they must be sacrificed on account of practicable limits of mechanical design. In single-cylinder machines where the blading is all on the same spindle the problem becomes doubly difficult.

The chief factor in the selection of the rotative speed is the design of the last row of blades with reference to height, diameter and exit angle, because this is the most important stage in the whole turbine. In order to secure the most satisfactory design and to prevent the stresses or physical dimensions with the ever-present cost from becoming prohibitive, several compromise features are employed.

The first of these consists of increasing the rotor diameter and blade heights, if necessary, until the safe limit of stress is reached, keeping the blade height within approximately one-fourth of the rotor diameter as a limit of good practice. The materials of which the rotor and blades are made will of course determine the safe stresses, and on account of the great import of safety and reliability in these parts only good quality

*For fuller details see paper presented before the A. S. M. E. at Philadelphia on "Notes on Large Steam-Turbine Design."

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of plain or 5 per cent nickel low-carbon steels should be used, because these are commercially common materials, uniform in quality, and do not require sensitive heat treatments.

Increasing the diameter not only permits increasing the blade height, but also the steam speed, without materially affecting the efficiency, by reason of the increase in blade speed. There is, however, a slight falling off in efficiency with the higher speeds, even though the ratio of blade to steam speed be kept practically constant, because, the actual velocity of the steam with reference to the blade being greater, the frictional losses will be greater.

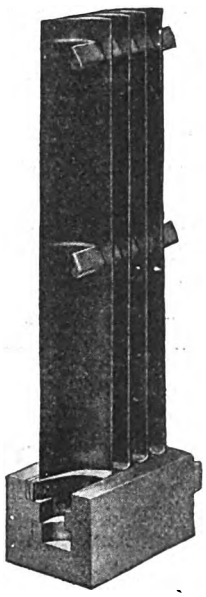

FIG. 1—BLADE FASTENING

The second compromise consists of increasing the steam passage area through the blades by changing the blade shape. This change increases the angle between the direction of steam flow from the blade and the direction of the blade, and a slight impairment of efficiency results therefrom. However, this loss is slight compared to the gain from the higher ratio of blade speed to steam resulting from the increased area. This practice is standard on practically all condensing machines built for high vacuum. The third compromise consists of permitting the steam speed to increase without a corresponding increase in blade speed, thereby decreasing the ratio of blade speed to steam speed and increasing the leaving losses. This compromise may properly be employed up to the point where the loss of efficiency will justify the increased expense of greater blade areas, which may necessitate dropping to a lower rotative speed or employing multiple stages.

Two or more low-pressure stages in multiple in connection with a single high-pressure stage are used when the required areas cannot be obtained with a single stage at the rotative speed chosen and when it is more feasible to employ multiple stages than a lower rotative speed. Other considerations favoring multiple stages are (1) reduced physical dimensions of the exhaust chambers, simplifying both the ribbing and bracing necessary to maintain the proper rigidity, and of the cylinder-supporting structure, including foundations, and (2) limitations of shipping dimensions established by transportation companies.

FACTORS IN DESIGN OF HIGHER STAGES

The design of the higher stages usually involves only an equitable selection of diameters, blade speeds and steam speeds. Keeping these low results in low stresses and high efficiency but large number of stages and high cost, while keeping them high reduces the length, weight and cost but increases stresses and impairs efficiency.

If the steam volumes in the first stages are relatively small for the rotative speed employed, as would be occasioned by the use of high steam pressure or low rating, a double-velocity stage impulse element may often be employed to advantage, the advantages secured being reduction of length, increased diameter, reduced pressure and temperature inside the main cylinder and adaptability for varying overload capacity.

Having fixed the rotative speed to secure proper design of the low-pressure stages, and the diameters and steam speeds of the high-pressure stages to give the highest economy, the length of the rotor may become excessive, necessitating its division into two parts in order to maintain requisite reliability. These parts may be arranged either in tandem form, driving a single generator, or in cross-compound form, driving two generators. When arranged cross-compound it will often be found advantageous to increase the rotative speed of the high-pressure element, thereby gaining reduced physical dimensions, weight and cost without sacrifice of efficiency or reliability. The multi-cylinder construction is especially desirable in the employment of high steam pressures and superheats in that the high-pressure turbine structure is small and there is no danger of stress complications resulting from wide temperature differences and no transmission of heat through the cylinder walls from high-pressure or low-pressure stages. It has a further advantage in these days of increasing steam conditions in that a unit may be designed for given steam conditions and later redesigned for materially higher conditions, the redesign being entirely carried out in the high-pressure element.

In units of 60,000 kw. or larger the three-cylinder cross-compound construction employing one high-pressure and two low-pressure elements possesses the advantages of high efficiency and reliability without employing excessively large structures and has greater flexibility than is possible with either of the other constructions. This flexibility, enabling the high-pressure element to operate with either low-pressure element, or either of the three elements to operate alone, admirably adapts it for use in systems not yet large enough to permit employing a single unit of such large capacity. These units may be provided with a control mechanism by means of which either of the elements may be taken out of service either automatically or manually, through operation of circuit breakers or automatic stop governor, and the remaining ones will continue to operate, carrying loads up to the maximum ratings of their generators. The low-pressure elements, when operating on high-pressure steam direct, may be made to carry loads for short periods considerably in excess of the rated capacities of their generators.

Reliability and general operative excellence of a large turbine are largely dependent on the excellence of design of details such as the blading and blade fastenings, provisions for maintenance of clearances and alignments under all possible variations of operating conditions, bearings and oiling system, control mechanism, glands, couplings and protective devices against overspeeding.

The chief destructive element of all blading is vibration caused by the flow of steam and by vibration of the entire rotor when operated under conditions of defective balance or alignment. The thickening of the blade section near its base serves to reduce very considerably the amplitude of its vibration and to prevent concentration of deflection with its attendant crystallization at the point of attachment, where the ordinary

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blade is weakest. Blades may be lashed together to minimize the vibration and maintain uniform spacing. Blades up to 4 in. (10 cm.) in height may have a single lashing near the top, blades from 4 in. to 12 in. (10 cm. to 30 cm.) may have two, and blades above 12 in. may have three.

To insure maintenance of clearances and alignment under all possible variations of operating conditions, such as reduction of steam pressure and total or partial loss of superheat or vacuum, is difficult but essential. In such large structures the amount of expansion and contraction due to temperature changes is considerable and usually occurs simultaneously with important stress changes caused by varying stage pressures; consequently a comparatively slight uneven temperature change or unbalanced stress will cause a distortion.

The introduction of high vacuum, bringing with it large diameters in the low-pressure stages, and enormous exhaust chambers necessitates a considerable amount of carefully devised ribbing and bracing in order that the bearings supported in the exhaust chamber structures shall under all conditions remain concentric with the stationary blade or nozzle-carrying elements.

Practically every turbine element contains three bearings, two to support the rotor and one to maintain the longitudinal alignment. The supporting bearings usually consist of heavy cast-iron shells lined with babbitt and split horizontally to facilitate removal. Kingsbury type bearings modified to serve the requirements of the turbine upon which they are used are used extensively for alignment. The oil-circulating system

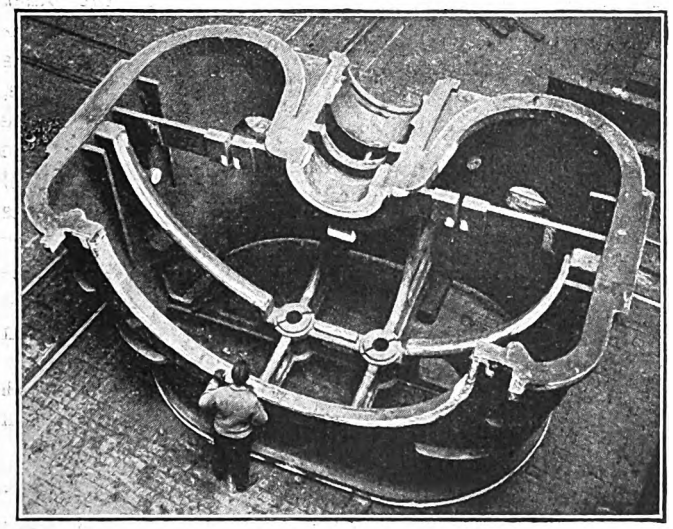

FIG. 2—BRACING OF EXHAUST OUTLET FROM TURBINE

should be designed with special reference to positive circulation, effective cooling, straining and settling for separation of foreign matter or impurities, accessibility for thorough cleaning and longevity of the lubricating qualities of the oil. Under normal operating conditions the maximum temperature of the oil should not greatly exceed 140 deg. to 150 deg. Fahr.

Since not only continuous service but also constant voltage and frequency have become a passion with public service companies, and a most commendable one too, the governing mechanism must be extremely sensitive, positive and quick to adjust itself to small or large changes in load and at the same time be rugged, reliable and unaffected by such variations as occur in ordinary wear and care. On account of the power required to operate the large valves, some form of relay mechanism is necessary. For this the regular turbine lubricating oil under suitable pressure has proved satisfactory.

Combination labyrinth and water glands constitute an excellent sealing arrangement to prevent leakage of steam or air where the rotor shaft passes through the casing. They require no adjustments for varying load conditions and do not depend on the operation of any automatic devices. There is no mechanical contact between stationary and rotating parts, and therefore no wear. They are extremely simple in design, requiring no special attention, and are as durable as any other part of the machine.

The simple water gland is not adapted to operation at high pressures or at speeds very much less than normal, but a labyrinth enables establishing a vacuum before starting up and reduces the pressure on the water gland when the pressure against which the gland must seal is high.

Flexible-pin couplings have important advantages over the solid-claw type in that sufficient elasticity is provided to distribute the shocks produced by heavy short circuits without danger of injury to the coupling.

These observations may aid in establishing a deeper appreciation of the present and prospective future growth of the electric power industry, of the need therein of generating units of large capacities, and of the fact that such units have been built and are commercially successful and that there appear to be no engineering, manufacturing or economic hindrances to their general use.

A REVIEW of past performances in the use of fuel will show that one industry and one alone stands preëminent as an efficient user of fuel. I refer to the central-station industry. For reasons over which this industry has had but little control, it has, regardless of any desire of its own, been forced to set the pace in all-around efficiency, and particularly in fuel efficiency. The natural outcome of this is that the central station has played one of the biggest parts in the winning of the war—a part that, while never in the limelight, was nevertheless so vitally important that its interruption would have instantly paralyzed practically the entire war machinery of the nation. . . . With the foregoing in mind, I would like to suggest that all state fuel administrators immediately inform themselves as to the present status of the central-station industry and give the subject such study as will enable them at a later day to be in a position to direct the movement of fuel and finances into avenues which will keep ours the foremost of commercial nations of the world.—*W. G. Williams, Head of Oil Conservation Activities in the Mid-Continent Field.*

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Artificial and Natural Industrial Lighting

Their Interrelations Considered—Predetermination of Artificial Lighting Requirements—Variation in Natural Lighting Intensities—Importance of the Daylight Factor—Methods of Measurement

BY C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

The following article is based in part on information gathered during the war at the request and for the use of the Employment Management Division of the War Industries Board. This information has been used as a partial basis for the present article and for several articles to follow with the permission of this division of the board. One of the main purposes in giving wide publicity to these data, in addition to their use for the specific applications of the employment management division, has been to aid the industries in the readjustment period following the war. In this way the outstanding lessons which have been brought home under pressure of the war emergency can be utilized in their fundamental aspects to raise the standards of normal industrial activity.

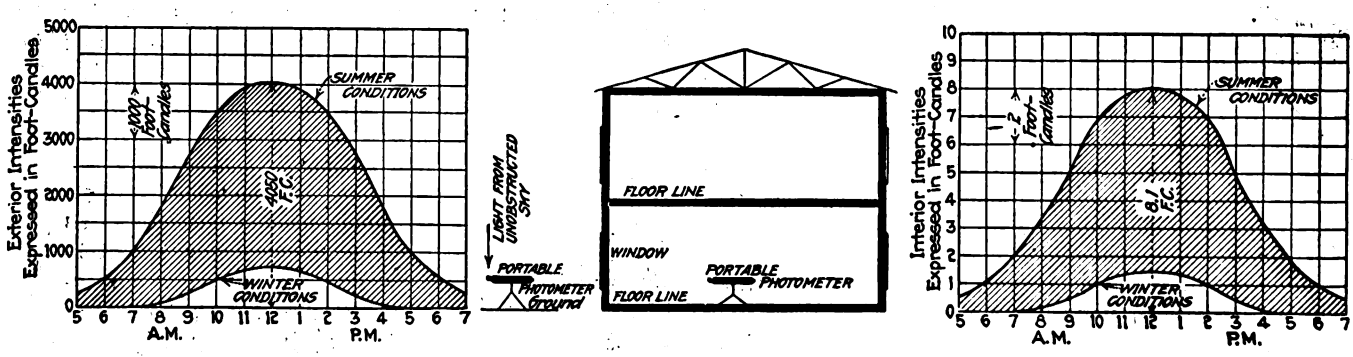
A WORKING environment which is highly favorable to the employee is now an accepted principle with persons who are concerned with modern industrial management. The logical conclusion drawn from this principle is that adequate natural light is of prime importance in any industry not only from the standpoint of efficient workmanship but also from that of the best interests of the management of the plant in general. It is not the purpose, however, in the present article to go into this side of the question, but rather to point out how inadequacy of natural light may effect the requirements for artificial light. This side of the subject is of considerable consequence to the electrical engineer in his appreciation of the artificial lighting problem.

It will be assumed in the following discussion that the presence or absence of adequate natural light may entail the three following characteristics: (a) The amount and distribution of the natural light should be such that every employee is suitably provided with the means for the best workmanship, and persons in charge of the management should have equally good facilities. (b) Any factory which has an excellent distribution of daylight throughout its entire floor space quite naturally has a greater value from the manufacturing standpoint than another factory in which the daylight conditions are inadequate and poorly distributed. (c) That plant in which the natural light is inadequate at those portions of the day when natural lighting would presumably be sufficient if the window areas were large enough has a larger requirement for artificial light than otherwise.

PREDETERMINATION OF PROBABLE ARTIFICIAL LIGHTING REQUIREMENTS

In an old factory where no provision has been made for an effective artificial lighting result it is possible by the methods described below to predetermine approximately the probable requirements for artificial light during the various months of the year. In many cases where the management of a plant is confronted with the necessary expenditure for a new lighting system little or no information is at hand in regard to the probable amount of time per day in which artificial light should be available. It is for such cases in particular that the following notes should be suggestive.

Again, in planning a new system, the intensity of illumination for a given class of work depends to some extent on whether the artificial light is to be used exclusively during night hours or whether it is to be used for a part of the time in conjunction with some natural light, for example, in the early morning hours of winter months. The scheme outlined below may also prove useful in the establishment of this point, since it indicates in a general way what proportion of each day in the summer and winter months given sections of the plant have daylight intensities which are so low that artificial light is essential. Thus,



FIGS. 1, 2 AND 3—VARIATIONS OF DAYLIGHT; ARRANGEMENT OF INSTRUMENTS

Fig. 1 shows variations of daylight on a horizontal plane under the open sky in a given geographical location. Fig. 2 gives the set-up of instruments for making simultaneous measurements of inside and outside illumination for establishing the daylight factor at a given point in a plant. Fig. 3 indicates light illumination within a plant at a given point based on an assumed daylight factor of two-tenths of 1 per cent.

if it is found after such a study has been made that the artificial light will be required for a considerable portion of the normal daylight hours, then the intensity of illumination adopted for the given plant may be made considerably higher than if the use of the lighting system were limited solely to night hours. Conversely, if such a study of the conditions in the plant indicates

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that the daylight intensities are sufficiently high for efficient workmanship for the day shift throughout the year, thus limiting the use of artificial light to night hours (excepting, of course, those special cases where storms make it necessary to turn on the lamps during the day), the intensity of the illumination may be made somewhat lower than otherwise.

It is well to remember, however, that even where the use of the artificial light is limited to the night hours its intensity should be sufficiently high to gain the benefits of the high efficiency in production which has been found to exist in those plants where the artificial illumination has been made as much as three times the values considered adequate for a given class of work in earlier lighting practice.

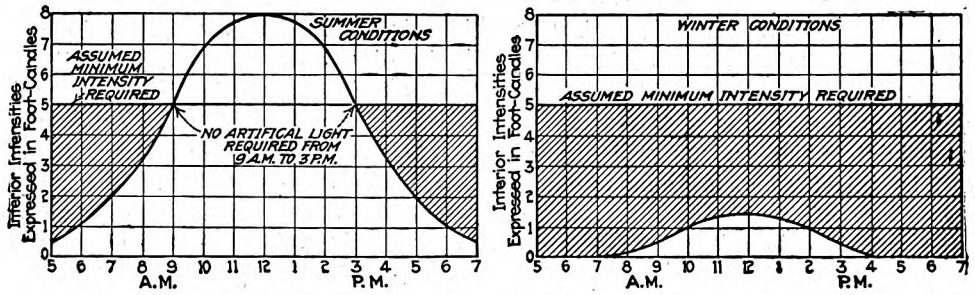
Furthermore, it is sometimes desirable in planning a new system of artificial lighting to estimate closely on the maintenance cost of various proposed systems. Such estimates usually call for a knowledge of the probable number of hours per annum during which the lighting system will be in service. Any scheme therefore which will indicate the number of hours of service per annum during which the light will probably be utilized may serve as a basis for preliminary estimates on maintenance.

One reason why so much difficulty is experienced in reducing the natural-lighting problem to the same definite basis as is now possible with artificial lighting systems is the extreme variations in the intensities of natural light. This is well illustrated in Fig. 1, in which the ordinates of the lower curve indicate the intensities of the natural illumination throughout the day out under the open sky in a typical winter month for one given geographical location. By way of contrast the upper curve shows the corresponding variations in the intensities of the natural illumination under the open sky throughout a typical summer day in the same geographical location.

The differences in the ordinates of the two curves, as shown by the shaded area in Fig. 1, indicate how much lower the intensities may be under the open sky in winter than in summer. These two curves show, therefore, that the variations of the natural illumination are very great from hour to hour in the typical day, and furthermore that the differences between winter and summer months are also very great. To these normal variations there must also be added the erratic changes which take place on many days due to clouds, fogs, storms and the like.

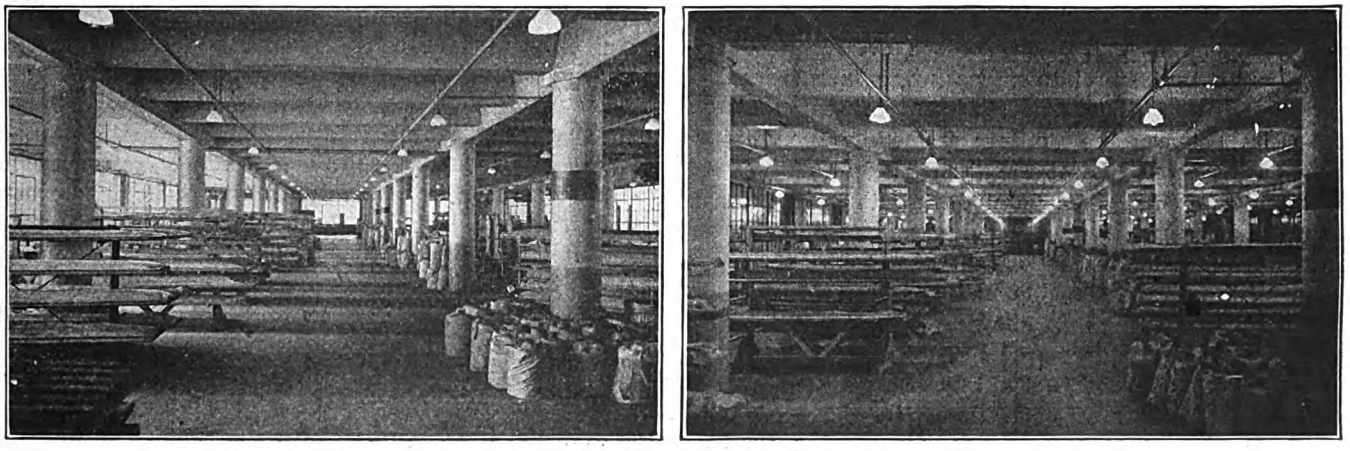
The curves in Fig. 1 also give a measure of the variations of natural light which occur within any factory, because, obviously, for a given window area when the exterior illumination is high the interior illumination will be correspondingly high, whereas when the exterior conditions are low the illumination in the interior will decrease proportionately.

As a measure of the difference between the interior and exterior illumination the "daylight factor" has been proposed. This factor relates to the ratio of the illumination at a given point within a building to a corresponding illumination at the same point if the walls and ceiling could be removed, thus exposing the given



FIGS. 4 AND 5—ILLUMINATION NECESSARY TO SUPPLEMENT DAYLIGHT IN FACTORY

The horizontal line in Fig. 4 represents the assumed illumination which should be provided for a given class of work within a factory, while the ordinates of the curve represent the probable illumination at this point due to the factory windows. This diagram refers to the conditions of a typical day in summer, whereas Fig. 5 is a corresponding diagram for a typical day in winter.



FIGS. 6 AND 7—FACTORY INTERIOR, SHOWING THE DISTRIBUTION OF NATURAL AND ARTIFICIAL ILLUMINATION

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point to the open sky. In practice simultaneous measurements may be made at a given point within the plant and at some point exterior to the plant which receives direct light from the unobstructed sky. The ratio of the interior intensity to the exterior intensity gives the daylight factor in question, a general set-up for such a test being indicated in Fig. 2.[1]

Experiment indicates that this ratio of the interior to the exterior intensity remains practically constant throughout a given day and is practically independent of the season of the year. Having found this factor, therefore, for given typical points within a factory and knowing the trend of the variations in the exterior daylight as indicated in a general way in Fig. 1, a number of interesting conclusions may be derived.

Let us assume that the daylight factor within a given plant and at a given point has a value of two-tenths of 1 per cent. By multiplying the various ordinates of the curves in Fig. 1 by this factor the probable values

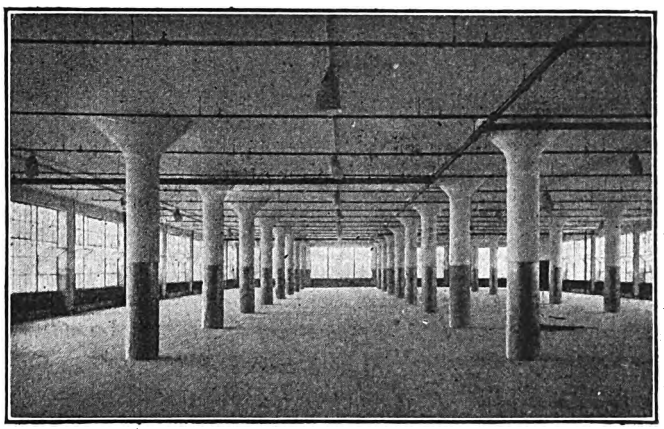

FIG. 8—WELL-LIGHTED MODERN FACTORY INTERIOR

of the interior illumination at the given point throughout typical summer and winter days may be plotted as in Fig. 3.[2] The upper curve in Fig. 3 indicates the probable interior intensities at the given point during a typical summer day, whereas the ordinates of the lower curve indicate the corresponding intensities for a typical winter day. The shaded area, which is the difference between the summer and winter conditions, indicates how much lower the daylight illumination will probably be at the given point during the winter days in contrast to those of the summer. Similar curves may readily be plotted for other typical points throughout a given factory area, but in themselves they are not so convincing perhaps in showing the needs of artificial light as the diagrams of Figs. 4 and 5.

Fig. 4 contains a horizontal line, the height of which represents, to scale, the minimum intensity of light which is assumed to be necessary for a given class of work. On this same chart a curve corresponding to the upper curve of Fig. 3 is plotted. The shaded portion of Fig. 4 indicates those parts of the day when artificial light must be employed to supplement the natural light, or, in other words, it indicates those portions of the day when the natural light is inadequate. Fig. 5 shows a corresponding diagram for a typical day in winter.

It follows at once that at those points in the factory where the daylight factor has the assumed value of two-tenths of 1 per cent artificial lighting will be required on the average before 9 a.m. and after 3 p.m. during the typical summer day, and for the entire day during the typical winter day. With this information in hand it is now possible to compile a table of the probable number of hours per annum when artificial light will be required during what may be considered normal daylight hours, which, coupled with the number of hours at night during which the artificial lighting system must be employed, forms a convenient basis for the determination of the relative importance of artificial light to the plant.

Such information also indicates the proportion of the total number of hours when artificial light is required during the day as compared with night hours, and therefore serves to establish in a general way whether the intensity of the artificial illumination should be based on the value considered desirable when used in conjunction with daylight or not. Of course, where charts of this kind indicate that the artificial lighting will be required almost exclusively for night hours a somewhat lower intensity might be employed than otherwise, on account of the absence of any daylight to conflict with the artificial illumination.

The same data may be utilized to establish the probable number of hours per annum during which the artificial illumination will be used, thus serving as an aid for preliminary estimates on maintenance cost.

Highly satisfactory artificial illumination for the spaces of tall buildings represents in certain cases a cost of approximately 2 per cent of existing rental charges. It is quite easy to conceive therefore that it would be considerably cheaper to use a building of many stories and employ artificial light for the lower floors than to limit the building height merely for the purpose of improving natural light, this statement of course having no relation to other advantages that might be secured from the hygienic standpoint if better natural lighting conditions were made available for the occupants of such lower floors.

A discussion of the interrelations of artificial and natural light should logically include a reference to the combination of natural and artificial light when the latter is used during those hours of the day when natural light, although inadequate, is present. First, the writer wishes to point out that artificial light which is entirely satisfactory at night when employed in the daytime fails to give the same stimulus to vision as at night (of course, this is not a new idea). Thus with the approaching twilight of a winter's day, when the artificial light is turned on, the conflict of the two results in a number of interesting happenings. One of these, as just intimated, is the lack of satisfaction which may be felt with the artificial lighting system at such times. One of the important points in the above discussion has been to bring out ways and means by which a determination may be made prior to the installation of a system showing whether or not the intensity should be made higher to take into account this very point. Based on wide observation, it would appear that some allowance should be made in every

[1] Extended discussions of the "daylight factor" and some of its relations to plant management will be found in articles by the writer in earlier issues of *Industrial Management*, the *American Machinist* and *Machinery*.

[2] Note carefully the differences in the scales of ordinates in Figs. 1 and 3.

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system for added intensities in such cases to make the lighting system satisfactory at those periods of the day when artificial and natural light combine.

Another interesting result which has been mentioned from time to time is the tendency for an increase of accidents at those periods of the day when natural and artificial lighting are combined. While this may be due in part to lack of satisfaction from the artificial lighting system when in competition with the natural light, it is also quite likely that differences in the directions with which the light reaches the work from the two sources is somewhat responsible. Thus, with the windows placed at the extreme sides of the buildings, the shadows and general outlines of the work may be entirely different from those due to the light from a nearby lamp or from overhead lamps where such a system exists, and this may result in confusion in the judgment of a punch-press operator, for example, resulting in an accident which might not occur under other circumstances. This would seem to strengthen the argument that in the late afternoon when the artificial lighting is turned on it should be of sufficiently high intensity to predominate sharply over the inadequate daylight.

The foregoing notes may be illustrated in a measure by a number of actual examples, which are merely included to give a better idea of the physical points involved. Figs. 6 and 7 are comparative views[3] of a section of an industrial plant showing the daylight and the artificial lighting conditions respectively. It is hardly possible to examine comparative cases of this kind without being struck with the great advantage of supplying illumination from overhead rather than from the side. Thus, in this view the natural lighting is received from the windows on the sides of the building, while the artificial illumination is distributed from overhead lamps which are placed symmetrically with respect to the floor. From this point of view the advantage of roof day-lighting in single-story buildings is at once apparent. An interior of a factory in which particular attention has been given to natural as well as artificial illumination is shown in Fig. 8.

Economical Operation of Hydraulic Turbines

Discussion of the Losses Incurred in Running Such Installations—Hydraulic Losses in the Setting and in the Turbine—Mechanical and Operating Losses—Importance of Thorough Cleanliness

BY E. A. GIBBS, S. MORGAN SMITH COMPANY

THE over-all efficiency of a hydraulic turbine installation is made up of two parts, namely, the efficiency of the turbine proper, consisting of the runners, regulating gates, bearings and draft tubes, and the efficiency of the setting, consisting of the headraces, supply pipes, wheel casings, flumes, wheelpits and tailrace. The product of the above two efficiencies will be the over-all efficiency of the turbine installation. Consequently, if the over-all efficiency of the installation is to be kept at a maximum, neither of the above efficiencies should be allowed to decrease. In discussing how the highest over-all efficiency can be maintained it will be assumed that the turbine has good efficiency, and likewise the setting. The losses that can occur from operation will be discussed under four headings: "Hydraulic Losses in the Setting," "Hydraulic Losses in the Turbine," "Mechanical Losses" and "Operating Losses."

Hydraulic Losses in the Setting.—The headrace to the turbine should be free of obstructions of all kinds and should not be used as a dump. It should be cleaned out at specified periods, depending on the character of the soil through which it passes and on the character of the water. The latter may carry a considerable amount of silt and foreign matter, which is deposited in the headrace, filling it up. In order that the water may flow with minimum amount of eddies and cross-currents, the headrace surfaces should be kept as smooth as possible. To this end the banks should be kept clean (all cutting and washing should be carefully looked after) and vegetable growth under the water should be eliminated. Constricted sections in the channel should be removed, so that the water can flow with a uniform velocity the entire length of the headrace. If possible, the banks above the water level should be covered with grass, forming a sod, to prevent washing and slipping. If the water is conveyed to the turbine by steel or wood flumes, they should be cleaned at regular intervals, the time depending on the characteristics of the water.

Trash racks should be kept absolutely clean. On streams carrying floating débris this requires considerable work. In all plants it should be the duty of some one in particular to inspect the trash racks four or five times a day and clean them if necessary. The trash-rack area of most plants is none too large, and when the trash racks become clogged with débris the head often becomes seriously reduced. In low-head plants this is particularly serious. For instance, in one plant operating under a head of 10 ft. (3 m.) a loss of 2.5 in. (6.4 cm.) of head through the trash racks would mean a loss of over 2 per cent in the operating efficiency of the plant. The velocity of the water through the trash racks should not exceed 1.5 ft. (0.5 m.) per second for low heads under 20 ft. (6 m.) or be more than 2.5 ft. (0.8 m.) per second for heads above 20 ft. (6 m.), if maximum efficiency is to be obtained. There are cases where the head loss at the trash rack was 15 per cent of the available head, owing to the high velocity of the water through the rack caused by the rack becoming clogged with débris. With a systematic cleaning of the trash racks the loss of head will be reduced to a minimum. When trash racks are long mechanical cleaners should be installed.

The wheel pit should be of sufficient depth and should

[3]Figs. 6 and 7 are due to the Macbeth-Evans Glass Company. Fig. 8 to Stone & Webster.

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be kept free of all obstructions. The tailrace should receive the same attention as the headrace, for the reason that deposits of silt and débris affect the head directly in the tailrace. High velocities should be eliminated from the tailrace as well as the headrace.

In all turbine installations a gage should be placed as near the turbine as possible, so that the elevation of the headwater can be easily noted. Another gage placed in the tailrace as near the discharge of the turbine as possible should be used to indicate the elevation of the tailwater. These gages should be calibrated so that the head can be readily determined and should also be read at regular intervals, the record being kept for reference.

In small streams a weir of sufficient length should be installed and readings taken and recorded, showing the amount of water flowing. The turbine can then be operated at the proper gate opening to correspond to the available water so as to obtain the maximum efficiency. The knowledge of the amount of water flowing in a stream at all times is one of the most valuable assets to water-power users on such streams. With such knowledge of the water available, and with power and efficiency curves of the turbine, high operating efficiency can be obtained.

Hydraulic Losses in the Turbine.—These losses are due mostly to lack of inspection and upkeep, excessive leakage of water being the result. When the chamber of the turbine directly above the runner is drained to the draft tube and the clearance between the top rim of the runner and the guide casing, called the "top running joint," becomes worn through lack of adjustment and repair of the steady bearing, a large amount of water is allowed to pass around the turbine and not through the runner. If the bottom running joint between the runner and the guide casing becomes worn excessively, owing to eccentric motion of the shaft or to the shaft moving endwise, excessive leakage of water will also occur, and consequently loss of efficiency.

The hydraulic losses in the turbine can be kept at a minimum by frequent inspection and rectifying the defects observed at once. Systematic inspections of the turbine should be carried out. Each turbine should be inspected at a specified time, at least three times a year. There are cases where turbines have run three or four years without any internal inspection, and there are no doubt cases where this time has been much longer, during which time the turbines were operating at a decreasing efficiency, owing to wastage of water. One thing in particular that is necessary is to keep the runners and gates clean and smooth. Breaking or erosion of parts so as to prevent the efficient utilization of the water power should also be watched for.

In the installation of hydraulic turbines in general not enough consideration is given to the methods and appliances for taking the water out of the wheel cases and flumes. Headgate operating devices are considered as only to be used in cases of emergency, when something happens, and are generally inferior in design and too small in capacity for the duty they should perform. Headgates and apparatus for operating them should be designed and built so they can be operated easily and quickly, and operated every day if necessary. In some cases, when it becomes necessary to take the water out of the wheel case or flume, several men must be secured to operate the hoists and close up the leaks in and around the gate with ashes, sawdust, etc. If headgates are designed and built so as to stand repeated operation and remain tight, and the hoisting apparatus is designed and built to operate the headgates easily, power-house attendants would give more attention to the internal inspection of the turbines.

Mechanical Losses.—Losses of this nature are due to non-alignment of the shaft caused by the bearing becoming worn and allowing the shaft to get out of its proper position. This causes undue wear on the running joints. The bearings should be frequently inspected and kept in correct adjustment so as to hold the shaft in its proper position. Thrust bearings should be looked after carefully and maintained so that the shaft will not move endwise out of its normal position.

Operating Losses.—These losses occur mostly in plants in which several units are installed when the load is such that all the units are not required to be in operation. The maximum efficiency of all turbines occurs somewhere between eight-tenths and full rating. By consulting the power and efficiency curves of the turbine, as furnished by the builder, the total load can be subdivided[1] among the several units, so as to obtain the maximum efficiency in operating the plant.

As shown, cleanliness, care and upkeep are the important factors in obtaining maximum efficiency in operating a hydroelectric plant, and it may be added that cleanliness can be applied to the interior of the power house as well as to the machinery. When a power plant has dirt, oil and water all over the floor it indicates that the plant is not efficiently operated and that there are a lot of lazy operators in charge, with a superintendent or manager who is not "on the job."

With frequent inspections, careful upkeep, cleanliness and intelligent manipulation of the load, economical operation of the hydraulic turbine will be achieved.

[1]See article by Lieut.-Col. Hirshfeld and C. L. Karr in ELECTRICAL WORLD for Dec. 21, 1918.

THE United States is the richest of all countries. It possesses one-third or more of the total wealth of the world. It has become the leader of finance and in this respect may properly exercise a commanding influence. Its natural resources are immense and are susceptible of increasing development. If industry is protected and fostered in accordance with its merit, the war burdens surely, even though gradually, will be lifted. We shall be a creditor nation with a large interest income, more virile, more progressive, more successful, wiser and better than ever before. . . . It remains for all who have been permitted to survive the horrors of war to enter upon the new era with a united and fraternal spirit and a fixed purpose to profit by the experiences of the past and to aid in the establishment of a permanent basis of peace and prosperity.—*E. H. Gary.*

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Radio Development in the Air Service

Problems Which the War Has Left Still Unsolved—How Shall Satisfactory Communication from One Plane to Another or from the Ground to the Air Be Attained?—Necessity of Policing the Air a Factor in Problem

BY LIEUT. EDWARD R. DOYLE, AIR SERVICE, U. S. A.

MANY engineers who have followed the rapid improvements in radio apparatus in the air service will be keenly interested in the solution of those problems which the war has left unsolved. Those of an inventive and scientific turn will endeavor to overcome some of the difficulties encountered. While the program of the air service may not be carried out as elaborately as heretofore, it is unquestioned that the technical needs of the service will be pushed without relaxation. This is especially true of the radio work, which began as a by-product of the war and which opens up unlimited possibilities with the increasing utility of the aëroplane.

It can be said that the spark telegraphic sets were fairly satisfactory for the purposes for which they were designed. The simple storage-battery type with the trailing antenna for use in fire control was reliable enough, though its tuning was a difficulty on the closely crowded sectors whenever many radio ships tried to work close together. The fan-driven generator sets with more diversified tuning and greater radiation were developed with minor difficulties of design, and the adaptation of the aëro engine as a source of power was only a logical step where the fan drive was impracticable.

However, in the use of the wireless telephone, where communication from plane to plane is desirable, and more especially communication from the air to the ground or vice versa, the antenna problem has not been satisfactorily settled.

A satisfactory telephone aërial requires (1) that the antenna must be non-directional, (2) must be adaptable to all flying conditions, and (3) tuning must be conveniently regulated while in the air to all ranges of wave length.

The ordinary trailing type of antenna throws the radiated signals in the direction in which the ship is moving and at an angle of about 45 deg. downward from the horizontal axis of the ship, so that to each side and behind there are zones of low audibilities, and on banking or turning the signals fade out. This is therefore not adaptable for the radio-telephone since its signals would only reach a ground station from certain limited positions and render ship-to-ship or ship-to-ground communication impossible in the majority of cases.

As for the reception of signals from the ground, it would require the ship to fly directly toward the ground station, and the ground aërial would have to have a radiation upward, which is not the case with ordinary L-type antenna. The ground problem, however, is logically considered as a special case.

Other types of ship antennas have been tried. Most successful of these is a double trailing antenna with the aërials trailing from the outer-bay rear struts and using very light wire without weighted ends. It gives a good heart-shape radiation in the horizontal plane of the ship (and to ground for limited heights) which is satisfactory for formation flying. The point of the heart is opposite the direction of motion. Here little difficulty is had while in the air, where the leading

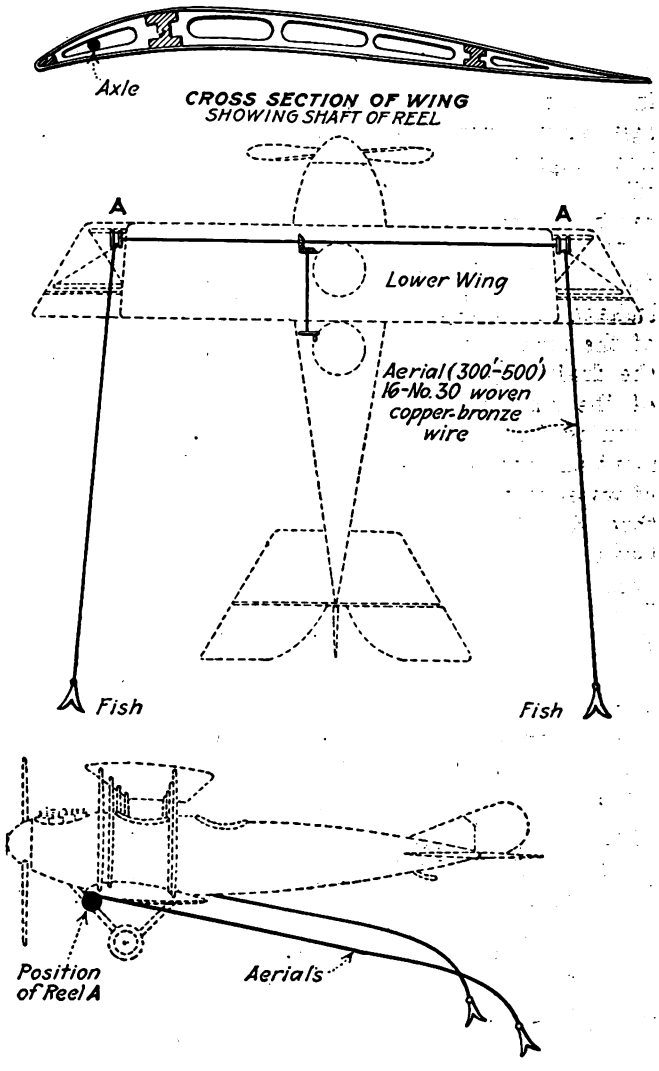

FIG. 1—ARRANGEMENT OF AERIALS TRAILING FROM WING ENDS

Wing-end aerials controlled as to accurate length by cross axle centered inside the wing sections and operated from fuselage (reeling in and out by hand wheel). Used as a counterpoise to combine radiation directly (1) downward and (2) straight ahead (and upward).

ship does the transmitting, but owing to the fact that the ship must start and land with its aërials trailing, frequent losses of wire occur and result in change of wave length if not total failure to operate. The safety in insulating this type is not high and the installation is awkward for mechanics working on the ship. In aërial fighting the wires can be shot away.

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This type of aërial is not adaptable for reception from the ground, but with the aërials now in use for ground stations it is perhaps more the fault of the ground station aërials than the ship aërials that signals cannot be picked up readily.

The best type of aërial for transmission to ships from

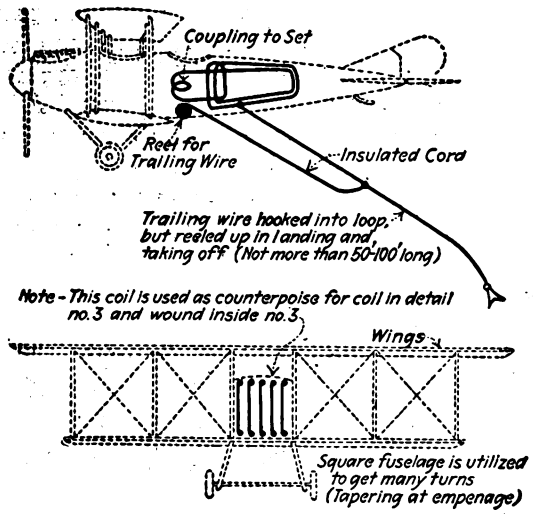

FIG. 2—COILS FOR RECEIVING SIGNALS FROM GROUND

"Vertical" loop of from thirty to fifty turns heavy insulated braided wire depending on power of set. Coiled in the fuselage and used to detect signals from ground and for transmitting in conjunction with trailing wire. Used to receive signals from ahead (independent set connections from Fig. 4).

the ground is the umbrella aërial using high power input. Special features of design which will force radiation upward and not parallel to the earth have yet to be developed. The solution probably lies in the use of a counterpoise which will offset the effect of ground currents. Theoretically, if the ground aërial is inverted—that is, with the counterpoise at the normally "high potential" end and insulated in the air, and the "open end" still far enough from the ground to reduce the capacity effect of the ground—the conditions might be fulfilled. By shifting the angle of the counterpoise and aërial with respect to the vertical the proper direc-

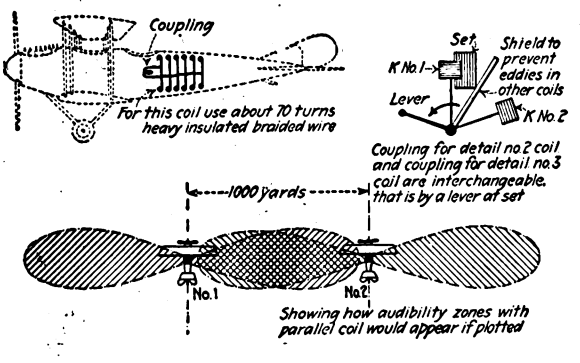

FIG. 3—SCHEME FOR RECEIVING MESSAGES FROM OTHER PLANES

"Parallel" loop used to receive from ships in air and on about same traveling plane—that is, going same direction; also used to send to ships at close range, as above.

tional control might be secured to talk with a ship at a considerable elevation. This feature would be especially valuable for aërial patrol work. A patrol ship at a high altitude can give chase to an invading enemy plane much more readily than one starting from the ground, owing to the loss of time and difficulties of maneuvering.

It is likely that the requirements for satisfactory aëroplane aërials will be met by the use of a multiple antenna of some kind; that is, by extending aërials in the directions in which communication is desired and using loading coils for the adjustment of wave length. The ultimate aërial will be one combining compactness and directional control. Since the ship-to-ship communication normally is over short distances, a maximum of 1000 yd. (914 m.), closed oscillators of high directional effect may be used, with a trailing-type antenna and adjustable counterpoise for communication to the ground.

There must also be special facilities for tuning while in the air which have not been available thus far. A wave meter which can be cut into the aërial circuit will be needed so that the aërial observer wishing to communicate with a particular station can adjust his set to the specific wave length while in the air. Closer tuning will also be required to avoid interference, and with the continuous-wave generators this means an accurate wave meter in the receiving side with exciting source of power for adjustment.

Pilots frequently have difficulty in keeping their

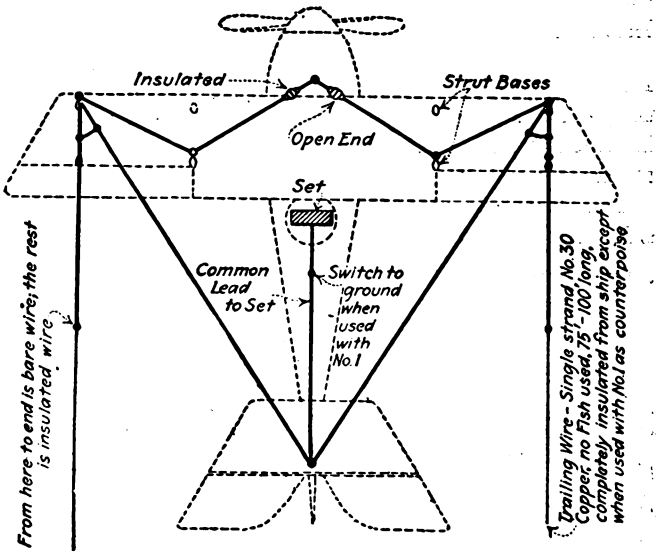

FIG. 4—FOR CONTINUOUS WARNING SIGNAL

Wire antenna distinct from that shown in Figs. 1, 2 and 3. It is to throw signals forward and upward for continuous warning ahead. When not used as such, it serves with wires shown in Fig. 1 as a counterpoise to throw signals down (Fig. 2, transmitting). It is interesting to note that there is a neutralizing magneto field present in the engine which is very detrimental and must be overcome in some way such as shielding or grounding.

bearings on cross-country flights, and if facilities are available to call up known ground stations, they can correct their bearings and continue in a proper course despite clouds and atmospheric haze. For long-distance postal routes and passenger service this would be a big asset. A ship equipped with radio sets suitable for operation on the ground can summon aid if forced to land in a sparsely settled district. This feature of radio utility presupposes a large number of land stations. Doubtless they will come into service as the need arises.

As the aërial highways become more and more crowded, the need for wireless warning signals will increase. Aëroplanes travel at high speeds and one ship will pass another in a few seconds. Visual warnings are unreliable, and in fogs or at night the dangers are

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greatly increased. Some system of continuous radiation in a direction directly ahead is needed. Two approaching planes properly equipped could be warned while 5 miles or 10 miles (8 km. or 16 km.) apart and thereby avoid any dangers of collision.

Hereafter the air will require policing the same as any highway, and if the policing planes cannot question

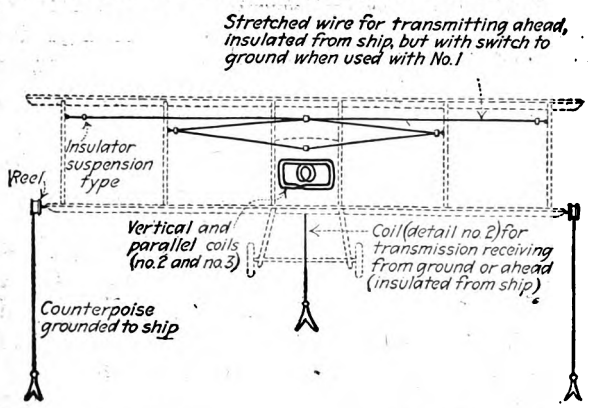

FIG. 5—COMBINED VIEW OF FIGS. 1, 2, 3, AND 4

Note that a plane so equipped could not maneuver with safety unless the driving power were offset; also, that to balance the weight of the coils the wires would have to be set farther back than on the ordinary training plane, but would be all right on bombing and weight-carrying planes.

a passing plane as to its cargo and character, there is no power to control traffic. This would indicate that in time laws will be passed requiring commercial planes to carry radio sets for this purpose.

The matter of interference will need serious consideration, and a likely solution is that a certain range of wave lengths will be restricted for aëroplanes only. Regulation of the power of the sets must also be considered and some method of standardizing the sets themselves be advanced so that their operation will be reasonably reliable.

The use of government planes in peace times as ambulance ships, for policing the air, forest fire patrol, mail and passenger service, sea patrol, life-saving service, etc., all suggest immediate utility of radio apparatus if properly developed. One-way communication has been a success in the war, but the ability to pick up and

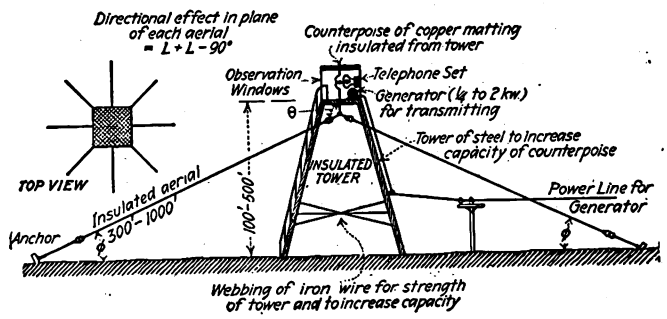

FIG. 6—INVERTED UMBRELLA AERIAL FOR GROUND STATIONS

The higher the tower and the greater $L\phi$, the more directional effect upward. Each tower would be erected near a landing field.

answer calls at various wave lengths while in the air has yet to be developed. The design of sets which will meet all these requirements is really simpler than the aërial problem. The military authorities are working on such problems now, but there is an open field for the engineer who can effect a solution.

An Entirely New Set of Problems for the Electrical Industry

BY JOHN B. MILLER
Chairman of the Board Southern California Edison Company

THE war brought entirely new problems—problems wholly outside of our own experience, problems of coördination, of production and of elimination of everything not essential to the war. Difficult and untried as were these problems, they were solved to a degree entirely satisfactory when the shortness of the time during which this nation actually was at war is considered.

Now that the war is over, we are again confronted by an entirely new set of problems. These problems are of many different phases, but have been given the generic term of "problems of reconstruction." We have little in our experience upon which to draw any help in the solution of these problems, and we can see into the future but a little way and that darkly, so that he who would lay down a general, cocksure plan at this time for the solution of all of these problems would be an exceedingly rash man and soon would be a prophet without honor in either his own country or any other. For that reason it seems to me wise to proceed slowly and with caution, one step at a time.

But I think all of us can recognize even as early as this that our main problem has to do with the replacement and employment of the men who left their occupations in civil life to go into the service of their country, and most employers plan to restore every old employee returning from the service, if not to exactly the same job which he relinquished at his country's call, to one at least as well paid. To do this will tax the resourcefulness of employers to the limit, but it must be remembered that ours is a business which by its very nature does not stand still but constantly increases with the growth of the community which it serves.

During the war all construction except that essential for war purposes was reduced to the irreducible minimum. On the Pacific Coast the pressure for new extensions is so insistent that there will have to be a great amount of construction—new power plants and new lines of transmission and distribution—and these developments will help to solve the first step in the problem of reconstruction indicated above, and as we proceed with that, we shall perhaps receive light with which to see a little farther ahead in the solution of the problems yet to come.

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Substation Operation a Woman's Job

When Trouble Has Arisen the Average Woman Has Been Found to Be as Capable and Resourceful as the Average Man—No Complaints About Service Received from Customers of Michigan Company

BY H. J. BURTON
Superintendent of Instruction, Consumers' Power Company, Jackson, Mich.

GENERALLY speaking, the operation of generating plants and substations has always been looked upon as a man's job, and although the Consumers' Power Company has employed women as switchboard operators in some of its substations for several years, it was not until the past year that women were employed to take care of all of the work previously done by the male substation operators. The women, of course, were employed as a war measure to take the places of men who had left the company to enter military service.

The Consumers' Power Company controls over seventy generating stations and substations in Michigan where operators are employed. At the present time seven of the substations are operated by women, and B. E. Morrow, manager of the production and transmission department, states that the work done by the women operators is entirely satisfactory and that the women are more dependable than some of the men who are available for these positions at the present time. They obey instructions better, are more careful and less apt to experiment with dangerous and expensive machinery than the male novice. The women keep the stations and apparatus neater and cleaner than the average man. The operation of a modern substation is in many respects just as much a woman's job as is the operation of a telephone switchboard, and Mr. Morrow sees no reason why women should not continue to do the work even now that hostilities have ceased and the war is practically at an end.

RIGHT TYPE OF WOMEN OBTAINED

Owing to the essential nature of the work applicants for the position of women operators were secured through the women's committee on placement, department of registration, and with the coöperation of this committee the right type of employee was found.

GROUP OF WOMEN SUBSTATION OPERATORS IN WORKING GARB

Most of the women started to take up the work through patriotic motives and a desire to serve the

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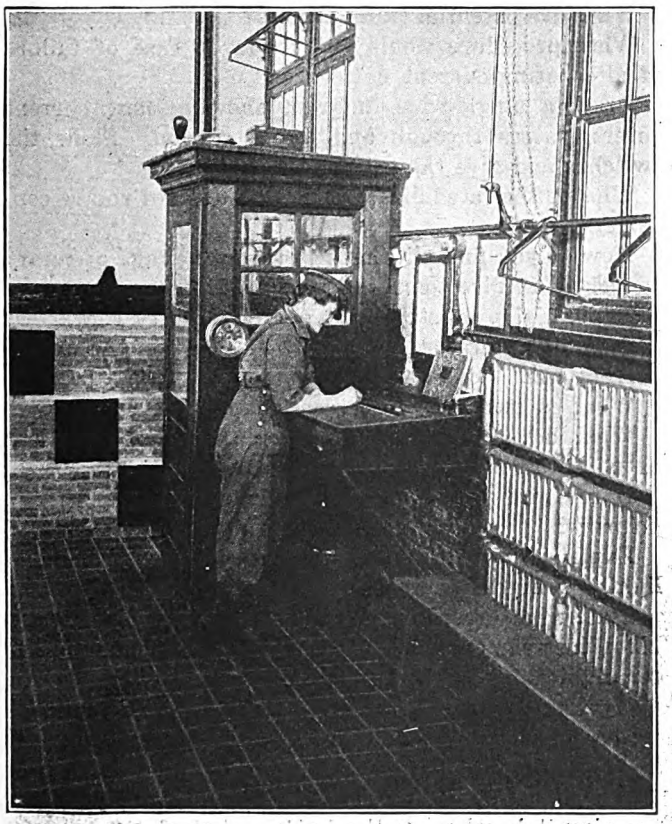
country. At first the constant hum of the transformers and the noise made by the rotary converters and motor-generator sets bothered the women considerably. As soon as they became accustomed to the noise, however, they began really to enjoy the work. They realized that they were doing an essential task. They attained a



ENTERING RECORDS ON LOAD SHEET

broader outlook and better spirits, and it has been noted that they are healthier and that a general improvement in physical condition has resulted.

Operators must, of course, be mentally and physically qualified for the work they have to perform. They must be strong enough to be able to operate the large oil switches and the starting and running switches of the rotary converters and motor-generator sets. They must possess a good grade of intelligence in order to learn readily the meaning of simple electrical terms, learn how to read meters, learn how to figure the daily operating results and make clear and concise reports regarding operating conditions and results to the load dispatcher or system operator. It has been found that a high-school education is desirable although by no means essential, as some of the most competent substation operators have not completed even a full grammar-school education.

WORK ESSENTIALLY HOUSEKEEPING

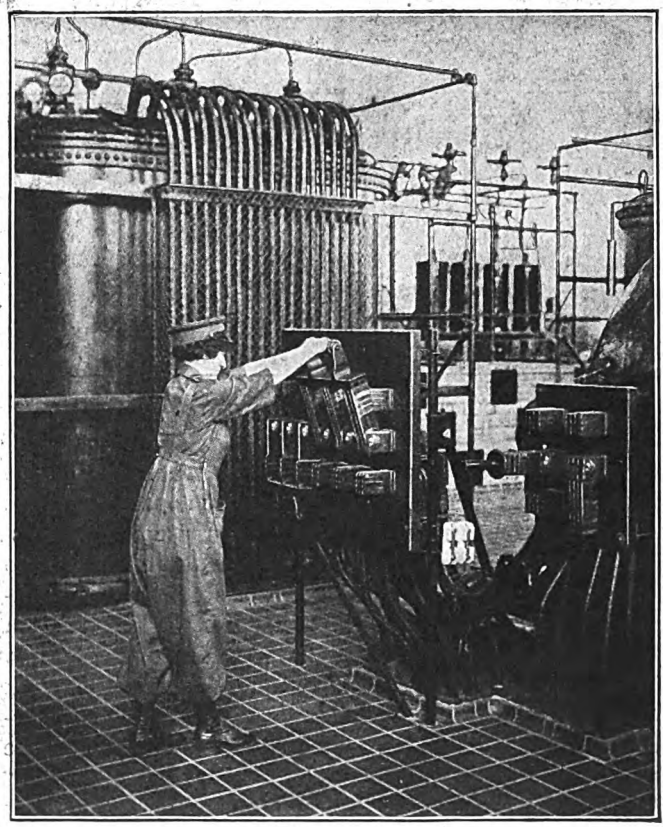
The work to be done in the stations is by no means physically fatiguing. Housekeeping is one of the most essential phases of the work. "A place for everything and everything in its place" is an excellent motto for it. One of the male substation operators who has just been promoted summed the situation up when he said: "It is really a woman's job; there is more housekeeping to it than anything else."

In the stations now being operated exclusively by women no complaints about the service have been made, and during trouble it has been demonstrated that the average woman is as capable and resourceful as the average man. It has been noted that the women follow instructions to the letter where the men follow them only in a general way. The women will take half-hourly readings exactly on time; with the average male operator a few minutes earlier or later does not seem to make any difference. The women are not so inquisitive about the apparatus as the men; for instance, they are not so apt without permission to take the cover off a meter or other instrument, to take it to pieces in order to find out "what makes it work or why it does not work." This does not mean that women are not interested in the work or the study of electricity; on the contrary, a number of them have purchased books on the subject and are studying in their spare time.

Very little, if any, trouble has been experienced due to lack of coöperation on the part of the men; in fact, most of the men have been very kind to the women and go out of their way to help them. The men realize that there is plenty of work for all and that the sooner there are others capable of taking their places the sooner they will be promoted.

The women have a shorter working day than the men. In stations where they do all the work previously done by the men they receive the same rate of pay.

So far no regulation uniform has been decided upon.



STARTING ROTARY CONVERTER

Most of the operators wear a one-piece working garment. In some of the stations the women wear short, narrow skirts while on general duty and put on overalls only when special work is to be done around the machines, such as cleaning and overhauling of the rotary

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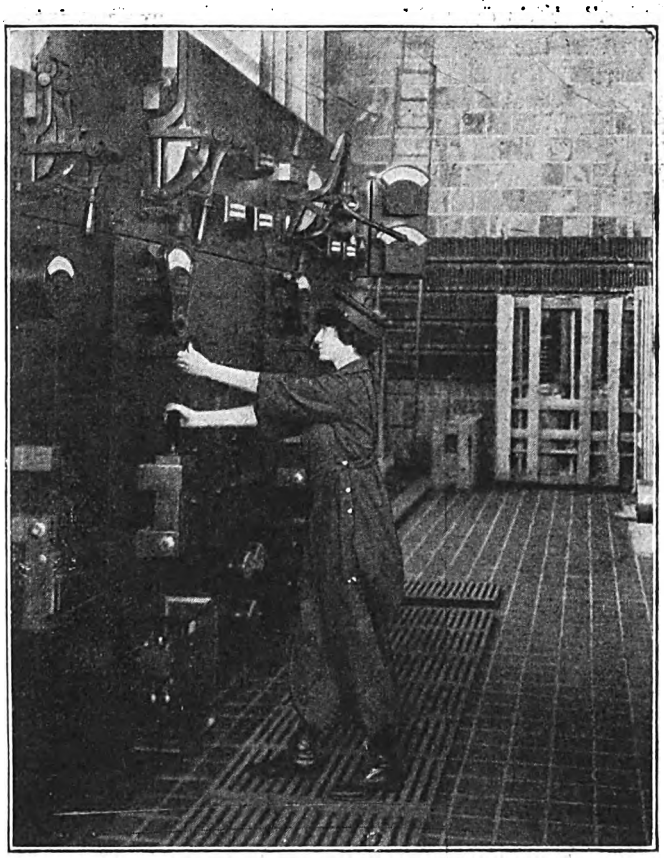
converters and motor-generator sets, changing brushes and work of like nature.

The time required to train an employee for substation work depends upon the local conditions: that is, the size of the station, the number of circuits and the nature of the service. In some stations two weeks is sufficient time; in others four weeks' training is necessary before all of the details can be learned. The new employee is first furnished with a copy of the general operating rules and instructions of the company and is placed in the substation under the care of one of the experienced male operators—one who is known to be in sympathy with the employment of women in the stations. For the first three days the new employee is



CUTTING IN ROTARY CONVERTER

not allowed to do any switching or to touch any of the electrical apparatus. She must study the operating rules of the company, get used to the surrounding conditions, and she must learn the names and purpose of all of the different pieces of apparatus in the station. New employees are given examinations by the instruction department before they are allowed to do any switching. The women operators must be qualified for the work they have to perform, and they are not allowed to operate until they have demonstrated their fitness for the work.

Following are some of the questions an employee must answer before she is allowed to operate:

What is the voltage and frequency of the transmission line that supplies energy to your station?

How many transmission lines feed station? Designate them.

Who has charge of all high-tension switching?

Are there any circumstances under which you would take instructions from any one else regarding high-tension switching?

What is the kilowatt capacity of your substation? Of your rotary converters? Of your transformers?

What is the voltage on the high-tension side of transformers? On the low-tension side?

What are series or current transformers?

What are potential transformers?

What procedure would you follow in case of failure of alternating-current power?

Draw a single-wire diagram showing how current enters, passes through and leaves station. Show the switches and give the voltages.

What is the rated direct-current voltage of rotary converters?

How do you find alternating-current voltage of rotary converter if direct-current voltage is known?

Explain step by step how you start rotary converters and motor-generator sets and place them on the direct-current bus. Give details for stopping them.

What is meant by reversed polarity?

What have you in your station to indicate whether or not your machines have correct polarity?

If reversed, how would you get them back to correct polarity?

Explain in detail how you change your aluminum lightning arresters.

State what procedure you would follow to report trouble in case you could not use the private telephone line to communicate with the load dispatcher.

Have you read the operating rules of the company?

What parts of the rotary converter or motor-generators require most attention? Why?

When opening a direct-current circuit would you open the circuit breaker or the knife switch first?

Can you operate with voltage regulator cut out of service?

State in detail how you would cut regulator out of service.

How many fire extinguishers are there in your station? Where are they located? Do you know how to use them?

WOMEN ARE SAFE EMPLOYEES

After a woman has been assigned to regular duty in a substation her instruction does not cease but she must continue to study. Periodical examinations are given to determine continued fitness for the work to be performed, and the operator's knowledge of the company's safety regulations is checked from time to time.

Women employees have proved themselves to be safe operators—they are quick to learn the proper sequence of opening and closing switches and the correct way to handle live conductors. Good housekeeping is one of the most important of the safety rules. The good housekeeper prevents accidents both directly and indirectly. Materials not in their proper places may directly cause an accident. The good housekeeper has everything in its place, the poor housekeeper has everything out of its place. Careless practices make careless employees. The operator in a modern substation should be a thinker. Brains more than brawn are required, and the woman operator has proved herself to be competent to handle the work. It is the writer's opinion that she is here to stay.

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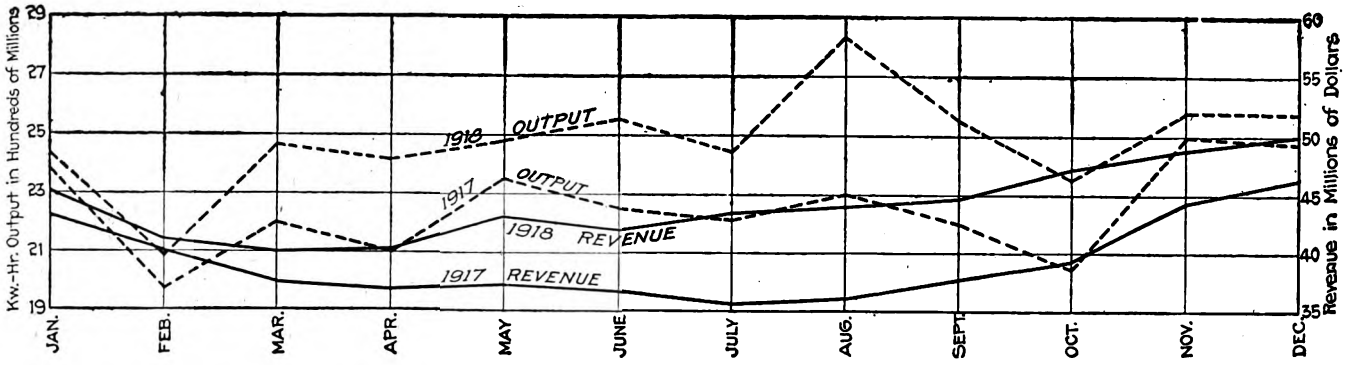
Central Station Operations in 1918



FROM the returns received by the ELECTRICAL WORLD it is estimated that the central electric stations of the country increased their revenue in 1918 about 12 per cent over 1917 and their output about 10 per cent. These calculations are made on the basis of the returns obtainable at this time. It will be recognized that they represent in part an estimate of what the companies in all sections of the country showed during the twelve months.

It is more difficult than usual to form a judgment as to the operations of the year because the war and the restrictions, expansions and other changes growing from it have diverted the properties in many ways from their normal practices. "Lightless" nights, "workless" days, daylight saving and the return of the clock to its old hours, coal shortage, curtailment of non-essential industries, stimulation of war industries, the nation-wide movement for economy, the higher rates received in some localities—all of these have left an impress upon the statistics.

Enough is obtainable, however, to make it certain that the gross business of electric utilities has continued to make a very satisfactory showing. Business was not conducted by any means as usual during the year. The output of energy was practically commandeered by the government in active munitions-making districts, and the regular custom of developing new markets was abandoned. The great need of power, however, to meet the urgent government and civilian population requirements assured an output which represented, in many communities the full plant capacity.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1917	1916	Per Cent Increase	1917	1916	Per Cent Increase
Nov.	62	$26,665,000	$23,183,000	17.0	1,485,370,000	1,292,113,000	15.7
Dec..	58	28,144,000	25,026,000	12.4	1,517,001,000	1,362,299,000	11.0
		1918	1917		1918	1917	
Jan..	62	27,035,000	24,977,000	8.2	1,508,353,000	1,422,121,000	6.3
Feb.	60	24,690,000	22,307,000	10.6	1,254,217,000	1,168,288,000	7.1
Mar.	60	25,396,000	22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct..	54	22,848,000	20,161,000	13.3	1,257,263,000	1,142,559,000	10.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				Central States				Pacific and Mountain States		
		Percentage of Industry Represented	1917	1916	Per Cent Increase	Percentage of Industry Represented	1917	1916	Per Cent Increase	Percentage of Industry Represented	1917	1916	Per Cent Increase	Percentage of Industry Represented	1917	1916	Per Cent Increase
REVENUE	Nov.	64	$3,391,000	$2,834,000	19.7	65	$10,159,000	$8,873,000	14.5	52	$8,454,000	$7,063,000	19.7	84	$4,661,000	$4,410,000	5.9
	Dec.	64	3,483,000	2,999,000	16.1	58	10,834,000	9,949,000	8.8	48	8,935,000	7,464,000	19.7	82	4,892,000	4,614,000	0.6
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan.	63	3,393,000	2,990,000	13.8	64	9,677,000	9,517,000	1.6	53	8,862,000	7,639,000	16.8	86	5,113,000	4,831,000	5.8
	Feb.	62	2,995,000	2,272,000	8.0	57	9,473,000	8,658,000	8.6	53	7,779,000	6,746,000	15.3	84	4,443,000	4,131,000	9.5
	March	62	2,985,000	2,724,000	9.2	59	9,904,000	8,922,000	11.0	53	7,947,000	6,735,000	18.0	84	4,560,000	4,321,000	5.5
	April	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824,000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sep.	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct.	63	3,360,000	3,036,000	10.6	52	7,695,000	6,872,000	11.9	44	7,639,000	6,512,000	17.3	77	4,154,000	3,741,000	11.0
KW.-HR. OUTPUT			1917	1916			1917	1916			1917	1916			1917	1916	
	Nov.	64	130,311,000	108,561,000	20.0	65	532,301,000	445,537,000	19.6	52	443,374,000	384,480,000	15.2	84	379,384,000	357,535,000	6.1
	Dec.	64	135,703,000	111,342,000	21.8	58	548,316,000	486,368,000	12.7	48	437,264,000	367,534,000	12.8	82	395,518,000	377,058,000	4.8
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan.	63	125,212,000	111,339,000	12.4	64	477,200,000	466,158,000	2.3	53	486,291,000	453,009,000	7.3	86	419,651,000	391,624,000	7.3
	Feb.	62	110,454,000	102,562,000	7.7	57	438,721,000	403,122,000	8.3	53	358,276,000	342,257,000	4.5	84	346,766,000	320,025,000	8.4
	March	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept.	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct.	63	139,784,000	128,970,000	8.3	52	346,090,000	311,749,000	11.0	44	403,202,000	368,198,000	9.5	77	368,187,000	333,642,000	10.3

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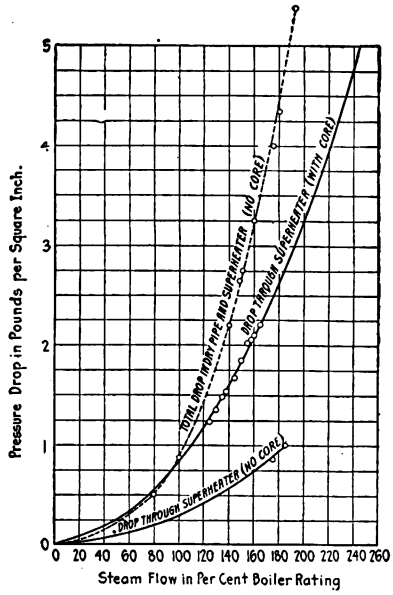
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

PRESSURE DROP IN DRY PIPES AND SUPERHEATERS

Lower Losses with Open-Tube Superheater—Drop Increased by Suspended Matter in Boiler Water—Tests Made in Detroit

While the pressure drop through the dry pipe and superheater of a boiler is not noticeable at low ratings, the rapid increase in pressure loss (proportional to square of rating) as the boiler rating increases makes this point one which should be watched. It is usually at the time when high ratings must be developed on the boilers that the need is felt for the maximum steam pressure, and a loss in pressure means a decrease not only in efficiency of operation but in the capacity of the prime movers.



RATIO OF STEAM FLOW TO PRESSURE DROP

When the boiler-feed water contains much matter in suspension it may be carried over into the dry-pipe holes, superheater, valves and even the blades of the turbines, especially during heavy loads, restricting the steam passages and increasing the pressure drop. Thorough washing of the passages whenever the boiler is down for cleaning helps considerably, but the only real remedy is to treat the make-up water.

A summary of a few tests on pressure drop through dry pipes and superheaters follows:

At the Detroit municipal lighting plant the total pressure drop through the superheater and dry pipe on a 685-hp. Stirling boiler at 189 per cent rating amounted to 20.40 lb. (1.5 kg.). At 100 per cent rating the pressure drop was 5.7 lb. (399 gm.).

On a test at the Brunots Island plant in Pittsburgh on an 800-hp. Stirling boiler at 200 per cent rating a pressure drop was noted of 3.5 lb. (245 gm.) through the dry pipe and an additional drop of 4 lb. (280 gm.) through the superheater.

At the Water Street station at Toledo on a 670-hp. Stirling boiler with cored superheaters the pressure drop through the superheater at 165 per cent rating was 2.2 lb. (140 gm.); at 100 per cent rating this would be 0.8 lb. (56 gm.). On another test at the Water Street station on a 670-hp. Stirling boiler with an open-tube superheater the drop through the superheater at 185 per cent rating was 1 lb. (70 gm.) and through the dry pipe 3.9 lb. (270 gm.). At 100 per cent rating this would mean a drop of 0.3 lb. (21 gm.) through the superheater and of 0.6 lb. (42 gm.) through the dry pipe.

The foregoing information was given by George M. Coughlin, assistant results engineer of the Toledo Railways & Light Company.

ELECTRIC RIVETING FURNACES FOUND HIGHLY SUCCESSFUL

Tests Show that Costs Compare Favorably with Costs of Gas Without Taking Into Consideration Superiority of Product

Last winter, when a gas shortage seemed inevitable, H. P. Smith, power engineer for the McClintic-Marshall Construction Company, Pittsburgh, Pa., made an investigation to discover if possible a substitute for natural-gas-fired rivet-heating furnaces. The tests which were made included a test of an electric furnace. According to statements on this test made by Mr. Smith before the Engineers' Society of Western Pennsylvania, the cost of heating with electricity compared favorably with that of natural gas, the prices of both classes of service in that district being somewhat lower than those usually found. In figuring these comparative costs no consideration was given to improvement in the product, which is a decided feature in favor of the electric furnace.

The thermal efficiency of the furnace when heating rivets is only about 50 per cent. This is low on account of the fact that the furnace door is opened frequently. The same furnace used for heat-treating steel or melting non-ferrous metals would probably reach a thermal efficiency of 90 per cent or more. The furnace which was used is of the Bailey type, measuring 6 ft. long, 30 in. wide and 18 in. high (1.8 m. by 76 cm. by 45 cm.). It has three doors at the front and is capable of heating every fifteen minutes seventy rivets weighing 45 lb. to the proper temperature for driving. This operation requires 40 kw. The heating element used is graphite, the loss due to oxidation amounting to about 30 per cent per ton of metal treated for rivet heating.

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SELECTION OF METERS TO GIVE PLANT RECORD

What One Ohio Company Considers Adequate Metering Equipment to Give Accurate Check on Plant Operation

In both the mechanical and electrical ends of the new power plant of the Mansfield (Ohio) Electric Light & Power Company special attention has been given to the selection of metering equipment. Arrangements have been made so that the station attendants have practically no readings to take. Moreover, the equipment permits the detection of the slightest inefficiency in the plant and enables the engineers to trace the inefficiency to its source.

In the boiler-room coal is weighed as it goes to the boilers on Richardson patent automatic scales of the stationary type. Gas, which is also used as fuel, is measured too. Each boiler is equipped with a Bailey boiler efficiency meter, recording steam flow, air flow and flue-gas temperature. The instrument also has a firebox draft indicator. There is a Columbia recording superheat thermometer of the Schaeffer & Budenberg type to assist in adjusting the baffling. A recording flue-gas temperature meter affords another check on the baffling. Water is measured by a recording and integrating meter, which besides measuring volume also takes the temperature of the water at the feed-water meter. Recording steam-flow meters of the Bailey type will be placed on each turbine to indicate the steam flow, steam pressure and superheat. At the condenser a meter is installed to indicate the temperature of the exhaust from the turbine, the temperature of the injection water and the temperature of the water discharged, all on one chart.

On the electrical end, in addition to all the common switchboard instruments, the plant will contain a totalizing panel with a recording watt-hour meter and recording voltmeter. With this equipment it is believed that an accurate check on the plant operation can be kept.

TEST DATA TAKEN ON 6000 SAMPLES OF INDIANA COAL

Information on Coal Which Is of Value as Supplementing Similar Data Already Published on Coals of Other Regions

About 6000 samples of coal from forty-six points of shipment in Indiana have been analyzed by the Indianapolis Light & Heat Company. The different kinds of coal tested include mine-run, screenings, nut and 1¼-in. lump. The analysis which this company has made includes seventy-six different groups of averages for the different kinds of coal from different locations. The tests show moisture content ranging all the way from 9.46 to 17.3. Volatile carbonaceous material ranges from 25.81 to 40.5. Fixed carbon values vary from 42.3 to 60.36. The percentage of ash is as low as 4.2 and as high as 28.6. The sulphur content ranges from 1.55 to 7.6 with the exception of coals for which no values are shown. All of the coals are above 10,000 B.t.u. in heating value, some going as high at 13,488 and as low as 10,310.

Similar information for all parts of the country has been published by the National District Heating Association, the Illinois Stoker Company and the Bureau of Mines, but the information collected by the Indiana company is particularly complete for that state. Since the variation in quality of Indiana coals is unusually large, T. N. Wynne, who recently presented these data before the Indiana Electric Light Association, urges that care be used in selecting coal that is best suited to operating conditions.

TESTS ON INDIANA COALS

No.	Point of Shipment	Kind	No. of Samples	Moisture	V.C.M.	F.C.	Ash	Sulp.	B.T.U.'s
1	Ayredale	Scgs. No. 4	63	14.9	33.5	58.7	7.8	1.74	12,807
2	Ayredale	Scgs. No. 5	6	12.78	33.36	56.95	9.69	3.95	11,789
3	Ayredale	M.R.	22	11.47	36.91	55.22	7.8	3.82	12,584
4	Bicknell	Scgs.	119	11.44	32.47	56.48	11.05	3.73	11,783
5	Bicknell	M.R.	91	11.72	33.56	56.13	10.31	3.25	12,262
6	Black Creek	Scgs.	281	15.23	33.03	57.84	9.13	2.19	12,253
7	Black Creek	M.R.	29	13.9	32.5	60.3	7.2	1.55	12,560
8	Big Vein	M.R.	1	12.1	40.5	55.3	4.2	....	13,380
9	Blackburn	Scgs.	1	11.9	.....	.....	12.5	....	11,800
10	Brazil	M.R.	16	12.61	33.60	48.45	17.95	5.55	11,181
11	Clinton	M.R.	10	11.9	33.49	49.91	16.6	4.25	11,699
12	W. Clinton	M.R.	7	12.0	37.9	45.5	10.6	....	12,494
13	Clovelly	Scgs.	6	12.41	.....	.....	17.36	....	11,711
14	Clovelly	M.R.	22	13.9	31.89	50.41	17.7	3.73	11,560
15	Coal Bluff	Scgs.	9	13.5	33.16	55.64	11.2	3.40	11,973
16	Coal Bluff	M.R.	1	13.95	37.89	54.47	7.64	4.77	12,481
17	Crown Hill	Scgs.	34	10.80	34.65	50.67	14.68	3.98	11,085
18	Crown Hill	M.R.	10	9.6	.....	.....	10.77	2.34	11,618
19	Dugger	Scgs.	57	13.37	34.10	58.17	7.73	2.20	11,890
20	Dugger	M.R.	1	10.7	.....	.....	6.1	....	11,830
21	Elberfeld	Scgs.	7	10.28	34.89	54.71	10.40	4.49	12,176
22	Essenbea	Scgs.	22	13.60	32.85	53.68	13.43	3.60	11,471
23	Essenbea	M.R.	4	11.96	33.40	51.8	14.8	....	11,215
24	S. Clinton	Scgs.	13	14.0	33.86	55.62	10.52	2.62	11,671
25	Eureka	M.R.	3	15.55	38.45	51.09	10.46	....	11,393
26	Glen	M.R.	16	13.98	31.91	55.89	12.20	3.11	12,140
27	Gandors	M.R.	33	13.5	30.98	55.52	13.5	3.15	11,860
28	Green Valley	M.R.	8	11.22	.....	.....	10.06	....	11,737
29	Hymera	Scgs.	2	12.7	35.25	49.85	14.9	....	11,930
30	Indian Valley	Scgs.	16	15.2	36.08	54.73	9.19	1.62	12,371
31	Indian Creek	M.R.	10	12.76	33.47	55.93	10.60	3.46	12,466
32	Isla[illegible] Valley	Scgs.	13	17.30	31.40	55.8	12.8	2.62	11,940
33	Island Valley	M.R.	3	16.4	.....	.....	11.55	3.18	11,608
34	Jackson Hill	Scgs.	2	10.37	36.16	51.71	12.13	4.34	11,230
35	Jackson Hill	M.R.	26	15.88	36.26	52.15	10.59	2.93	12,815
36	Kettle Creek	Scgs.	2	12.0	33.0	53.1	13.9	....	11,810
37	Kettle Valley	M.R.	1	12.5	33.3	54.9	11.8	....	12,160
38	Latta	M.R.	2	14.8	37.0	50.6	12.4	4.30	11,997
39	Latta	Scgs.	1	15.4	31.0	54.1	4.9	....	11,865
40	Le Noir	Scgs. No. 4	1	14.9	33.54	57.58	8.88	4.09	12,078
41	Linton	Scgs.	39	14.94	34.77	55.35	9.88	2.59	11,670
42	Linton	M.R.	34	13.38	38.28	54.11	7.61	3.23	12,134
43	Linton	Nut	1	14.10	.....	.....	12.3	2.30	10,550
44	Mackville	M.R.	6	11.20	33.9	52.3	13.8	3.07	11,501
45	Mackville	Scgs.	2	11.90	35.1	50.3	14.6	4.90	11,340
46	Midland	M.R.	26	12.80	34.13	49.63	16.24	3.83	11,232
47	Midland	Scgs.	11	14.20	33.47	54.85	11.69	1.75	11,527
48	Muren	Nut No. 5	7	11.73	34.79	56.88	8.23	3.56	12,209
49	Muren	Scgs.	1	14.8	28.39	58.95	12.66	3.21	11,028
50	New Goshen	Scgs.	1	12.03	35.65	50.39	13.96	4.89	13,488
51	North West	M.R.	444	14.62	33.28	58.15	8.57	2.18	12,190
52	North West	Scgs.	317	14.32	32.62	56.38	11.00	4.46	11,877
53	Paxton	M.R.	79	11.50	34.25	54.25	11.50	3.52	12,251
54	Paxton	Scgs.	22	12.19	33.31	54.94	11.75	3.42	11,696
55	Queen Valley	Scgs. No. 4	1,166	15.14	32.95	56.61	9.44	2.45	12,106
56	Queen Valley	Scgs. No. 5	754	13.50	39.07	47.03	13.9	3.71	11,551
57	Queen Valley	M.R. No. 4	502	14.68	35.98	56.39	7.63	2.14	12,518
58	Queen Valley	M.R. No. 5	188	13.69	35.14	54.35	10.51	3.17	11,854
59	Queen Valley	1¼ in. Lp.	197	13.59	35.87	54.13	10.00	3.87	12,055
60	Seelyville	M.R.	3	13.81	25.81	58.34	15.85	3.78	11,433
61	Seifert	Scgs.	34	12.99	33.18	53.25	13.57	2.94	10,982
62	Seifert	M.R.	100	14.93	31.97	60.36	7.67	2.69	12,297
63	Shelburn	Scgs.	4	13.79	31.04	49.63	19.33	3.96	10,455
64	Shelburn	M.R.	2	10.93	31.72	58.55	9.73	3.11	11,331
65	Sponsler	M.R.	43	13.77	33.15	57.14	9.71	2.58	12,113
66	Sponsler	Scgs.	33	17.50	31.80	59.27	8.93	1.74	11,758
67	Staunton	M.R.	2	11.45	29.1	42.3	28.6	7.6	10,310
68	St. Clair	M.R.	2	12.35	30.70	53.4	15.9	....	10,920
69	Shirkie	M.R.	10	11.1	35.53	47.67	16.8	....	10,981
70	Shirkie	Scgs.	18	11.69	27.63	55.61	16.76	....	11,139
71	Sullivan	M.R.	6	15.24	31.10	58.20	10.70	3.97	11,867
72	Templeton	M.R.	238	11.78	34.99	52.31	12.70	4.44	11,948
73	Templeton	Scgs.	10	11.48	35.23	50.53	14.24	4.41	11,764
74	Turner	M.R.	43	11.80	31.14	51.16	17.70	5.55	11,232
75	Victoria	Scgs.	4	14.15	.....	.....	17.80	2.99	11,308
76	Worthington	Scgs. No. 4	1	9.46	38.89	50.87	10.24	3.48	11,892

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PHOTOGRAPHIC EVIDENCE OF METER READINGS

Detroit Company Uses Meter Camera with Time-Taking Attachment for Readings Taken to Determine Demand Charge

The Detroit Edison Company is using a special camera for taking "load-test" meter readings to establish cusotmers' demand charge. A regular meter-reading camera was rebuilt so that now photographs are taken showing in the picture not only the meter reading but a watch dial with the time of reading and also the name and address of the customer.

The photographic readings have shown their value in a number of instances where differences of opinion have come up with regard to the correctness of load curves. For example, in a case where a customer raised an objection to his bill on the ground that readings were not taken exactly one hour apart, the production of an actual photograph of his meter with the time of taking shown on the same film satisfied him as to the correctness of the load test.

COMMERCIAL MEN SHOULD STUDY LOAD-FACTOR CONDITIONS

Long-Hour-Use Clauses in Industrial Contracts May Help to Prevent Marked Decline in Central-Station Load Factors

Many of the central stations throughout the industrial sections of the country have experienced within the last year or two a considerable increase in their load factors, due largely to the fact that consumers have been required, because of war production, to increase their output, and in many cases this has been accomplished by making further use of the equipment at hand. In certain cases plants that formerly always ran on a single-turn basis had during the war period their working hours increased to cover two or possibly three turns. Consequently the consumers' load factor has been raised from perhaps the value of 30 per cent to 60 per cent or above.

Just what dropping back in load factor central stations are to experience where they have had this war-time increase is difficult to estimate, because the war industries have not sufficiently readjusted themselves to be able to tell the extent of the operation for the next few months to come. It is probable, however, that working hours will be decreased, that the extreme pressure for production will be relieved and that load factors in many instances will fall off to a marked extent. Just how far the central station can go in keeping the load factors up during the next year is indeterminate, but the fact remains, according to C. I. Cupper of the Mahoning & Shenango Railway & Light Company, that a program calling for education of employees and consumers will produce very excellent results. In making these suggestions before the commercial men of the Ohio Electric Light Association, Mr. Cupper brought out that many central-station consumers do not fully understand the benefits to be derived by operating their plants at the best possible load factor, although practically all power rates these days are worked out in such a way as to give the man with good load factor or the long-hour user, as he is frequently termed, a materially lower rate.

This point should be brought clearly to the attention of the consumer, Mr. Cupper said, and it is quite easy to explain the situation so that he will have a very clear conception of the desirability of working in the right direction. However, the customs of the business, working hours, materials, plant equipment and many other items have considerable bearing on the question, and time and thought must be given to the subject by both the central-station company and the consumer.

In looking over station production costs there is a very interesting relationship between the cost of power and load factor at various power factors, as the cost of producing the energy increases very markedly as these two factors do. A detailed study of this relationship is very enlightening to the commercial man, and Mr. Cupper suggested that wherever possible consideration be given to this point.

SUB-METER ENERGY LOSSES REGISTERED ON MASTER METER

Central Station Must Be Prepared to Explain to Landlords Any Seeming Discrepancy in the Record

BY HALBERT R. THOMAS
Meter and Test Department, Southern California Edison Company

Large apartment houses and office buildings frequently purchase their electrical energy for lighting through a main meter, reselling to tenants through sub-meters which are either bought outright or leased from the lighting company. Such an arrangement relieves the central station of the cost of keeping many small accounts and of dealing directly with consumers whose occupancy is in many cases of a transitory nature.

If a considerable number of sub-meters are installed on a master meter, some difficulty is usually experienced in checking the consumption registered by the master meter against the total shown by the sub-meters. If all the meters are in accurate calibration, the main meter will show a slightly greater registration than the meters supplied through it. This is perfectly proper,

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and the central station should be prepared to explain it to the consumer.

The modern small lighting meter consumes an amount of power in its potential coil averaging from one to two watts, effective as long as it is connected to the line and irrespective of the load current being used. Owing to the internal connections this loss is not registered by the meter, but it will be registered by any other meter placed ahead of it in the same circuit. It is obvious, therefore, that a master meter registers in addition to all energy used by consumers the sum of the potential losses of the sub-meters. This energy amounts to little per meter, but is worth considering if a large number of meters are in question.

For instance, a meter with a potential loss of 1.5 watts will consume 36 watt-hours every twenty-four hours, or 1.08 kw.-hr. per month. Fifty such sub-meters would therefore increase the consumption of the master meter by 54 kw.-hr. per month. This may not represent a large fraction of the total energy involved, but if not understood it is likely to bring a vigorous complaint from the customer landlord.

The energy supplied through the master meter is usually obtained at a quantity discount, so that its resale to the tenants will be at a profit to the landlord. He should therefore be made to see that the losses on sub-meters are a part of his operating costs and should be charged against the profits along with the cost of bookkeeping and billing.

MAKES CAPITAL OUT OF SERVICE INTERRUPTION

Central Maine Power Explains Why Lights Went Out and How Quickly Service Was Restored by Its Efforts

A service interruption on the Skowhegan distribution lines of the Central Maine Power Company was turned to good account in a recent issue of the company's monthly new bulletin to consumers, "Power," reaching about 20,000 homes a month. The accident was caused by the backing of an automobile truck belonging to a large manufacturing company into a pole of the Central Maine system, the vibration burning the wires off in nineteen places. The explanation of the interruption and the speed with which repairs were made were featured in a newsy illustrated account of the occurrence which set forth to the public the company's understanding of the inconvenience of the interruption and the efforts made to restore normal service.

The statement follows:

Once in a while the lights will go out in almost any town or city lighted by electricity. Everybody affected is irritated—and we don't blame them. But did you ever consider that it is not always the fault of the company? For instance:

In Skowhegan one day this fall an American Woolen Mill truck backed into one of the company's poles, giving it a hard push and setting the wire swaying. The vibration continued down the street and around two right-angle corners, a distance of a quarter of a mile. The vibration was so violent that the wires were thrown together and burned off in nineteen places, causing a series of electrical illuminations and explosions that startled the town and put the lights out of commission.

The Skowhegan district linemen were at Norridgewock, 6 miles away—and the auto at the wrong end of the line! Depsite that thirteen splices were made and 560 ft. of new wire put up. In fifty minutes much of the service was restored. In one and one-half hours the lights were on. The next morning the entire service was back to normal.

For a few minutes, however, the sale of kerosene hand lamps in Skowhegan established new records, and the Central Maine Power Company was as popular as the plague—and all because a big Federal truck backed some six inches too far!

DO UTILITY MEN STUDY LABOR CLOSELY ENOUGH?

Causes of Unduly High Labor Turnover May Be Discovered and Removed if Time Is Given to Examine Individual Cases

A real problem which utility operators face is that of handling labor. Recently Edward Marshall of Cincinnati made the following remarks on this subject before the station operating committee of the Ohio Electric Light Association:

Many times during the last year we would come to work in the morning and find that some who were our most faithful employees in ordinary times had not shown up. They had been offered more money elsewhere. As a consequence we have had an inferior class of labor.

Do you think most of us give our help the proper consideration and attention? Should we not have in all plants some one whose duty it is to investigate each employee's home life and the condition he labors under? Should we not know whether our help live economically and whether each man is saving a little each month? We all know that the man who is continually in debt does not make a good employee. Some system of education and relief for such an employee should be provided.

Quite a few employees have changed from one position to another in the last year, employment being plentiful, when they needed ready money for immediate and legitimate use. Owing to the fact that some companies have a hard and fast rule forbidding money to be advanced between pay days the employees who needed money had to quit to get wages that were due. This has been the cause of not a little turnover in labor. Some method of keeping in closer personal touch with employees at all times makes the employer stand better with the employees, and better general results follow. How many of us when an employee does not appear on his proper shift make it our business to know why? Do you not think efforts along this line would be repaid in better service from the employees?

ELECTRIC FURNACE SHOWS SATISFACTORY ECONOMY

Test Made by Louisville Company Shows 20 per Cent Saving in Fuel Costs and 84 per Cent Saving in Metal Loss

Recently the Louisville (Ky.) Gas & Electric Company installed an electric furnace in the plant of a manufacturer of sanitary bathroom articles. An eight-day test of the installation shows that not only was there an actual saving in money per 100 lb. of metal poured, but there was a decrease in metal loss and a fuel economy of nearly one-third.

The summary is as follows:

	Per 100 Lb. of Metal Poured With Oil	With Electricity	Improvement, Per Cent.
Cost, in cents	24	19	20
Metal loss lb.	7	1.13	84
Heating units required, B.t.u.	708,000	475,000	32

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Calculation of the Transverse Field in the Slots of Unloaded Armatures.—L. DREYFUS.—It is first shown that the magnitude of the transverse field increases from zero under the pole centers to a maximum near the pole tips and decreases again to zero midway between the poles. This distribution round the armature at a given slot depth is worked out. The distribution of the transverse field along the depth of the slots is then calculated. The results of these investigations are expressed by rather complex differential equations. These are applied to numerical cases for straight slots and for radial slots. The calculations involved are long and somewhat complicated, but the author claims that the results arrived at are such as to permit simple and rapid calculations to be made in special cases.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Archiv f. Electrot.*, 6, pp. 165-224, 1917.)

Suggested Amplification of Heating Rules for Electrical Machinery.—M. VIDMAR.—It is suggested that existing rules concerning the heating of electrical machinery impose severe and unnecessary restrictions upon designers, do not accomplish their aim, and do not fully protect the purchaser. It is difficult to measure the temperatures which really determine the danger point. If the maximum (not the mean) temperature at any point in a cotton-insulated winding exceeds 105 deg. C. there is danger of burning. Rules and tests should refer to the maximum temperature, which may exist at one point only in the winding. The margin between maximum and mean temperature must not be too great, or progress is retarded and economical design is impossible. Mean temperature rise is easily measured by the increase in electrical resistance, whereas the point of maximum temperature cannot readily be determined, neither is it acessible for measurement. Clauses relating to mean temperature rise should be retained, but they should be supplemented by limiting the temperature difference between the points of maximum and mean temperature.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Electrot. u. Maschinenbau*, Feb. 3 and Feb. 10, 1918.)

Lamps and Lighting

Rules Concerning Supply and Decay of Tungsten Lamps.—The lighting rules committee of the Union of Electricity Works has agreed with representatives of tungsten-lamp manufacturers on rules for delivery and acceptance of tungsten lamps. They apply only to vacuum lamps with plain, not spiral, filaments and to standard gas-filled lamps. Detailed rules for acceptance and rejection of lamps follow.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Vereinig. d. Elektrizitätswerke*, Mitt. No. 204; *Elektrot. u. Maschinenbau*, Jan. 13, 1918.)

Generation, Transmission and Distribution

Good Operating Practice in the Boiler Room.—A. E. UEHLING.—This paper was designed to demonstrate the importance of attention to the operating conditions in individual boilers in the power plant. The author says that the economical status of a boiler plant can be approximately determined by either of two methods—the mechanical one based on the heat utilized and the chemical and physical one based on the heat wasted. In the former reliance is placed on the coal weigher and the water meter or steam-flow meter; in the latter the CO_2 meter and the pyrometer are used. While both methods are necessary for complete results, the chemical and physical method gives more directly useful information. It is pointed out that there is no such thing as a fixed adjustment in the operation of a boiler. The rate of combustion must be changed to keep the steam pressure right, and the thickness of the fire must be changed to keep the efficiency of combustion (per cent of CO_2) right. As the fuel and ash bed thickens a stronger draft is necessary to keep the required rate of combustion, and there are numerous minor variables which require changes in the draft adjustments if combustion efficiency and the required boiler capacity are to be maintained; *i.e.*, maximum CO_2 and a uniform steam pressure. The author believes that the CO_2 meters, the boiler draft gage and the pyrometers, the last and first named being inserted in the main gas flue at or near the chimney, should be autographically recording in order that data may be furnished for study of operating conditions in detail. In addition to the autographic instruments an Orsat apparatus for analyzing the flue gases is essential. In order to make the general principles concrete, Mr. Uehling gave formulas for the actual calculation of the physical quantities involved in boiler operation, illustrated them by sample calculations and applied them to data of a number of boiler tests.—Paper presented before A. S. M. E. convention, December, 1918.

Hydroelectric Reconstruction at Sherbrooke.—The reconstruction work of the water-power plants owned by the city of Sherbrooke, Ohio, brought about interesting results, and a short review of the work done shows what can be accomplished in the way of raising the capacity of many existing hydroelectric plants at a comparatively small outlay and with little interruption to plant operation. After investigation the following conclusions were arrived at: (1) The turbines were inadequate in capacity and inefficient. (2) The transmission line losses were too high and the line drop excessive for satisfactory operation. (3) The crib dam at one of the plants was wasteful of water. (4) The small turbines driving the exciters of the plant were inefficient. The correction of these faults is described in detail.—*Electrical News*, Nov. 15, 1918.

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Water Power in Brazil.—Of the Latin-American states there is probably none that possesses a greater wealth of undeveloped water power than Brazil, and it is the avowed intention of the government to make the most of this water power to foster the many different industries that are being developed in the republic. It is pointed out that, while the Brazilian cotton and woolen industries compete with the British, there is an excellent opening for foreign interests in financing the new enterprises. It is said that Canadian interests designed and now control the largest hydroelectric system in Brazil, namely, that on the Rio das Lages.—London *Times Engineering Supplement,* October, 1918.

Operation of Hydroelectric Plants with Irregular Loads.—A. CAUSSE and H. GOUA.—In hydroelectric plants supplying power for traction, motors, lighting, etc., although in general the total daily output of energy varies little from one season to another, the peak loads are likely to demand three times the average daily output, or even more. It is therefore necessary for these plants to standardize as nearly as possible the yearly output and to apportion the average thus obtained according to the needs of the different hours of the day. These conditions can be realized by the use of supplementary "annual" reservoirs in addition to the "daily" reservoirs. The authors examine the establishment of these reservoirs, and they give precise instructions concerning the conduit system serving the reservoirs, the surge pipes and the calculation of forced flow.—*Revue Générale de l'Electricité,* Nov. 2, 1918.

Utilization of Tides for the Production of Motive Force.—E. MAYNARD.—The author holds that the employment of the power of the tides in the coast regions of France is very important. He points out the difficulties imposed by the irregular movements of the sea and gives the result of his observations on tide levels at various ports and on the conditions existing in the coast lands which are overflowed directly by the sea or by bays, inlets, canals or the mouths of rivers. He advocates an official investigation into the feasibility and expense of the project.—*Revue Générale de l'Electricité,* Nov. 2 and 9, 1918.

The Unification of Frequencies.—U. DEL BUONO.—In view of a more rational utilization of the power of the hydroelectric plants in Italy, it would be desirable that they be connected in parallel so as to help one another during the periods of maximum demand for some of them. This mutual assistance will be of still greater importance when the great national electric power main connecting all the hydroelectric plants throughout the country is realized. It appears that the adoption of the frequency of 50 cycles or of that of 46 is the best solution of the problem, but the definitive solution will depend not only upon the technical discussion of the problem but also upon the commercial, financial and political discussion.—*Science Abstracts, Section B,* April 30, 1918. (Abstracted from *Elettrotecnica,* Feb. 5 and Feb. 15, 1918.)

A General and Quick Method for Calculating Masts.—M. SEMENZA.—In a former article (*Abs.* 802, 1917) the author has set forth a quick method for calculating a mast of square cross-section. In the present article he develops his method for rectangular-based masts. Adopting the same method as for square-based masts, a system of seven equations among seven unknown quantities is obtained, the solution of which would require a three-dimensional diagram. But, assuming that the ratio between the two sides of the pole be known, this system of equations is split off into two separate systems, each of four equations among four unknown quantities, like those for square-based poles, and these can be solved in the same manner. The method of "false position" allows, then, the finding of the value of this ratio, two or three attempts being generally sufficient to determine with good approximation the values of the sides of the pole. A practical example of the method is subsequently given.—*Science Abstracts, Section B,* April 30, 1918. (Abstracted from *Elettrotecnica,* Feb. 25, 1918.)

Current Intensities in High-Voltage Cables.—E. SOLERI.—The purpose of this article is that of setting forth the methods for determining the current intensity for high-pressure cables, taking into account the losses in the insulating substance. These for some substances, such as mica, paraffin, etc., are proportional to the square of the dielectric stress, but for other substances, such as india-rubber, impregnated paper, etc., the losses are proportional to a higher power of the dielectric stress. This fact was already known and is confirmed by the author's experiments, The temperature has a bad influence both upon the resistibility and upon the losses in the insulating substance.—*Science Abstracts, Section B,* April 30, 1918. (Abstracted from *Elettrotecnica,* Feb. 15 and Feb. 25, 1918.)

Installations, Systems and Appliances

The Heating of Houses.—It is pointed out that electric heating has advantages incident to no other system. Two main difficulties, however, preclude a very extensive use of the system, (1) the enormous amount of energy that is required (2) the high cost of electrical energy for heating as compared with other sources of heat energy. Figures are given to show that the average householder would have to pay about $357 per year for electric heating on the basis of the lowest domestic lighting rates, or even $140 on the basis of low power rates. The use of electric heating as an auxiliary to other systems for mild weather is, however, pointed out.—*Report of Hydro-Electric Power Commission of Ontario,* Feb. 28, 1918.

Notes on Electric Welding.—H. K. PORTER.—Modern locomotive specifications call for electrically welded boiler tubes and other parts, and the mechanical committees of the railroads favor the repair of bars, plates and similar pieces by the electrical process. Many other industries also recognize the rapidity with which repair work may be done by this means. The writer points out that many mining companies are wasting money, not through negligence, but because they are not thoroughly familiar with the multitude of uses to which an arc-welding system efficiently operated can be put. Some of the advantages of electrical welding are set down and some description of the equipment required for this work is also given.—*Engineering and Mining Journal,* Nov. 23, 1918.

The Improvement of Power Factor.—G. SARTORI.—The author describes the static condensers of the British Insulated and Helsby Cables, Ltd., and the Miles Walker phase-advancing machine. Of the latter an elementary

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calculation is given in order to find out its fundamental dimensions. The improvement of the power factor of electric lines is of such importance that at this moment the problem of taking it into account when charging for energy is being discussed by several electrical associations of the world. The author agrees with Boucherot in the view that the price of energy must be proportional to $A \times VI \cos\varphi + B \times VI \sin\varphi$ and not to $A \times VI \cos\varphi + B' \times VI$, as proposed by Arno.—*Science Abstracts, Section B*, April 30, 1918. (Abstrated from *Elettrotecnica*, Feb. 25, 1918.)

Large Generating Stations.—M. SEIDNER.—The author considers in detail the composition of total energy costs and gives general curves and formulas for the variable and total costs in any particular case. With increasing load factor the total cost per unit decreases hyperbolically toward the "fuel cost," whereas at low load factor fixed charges are of chief importance and fuel costs may almost be neglected. The advantage of large compared with small generating sets in point of lower first cost per kilowatt is well known, and the author gives typical data illustrating this point. Labor costs per unit may be twenty times as great in a small station as in a large one. Some reserve plant is essential, but the proportion may be lower and the plant factor therefore higher in a large station than in a small one. A large station can accept all industrial loads, whereas a small station dare not connect loads exceeding a fraction of its own plant capacity. The problems of cheap coal supply and the possible operation of a private colliery are best solved by a large station. Whereas the thermal efficiency of a small hand-fired boiler rarely exceeds 50 to 60 per cent, that of a large boiler with machine stoking may be 83 per cent. Finally the steam consumption of a 50,000-hp. turbine is about 5 kg. per kilowatt-hour, compared with 10 kg. per kilowatt-hour of a 500-hp. machine. A detailed numerical example is given comparing stations with a 300-hp. crude-oil engine and a 9000-hp. steam turbine respectively. It is concluded that the total cost of energy is five times as great in the smaller station, which has principally a lighting load, as in the larger station, which serves a large number both of small and large motors.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, Jan.. 6 and Jan. 13, 1918.)

Electrophysics and Magnetism

Electric Resistance of Porcelain at Different Temperatures.—R. G. ALLEN.—The resistance of eight samples of porcelain was investigated up to about 250 deg. C., three methods of measurement being employed. These involved the use of (a) a megger, (b) a high-resistance galvanometer, (c) a 0.005-mfd. condenser, the rate of leakage of which was determined by a Kelvin multicellular electrostatic voltmeter. Over the limited temperature range investigated it was found that the specific insulation resistance d and the absolute temperature T were related by the formula $\log d = a/T + b$, due to Rasch and Hinrichsen. a and b are constants for the material under consideration, and the author suggests that these may serve to identify the origin of the porcelain.—*Science Abstracts, Section B*, September, 1918. (Abstracted from *Royal Dublin Society Proceedings*, June, 1918.)

Electrochemistry and Batteries

Products of the Electric Furnace and the Electrolytic Cell.—At the recent Chemical Exposition a chart was exhibited in the booth of the American Electrochemical Society portraying the production of the electric furnace and the electrolytic cell. This chart was compiled by Dr. C. G. Fink. It showed some thirty-three products together with the raw materials from which they were made as well as the applications which they have found in the industries.—*Chemical and Metallurgical Engineering*, Dec. 1, 1918.

Telegraphy, Telephony and Signals

Increasing the Efficiency of Telegraph Lines.—O. SRNKA.—The present paper deals very completely with the transmission of high-frequency currents over line wires, and the usual equations are established. A comparison of impedance variations with frequency of various iron and copper wires is given. The author also investigates at length the alteration in the line constants—*i.e.*, capacity, inductance, leakage and resistance—over a range of frequencies between 200 and 1200 cycles per second for bronze and steel aerial wires and telephone cable. The current intensities for different frequencies in various classes of line are also investigated. The purpose of the investigations is to find the best conditions necessary for a form of multiple telegraphy based on differentiation by frequency, selection being accomplished by mechanical resonance.—*Science Abstracts, Section B*, April 30, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, Dec. 30, 1917.)

Thermionic-Valve Slope Meter.—E. V. APPLETON.—According to Latour's definition of amplifying power, it can be shown that maximum amplification is obtained with a thermionic valve when the extra plate circuit resistance has a value equal to the reciprocal of the slope of the plate-voltage, plate-current curve. Means of obtaining experimentally the characteristic curve from which the slope may be obtained are outlined in this article.—*Wireless World*, November, 1918.

Miscellaneous

Employment of Discharged Soldiers.—Considering particularly the character of discharged soldiers who have not been seriously mutilated and who have not lost their eyesight, the use of these men in industry has not been altogether successful. It is pointed out that the experience in the army is such that the men have been accustomed to some form of amusement and recreation while not in the trenches, and it is hard for them to settle down to a monotonous job. It is said that some constructive educational scheme should be adopted whereby these men might be interested in their occupations or diverted to some other work in case the first attempt is unsuccessful.—London *Times Engineering Supplement*, October, 1918.

Empire Water-Power Development.—Owing to the fact that water-power development has not been extensive on the British Isles, the training of engineers for undertaking large hydroelectric developments has not been adequate. But owing to the present and prospective hydroelectric possibilities in the British colonies it is proposed that this deficiency in the training of engineers in England should be quickly remedied.—London *Times Engineering Supplement*, October, 1918.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

END OF WAR COMMITTEE OF TECHNICAL SOCIETIES

Report of D. W. Brunton, the Chairman, Reviews the Work Done by the Organization, Representing Many Technical Societies

A report of the activities of the War Committee of Technical Societies, by D. W. Brunton, the chairman, reviews the work from its organization on June 27, 1917, to its termination on Dec. 31.

That the war committee should cover as broad a field as possible and afford full facilities to the technical men of this country to utilize their inventive talent for the benefit of the government, membership in this committee was not restricted to the four great national societies, but other technical organizations were invited to join, with the result that the committee now consists of two members from each of the following societies: The American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Electro-Chemical Society, the Mining and Metallurgical Society of America, the Illuminating Engineering Society, the American Gas Institute, the American Society of Refrigerating Engineers, the American Institute of Chemical Engineers, the Society of Automotive Engineers, and the American Society of Heating and Ventilating Engineers. The American Chemical Society also coöperated, and the officials of the committee, in addition to the chairman, Mr. Brunton, were: Vice-chairman, Edmund B. Kirby; secretary, Capt. Lloyd N. Scott; treasurer, Preston S. Millar.

The report says in part:

The General Staff of the army offered to aid us by appointing a liaison officer who should be free to devote half his time to war committee work.

After due consultation with the chairman and the secretary of the Engineering Council, this offer was accepted, and Capt. Lloyd N. Scott of the inventions section of the General Staff was appointed liaison officer to the war committee and at a meeting of the board held in New York on Sept. 10 he was elected secretary. This arrangement has proved most satisfactory to the army, the Naval Consulting Board and the war committee, as Captain Scott is a staff officer with a wide experience in engineering and business undertakings, which, combined with forcefulness and tact, has made it possible for him to achieve wonderful results under conditions such as now exist in Washington.

The war problems received from the army and navy may be grouped into three classes: (a) Those which are suitable for general distribution to our members by means of bulletins and letters; (b) semi-confidential problems which are sent to selected individuals and groups of inventors who are known to be interested in that particular class of work; (c) strictly confidential problems, the solution of which requires the highest order of technical information and which can be sent only to carefully selected scientists and prominent inventors whose life study has fitted them for the work in hand.

These problems are always mailed in double envelopes, the outer one giving no trace of its contents and the inner envelope marked "private and confidential." At present the outstanding problems in Class C relate principally to submarine detection devices, aëroplane instruments, especially those required in cloud and night flying, and liaison devices for communication between the advancing front of an army and the artillery at the rear.

The war committee, in sending out both bulletins and letters, requested our members to forward all ideas, suggestions and inventions on naval warfare to the Naval Consulting Board, and on land warfare to the inventions section of the General Staff. The material received in response to our bulletins and letters ranged from aëroplane supercharges and fuel for high-altitude flying down to submarine detectors and depth bombs, from long-range guns to trench knives, from observation balloons to tunneling machines, and from caterpillar tanks to radium sights.

Up to date, more than 110,000 ideas, suggestions and inventions have been received and passed upon by the Navy Department and the Naval Consulting Board, either separately or conjointly, and the inventions section of the General Staff, which is a much younger organization, has already handled over 25,000. The crest of the inventions wave for the Navy Department and the Naval Consulting Board was reached in the early months of the war, when the receipts amounted to as high as 600 per day, and that of the inventions section of the army in July last, when they reached 124 per day. All the material received by both organizations is subjected to careful study.

In its financial relations the committee has been singularly fortunate, as, owing to the generous support given by the Navy Department, the Naval Consulting Board and the inventions section of the General Staff, it has expended only $1,843.01 of the $4,700 appropriated by the Engineering Council, and all of the funds contributed by organizations not included in the four founder societies are still intact in the hands of the treasurer.

The great war which has just been brought to such a glorious conclusion has given us all a realization of the dangers of inadequate preparation for national defense. In no department has this been felt so severely as in the scarcity of engineering officers and the ignorance of military affairs on the part of those that were obtainable. To benefit by past experience we must insist that in every engineering school the students shall have a thorough military training. The last war and the wars in future will be engineers' wars, and it is to the engineers that the country must look for officers to supplement the efficient, highly trained but numerically inadequate supply graduated from West Point and Annapolis.

Now that the war is over, the government can scarcely expect continuous volunteer service from our members, and after consultation with all of the parties at interest it has been decided that though the engineers of this country still maintain their readiness to assist the government in every possible way, it will be more economical and convenient for the army and navy to function with the members of the societies which united to form the War Committee of Technical Societies through the secretaries of these organizations. For this reason the Engineering Council has asked that the committee be dissolved on Dec. 31, at which time our appropriations will cease.

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Annual Convention at Baltimore Discusses a Wide Range of Topics—Dr. Drinker on Conservation of All Resources

The American Association for the Advancement of Science held its annual convention in Baltimore during Christmas week, most of the meetings taking place between December 26 and 28.

The engineering section met on the afternoon of Dec. 26, and the retiring vice-president of the section, Dr. Henry S. Drinker, president of Lehigh University, gave an address on "The Need of Conservation of Our Vital and Natural Resources as Emphasized by the Lessons of the War."

DR. DRINKER ON CONSERVATION

Dr. Drinker said that the war has, in transportation and in national industry, taught and enforced on our nation, quick to learn, lessons of waste in the past and of future economic management by joint coöperative effort. Of all the lessons of conservation of our resources taught by the war, those of needed coöperative effort in our railroad and industrial interests are perhaps the most prominent and important in a material sense, and the lesson has been one not only to and for the public and our national and state authorities, but one by which those interests are benefiting in a direct manner.

While, as a war measure, the temporary possession and operation of our railroads by the government was necessary, the continuance of such a system in peace, or of any measure of government ownership with its political evils, Dr. Drinker declared, would be a calamity depriving the traveling public of the efficient operation naturally coming from the initiative and enterprise and sense of responsibility attending individual management, and always absent where governmental red tape and autocratic authority rule regardless of the comfort or needs of the public.

Some reasonable, responsible governmental oversight or control of these great interests is without doubt necessary. The war urgency, the more intimate relations that war needs have established between governmental agencies and railroad and industrial managers, must and will lead to the establishment of systems of regulation not destructive but constructive in character, that will operate to the lasting benefit of our country.

The need of conservation and development of our latent water-power resources has been emphasized by the war, continued Dr. Drinker. Serious differences of opinion have existed in the past as to the proper measure of governmental control that should be exercised in the development and use of the great latent water powers of the West, and enabling legislation has been impeded and halted by visionary and wholly unpractical objections to such reasonable and liberal legislation as would encourage capital to enter into and support such development. As a wise Westerner has said of the development of the West in the past, "The western country was never settled, and never could have been settled, with thirty cents and an infant class," and conservation of our natural resources was well defined by Dr. C. W. Hayes, when chief geologist of the Geological Survey, as "utilization with a maximum efficiency and a minimum waste."

One great lesson in conservation peculiarly applicable to our nervous, energetic and always hard-working people which we have not yet adopted, because we are so constituted that as a nation or a race we will not learn it, is that of the better conservation of our vital resources.

The trouble with most of the plans for railroad and business regulation and for mineral and water-power conservation proposed by men untrained and inexperienced in engineering and in business and financial methods and problems, said the speaker, is that their plans are apt to be ideal rather than real, their dicta negative and destructive rather than affirmative, positive and constructive, and their remedies untried and theoretical experiments rather than of practical and efficient effect.

In his concluding remarks Dr. Drinker said that we should recognize, and this great war's awakening and upturn of all preconceived and preëxisting conditions have emphasized, the importance of businesslike rather than political management of our national transportation and industrial interests and of all other national affairs involving expert scientific or business knowledge and training. Our country owes an incalculable debt of gratitude and appreciation to the great interests that have led in and made possible the wonderful transportation and industrial development of our land, and we may find that on a large scale we will be killing the goose that lays the golden egg of national prosperity if we suffer our railroads and our great industries to be nagged and oppressed to the point of possible insolvency by blind unreasoning prejudice largely born of ignorance and largely based on political considerations that should not control.

C. R. Dooley of the committee on education of the War Department spoke on "Intensive Training," describing the system of vocational training for soldiers in operation in more than 100 American colleges during the past year. His paper was in substance the same as that read by him at the annual meeting of the American Society of Mechanical Engineers last December. A lively discussion followed this paper, mainly on the incentive which made each soldier achieve so much in a short time. The consensus of opinion was that these young men were primarily prompted by patriotism and by a clear understanding of the importance of engineering in the war. Various opinions were expressed as to how similar training could be carried on just as intensively in peace times.

Dr. Henry G. Reist's paper on "A New Principle Used in the Design of Large Bearings" was read by title.

MANY ENGINEERING TOPICS DISCUSSED ON SATURDAY

The second meeting of the engineering section took place on Saturday morning, Dec. 28. William L. De Baufre read a paper on "The United States Naval Engineering Experiment Station," in which he described the equipment and the tests on machinery and materials performed for the Steam Engineering Bureau of the navy. F. J. Trumpour read a paper on "Hydraulic Tunneling," in which he described his new device combining the usual shield system with cutters and suction used in hydraulic dredges.

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Dr. J. B. Whitehead of Johns Hopkins University regretted that he was not in a position to give the results of his research done for the army during the past year and reviewed his experiments on the corona voltmeter which have been described in previous years.

F. A. Halsey, the secretary of the American Institute of Weights and Measures, read a paper on "The Metric System Used in Engineering." The institute which he represents is opposed to the metric system, and he gave examples of difficulties which would arise if computations were performed in the metric system while the available materials are all made to dimensions in inches. Several members present disagreed with the speaker and pointed out not only the advantages but the inevitability of the metric system if this country is to retain a commanding position in the world's markets.

The meetings of the physics sections held in conjunction with the American Physical Society were interesting and spirited as usual. One noticeable feature of the meetings was the large number of papers from industrial laboratories and from government bureaus as compared with only a few papers from college professors. This fact is probably due to a feverish activity in all industrial laboratories upon war problems, while the colleges were depleted of their scientific personnel and had to devote their whole energy to the training of student soldiers. The Bureau of Standards led with three papers on glass and its properties. There has been considerable interest manifested in the production of high-grade glass for optical purposes since the supply from Germany has been cut off. Two papers were presented by the Bureau of Standards on photoelectric sensitivity and two others on topics more remote from applied electricity. Three papers were presented from the Nela Laboratory, on optics, on pyrometry and on energy distribution in spectra. Three papers were from the Westinghouse Research Laboratory, two of which were on hot-wire anemometer and on thermal conductivity of important materials used in the manufacture of electrical apparatus. Papers were also read by members of the staff of the United States Weather Bureau and other bodies.

The comparatively young Optical Society of America met for the third time, showing a healthy growth and a tremendous development of the glass industry, due to the war. Of particular interest was a symposium on applied optics, with special reference to the future of the optical industry in this country. The topics discussed were optical glass, photographic cameras, projection apparatus, photometric apparatus, special-research apparatus and illuminating engineering. The needs were also emphasized for education and training, for scientific control in manufacturing and for testing and research.

The American Metric Association had a very successful and well-attended meeting under the guidance of its president, Dr. George F. Kunz of Tiffany & Company. Part of the meetings were held jointly with the section on social and economic science, to emphasize the economic value of metric weights and measures. Representatives from the American Chemical Society, from the Wholesale Grocers' Association and from the Druggists' Association also voiced their conviction in favor of the metric system. A very successful metric dinner and victory celebration was held at the Southern Hotel. William C. Redfield, Secretary of Commerce, gave the main address, in which he expressed his conviction that the metric system must ultimately prevail in this country. Senator Shafroth of Colorado read the bill which he has introduced into the United States Senate to make the metric system obligatory in all government contracts after a certain date.

One of the sessions of the section on psychology was devoted to mental testing and psychological examining in the United States Army, also on the relation of intelligence to occupation as indicated by army data. It is thought that much of this work will be found useful in peace industries after the war and that the methods and tests developed will help to place men and women in occupations for which they are best adapted.

RE-EMPLOYMENT OF MEN IN NATIONAL SERVICE

President E. W. Rice, Jr., of General Electric Company, Says It Is First Duty to Provide for Those Who Served Country

A letter sent by President E. W. Rice, Jr., of the General Electric Company to all departments on the subject of reëmployment of men in the service follows:

It has been a matter of great pride to us all that nearly 8000 of our men left the company's employ to enter the military or naval service of our country. Many of them will return to us in the near future and we shall welcome them home with deep pleasure. After consultation with the executive officers and factory managers, it has been decided that:

Those who return from military or naval service and who apply for reinstatement will be placed if possible in positions in the department, office or works that they left in order to enter the service. Such reëmployment is to be limited to men who have been honorably discharged from military or naval service and, except in special cases, who apply for reëmployment within sixty days from the date of such discharge.

Those who return direct from military or naval service to the company's employ, without accepting employment elsewhere, will be given credit for continuity of service in the company's employment record, including the length of time spent in military or naval service as if they had worked continuously for the company during that period.

Compensation of men so reëmployed shall be the current rate paid to employees engaged in similar work at the date of reëmployment. The reëmployment of men disabled in military service will be directed by committees to be appointed. It is obvious that in anticipation of the above care should be taken to avoid, as far as possible, the employment of additional help or the replacement of employees who may leave.

The company has been asked to cancel certain orders for large amounts and to suspend work on other orders, and a further reduction during the next few months is probable. These conditions may make it difficult to provide full-time employment for all of our present forces, but in order to keep as large a proportion as possible at work, our managers are asked to coöperate with our employees as follows: Those who have recently come to us from other places or occupations should be encouraged and aided to return to the work in which they were engaged before the war, or they should receive our hearty cooperation in finding other satisfactory work.

We shall do the best we can for all, but we are confident that our entire force will share the view that it is our first duty to provide employment for the men who gave up their positions in order to serve their country.

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A NEW INTERNATIONAL ENGINEERING PERIODICAL

McGraw-Hill Company to Publish on March 1 in Spanish "La Ingenieria Internacional," with Editions in Several Languages Later

Realizing the value of the international exchange of ideas on things engineering, the McGraw-Hill Company on March 1 will begin publication of a magazine dedicated to that purpose. While eventually it is expected to appear in editions in several languages, the original issue will be in Spanish, under the name *La Ingenieria Internacional*, aimed to serve Latin America and Spain.

The purpose of the new magazine, which has been under consideration for some years, is to afford a medium for the presentation of those developments in American engineering which may be of value to engineers, contractors and manufacturers in other lands. At the same time, following the practice of the present McGraw-Hill publications, a far-flung editorial organization will be developed, so that there will be drawn into the paper the best of engineering practice in Latin America, Spain and other Spanish-speaking countries. Aside from this function, the new magazine will be an important developer of international good will and at the same time a medium by which American manufacturers engaging in expert trades can carry their message to prospective buyers in foreign lands.

It may be a cause of surprise that the McGraw-Hill Company, whose specialized papers circulate so widely overseas, should establish a magazine to serve the foreign field. The reason, however, is not hard to find. The present highly specialized papers appeal only to those who are situated where engineering enterprise has made such progress that there is room for the specialist and need for the last refinement in equipment and design. But everywhere the world over are territories newly developing where the engineer, the contractor or the manufacturer must turn his hand to many lines. It is to serve the general practitioner so situated that the new magazine and its later companions in other languages will be started.

The specialized papers in English will still hold their place as the recorders of the best in the advanced practice of American engineering.

BYLLESBY REVIEW OF UTILITY CONDITIONS

Rate Increases in Majority of Companies Maintain Position of Properties, but Net Revenues Show Slight Reduction

H. M. Byllesby & Company in issuing their brief annual review of the general situation affecting electric and gas service companies disclaim any intention to speak for these industries as a whole and confine their remarks to the companies directly under their own management.

It appears that the utility companies under Byllesby management, serving upward of 400 cities and towns, with a population of more than 2,000,000, in sixteen states, went through the second year of the war, rendering vastly more service to public and industry than ever before, with practically stationary net earnings, but at the same time maintained bond interest and preferred stock dividends. In a number of cases dividends on common stock were reduced or discontinued.

Electric service companies were exceedingly important factors in the industrial stimulation necessary to win the war. Demands for additional electric energy at many points were imperative either to render service to war and essential industries or to conserve fuel. This meant that construction had to proceed despite every handicap. Upward of 66,000 hp. in steam-turbine units, 254 miles of high-voltage transmission line and many other additions had to be financed and installed.

This unavoidable construction, with certain maturing obligations, made necessary financing amounting to approximately $24,500,000 par value in bonds, notes and preferred stock. The new bonds issued totaled $14,569,000, coupon notes $7,953,300 and preferred stock about $1,900,000.

Byllesby & Company accomplished this financing with the assistance of a number of investment banking houses and through their own bond department, without government aid. New preferred stock and bonds and notes sold locally or in territories where the companies operate amounted to more than $4,500,000.

In the face of the unprecedented price levels and wage standards it was necessary for the majority of the operating companies to place in effect higher rate schedules for service. This was accomplished in the great majority of cities with the friendly coöperation of the public, which recognized the fact that in the past rates had been reduced when operating expenses were low.

The effect of these rate increases enabled the companies to continue good service, maintain credit, perform necessary financing and make the extensions and additions necessary to war production and public welfare. How far short they fell of enabling anything approaching "profiteering" may be judged from the following:

During the year ended Oct. 31, 1918, the Byllesby properties delivered 20 per cent more service to the public than during the preceding twelve months. For this service the properties received a total gross revenue of $22,437,432, which represented an increase of $3,653,382, or 19.4 per cent, over the previous year. Here was a large increase in service and a large gain in gross earnings, but advanced operating expenses and taxes actually reduced the aggregate net earnings by $2,463. During the latter quarter of the year 1918 an improvement in net earnings was made, and it is apparent that the future showing will be much better than for the period mentioned.

The strain of the war was met as above described by an organization exerting itself to the utmost in direct participation in the war. Thirty-three per cent of the men connected with the home office were in the army and navy, including Lieutenant-Colonel H. M. Byllesby, Brigadier-General George H. Harries and Major W. R. Thompson, all serving abroad. At the properties the male forces were depleted from 14 to 50 per cent, while the executives and employees who remained behind were exceedingly active in civilian war work of all kinds. Byllesby & Company and affiliated companies and employees purchased a total of $2,558,150 of Liberty bonds.

The Byllesby plan of building up home ownership of their utility companies was continued successfully de-

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spite many adverse conditions. For the year to Dec. 16 preferred stock sales at the properties aggregated $2,186,300 par value, there having been 4312 separate sales, or an average of five shares each. Bonds and notes absorbed locally aggregated about $2,750,000.

Byllesby & Company believe that the return to normal conditions in the operation of electric and gas companies will be steady and that enterprises which have withstood the exceedingly severe trials of the past two years are assured of a satisfactory future.

Lieutenant-Colonel Byllesby received his honorable discharge and rejoined the company of which he is president late in December, after a year's absence in the service.

NEW ENGINEERING HOUSE ESTABLISHED IN BOSTON

Engineering, Managing and Purchasing House of Merrill, Sweeney & Company Will Take Over Warner, Tucker & Company Properties

Meldon H. Merrill and Thomas B. Sweeney announce the organization of the firm of Merrill, Sweeney & Company, engineers, managers and purchasing agents, with offices at 50 State Street, Boston, where they are prepared to give special attention to the requirements of public utility properties and to engage in general engineering and construction practice. Both Mr. Merrill and Mr. Sweeney are well known in the New England electrical field.

Mr. Merrill is a native of Yarmouth, Me., and was educated at Tufts College, from which he was graduated in 1896 in the course in electrical engineering. He spent a year with the Boston Elevated Railway in the department of motive power and machinery, five years with the Edison Electric Illuminating Company of Boston, where he was active in commercial power work; eight years with the Westinghouse Electric & Manufacturing Company, specializing in mill power and textile motor applications, Boston office, and five years in the Boston office of the Allis-Chalmers Company, where he added paper-mill practice to his previous experience. He then became associated with the banking and managing house of Warner, Tucker & Company, Boston, where he had wide experience in financing, operating and purchasing for central stations, power companies, gas and street railway companies, including properties in the Connecticut Valley, Tennessee and Texas.

With the dissolution of Warner, Tucker & Company, resulting from the departure of R. L. Warner from Boston to become vice-president of the United Electric Railways of St. Louis, Mo., the public utility properties under the management of that firm will be taken over by Merrill, Sweeney & Company. These include the Texas Gas & Electric Company, serving eleven municipalities in Texas, and the Tennessee Eastern Electric Company, which includes the Johnson City Traction Company.

Mr. Sweeney is a native of St. John, N. B. His business career began in New England in 1901, when he joined the Boston office of the Westinghouse company as private secretary to R. L. Warner, then manager. In 1903 Mr. Sweeney became associated with Mr. Warner in the Federal Construction Company of Boston, which built a number of public service properties, including the Rockingham Power Company of Blewett Falls, N. C., now the Yadkin River Power Company, a 32,000-hp. initial hydroelectric development; the Greenville-Carolina Power Company of Greenville, S. C., a 6000-hp. development, and the South Carolina-Western Railway, a 300-mile steam road now a part of the Seaboard Air Line. Mr. Sweeney joined the organization of Warner, Tucker & Company in 1906 and became a member of that firm in 1914.

RECOMMENDATIONS MADE BY THE INCOMING NEW YORK GOVERNOR

New Executive Declares for Reconstruction Commission, Public Ownership of Utilities, Water-Power Conservation Policy and Changes in Commissions

In his inaugural address Governor Alfred E. Smith of N. Y., announced that he would appoint a reconstruction commission immediately.

"During this period of reconstruction," he said, "we must not forget that New York State is now the commercial center of the world, and that the great business interests of this state have made sacrifices because of war. Irresponsible and wanton attacks on business are a blow to capital and labor alike. The prosperity of the workingman depends in large part upon the prosperity of the employer. In framing laws and in administering government it is therefore of prime importance that legitimate business should be safeguarded, promoted and encouraged, to the end that we maintain our financial, commercial and industrial supremacy."

Governor Smith recommended that legislation be passed granting cities the power to acquire, own, operate and control their public utilities. In making this recommendation he said:

"Recent years have been marked by a great opening of the popular mind to the true scope of enlightened municipal administration. There is everywhere a recognition that it is only through the application of progressive conceptions of public duty that life can be made tolerable in our teeming cities, with their unprecedented growth in population and the consequent living conditions. From every city in the state, represented by the chief executives in conference, there comes the demand that the state confer upon the cities the power to acquire, own, operate and control their public utilities. . . . These great services are monopolies, and whatever is of necessity a monopoly should be a public monopoly, especially where it offers a service of universal use."

Declaring that the undeveloped water-power resources of New York surpass those of any other state in the Union and that the Niagara and St. Lawrence Rivers alone are capable of providing sufficient power for the ordinary needs of the state, Governor Smith said that development is impossible until the state adopts a definite policy upon this important question.

After the Governor has had time and opportunity to state what progress has been made in recent years by the Conservation Commissioner and what policy is under consideration by the conference of mayors of the state, who appointed a committee to draft a bill outlining a policy that meets with their approval, he will communicate with the Legislature. Single-headed public commissions are recommended.

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PLANS OF MANUFACTURERS IN RECONSTRUCTION WORK

General War Service Committee of the Electrical Manufacturing Industry Calls Meeting of Chairmen to Be Followed by Conference

The General War Service Committee of the Electrical Manufacturing Industry, in Bulletin No. 13, addressed to every electrical manufacturer, states that it has carefully considered the type of organization best calculated to continue coöperation between individuals, companies and the industry as a whole with the government. It was recognized that to comply with the spirit of the times as shown at the Atlantic City war emergency and reconstruction conference any such organization must be founded on the constituent group idea.

As an instrumentality for initiating such a movement a meeting of all the present group chairmen is called for Jan. 7 in New York to confer upon and make recommendation as to further procedure. The success of this movement depends on the fullest opportunity being given for individual expression.

It follows in due course that representative group committees would be elected by each group and that a general executive committee, to succeed the General War Service Committee, would be selected to coördinate the various group committees in effecting the industry's contact with the government.

It is planned to call a mass meeting of the industry the latter part of January, in order to discuss and act on recommendations which may be formulated at the meeting of Jan. 7. At this meeting also it is expected that speakers of national prominence will discuss the various problems of reconstruction.

APPLIANCE SECTION OF THE ASSOCIATED MANUFACTURERS

At New York Meeting It Was Decided War Service Committee Should Be Maintained for Possible Future Contact with Government

A meeting of the Heating Appliance Section of the Associated Manufacturers of Electrical Supplies was held at the association's offices in New York on Dec. 17. It was the best attended and most constructive meeting yet held by this section.

The war service committee of the electric heating industry, of which W. M. Stearns is chairman, has been representing the manufacturers in their negotiations with the War Industries Board and other branches of the United States government. This committee reported on its work to date, and while the practical end of the war would act to terminate the functions of the committee it was felt by the manufacturers present that the committee should be maintained for possible future contact with the government on reconstruction or reorganization.

The feeling among the electric heating manufacturers is unanimous that advantage should be taken of the lessons in conservation learned under the pressure of war conditions. It is recognized that differences of opinion as to details will, of course, arise, but the present period of readjustment will be utilized to bring about methods of conservation and standardization.

The various sub-committees of the Heating Section of the Associated Manufacturers of Electrical Supplies were instructed to investigate and report on specific problems at the next meeting of the section, the latter part of January.

TO USE THE WEBB LAW TO FURTHER EXPORT TRADE

Companies Which Have Filed Statements with Federal Trade Commission Include Foreign Subsidiaries of General Electric Company

A number of companies have filed statements with the Federal Trade Commission indicating their intention to take advantage of the provisions of the Webb law permitting combinations in export trade. Among them are the Australian General Electric Company, the General Electric Company of Brazil, Inc., the General Electric Sudamericana, Inc., Cia. and the South African General Electric Company. These companies are subsidiaries of the General Electric Company, Schenectady.

CENSUS RETURN FOR THE CONNECTICUT STATIONS

Income from Electric Service Increased 100 per Cent in Five Years, While the Kilowatt-Hour Output Gained 164 per Cent

Preliminary figures from the forthcoming quinquennial report on the central electric light and power stations of the State of Connecticut have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics relate to the years ended Dec. 31, 1917, 1912 and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which consume the energy generated, those operated by the federal government and state institutions, nor plants that were idle.

The figures are shown in detail below:

	1917	1912	1907	Per Cent of Increase* 1907 to 1917	Per Cent of Increase* 1912 to 1917
Number of establishments	43	44	41	4.9	—2.3
Commercial	37	38	36	2.8	—2.6
Municipal	6	6	5	20.0	.....
Income	$10,721,264	$5,347,552	$2,469,543	334.1	100.5
Electric service	$10,515,080	$5,057,132	$2,452,359	328.8	107.9
All other	$206,184	$290,420	$17,184	699.9	—29.0
Total expenses, including salaries and wages	$8,941,939	$4,109,311	$1,682,231	431.6	117.6
Number of persons employed	1,938	1,340	745	160.1	44.6
Salaries and wages	$1,872,148	$1,054,261	$529,652	253.5	77.6
Total horsepower	195,286	109,691	56,243	247.2	78.0
Steam engines:					
Number	110	118	123	—10.6	—6.8
Horsepower	162,042	89,372	37,492	332.2	81.3
Internal-combustion engines:					
Number	5	7	6	—16.7	—28.6
Horsepower	835	885	706	18.3	—5.6
Waterwheels:					
Number	44	51	54	—18.5	—13.7
Horsepower	32,409	19,434	18,045	79.6	66.8
Kilowatt capacity of dynamos	152,649	77,655	39,363	287.8	96.6
Output of stations, kilowatt-hours	345,563,143	130,672,201	67,406,232	412.7	164.5
Stationary motors served:					
Number	19,931	7,979	2,741	627.1	149.8
Horsepower	216,973	59,536	21,146	726.1	264.4
Number of street lamps:					
Arc	5,299	5,068	(2)	.....	4.6
Incandescent, etc.	26,467	21,620	(2)	.....	22.4

* A minus sign denotes decrease.

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Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 63 of this number.

Electrical League of Cleveland.—On Dec. 26 the Electrical League of Cleveland was addressed by Charles Higley on the subject "A Government of Laws and Not of Men."

American Electrochemical Society.—It has been announced that the spring meeting of the American Electrochemical Society will be held in New York City early in April, 1919. The exact date will soon be announced.

American Institute of Consulting Engineers.—On Jan. 13 a meeting of the American Institute of Consulting Engineers will be held at which the subject for discussion will be "The War and Reconstruction."

Pacific Service Employees' Association Elects New Officers.—The second annual meeting and election of this association was held in San Francisco on Dec. 10. F. R. George was elected chairman and R. W. Robinson secretary.

I. E. S., New York Section.—At a meeting of the New York Section of the Illuminating Engineering Society to be held on Jan. 9, in the Engineering Societies Building, a paper on "Urban Car Lighting" will be presented by Messrs. Wilder and Allen.

A. I. E. E., Washington Section.—Lieut.-Col. John H. Finney, a member of the Washington Section of the American Institute of Electrical Engineers, addressed the section's meeting on Dec. 10, speaking on "Experiences Abroad in the Study of Zeppelins." Lieut.-Col. Finney described his inspection of factories, flying fields and aircraft in England, France and Italy.

Society of Automotive Engineers.—The Society of Automotive Engineers announces that the date of its annual winter meeting has been changed from Jan. 12-14 to Feb. 4-6 as a matter of convenience for members who desire to attend the automobile show which will be held at Madison Square Garden the first two weeks in February. This meeting will be the occasion of interesting technical sessions.

A. I. E. E., Seattle Section.—"Electric Welding—a New Industry," a paper by H. A. Hornor which was printed in the October *Proceedings* of the American Institute of Electrical Engineers, was read before the Seattle Section of this organization at its Dec. 17 meeting by Mr. Lindsay. Mr. Bissell of the Puget Sound Navy Yard spoke on the latest results in electric welding at that yard, showing photographs of weld sections made there.

Engineers' Club of Philadelphia.—G. Douglas Wardrop will address the Engineers' Club of Philadelphia on Jan. 21 on the subject "War Aviation in Retrospect; Commercial Aviation in Prospect."

A. I. E. E., Chicago Section—Electric Club-Jovian League.—At a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electric Club-Jovian League held Dec. 30 Comfort A. Adams spoke on "Electric Welding in Shipbuilding."

Massachusetts State Association of Electrical Contractors and Dealers.—The annual meeting of the Massachusetts State Association of Electrical Contractors and Dealers will be held at the Hotel Bancroft, Worcester, on Jan. 9. It is planned to have the following speakers: William L. Goodwin, author of the "Goodwin plan"; Samuel A. Chase, special representative of the Westinghouse Electric & Manufacturing Company; E. R. Davenport, sales manager of the Narragansett Electric Lighting Company, Providence, R. I.; J. M. Wakeman, general manager Society for Electrical Development, and W. H. Morton, general manager National Association of Electrical Contractors and Dealers.

Joint Meeting of San Francisco Electrical Men.—A "get-together dinner" to which members of all branches of the electrical industry were invited was held in San Francisco on the evening of Friday, Dec. 13. Major George F. Sever, special representative of the War Industries Board, Power Section, acted as toastmaster. Branches of the industry represented by the speakers were as follows: National Electric Light Association, Arthur Halloran, secretary Pacific Coast Section; Electrical Development League, Garnett Young, president; California Association Electrical Contractors and Dealers, M. A. De Lew, president; California Electrical Co-operative Campaign, Lee H. Newbert, chairman; California Industrial Accident Commission, Robert Eltringham. Miner Chipman spoke on the subject of "Efficiency."

Boston Section, A. I. E. E., to Hear Mr. Luckiesh on "Camouflage."—"Camouflage on Land, Sea and Air" will be the subject of an illustrated address at Chipman Hall, Tremont Temple, Boston, on the evening of Jan. 7, by M. Luckiesh of the Nela Research Laboratory of the National Lamp Works of the General Electric Company. The meeting will be held under the auspices of the Boston Section of the American Institute of Electrical Engineers, and members of other engineering societies, ladies and all interested in camouflage are invited to attend. Mr. Luckiesh has been actively engaged in war work for the United States government involving the study and practice of camouflage in its most varied aspects. He was chairman of the committee on camouflage of the National Research Council.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Unremunerative Extensions. — The Pennsylvania Public Service Commission has handed down an order requiring the Chenango Valley Electric Company to furnish service to a resident of Farrell, Pa., who brought a complaint against the company for refusal to make the necessary extension for service. The commission says: "A public utility cannot choose and serve only the sections immediately remunerative. Whenever required to do so it should, at its own cost and expense, make all reasonable and needed extensions. The law does not contemplate that the patron should provide the capital to make such extensions. . . . In no circumstances should the burdens imposed by abnormal conditions be placed on the shoulders of the patrons."

Plant Held Inefficient, but Rate Increase Authorized.—In authorizing the Intermountain Railway, Light & Power Company to increase electric rates in Lamar the Colorado Public Utilities Commission says in part: "The Lamar plant of the Intermountain Railway, Light & Power Company is a very inefficient one, the coal consumption being in excess of 16 lb. of bituminous coal per kilowatt-hour of output. While it is fully realized that this condition cannot be corrected at this time on account of the difficulty in securing equipment, the company is not entitled to any reward for efficient operation in the disposition of this case. The cost of steam-power plant generation alone for the year 1917 was 70 per cent of the operating revenues for that period, and this ratio will probably be increased for the year 1918. There is also a very high unaccounted-for loss in distribution, which, in the opinion of the commission, does not result largely from leakage through trees, as stated in testimony. The serious problem before the commission, the company and the citizens of Lamar is that of providing sufficient revenue to enable the company to meet operating expenses necessarily incurred. It would be idle at this time to discuss the proposition of providing more efficient equipment for the purpose of reducing operating expenses. Such equipment, even if available, has so advanced in price that its substitution for the present equipment, even if obtainable, might not be desirable on account of the increase in fixed charges which would result. The commission is of the opinion that the rates of the applicant are unremunerative under the conditions prevailing at this time."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Coal Price and Zone Regulations Continue.—Maximum prices on coal and zone regulations will not be removed before Feb. 1, 1919, United States Fuel Administrator Harry A. Garfield has announced.

Cleveland May Cut Street-Lighting Service.—Because of a shortage in finances in 1919, the committee on appropriations of the City Council of Cleveland, Ohio, has recommended a reduction of expenses in nearly all city departments. The budget for street lighting will probably be reduced $150,000 for the year. That will mean the discontinuance of about one-third of the number of gas lamps, about one-half of the "white way" lamps and about one-fourth of the arc lamps.

Declines Telephone Appointment.—Paul P. Haynes, a member of the Indiana Public Service Commission, has declined an appointment as a member of the national committee on standardization of telephone rates in the United States, the appointment coming from Director-General Burleson. Mr. Haynes said that not only were the requirements of the Indiana commission's post-war readjustment work too heavy to permit of his taking leave from that body but also that certain questions involved in the jurisdiction of the federal telephone control and the various state commissions caused him to decline the appointment.

Renewed Activity in Gas and Electric Industries.—William H. Clarke, manager of the bond department of H. M. Byllesby & Company, says: "We can again look forward to the renewed development of the electric and gas industries, because equipment and apparatus of all kinds should soon be more easily obtainable as national interests permit the release of manufacturing capacity from government work to ordinary pursuits. The importance of efficient and continuous gas and electric service has been emphasized by war-time necessities. Much of the ordinary and regular development or extension work of utilities during 1917 and 1918 has been postponed, and this accumulation will require immediate construction as fast as material and labor become available. The participation of local capital in the stock and bond issues of utilities has been growing rapidly. It may be expected that millions of people who have made their first purchases in public securities during the past two years will look to their local utilities as a safe and profitable medium for their investment funds."

To Study Government Ownership.—The Merchants' Association has appointed a committee of which Otto Kahn, James G. White and other well-known men are members to investigate government ownership and operation of public utilities. William Fellowes Morgan, president of the association, wrote as follows in asking the members of the committee to serve: "Although the Merchants' Association has hitherto contended that government ownership and operation are economically, politically and socially unwise and harmful, the changed conditions resulting from the war make desirable a reëxamination of the subject."

Examination for Aid Qualified in Radio.—The United States Civil Service Commission announces an open competitive examination for aid qualified in radio, for both men and women. Vacancies in the Bureau of Standards, Department of Commerce, for duty at Washington, D. C., or elsewhere, at $900 a year, and in positions requiring similar qualifications at this or higher or lower entrance salaries, will be filled from this examination unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer or promotion. The duties of this position will include miscellaneous laboratory work in the radio communication laboratories of the Bureau of Standards, with special assignment to sending and receiving in connection with experimental testing and developing work. Applications should be properly executed, excluding the medical certificate, and must be filed with the Civil Service Commission, Washington, D. C., not later than Jan. 28, 1919.

Radio Communication for President on the Seas.—President Wilson was in constant communication with the United States and France during his entire voyage from the United States to France through the U. S. S. Pennsylvania's powerful radio transmitting and receiving sets. The Annapolis high-power transmitting station, transmitting on 16,900 m., the high-power transmitting set at New Brunswick, N. J., transmitting on 13,000 m., the high-power transmitting set at Tuckerton, N. J., on 9200 m., and the high-power transmitting radio station in Lyons, France, on 15,500 m., were used for communications to and from the President. The President, on board the U. S. S. George Washington, was convoyed by the Pennsylvania, which is the best equipped ship afloat for signaling purposes in regard to radio communications, and five torpedo boat destroyers. The Pennsylvania transmitted messages direct to the United States up to a distance of 2500 miles. Communication with the Lyons station, France, was established long before the Pennsylvania was beyond communication range of the United States. The radio communication was directed by Commander H. W. McCormack, U. S. N., fleet radio officer. Lieut. S. V. Edwards is in charge of the radio of the Pennsylvania.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Uninsulated Wire.—Where a petition in action for death of lineman alleged in one place that "the insulation" on a wire "was rough and worn off," but in another place alleged that it was "uninsulated," it was not error to instruct that recovery could be had whether wire was wholly uninsulated or whether it had such defect in insulation as proximately to cause the injury complained of, according to the Supreme Court of Iowa in Shilling versus Sioux City Gas & Electric Company (169 N. W. 416).

Negligent Construction of Dam. — Although defendant had been given right to construct dam across Broad River by plaintiff's grantors as well as by law and plaintiff had purchased his lands subject to such right, defendant would be liable to plaintiff for damages to the lands due to negligent construction of dam. the Supreme Court of North Carolina held in Free versus Parr Shoals Power Company (97 S. E. 243). In action for damages to land due to negligent construction of dam which defendant had the right to construct it was unnecessary for plaintiff to allege that the injuries to his lands were different in kind from injuries to other lands similarly situated, since it is only where injuries arise from nuisance *per se* that peculiar damage must be alleged.

Remedy of Owner for Trespass by Municipal Plant.—Where a city constructed a power plant, and for operation thereof conducted water from a river and discharged it in large quantities into a slough, materially increasing the accustomed flow, to the damage of the owner of lower riparian land on the banks of the slough, such discharge constituted a continual trespass which riparian owner could have enjoined, the Supreme Court of Oregon held (175 P. 855). In the construction and operation of electric and waterworks for profit, the city occupies the same position as a private corporation organized to buy or sell and get gain, and in the same manner as an individual it is liable, both at law and in equity, for its trespass upon rights. Where a city diverted water from a river for operation of a water plant and discharged it into a slough in large quantities, materially increasing accustomed flow, so that the owner of lower riparian land on both banks of the slough could not ford the slough, as he had prior thereto been doing, and was compelled to go two miles out of his way to reach his plow land, he was entitled to damages.

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

Harold G. Payne, for the past year in charge of electrical designing construction at several of the government cantonments and formerly associated with M. J. Neall, consulting engineer of Boston, has recently opened offices as consulting electrical engineer at 201 Chamber of Commerce, Boston, Mass. Mr. Payne, after being graduated from the University of Minnesota, was for several years connected with Stone & Webster organizations at Minneapolis and elsewhere. For four years prior to becoming associated with Mr. Neall he was a member of the engineering staff of D. C. & Wm. B. Jackson. He has been engaged in electrical and allied branches of engineering in Boston and Chicago.

Capt. William T. Taylor, who has been in active service since 1915, for the past six months has been a staff officer with the British Air Forces and

CAPT. W. T. TAYLOR

is on the Air Ministry staff. Since 1916 he has taken an active part in the welfare of disabled soldiers and their training for industrial employment after the war. Captain Taylor is a member of the American Society of Mechanical Engineers, a member of the British Institution of Mechanical Engineers, a fellow of the American Institute of Electrical Engineers, a member of the British Institution of Electrical Engineers, and is the author of "Transformer Practice" and of "American Hydroelectric Practice."

L. S. Brainerd has been appointed safety engineer in charge of the inspection division of the Utilities Indemnity and Fire Exchanges. For many years Mr. Brainerd was engaged in experimental work and in construction and operation of various important electric, gas and waterworks plants. For the past fifteen years his activities have been in the line of safety engineering and inspection work. He has resigned the position of supervising inspector for the St. Louis district, in charge of all character of inspections, for the Travelers' Insurance Company and Travelers' Indemnity Company of Hartford, Conn. Mr. Brainerd holds certificates of competency as inspector for the states of New York, Pennsylvania, Ohio and Wisconsin.

Hamilton F. Gronen, commissioner of the municipal light and water department of the city of Tacoma, Wash., has resigned his position, following a disagreement with the City Council in regard to power development of the municipal properties. It is understood that Mr. Gronen is about to resume the practice of his profession of engineer.

W. C. Campbell has been promoted from assistant to general superintendent of the Columbus (Ohio) Railway, Power & Light Company, succeeding H. W. Clapp, who was promoted to be general manager. Mr. Campbell graduated from Union College in Schenectady in 1900. He spent one year in the General Electric shops, another in special work at Purdue University and a third on the General Electric test floor, when he was assigned to the New York territory of the company. In 1907 he resigned to become general carhouse foreman for the New York Railways, but in the following year he returned to the General Electric Company in the New York territory and shortly afterward was transferred to the San Francisco and Portland district. In 1914 he became associated with the Columbus property as assistant general superintendent.

C. M. Kaltwasser has resigned as vice-president and general manager of the Harrisburg (Pa.) Light & Power Company, and after Jan. 1 he will be connected with the Century-Plainfield Tire Company of Plainfield, N. J., as president and general manager. Mr. Kaltwasser was born in New York City in 1883 and was graduated from the Stevens Institute of Technology in mechanical engineering. He was first connected with the Connecticut Railway & Light Company as a cadet engineer and later for three years was in charge of the South Norwalk division of the company. In 1910 he became commercial representative in the New York office for the Susquehanna Railway, Light & Power Company, later the United Gas & Electric Company, and after some traveling about among the properties was appointed manager of the Lockport (N. Y.) Light, Heat & Power Company. In the fall of 1914 he became general manager of the Harrisburg property, in which work he has continued up to the present time.

James T. Hutchins, formerly vice-president and general manager of the Rochester (N. Y.) Railway & Light Company, has been elected president of the company, succeeding the late Horace E. Andrews. Mr. Hutchins has been general manager of the company since early in 1909. He was graduated in 1889 from the Massachusetts Agricultural College in Amherst and shortly afterward became connected with the Thomson-Houston Company. Later he was appointed assistant superintendent of the West End Electric Company of Philadelphia. He was promoted to be superintendent, retaining that post until the Philadelphia Electric Company was organized in 1897, when he became its electrical engineer. In 1904 he joined the Rochester company as superintendent of the electrical department, two years later was promoted to be assistant general manager

J. T. HUTCHINS

and three years after that to be general manager. In 1917 he was elected vice-president in addition. Mr. Hutchins was a member of the State Advisory Board in the United States Employment Service Organization, assisting the government in labor distribution.

Obituary

Harry L. Bleeker, vice-president and general manager of the Washington Water Power Company, Spokane, Wash., died recently of pneumonia at the age of forty-five years. Mr. Bleeker was born in Belleville, Ontario, and had been with the Washington Water Power Company for the past sixteen years. After studying law he entered the legal department of the San Diego Street Railway and in 1900 became private secretary to J. P. Graves at Grand Forks, B. C. Two years later he went to Spokane and became private secretary to the late Henry M. Richards, then president of the Washington Water Power Company, and to D. L. Huntington, now president of the company. In 1903 he was made secretary and later was chosen vice-president.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

TRADE MEETS MANY PROBLEMS IN YEAR JUST CLOSED

Review of Sales, Production and Distribution Activities of Manufacturers and Jobbers During 1918

Many startling changes have taken place in the electrical commerce of the nation during the past year. The industry has gone through a period of maximum production, government control, priorities, etc., and is now once more in a free market.

Up to the date of the signing of the armistice the industry was almost entirely engaged in producing goods for government or allied consumption; the trade a large part of the time was serving only essential demand. Commercial business was reduced to the barest minimum. There was some commercial business, but it is doubtful if on the whole it represented more than 25 or 30 per cent of the entire output of the industry for the first ten months of the year. Even those lines which at first blush might be considered non-essential — such, for instance, as the appliances—had a big war demand.

Heaters for aircraft guns and for ship bridges, electric ranges for the army and navy, fans for the government offices and for the navy, dry batteries for radio sets on airplanes, and a good many more too numerous to mention, were sold to the government in large numbers.

Up to Nov. 11 shops were generally working to the extent that they could get labor to operate the machinery. Since that time there have been many cancellations of war and other contracts, and incoming business is now small. The total output for the year was probably no larger than in 1917, which was in the neighborhood of $750,000,000. Throughout the year labor first and raw materials second have been the controlling factors. In addition to a very acute shortage of each, labor has been very undependable. Dilution was tried and found in most instances to work very well. Women as a rule were found to be more dependable in the work in which they were employed than men. Wages for industrial labor advanced by leaps and bounds. The government labor board did much to prevent loss of time through strikes, but it pretty generally recommended higher wages and the shortening of working time to eight hours. This latter did not actually shorten the hours of work but materially increased wages by making it possible to get in more overtime work. Labor priorities were outlined, and in one instance in the industry labor was close to being drafted.

Raw materials, particularly iron, steel, copper, tin and brass, were insufficient to supply the demand. Substitutes were urged, particularly for brass. Prices of these products were fixed by the government with provisions for maximum output, but even so there were not enough to go around. The natural result was that along in the summer the War Industries Board began to limit the supply of raw materials through priority certificates in accordance with the essential character of the production. Nothing was termed non-essential, but many lines of production were considered less essential to the winning of the war than others.

There consequently sprang up a system of classification. Those industries in Class A or AA were reasonably sure to be able to get all of the raw materials needed; those in Class B (electrical manufacturers automatically were in this class) would for the most part probably be taken care of, while those in Class C (less essential, with curtailed production) would be apportioned raw material sufficient to take care of the curtailed output, provided that the material was available. In all cases, however, individual orders might receive a higher classification than the automatic rating, and it did so happen frequently.

Many electrical lines had to curtail their production considerably as a result. As the fighting stopped curtailment in many other lines was under consideration at Washington or by the manufacturers for recommendation to the War Industries Board.

Thus the output of fans was curtailed to 40 per cent less than the 1917 production, vacuum cleaners for six months from Oct. 1 were curtailed to 75 per cent of six months of 1917 production, heating appliances production to 50 per cent of 1917 output, etc.

The curtailment was largely taken care of by reducing drastically the number of sizes and types of product. In some instances whole lines were abandoned. Such lines were clearly not necessary to winning the war. They were for the most part in the luxury class. Much of the curtailment also was taken care of by eliminating, at least for the period of the war, the "special" article. In the wiring device line particularly there were a number of special types.

Naturally such a condition tended to hasten standardization in the electrical line. Much that happened under stress during the year gone by has been talked over repeatedly in former years at committee meetings. Now that the restrictions are removed, some of these lines will probably again come on the market but not all. In the wire field, for instance, Nos. 8, 10, 12 and 14 double-braid seem likely to be discontinued. Heating-device manufacturers are to meet this month to discuss standardization, among other things, of output. The jobbers have asked for more standard lines as they reduce the amount of stock that must be carried and therefore decrease the cost of doing business. Standards of dome reflectors were adopted by the manufacturers.

War conditions caused many parts of the industry to organize. Some of these formed sections of the Associated Manufacturers of Electrical Supplies, and others, such as the manufacturers of portable electrical tools, hoists and stokers, formed independent associations.

Incandescent Lamp Advance

For the first time the price of incandescent lamps advanced. The first advance was on Jan. 1, 1918, and called for 10 per cent. Ten months later vacuum-type tungsten lamps advanced again, this time 15 per cent. Miniatures, carbons and gems advanced 10 per cent during July.

The shortage of lamps that arose during the latter part of 1917 was well caught up with by February. Manufacturers begun to rearrange agents' stocks and as a result greatly increased the movement of all sizes. Production was pushed and agents were urged to stock up in the summer months. Lamp sales for 1918, it was reported, were running ahead of 1917. September sales were roughly 30 per cent greater than for September, 1917.

In September it was recommended by the Fuel Administration to stop the output of gem lamps and to use carbons only for rugged service. Other changes were recommended, all to make the most efficient use of fuel. These restrictions are now off, but it is doubtful if anything like the normal production will ever again take place in the curtailed types. Already a rugged-type tungsten lamp is on the market to compete with the carbon lamp.

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Wire

Copper wire, the output of which has a greater value than any other electrical product, was higher at the close of the year than at the beginning, but the average throughout the year was below that for 1917. The increase during the year was due to higher copper, higher cotton and higher labor. During December wire base dropped a couple of cents. The highest for rubber-covered wire base was, considering all discounts, 34 cents.

The wire industry up to September roughly was working 80 per cent on government orders. At that time the Signal Corps increased its order from 10,000 to 65,000 miles monthly of outpost wire. This was more than the industry could immediately handle, but additional machinery was purchased and work begun. From that time on it was almost impossible to get small sizes of braided, stranded wire. Heater cord was virtually out of the market. So far as can be learned the manufacturers are still working on this order. Stocks of wire held in anticipation of government orders are now beginning to appear.

Appliances in Large Demand

Throughout the year sales of electrical appliances were very large. Stocks were short and manufacturers were behind on orders. Washing-machine manufacturers, even though they early in the year decided to eliminate 171 distinct styles, by the first of June in many plants were 2000 to 3000 machines behind the orders.

It seemed almost impossible to get a stock of licensed flatirons after the middle of the year. Even electric ranges sold better in 1918 than in 1917, reports up to August indicate. Sales were mostly in small quantities and in small cities, the big cities having ceased to push ranges during the war.

Fans were sold out early to the trade. The consumer demand was greater than the supply in 12-in. and 16-in. oscillators, but not so good in the small sizes. Government demand was large.

Prices on all appliances advanced considerably and as a rule more than once during the year.

Central stations during the year received recognition in the way of a discount differential in the distribution of electric ranges, while the jobber received similar recognition in the distribution of socket heating devices.

Early in the year some of the large central stations cooperated to purchase 30,000 portable lamps to sell at a low figure. These sold so well that the scheme has been greatly enlarged.

Large power equipment was hard to get throughout the year. In November six months were quoted on motors of more than 100 hp. Turbines of over 500 hp. were taken under complete government control as to distribution. After the fighting stopped deliveries on large turbines were quoted at four months and longer, depending on the condition of the individual factories. At the close of the year there was still a large volume of unfilled business in steam turbines.

In the spring stocks of small power equipment began to appear, and conditions in this line have been getting better and better. The used-equipment dealers, while finding it difficult to take care of inquiries for large equipment, report that the market for small machines is dull.

The transformer demand was not so large last year as in the preceding year. In April it was reported to be down to about 70 per cent of that for 1917.

Around the first of June power equipment, including motors, generators, turbines, transformers, etc., advanced about 10 per cent.

Prices on small material advanced as a rule 25 per cent or more during the year. Some items, such as lamps and flashlamps, were increased in price for the first time. Metals and labor generally caused the advances, but not a few were caused by the sky-rocketing of cotton. Tapes and insulated wire especially reflected the cost of cotton in higher prices. The 25 per cent advance in freight rates was the occasion also for a number of advances, particularly items of large bulk, such as conduit, poles, cross-arms, etc.

Building, except for war purposes, was very small all year. Yet even such as was projected was held up by the government late in the year. This was expected to show a heavy slackening in orders to jobbers. By the time, however, that the building curtailment order was fully in effect the jobbers were operating under a pledge not to supply materials except for essential purposes. This pledge was kept remarkably well by the jobbers.

The jobbers were very much pleased at being recognized by the government. They were given a B rating in the preference list and later were allowed an A rating for replacement of iron and steel stocks that had been diminished by orders with an A or AA rating.

The jobbers were relieved of their pledge Nov. 18, about the same time the restrictions on new buildings were withdrawn.

Jobbers' stocks were as large during the year as they could maintain them, but after fighting ceased ordering was shortened. It was stated at the Cleveland convention of the jobbers that jobbers have a stock of $40,000,000 and are doing a business annually of $300,000,000.

As the year closed local jobbers' stocks were in pretty good condition, small wire being perhaps in poorest supply. Conduit, which had been particularly short all through the year, was beginning to come in fairly well, as was heater cord.

The cost of doing a jobbing business continued to increase during 1918. Labor was a particularly costly item. More capital to the extent of 25 to 30 per cent was needed to do business.

Considerable difficulty was experienced in handling government orders. The government's way of doing business is different from that of regular commerce, and where so much was ordered by the government the trade particularly was greatly handicapped. The slowness with which payments were made was perhaps the most trying.

On the other hand, the government orders, it was noticed, brought a lessening of the small-order business. In certain sections of the country the jobbers made considerable progress in retiring from the retail sales end of the business.

The shrinkage and then curtailment of new building caused watt-hour-meter sales to fall off a great deal. Housing projects and exports, however, served to bring in a tidy volume of business.

A number of manufacturers began to study the export field during the year. There were quantities of inquiries from South America, but the ban on shipping made it hard to do business. However, as soon as the war ceased the manufacturers began to show unusual activity.

American manufacturers during the past year have developed quite a few electrical fittings and, it is understood, some wire for use in foreign markets. With the establishment of branches of American banks abroad American manufacturers are apparently going after foreign trade strong.

Electrical exports during the fiscal year ended June 30, 1918, were the largest for any fiscal year, amounting to

NEW YORK METAL MARKET PRICES

	Jan. 7, 1918	Dec. 23, 1918
Copper	£ s d	£ s d
London, standard spot	110 0 0	122 0 0
	Cents per Pound	Cents per Pound
Prime Lake	Govt. price 23.50	Govt. price 26.00
Electrolytic	Govt. price 23.50	Govt. price 26.00
Casting	Govt. price 23.50	Govt. price 26.00
Wire base	27.00	28.75
Lead, trust price	6.50	6.50
Nickel, ingot	50.00	40.00
Sheet zinc, f.o.b. smelter	19.00	15.00
Spelter, spot	7.82½ to 7.91½	8.47½
Tin	85.00	71.75
Aluminum, 98 to 99 per cent	34.00 to 36	Govt. price 33.10

SOLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	22.00 to 22.50	17.00 to 18.00
Brass, heavy	14.00 to 14.50	10.00 to 10.50
Brass, light	10.00 to 10.50	8.00 to 8.50
Lead, heavy	6.00 to 6 12½	5.25 to 5.50
Zinc, old scrap	5.00 to 5.50	5.25 to 5.50

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$54,527,570, in comparison with $51,903,823 for the previous year. Exports for the first eight months of 1918 amounted to $38,610,824, or at the rate of $55,000,000 for the year. Figures for the calendar year 1917 were $55,478,079.

Metal prices, generally speaking, were much lower at the close of the year than at the opening. Copper, which owing to the continuance of the government price of 26 cents until Jan. 1 is apparently higher, was actually being offered for resale during the last two weeks of the year at 21 cents. Producers late in December agreed on a price of 23 cents for export. Prices at the beginning and end of the year are given in the tables printed on the preceding page.

Even with the tremendous totals for Liberty bonds and the large income and other taxes, collections were well maintained during the year. Credits, of course, were very closely watched. The Engineer Depot, which purchased large quantities of electrical supplies, made strenuous efforts to take advantage of cash discount.

Both manufacturers and jobbers urged the use of trade acceptances, and the latter particularly made good use of them, especially with slow-pay customers.

The electrical industry enters the new year looking for business. All priorities and restrictions are off—the bars are down. For the first time since the late summer of 1915 has a buyers' market in any degree been present. Prices, however, are up, and there are no indications that they will come rushing down. That there will be a drop none deny, but a slowly drawn-out affair is expected.

Both the producing and the wholesaling branches seem to be in good shape to stand a few lean months, after which a steadily growing demand is anticipated. The industry closes the three best years in its history.

SURPLUS WAR STOCKS NOT TO BE USED TO BREAK MARKETS

Manufacturers Are Assured Utmost Protection—Government Departments' Foreign Purchasing Commissions Supplied First

Government surplus stocks piled up in 1500 warehouses of the War Department are to be disposed of in such a manner as to affect the market prices least. No small groups of men are to be allowed to buy at ridiculously low prices and then glut markets at fair prices, thereby making enormous profits such as were made at the end of the Civil War. Preferential markets are to be supplied first. Those include the Post Office, Agricultural and other federal departments, the Red Cross, Y. M. C. A. and purchasing commissions for foreign governments. This is the plan outlined to business men and manufacturers on Dec. 22 at a meeting of the Chicago Association of Commerce by L. H. Hartman, director of the Surplus Stock Division, established in the Munitions Building, Washington. The machinery for the disposal of surplus stocks has been decentralized as much as possible, the country being divided into thirteen zones.

No one knows how much stock there is on hand for disposal and no one will until the inventory of Jan. 1 has been taken and deductions have been made for an army of 2,000,000 men up to July, 1919, and of 500,000 men to July, 1921.

The first thought of the division, said Mr. Hartman, was to protect the manufacturer from unfair competition induced by auctioning of immense stocks to small groups which would learn of the government's routine. Thus elimination of the middleman's profits is to be accomplished.

When these "preferential markets" are supplied, and at a favorable time determined upon by full consultation with representatives of the manufacturers interested, auctions will take place, but only after the widest publicity has been given and the original manufacturer has had every opportunity to buy back his own product at the price at which it was furnished.

Instances of the preferential disposal of stocks were given as follows: The 180,000-tonnage per month allotment for Belgian relief will come from the surplus stocks. Through the War Trade Board, the Russian Purchasing Commission has arranged to ship to Siberia 800,000 pairs of shoes and immense stocks of clothing. Aeroplanes, automobiles and trucks to the extent of $45,000,000 will go to the Post Office Department. The Department of Agriculture will take 10,000 cross-cut saws, 30 miles of telephone wires, 1000 units of office furniture, 1000 wagons, 15,000 stoves, 1000 fabricated houses and 10,000 miles of barbed wire.

When it was learned that 90,000 tons of sulphur had been accumulated two of the largest producers were called to Washington and agreed with the division that, in order not to disturb the market price of sulphur, they would dispose of 1000 tons of the government supply at the same time and price as each 1000 tons of their own output.

Inasmuch as the Allies also have enormous stocks on hand, General Pershing has arranged for an interchange bureau. Locomotives, heavy construction equipment and trucks are not to be returned to this country but will be disposed of along the same stabilizing lines in foreign countries.

ELECTRICAL EXPORTS FOR MONTH OF AUGUST LAST

Figures for First Eight Months of Year Indicate a Total of Around $55,000,000 for the Twelve Months of 1918

Reports on electrical exports for August last have just come in and show a total for the month of $5,340,110, in comparison with $3,607,278 in August, 1917. The difference is explained largely by the figures for transformers, which were $554,576 in August last and but $95,311 in August, 1917. Higher prices were undoubtedly accountable for a large portion of the remainder. The exports of insulated wire and cable amounted to $676,670 in August last.

Exports of electrical merchandise during the first eight months of 1918 amounted to $38,610,824, as compared with $36,035,423 for the similar period of 1917 and $23,536,406 for the first eight months of 1916. Roughly, 10,000,000 tungsten lamps were exported during this period of 1918. For the most part the 1917 and 1918 figures run about the same, the most notable increases being in transformers. Insulated wire and cable appears to be running behind. This, however, can be explained by the lower prices that prevailed for wire in 1918. Copper prices reached a level more than 50 per cent higher than the 1918 average.

Based on the figures for the first eight months of the year 1918, exports are running at the rate of $55,000,000.

The accompanying figures were compiled from reports by the Bureau of Foreign and Domestic Commerce.

	August		Ten Months Ended August	
	1917	1918	1917	1918
Batteries	$242,668	$252,529	$2,380,384	$2,068,187
Carbons	137,055	123,926	*239,883	1,009,435
Dynamos or generators	295,029	258,589	1,751,221	2,195,653
Fans	42,394	29,296	421,430	681,267
Heating and cooking apparatus	22,174	79,954	*45,469	422,232
Insulated wire and cables	389,909	676,670	4,717,957	3,665,799
Interior wiring supplies, including fixtures	111,961	108,386	865,087	1,003,240
Arc lamps	486	2,135	12,222	9,323
Carbon-filament lamps	14,886	5,474	127,416	62,091
Metal-filament lamps	181,571	203,046	1,811,096	2,241,894
Magnetos, spark plugs, etc.	202,680	181,347	*472,621	1,742,645
Meters and measuring instruments	73,955	189,393	700,275	1,362,019
Motors	436,232	573,547	4,130,170	4,899,746
Rheostats and controllers	18,762	17,408	*32,963	154,585
Switches and accessories	158,546	159,811	*335,598	1,549,917
Telegraph apparatus, including wireless	47,735	36,858	452,644	196,971
Telephones	118,551	259,185	1,388,487	1,999,846
Transformers	95,311	554,576	949,990	2,180,776
All other	1,017,373	1,627,980	15,200,510	11,165,198
Total	$3,607,278	$5,340,110	$26,035,423	$38,610,824

* Figures cover period beginning July 1.

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INCREASED SALES OF PLEASURE ELECTRICS

The Prevalent Gasoline Shortage and Existing High Prices Have Served to Make the Electric Car More Popular than Ever

During the past year the demand for electric passenger cars has reached proportions never before attained in the industry. Shortage of gasoline and consequent high prices, combined with government restrictions, have greatly increased the sales of electric cars. In foreign cities, particularly London, this type of car is extremely popular, and shipments of American cars will now go forward rapidly on large back orders. In Norway and Sweden great electric vehicle developments have taken place, and large installations of cars of American make have been made and are operating satisfactorily. Gasoline in Norway and Sweden during the war period reached $1 a gallon, making the operation of a gas car almost prohibitive. Good performance of electric passenger vehicles in the United States last winter, when conditions were particularly trying, coupled with the scarcity of good chauffeurs, insures a healthy and growing domestic market for the electric passenger car. Deliveries are improving and shipping facilities will be plentiful soon, the manufacturers state.

METAL MARKET SITUATION

Copper Quotations Lower—Brass Manufacturers May Unite for Export Trade

This is the last week of government prices. From now on metals will be in a free market. As indicative of what may be expected is the announced export price of 23 cents for copper. However, resale prices are even lower—21½ cents for January shipments, 21 cents for first quarter and 20 cents for first half have resulted in business.

Tin, while it is being held by the government at 72½ cents, is being quoted outside at under 70 cents. Lead is also coming down. The trust price is unchanged at 6 cents, but offerings were made last week at 5½ cents.

Scrap metals showed a loss all along the line during the week.

Brass manufacturers and other domestic companies which make copper rods, wire, etc., are discussing some sort of a combination to handle the export sales of their products.

In all probability a corporation will be formed along the lines of the Copper Export Association, Inc., which was organized on Dec. 17 to offset the buying of metal by various foreign combinations, and is expected to include American Brass, Bridgeport Brass, National Conduit & Cable, and other companies. Anaconda Copper Mining Company might also take part in the movement, since it is a big producer of copper rods and wire.

NEW YORK METAL MARKET PRICES

	Dec. 23	Dec. 30
Copper:	£ s d	£ s d
London, standard spot	122 0 0	112 0 0
	Cents per Pound	Cents per Pound
Prime Lake	Govt. price 26.00	23.00
Electrolytic	Govt. price 26.00	23.00
Casting	Govt. price 26 00	23.00
Wire base	28.75	28.75
Lead, trust price	6.50	6.00
Antimony	7.62½	7.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	15.00	13.00
Spelter, spot	8.47½	8.15
Tin	71.75	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	17.00 to 18.00	16.00 to 16.50
Brass, heavy	10.00 to 10.50	9.00 to 9.50
Brass, light	8.00 to 8.50	8.00 to 8.25
Lead, heavy	5.25 to 5.50	4.50 to 4.75
Zinc, old scrap	5.25 to 5.50	4.75 to 5.00

THE WEEK IN TRADE

AS IS usual, business in the pre-inventory days is quiet. However, the trade and manufacturers see considerable brightness after the first of the year.

Prices up to the first of the year have been remarkably firm. There seems to be speculation at this writing concerning what may happen after the inventory period.

Building is still quiet, although architects are known to be giving estimates on many projects. The government officials continue to urge appropriation for public works.

NEW YORK

Everything is quiet. After January first inventories better business is expected. There is a feeling that some price revisions may follow inventory taking. Jobbers are ordering virtually nothing and are trying to keep stocks as low as possible, at least until after inventory taking. Manufacturers, however, seem filled with a similar desire to reduce stocks and as a consequence are rushing goods on back orders to dealers as fast as they can. Prices are holding up, but without bidding this indicates nothing.

WIRE.—Plentiful jobbers' stocks of all sizes have come to light. There is no bidding, however. Manufacturers, it is reported, have heavy stocks of copper and orders placed with refiners with a "no cancellation" clause. On this basis it would not be unreasonable to suppose that dealers would be held to the orders for future delivery.

CONDUIT.—No indications of a price change are apparent locally. Plenty of pipe is coming through. Jobbers, however, will probably maintain smaller stocks now than they have done. Deliveries are so much better and more certain that shipments will again be made to customers from manufacturers' stocks. This is in line with the intention of jobbers to watch stocks more carefully and curtail on expenses.

ARMORED-STEEL FLEXIBLE CONDUCTOR.—There is no demand locally, and stocks are naturally large. The housing projects did not develop so large a demand for this material as was anticipated. Knob-and-tube work was more generally used.

SCHEDULE MATERIAL.—Business is quiet. Stocks are coming in and are considered ample. They might have been considered small, however, four months ago. Manufacturers are cleaning up on back orders.

CHICAGO

All down the line the Christmas business in electrical circles was a smashing success. Jobbers, dealers and central-station merchandising men all agree that 1918 was the biggest year they individually ever had, and that December was a banner month among banner months. Every night for the last two weeks the men of the Edison Electric Shop sales force have worked until midnight or later restocking the depleted floor and shelves which were each day eagerly beset by throngs of shoppers. The electric shop's business for the year showed an increase of 40 per cent gross. Silk shades and lamps were the most active items, showing an increase of 50 per cent over last year's record. Appliances showed an increase of 25 per cent.

The real retail problem now is to get together enough goods to use in the January clearance sales. So depleted are the stocks that large orders for merchandise to use in clearance sales were going out on Dec. 28. Stock taking will be a very simple job.

Jobbers' stocks are well in hand. The only item they

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are seriously long on is wire. Because they had to order it well in advance and did not buy subject to cancellation great quantities of it were shipped almost immediately upon the signing of the armistice.

The opinion is gradually gaining among manufacturers that the next business will come from the public utilities. The success which attended the efforts of the West Penn Power Company and the Consumers' Power Company of Michigan in raising several million dollars of 6 per cent money is taken to indicate that public utility financing is already easily possible.

The price question is disturbing markets somewhat, but it is difficult as yet to get any definite trends out of the changes that have taken place. That copper and steel will both be cheaper in 1919 than they were in 1918 seems to be established as a fact.

Labor is becoming plentiful at what appears to some to be an alarming rate. A permanent office through which discharged army and navy men will be found jobs will soon be opened. There appears to be a shortage of clerical jobs at present.

Members of the Chicago district board appointed to adjust cancellations of war contracts are fully prepared to expedite matters. The government's policy on sales of supplies and equipment now in warehouses is regarded as extremely fair. There will be no dumping of goods in a manner to break markets, it is reported.

Optimism of the first water prevails regarding the outlook for business in 1919.

COPPER WIRE.—Chicago jobbers are long on wire. One jobber is holding his base price of rubber-covered wire at 34 cents, but the market is at 32 cents. Weatherproof wire is on a 32-cent base.

APPLIANCES.—Shipments that should have come in before Christmas are arriving now. The Commonwealth Edison Company claims it could have sold $25,000 more goods if it had received them in time. There was some heating-device shortage among the jobbers before the holidays.

CONDUIT.—It is said that merchant pipe will be off about 5 per cent in price on Jan. 1. Rumors of lower prices in conduit predict declines of from 3 to 6 points indicating a reduction of from 4 per cent to 8 per cent.

BOSTON

Trade reflects the usual dullness at the final turn of the calendar, but the opinion is general that the industry is only taking up a notch in its belt in preparation for a fine run of business this year. Collections are fairly good and stocks on the whole well prepared to meet expected demands. Labor conditions are reasonably good, barring the continued strike at the Pittsfield works of the General Electric Company. There are signs that many more workers will return to the shops this week, and so far the employees of the company at the Lynn factories have remained "on the job." Central-station power business is showing a moderate falling off as the November figures are analyzed and as present loads are considered, but this is being to a considerable degree offset by increased use of lighting service. Men from the national service are being generally absorbed into the trade and industry. Contractors are getting busier with estimates than for some time. Fan-motor prices are up 15 per cent for this year's models, but other prices are holding pretty steadily to the levels of the last few weeks. There is less disposition to wait for sharp cuts in prices before placing orders, although houses heavily stocked are naturally slow to go into the market until their accumulated material begins to run much lower.

AUTOMOBILE SUPPLIES.—Electrical supplies for automobiles are moving unusually fast. Stocks are being well maintained and deliveries are more satisfactory than for some time. Distributers are "cashing in" upon the open winter. Batteries, lamps, starting sets and lighting units are in good demand for cars kept in operation as well as for annual overhaul work in the garages.

MOTORS.—The demand holds up well despite the temporary reduction in power requirement due to cancellation of war contracts. Business appears to be undergoing a steady transformation to a peace basis, and an indication of the healthy state of the electrical market is afforded by a recent auction sale of motors at a war plant in Connecticut. Twenty-six motors ranging from 3 hp. to 50 hp. in rating and aggregating 305½ hp. were knocked down at practically list price, so keen was the competition among bidders for these three-phase, 550-volt machines. So far the primary market has shown little tendency toward disorganization as a result of the release of war-plant equipments. Stocks are in good shape up to 50 hp.

FANS.—An advance of 15 per cent in 1919 designs of fans is announced. As many jobbers ran low on last year's purchases and are not carrying over substantial stocks, orders at the new prices will be in style before long. It is believed that the public will be in the market for a large supply of fans this year, apart from the possibilities of the weather.

ELECTRIC RANGES.—Sales in 1918 were held back by the conservatism of central stations regarding extensions, but the outlook for the new year is excellent. Carload shipments are coming into New England, and one central station has just purchased twelve ranges for stock in anticipation of 1919 delivery requirements. During the war it is safe to say that for every five electric ranges placed in service in New England thirty-five orders for range services had to be declined by the central stations, but this condition is sure to relax this year in face of the demand for ranges on the part of the buying public. Already there are hints of one or two central stations breaking away from the conservative policies as to extensions which characterized 1917 and 1918. Distributers are laying in good stocks of ranges for immediate delivery, and where high-class service is a sequel to installation a substantial growth of business is to be expected. The institutional market looks particularly bright at this time. Prices hold firm. It is believed that this will be an excellent range year in the prosperous residential cities and towns of eastern Massachusetts in particular and in many sections of New England where low-cost energy is available from large steam-turbine or water-power plants.

FIRE-ALARM TELEGRAPH APPARATUS.—Inquiries are increasing, and the prospects of enlarged sales to municipalities are good. Prices have not advanced as fast as in many other lines, and this is expected to stimulate trade in the new year. The factories are now in excellent condition to produce this class of equipment.

WIRE.—Prices do not show much change as yet. The demand reflects the slowness of building operations to get under way. Meanwhile stocks are accumulating somewhat, and the outlook is good for the year's business.

WASHING MACHINES.—The market is still oversold. One prominent jobber remarked Monday that he always seems to be a couple of carloads behind and begins to wonder if the supply will ever equal the demand.

APPLIANCES.—The Christmas trade ran about neck and neck with last year's. The lighter devices were in heavy demand where they were put in the public's way, but in cases where they were exhibited below stairs or on side streets trade was less satisfactory. Deliveries are now so good that distributers and retailers will be able to "make a killing" in 1919 if they cultivate the market intensively.

ATLANTA

Representatives of various building exchanges in the Southeast appear to be very optimistic regarding the building situation for 1919. Some predict that this year's construction will be a record breaker. The consensus of opinion among architects, engineers and contractors is that material prices are not going to decline for some time to come, and that since restrictions are off there is no reason why activity in building should not begin immediately. New plans covering substantial construc-

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tion are being distributed, and it looks now as though the Southeast will again be busy on normal commercial construction. A great deal of activity is noted in the real-estate field, and this is in a measure a barometer of building activity. Compared with the previous week, there is practically little wholesale activity in the electrical field, but this is to be expected during the holidays and inventory period.

The government will expend approximately $500,000 for additional hospital accommodations at Fort McPherson, Atlanta, Ga. This will call for more electrical material. The Birmingham Steel Corporation is planning the erection of additional buildings. Contemplated ultimate expenditure will be from $15,000,000 to $20,000,000.

The lumber industry of the South is entering upon the greatest development in its history. Information at hand indicates that the export demand this year will be greater than ever. Sawmills have been working short-handed for the past six months. The industry will therefore be an important factor in steadying the labor situation.

CONDUIT.—No change in price has been noted in black and white rigid conduit, although buyers are holding off looking for a shading in prices any day. The trade is cognizant, however, that the demand for steel in general will have a big effect on conduit prices. Manufacturers report freer shipments in taking care of the present demand. Southeastern stocks are very low, but this is accounted for by the fact that purchasers are now hesitating and that rigid restrictions a few months ago prevented any accumulations. This condition exists as well for the flexible-steel product, with slight exceptions. The call for flexible conduit is off when compared with the volume transacted in December, 1917, but about normal taking the five-year average into consideration.

FLEXIBLE-STEEL ARMORED CABLE.—The manufacturers are beginning to catch up and ship many back orders that they were unable to do anything with prior to Nov. 1. There has been no change in price since Sept. 1. At the present time stocks are getting in good shape and are about 75 per cent of normal. Deliveries are much easier.

STAMPED-STEEL BOXES.—The market for these is very sluggish. Prices are steady, and big stocks are on hand. A feeling exists that prices on this product may weaken in the face of ample stocks and slow movement.

FITTINGS.—Stocks are ample, and the demand is naturally following very closely the trend of other steel products.

PANELBOARDS AND CABINETS.—Present scattered buying places the present-day volume of sales on the basis of 30 per cent of normal. Prices remain steady. With the accumulation in the building trades, manufacturers are looking forward to a substantial volume of business this year.

SEATTLE—PORTLAND

A singular combination of confidence and perplexity prevails among jobbers of electrical merchandise in the Northwest, particularly in Seattle and Tacoma. The perplexity naturally is occasioned by unsettled conditions along several lines, especially lumbering. At present mills and logging camps employing thousands of men are closed down for the holiday season and annual repairs. This is the usual situation at this time, but it is persistently rumored that a large number of the mills and camps will not reopen until the industry is on a more stable basis. However, both jobbers and dealers have completed a year of active business and are hopefully anticipating that the coming year will show up equally well. Puget Sound cities, Seattle in particular, enjoyed a holiday business far in excess of the most optimistic predictions. Electrical purchases this year were confined almost exclusively to domestic appliances. Washing machines, percolators, toasters and sewing machines were the leaders. Few electrical novelties were sold. Local jobbers are now settling back in the usual after-holiday lull, which is expected to continue for a week or more. Small dealers are also experiencing the after effects of holiday business.

Reports from Spokane covering the week prior to Christmas state that the wholesale trade is fair and collections very good. Tacoma reports wholesale trade fair and retail business good, due largely to a good holiday business. Portland states that holiday buying was active. A report covering Oregon cities, not including Portland, says that Christmas trade this year far exceeded that of any other season for the past twenty-five years.

The validity of the five-million-dollar port bond issue voted in Portland at the November election has been assured. Portland wooden shipyards are making preparations to meet the expected demand for wood tonnage from foreign sources. General contractors and other authorities are of the opinion that building costs will continue high and will not materially decrease for at least one year. In spite of excessive costs, building is proceeding without noticeable diminishment in Puget Sound cities and in Portland. The Pheasant Northwest Products Company of Salem, Ore., is completing an addition to its plant which will be motor-driven.

SAN FRANCISCO

The general opinion of the electrical fraternity on the Pacific Coast is that 1919 will be a poorer electrical year as regards industrial sources, a better year for central-station business because heavy winter rains are decreasing the possibility of drought and releasing considerable electrical energy for other work, a poorer year, naturally, for government business, and a better year for railroad business as the better conditions of Eastern factories will enable them to turn out needed material for railroad maintenance and reconstruction; but, best of all, 1919 promises to be a wonderful year for the electrical dealers and contractors' business. War-essential boards are now passing very liberally upon new construction that was formerly deemed non-essential; wages are still at their higher standard, and there will not be so many patriotic calls upon the public as there were last year, when war was still being waged.

WIRING DEVICES.—Provided that the factories will make good delivery, this business will be far beyond the sub-normal year of 1918. Most of the construction will be in the nature of dwellings, apartment houses, office buildings, etc., requiring big quantities of wiring devices of various kinds.

INTERPHONES.—The housing situation is very serious at the present time. Practically every Pacific Coast city is deficient in facilities for housing its present population, to say nothing of any expected increase. While there are plenty of flats and old cottages to let, it is noticeable that apartment houses are eagerly snapped up. It is reported that the architects have plenty of projected apartments ready for the owners' permission to go ahead. All this means that interphones, or connecting telephones for such buildings, will be sold in large numbers provided that the factories can quickly finish their government work and get out these private devices. Shrewd San Francisco observers predict, within the next few months, a business in interphones, annunciators, etc., comparable only to that which followed the 1906 fire, when there was an unprecedented increase in building.

FARM PLANTS.—All parts of California are now being eagerly canvassed in the interests of these plants, and it is safe to say that the missionary work is practically completed and that there will henceforth be a steady demand for them.

HEATING DEVICES.—Although badly hampered by exceedingly poor deliveries from the factory, the Pacific Coast experienced the best holiday business in its history, and it was noticeable that higher-priced devices, such as chafing dishes and percolators and certain sick aids such as heating pads and radiators, were all sold up to stock limits.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demahds which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 30%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
2 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40 to $0.45	$0.40 to $0.45
12 to 50	.35 to .38	.35 to .38
50 to barrel	.319 to .35	.329 to .35
Barrel lots	.289 to .32	.299 to .32

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
½-in. single trip.	$75.00	$63.75— 69.75
½-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.25 to $63.75
½-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00–50.70	$24.60–35.20	$23.00–30.25
½-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–29.15
½-in.—	65.00	33.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
⅛	$0.08½
¼	.08½
⅜	.08½
½	.11½
¾	.17
1	.23
1¼	.27½
1½	.37½
2	.58½
2½	.76½
3	

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
⅛	$0.05	$0.19
¼	.06	.19
⅜	.07	.19
½	.10	.25
¾	.13	.37
1	.17	.45
1¼	.21	.50
1½	.28	1.10
2	.40	1.80
2½	.60	4.80
3		

DISCOUNT—NEW YORK

	⅛ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10.1% to 20%	12.1% to 31%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	⅛ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+5.5% to 3.5%	+3.5% to +1.5%
2500 to 5000 lb.	+2.5% to +0.5%	+5% to 1.5%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.00 to $7.00
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List, each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted:		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.47—$40.77
Coil to 1000 ft.	27.42— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$38.00
Coil to 1000 ft.	28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$24.00 to $33.00

CHICAGO

Net per 100	$23.93 to $30.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%	10%
$10.00 to $50.00 list	30%	20%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00
1/5 to std. pkg.	17.85

Standard package, 2200. List per 1000, $20.00–21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$16.00—	$32.00
1/5 to std. pkg.	13.60—	27.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$13 00—	$32.00
1/5 to std. pkg.	11.50—	27.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅜-in. cap key and push sockets	500	$0.33
⅜-in. cap keyless socket	500	.30
⅜-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	2% to 5%
$25 to $50 list	5% to 10%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	8% to 15%
$25 to $50 list	15% to 20%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+ 15%
$10 to $25 list	List to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15% to 16%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List to 10%
1/5 to std. pkg.	10% to 16⅔%
Std. pkg.	18% to 25%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.50 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.55–$0.66
No. 18, full spools	.53– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.65 to $0.75
No. 18, full spools	.55 to .635

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$20.00–$25.00	$13.50–$17.00	$12.50–$15.00
12	25.00– 27.09	22.50– 23.22	18.75– 23.22
10	31.26– 32.40	28.66– 32.40	25.00– 27.45
8	43.92– 45.72	40.26– 45.72	35.14– 38.10
6	63.69– 72.36	57.90– 60.30	55.58– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$25.00	$18.00–$25.00	$15.50
12	$29.46– 31.44	29.46– 31.44	$25.54– 31.44
10	41.10– 43.84	41.10– 43.84	34.62– 38.36
8	57.00– 61.76	57.00– 61.76	50.18– 54.04
6	85.31– 97.68	85.31– 85.47	77.21– 85.47

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$39.75
25 to 50 lb	39.75
50 to 100 lb	38.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$39.76 to $41.00
25 to 50 lb	38.76 to 40.00
50 to 100 lb	37.76 to 39.00

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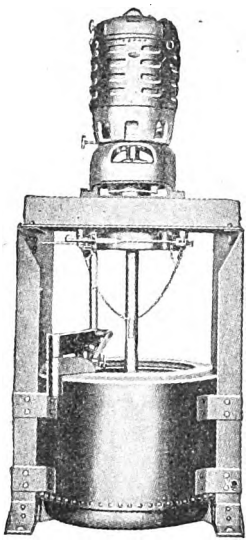
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Centrifugal Machines with Direct-Connected Motors

Centrifugal machines are used for expelling water or other liquids from moist substances or for separating liquids of different densities. In the salt and sugar industry they find particular application. Because their position does not have to be limited by



SQUIRREL-CAGE MOTOR DIRECTLY CONNECTED TO CENTRIFUGAL MACHINE

proximity to the boiler house for steam economy and because there are no belts to tighten and maintain it is very desirable to have these machines directly driven by an electric motor. However, there have been many difficult problems to be overcome in applying motor drive to this service. The centrifugal spindle must be allowed to swing, whereas the motor must be rigidly supported unless a cumbersome bearing is designed to carry this combined weight. Also a centrifugal machine requires very high starting torque. It is likewise pointed out that alternating current is usually available, and this does not lend itself as readily as direct current to motors operating at all speeds from 0 to 1200 r.p.m. A flexible coupling is therefore necessary between the shaft of the motor and the spindle of the centrifugal machine itself. Moreover, either a motor with a slip-ring rotor and external resistance must be provided or else a clutch in addition to the flexible coupling, so that the motor may come up to speed and then run at a speed where it can develop the necessary torque.

In the new "Mackintosh" centrifugal machines being manufactured by the S. S. Hepworth Company of 2 Rector Street, New York City, a high-resistance squirrel-cage motor is employed, being equipped with a centrifugal clutch that acts both as a flexible coupling and as a clutch. A light fork is attached to the motor shaft, revolving with it. The centrifugal force throws the blocks between these arms outward, gripping the rim of the friction drum with increasing force as the blocks revolve faster until a balance is attained between the motor torque and the friction grip on the drum. This, the manufacturer states, makes the motor simple and dependable without brushes or commutators, slip rings, solenoids or resistances and the consequent expense and difficulty which would be necessary to keep these in adjustment.

In the motor used on these centrifugals the bearings are so arranged that by lifting the motor up, without even releasing it from the slings, access is immediately possible to the bearings. These can all be replaced without taking out the rotor or other parts of the mechanism. A special feature of the Mackintosh centrifugal machines is that the motor is arranged to run at two speeds. The high speed is used for drying the material and the low speed for unloading, which has been considered the hardest portion of an operator's work but which is said to be now rendered very easy. An important difficulty in centrifugal machine operation has been the tendency of the basket to swing. To overcome this tendency the "Mackintosh" employs a suspension which effectively holds the center of the spindle close to the axis of rotation but uses no springs, buffers or other elastic members.

Dishwasher for Limited Quarters

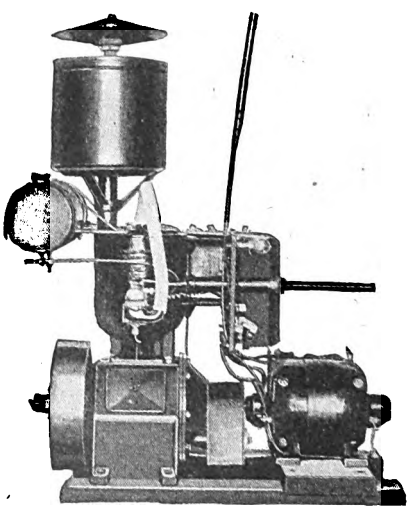
The latest addition to the line of electrically operated dishwashing machines made by the Insinger Company, Inc., Philadelphia, is its model No. 5, which is said to be especially adapted for use in hotels and restaurants where space is at a premium. The machine is 36 in. (0.9 m.) by 18 in. (0.45 m.) and has a capacity of 3000 dishes per hour. The motor used is rated at ¾ hp. and is connected to the paddles in the cast-iron tank by belt drive. In operating the washer, dishes are placed in a basket which is lowered by a traveling crane into the hot washing water agitated by the electrically driven paddles or propellers. After a few seconds in this water the basket of dishes is raised and then lowered for a similar period into the second compartment of the tank, which contains the rinsing water. The basket is then raised and allowed to stand a few seconds while the dishes dry, thus making wiping unnecessary.

Automatic Farm Power and Lighting Plant

The "Alco" farm lighting and power plant, which uses a battery only for starting purposes and which generates 110 volts, has been placed upon the market by the Automatic Light Company of Minneapolis, Minn. The unit is compact, light in weight and automatic in its operation.

An advantage claimed for the plant is that not only does the standard 110-voltage permit distribution at nominal loss for longer distances than with low-voltage systems, but lamps, motors and other appliance, being for standard voltage, cost less than if the plant had a different voltage; they can also be repaired with greater ease. Eliminating a storage battery means lower first cost and lower plant upkeep expense, says the manufacturer.

The single-cylinder, four-cycle, valve-in-the-head engine used, which operates on gasoline, is water-cooled by a



COMPACT AND USING A BATTERY ONLY FOR STARTING

percolator system said to require only 4 gal. of water and to keep the cylinder temperature between 230 deg. and 240 deg. Fahr. (110 deg. to 115 deg. C.) A specially designed General Electric

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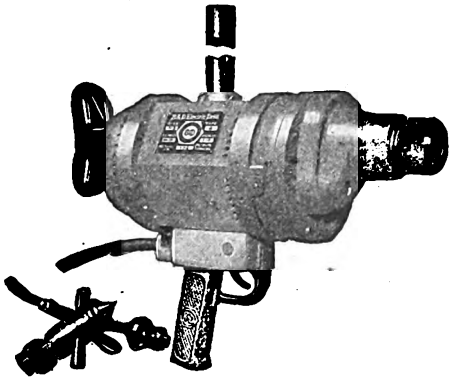
generator is used, having a 110-volt winding on its light and power end and 7½ volts on the other end, which is used as a motor in starting the plant from a standard 6-volt starting battery. A relay, two electromagnets and an automatic cut-out to protect the starting battery should the gasoline tank be empty are provided.

When the switch controlling a light or appliance connected to the plant is turned on the circuit of the relay is closed. This in turn closes the switch on the 6-volt starting motor, which then starts the gasoline engine. When 90 volts have been reached the starting current is cut off and the 110-volt circuit is cut in. This latter operation is reversed when the lamp or power appliance has been turned off, and the plant then stops.

One of the novel features of the "Alco" plant is pointed out by the manufacturer to be the voltage regulation. This is accomplished by an electric solenoid governor which acts directly on the throttle of the carburetor without any intervening cams, levers or springs, opening and closing it to take care of the slightest voltage variations, thus producing a steady, flickerless light direct from the generator. Another feature of the plant is the high overload capacity of the generator.

Portable Light-Weight Drill

A new-size drill has been added to the line of portable electric drills made with pistol grips and trigger switches

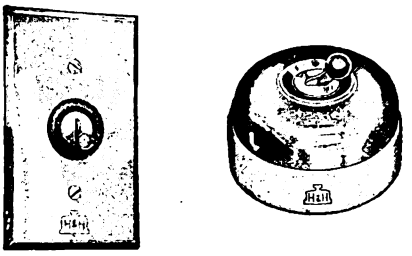


EASY CONTROL PROVIDED BY PISTOL GRIP AND TRIGGER SWITCH

by the Black & Decker Manufacturing Company of Baltimore, Md. The removable taper socket with which this drill is equipped makes it possible to use taper shank drills up to ⅞ in. (2.2 cm.) in diameter. Weighing but 27 lb. (12.2 kg.), the drill is 5¼ in. (13.3 cm.) in width, 17 in. (43 cm.) long and has an offset spindle 2⅜ in. (6 cm.) from the spindle's center to the edge of the frame. A maximum output of ½ hp. is delivered by a light-weight, series-compensated motor, which has a plug for lamp-socket insertion. Because of its light weight and automatic control the makers claim for this drill adaptability to a wide variety of work.

Flush and Surface Tumbler Switches

Handles and covers of surface switches frequently drop off or are maliciously removed, causing considerable



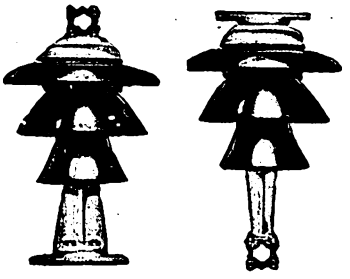
INSULATING RING ON FLUSH TYPE PROVIDES ADDED INSULATION

annoyance and inconvenience. The new surface-type tumbler switches being made by the Hart & Hegeman Manufacturing Company of Hartford, Conn., are designed to eliminate trouble of this nature. The arching shape of the cover helps to protect the mechanism from injury as well as adding to the attractive appearance of the switch.

The maker suggests that this switch will be particularly suitable for installation in manufacturing plants where severe usage is frequently encountered. Two styles of cover plates are furnished for the new flush-type tumbler switches also being marketed by this company. One has ornamental embossing around the center, while the other has a center ring, furnishing additional insulation for the plate. These switches are supplied in single-pole or three-way types with ratings of 3 amp., 250 volts, or 5 amp., 125 volts, and 5 amp., 125 volts, or 10 amp., 125 volts. Polished brass is the standard cover finish used on the surface type and on the flush style brushed brass is supplied.

Unit-Type Outdoor Busbar and Wiring Supports

Interchangeable unit-type supports for outdoor substations making use of high-tension buses have just been de-



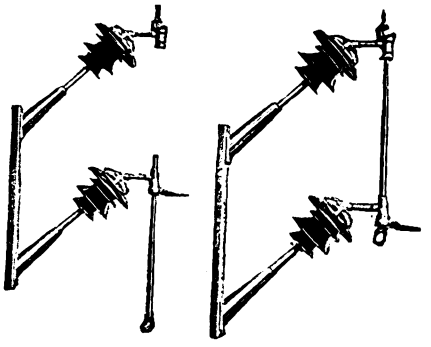
FOR UPRIGHT OR SUSPENDED BUSBARS

veloped by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. These supports are adjustable for top and bottom fastening and enable the conductors to be run at any desired angle. In one size of these supports two slots are provided for ½-in. (1.3-cm.) bolts, permitting a minimum distance of 5⅛ in. (13 cm.) and a maximum of 5⅜ in. (13.6 cm.) between them. In a larger size the holes for ⅝-in. (1.6-cm.) bolts are spaced 6½ in. (16.5 cm.) apart.

Outdoor-Type High-Voltage Disconnecting Switch

A plunger-type outdoor disconnecting switch for high voltages and designed for great rigidity with little weight has recently been placed upon the market by Hickey & Schneider of Elizabeth, N. J. Being of the plunger type, the switch is easily operated, a hook inserted into an eye at the lower end of the plunger pulling the latter down into the open position, while to close the switch the plunger is simply pushed up. An automatic lock is used to hold the switch securely in closed position.

A notable feature claimed by the manufacturers is the complete protection from the weather afforded to the contact parts. Any sleet that may form on the plunger while the switch is in an open position will be shaved



SLEET IS SHAVED OFF BEFORE PLUNGER ENGAGES CONTACTS

off when the plunger passes through the neck of the upper contact bell so that it is perfectly clean when engaging the contacts situated in the upper part of the bell. Since the contacts in the upper and lower bells are self-aligning, a perfect electrical contact is said to be always assured.

The insulators are mounted at an angle of 45 deg. to the vertical, thus putting them in the nearest position to the correct vertical one. This outdoor switch is built for all voltages, while in the style for indoor service the post-type insulators are mounted at an angle of 90 deg. to the vertical.

Notice to Manufacturers

The "Electrical World" is living up to the letter of the Post Office Department ruling outlined on the New Apparatus page of the issue of Nov. 16. Manufacturers must do their part by sending descriptions of new products in advance of date of general publicity.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A representative of a French syndicate (No. 27,817), who is at present in this country, desires to purchase and secure an agency for electrical apparatus and supplies.

A man in Canada (No. 27,833) desires to represent manufacturers of electrical specialties.

A commercial agent in New Zealand (No. 27,845) desires to secure the representation of manufacturers and exporters for the sale of electric torches and batteries.

A man in England of Belgian descent (No. 27,865) wishes to obtain an agency for the sale of gas and electric fittings and motors throughout Belgium.

Agencies (27,868) are desired from American manufacturers and exporters for the sale in France of electrical material, steam fittings, etc.

There is a shortage of electrical supplies in Norway, it is reported by Consul Ralph C. Busser, Bergen, Norway, as imports from Germany, Great Britain and the United States have not yet been resumed and there are difficulties in importing them from Sweden. The domestic industry is hampered by lack of raw materials, fittings, etc. During the past six months prices of general electric supplies have advanced 30 to 40 per cent, and of luxuries such as electric chandeliers up to 70 per cent.

A man in Italy (No. 27,903) desires to purchase and secure an exclusive agency for the sale of incandescent-lamp bulbs with screw mountings. Quotations to be made f.o.b. New York, cash (United States currency) against documents; English correspondence.

A man in Italy (No. 27,888) desires to purchase nitrogen lamps for medical light and heat baths and metals of high electric resistance. Correspondence should be in Italian.

A new firm (No. 27,859), recently established by two government officials in Italy, desires to secure an agency on commission for the sale, among other things, of electrical machinery and apparatus.

GROWTH OF ROBBINS & MYERS.—Four years ago last month, on Dec. 12, 1914, the Robbins & Myers Company, Springfield, Ohio, was almost wiped out by fire. Since that time the company has grown very rapidly, the number of employees increasing from 1000 to three times that number. New and modern buildings have replaced those destroyed.

THE LYONS SAMPLE FAIR OF 1919.—In view of present conditions American participation in the fourth international sample fair, which is to be held at Lyons, France, from March 1 to 15, 1919, becomes increasingly desirable and important. The Department of State has allotted to the American consul at Lyons $1,000 for the rental of space at the fair for the display of American goods and catalogs, following a precedent established in recent years. As a result three ways are open to manufacturers and exporters of the United States in which to exhibit at this fair: (1) A stand or several stands may be rented. The area of each stand is about 20 sq.yd., and the rental for the duration of the fair is 600 francs ($116 at normal exchange); (2) samples may be exhibited in the official consulate stand on payment of a fee to the fair committee of $25 for the privilege, or (3) catalogs may be shown in the consular stand free of charge. The consul and his staff will endeavor to give the widest publicity to these catalogs. Each prospective exhibitor is required to fill out and sign an entry form, a copy of which may be obtained from the Bureau of Foreign and Domestic Commerce at Washington. Under no circumstances will any exhibits be shown unless the necessary forms are signed. Manufacturers and exporters desiring to exhibit under plan (1) above should write at once to the Comité de la Foire, Hotel de Ville, Lyons, France, giving complete information as to the character of their exhibit and inclosing the necessary fee for the stand or stands engaged. If, on the other hand, a manufacturer desires to be represented by catalog or sample in the consular stand under plan (2) or (3), this fact should be immediately communicated to the American consul at Lyons, France, and, if samples are to be exhibited, the necessary fee sent him.

V. I. SMART, formerly professor of railway engineering and transportation at McGill University, Montreal, and J. A. Burnett, formerly electrical engineer with the Grand Trunk Railway system, are now associated as consulting engineers at the New Birks Building, Montreal. The lines handled will be civil, electrical and mechanical, engineering.

THE BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY at a meeting held on Nov. 20 voted to increase the capital stock by $25,000,000, $5,000,000 of which will be issued at the present time and perhaps another $5,000,000 within a year. The formation of subsidiary undertakings at home and abroad was proposed. The increase in capital is necessary for developing the business. There are certain experimental works that will take large sums, it is understood.

THE FULLER ENGINEERING COMPANY, designing and constructing engineers, Allentown National Bank Building, Allentown, Pa., announces that Frederick A. Scheffler, formerly connected with the New York offices of the Babcock & Wilcox Company, has now become associated with it and will make his headquarters at its New York office, 50 Church Street. The Fuller Engineering Company is making a speciality of applying the pulverized-coal method of firing to boilers of all kinds for generating power, and Mr. Scheffler will be in a position to furnish complete information regarding the cost of installation, preparation and probable economies obtainable by the adoption of this method of firing coal.

E. S. LINCOLN, INC., of Portland, Me., was enlarged on Jan. 1 and is now known as Lincoln, Hanson & Abbott, Inc. The two new partners were formerly with the Moulton Engineering Corporation, which has given up its Portland office, and one of them, Major Abbott, has just returned from service with the engineers in France. The new firm will occupy the same offices but will enlarge the scope of its work so as to cover civil, mechanical, hydraulic and electrochemical engineering in addition to electrical engineering. The firm proposes to go into the business of consulting and designing engineering and management of properties with renewed energy now that the great war is over. The Electrical Standardizing Laboratories will be retained and enlarged, leading to greater activities than have been possible in the past.

LAMP EXPORTS FOR OCTOBER.—Statistics just compiled by the Bureau of Foreign and Domestic Commerce show the exports of electric incandescent lamps during the month of October to have been slightly less than $200,000, as follows: Six arc lamps, valued at $273; 28,388 carbon lamps, valued at $5,758, and 769,657 tungsten lamps, valued at $191,344. Canada, which was the largest receiver of these goods, took practically 10,000 carbon lamps and more than 160,000 tungsten lamps. About 500,000 of the tungsten lamps went to Central and South America. Italy took the greatest number of lamps in Europe, namely, 20,000, all others taking under 1000 lamps. It is interesting to note that roughly 40,000 lamps went to British India and slightly more than 35,000 lamps to the Philippine Islands.

RE-EMPLOYMENT OF MEN DISCHARGED FROM SERVICE.—The Pittsfield Works of the General Electric Company have arranged for the reëmployment of men returning from the service as follows: (1) Those who return from military or naval service and who apply for reinstatement will be placed if possible in positions in the department, office or works that they left in order to enter the service; (2) such reëmployment to be limited to men who have been honorably discharged from military and naval service and, except in special cases, who apply for reëmployment within sixty days from the date of such discharge; (3) those who return direct from military or naval service to the company's employ, without accepting employment elsewhere, will be given credit for continuity of service in the company's employment record, including the length of time spent in military or naval service, as though they had worked continuously for the company during that period; (4) compensation of men so reëmployed shall be the current rate paid to employees engaged in similar work at the date of reëmployment; (5) the reëmployment of men disabled in military service will be directed by committees to be appointed.

Trade Publications

MARINE FIXTURES.—Its line of marine electric fixtures is described in an eighteen-page catalog, No. 15, issued by the Seidler-Miner Company, Detroit, Mich.

RECHARGEABLE DRY BATTERY.—A booklet has been issued by the Stolp Company of 2210 South Park Avenue, Chicago, on the "Maxilife" rechargeable dry battery.

LIGHTING FIXTURES. — The Trop Specialties Company, 1834 Broadway, New York City, is distributing a folder about its "Tropiolite" and "Deadlite" lighting units.

DRY BATTERY.—The Standard No. 6 dry battery marketed by the Williamson Electric Company, 696 Jamaica Avenue, Brooklyn, N. Y., is described in a recently prepared folder.

CABLE FAULT FINDER.—A four-page circular about their cable fault-finding apparatus, which uses a high potential and high frequency discharge, has been printed by Norman Stell & Company, Bradford, England.

DISHWASHER.—Four models of the "Victor" motor-driven dishwashing machines are described in an illustrated four-page circular from Louis A. Haustetter, Locust Avenue and East Sixteenth Street, Brooklyn, N. Y.

METERS.—"The Esterline Graphic," issued by the Esterline Company of Indianapolis, contains general announcements on type MS graphic recording instruments, type MS portable graphic recording power-factor meters and type W duplex indicating instruments.

ENGINE.—Bulletin 34-W issued by the Chicago Pneumatic Tool Company, Fisher Building, Chicago, deals with the "Giant" semi-Diesel engines. Low fuel oil may be used in these engines, which are of the horizontal type, use a cross-head and have a hot plate instead of a hot ball or electric ignition for starting purposes.

New Incorporations

THE NICHOLS ELECTRIC COMPANY of Bennington, Vt., has been chartered with a capital stock of $5,000 by William H. Inez, M. R. Nichols, Whitney Nichols and E. H. Holden of Bennington.

THE CENTRAL CONDUIT COMPANY of Wilmington, Del., has been incorporated by M. L. Horty, J. D. Frock and M. A. Denver of Wilmington, Del. The company is capitalized at $100,000, and proposes to build and lay conduits.

THE ONTARIO ELECTRIC STEEL COMPANY of Fulton, N. Y., has been chartered with a capital stock of $1,000,000. The directors are: Carl Ehlermann, Jr., Donald R. Abbiott and Frederick W. Jockel, all of 61 William Street, New York.

THE RENEW ELECTRIC LAMP COMPANY, of Wilmington, Del., has been incorporated by C. B. Bishop, A. M. Fox and S. H. Baynard, Jr., of Wilmington, Del. The company is capitalized at $100,000, and proposes to manufacture electric lighting devices and to operate electric light plants.

THE WOOLFOLK ENGINEERING & SUPPLY COMPANY of Rutherford, N. J., has been incorporated by Edward G. Woolfolk and Frances A. Woolfolk of Rutherford and Edward G. Woolfolk, Jr., of New York. The company is capitalized at $125,000, and proposes to do a general contracting business.

THE TITAN FURNACE COMPANY of Buffalo, N. Y., has been incorporated with a capital stock of $100,000 to construct boilers, furnace, heating and power plants. The incorporators are: M. W. Comstock, 39 Erie Street; G. S. Kent, 85 Winslow Avenue, Buffalo, and F. F. Williams, 904 D. S. Morgan Building, Buffalo, N. Y.

THE NIAGARA-FRENCH BATTERY COMPANY, 161 Ogden Street, Newark, N. J., has been incorporated with a capital stock of $125,000 to manufacture electrical batteries, appliances and novelties. The incorporators are: Herbert M. Lloyd, 24 Lloyd Road, Montclair; Raymond E. Cook, 419 West 115th Street, New York, N. Y., and Ransom Noble, 304 West Seventy-seventh Street, New York.

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New England States

RUTLAND, VT.—The boiler plant and electrical department of the Rauber Rytenburg Shirt Company was recently destroyed by fire, causing a loss of about $25,000.

NATICK, MASS.—Work has begun on the construction of an automobile factory for the Northway Motors Corporation in Natick. The building will be one story, 200 ft. by 600 ft.

PEABODY, MASS.—The Hunt & Rankin Leather Company is building a power plant, 50 ft. by 50 ft., one story, at its plant in Peabody.

WATERBURY, CONN.—The Waterbury & Bristol Tramway Company is contemplating extending its electric railway from South Street, Bristol, over Wolcott Street and through Wolcott, connecting with the car line from Waterbury to Hotchkiss Lake. For further information address J. H. Cassidy, 144 Bank Street, Waterbury.

Middle Atlantic States

BLACK RIVER, N. Y.—Temporary electrical service, pending the installation of new electrical equipment at the local plant, operated under the auspices of the St. Regis Paper Company, is being furnished by the Northern New York Utilities, Inc., of Watertown, in Black River and vicinity.

BROOKLYN, N. Y.—The Department of Water Supply, Gas and Electricity will take over the lighting in Borough Park Heights. Electric lamps of 400 cp. will be erected on several streets.

BROOKLYN, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 13, under Specification 3599, for elevator and dumbwaiter in building D at the Brooklyn Navy Yard. The cost is estimated at $3,500.

BUFFALO, N. Y.—The Perfect Fuse Company has increased its capital stock from $100,000 to $200,000, the proceeds to be used for extensions. The company manufactures fuses and kindred specialties.

BUFFALO, N. Y.—Work has begun on the construction of an addition to the boiler plant of the Pierce Arrow Car Company, 1695 Elmwood Avenue, to cost about $300,000. The Stone & Webster Company, Electric Building, has charge of the work.

BUFFALO, N. Y.—Plans are under consideration by the Marine Elevator Company, Chamber of Commerce Building, for the construction of a new electrically operated grain elevator at the foot of Childs Street. An electric power plant will be erected in connection with the project. The cost of the entire plant is estimated at $1,000,000.

CLEVELAND, N. Y.—The engine department at the power plant of E. Moreness & Company and a section of the factory was destroyed by fire recently, causing a loss of about $15,000. The company manufactures thermometers.

ITHACA, N. Y.—The electric power plant of the Ithaca Traction Company was destroyed by fire on Dec. 20, causing a loss of about $75,000. The plant has supplied electricity for operating the railway system and for local lighting service, and will be rebuilt immediately.

NEW HAMPTON, N. Y.—Arrangements are being made by the Department of Corrections, Municipal Building, New York City, for the construction of a new power house at the New York City Reformatory in New Hampton.

NEW YORK, N. Y.—The capital stock of the Reliance Electric Inspection Company, 241 West Twentieth Street, has been increased from $5,000 to $50,000, the proceeds to be used for expansion.

NEW YORK, N. Y.—Plans have been completed by M. Groh's Sons, Inc., 238 West Twenty-eighth Street, for the erection of a ten-story cold-storage plant at 245-51 West Twenty-seventh Street, to cost about $250,000.

NIAGARA FALLS, N. Y.—The Niagara Falls Power Company is building a new three-story substation, 100 ft. by 158 ft., to cost about $35,000.

RICHMONDVILLE, N. Y.—At an election held recently the proposal to raise an additional $5,000 to complete the electric lighting plant was carried.

SONYEA, N. Y.—Bids will be received by Percy L. Lang, president of board of managers, Craig Colony for Epileptics, Sonyea, until Jan. 14, for construction of dining room and kitchen buildings, West Group, Craig Colony for Epileptics, including heating, plumbing and electric work. Drawings, specifications and blank forms may be consulted at the above institution at Sonyea, at the New York Office of the Department of Architecture, 1715 Tribune Building, and at the Department of Architecture, Albany. Lewis F. Pilcher, Capitol, Albany, is state architect.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

UTICA, N. Y.—The installation of new boiler equipment at the Utica State Hospital is reported to be under consideration by the State Hospital Commission.

UTICA, N. Y.—Preliminary plans are being prepared by H. P. Knowles, architect, 52 Vanderbilt Avenue, New York City, for the erection of a hospital for the Masonic Order, 46 West Twenty-fourth Street, New York City, at Utica, to cost between $400,000 and $1,000,000.

VERONA, N. Y.—The Adirondack Electric Power Corporation of Glens Falls has petitioned the Public Service Commission for permission to construct and operate an electric power plant in Verona.

AMPERE, N. J.—Plans are being prepared by the Crocker-Wheeler Company of Ampere for an addition to its boiler room and power house, 40 ft. by 55 ft., known as plant 8-A.

HARRISON, N. J.—The Edison Lamps Works of the General Electric Company, Sussex Street, Harrison, is reported to be considering the erection of a new plant on a site recently acquired at Frelinghuysen and Evergreen Avenues, Newark.

JERSEY CITY, N. J.—Plans are being considered by the City Commission for the construction of a boiler and engine room on the City Hospital grounds.

NEWARK, N. J.—Plans have been prepared by F. A. Phelps, architect, 920 Union Building, for a silk mill, 52 ft. by 213 ft., four stories, and power house, 100 ft. by 120 ft., one story, on Purdy and O'Dell Streets, to cost about $75,000.

NEWARK, N. J.—The Wilson Building at Lawrence and Mechanic Streets, occupied by a number of industrial concerns, was recently destroyed by fire, causing a loss of about $60,000. Among the companies that occupied the building are Felzenberg Brothers, manufacturers of electric and gas fixtures, the Dual Welding Apparatus Company and the American Art Metal Company.

PATERSON, N. J.—Plans are under consideration by the Public Service Electric Company for the installation of new electric lamps in the borough of Prospect Park, replacing a number of installations now in use.

SOMERVILLE, N. J.—The construction of a new electric railway to extend from Somerville to Bernardsville to develop the extensive holdings of the Schwartz-Hermann Steel Works north of Somerville and to open up the country further north is reported to be under consideration. Louis Schwartz, president of the steel company, is reported interested in the project.

BROWNSVILLE, PA.—The boiler plant, machine shop and other buildings, including electric and operating equipment, at the Pike mine of the Diamond Coal Company were recently destroyed by fire, causing a loss of about $50,000.

CORAOPOLIS, PA.—A site of about 25 acres has been acquired in Coraopolis by the Montour Railroad Company of Pittsburgh, a portion of which will be used for the construction of a new car manufacturing plant, including shops, wheel works and other buildings.

HARRISBURG, PA.—The Harrisburg Electric Supply Company, 24 South Second Street, is planning to make alterations and improvements to its building on Chestnut Street near Second Street, to cost about $10,000.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company is contemplating the construction of an addition to its substation, to cost about $12,000.

PHILADELPHIA, PA. — Arrangements have been made by the Electrical Bureau for extending its conduit service during the coming year. With a return to peace conditions the proposed program to complete the large power plant at the City Hall will probably be carried out.

WEATHERLY, PA.—Arrangements are being made by the Weatherly Electric Light Company to furnish additional service to the Weatherly Steel Company, which is increasing the capacity of its plant. Electrically operated machinery will be installed.

ELKTON, MD.—Plans are under consideration by the Scott Fertilizer Company for rebuilding its local plant, recently destroyed by fire. The loss, including machinery and equipment, is estimated at about $250,000.

BRISTOL, VA.-TENN.—The power house of the Bristol Gas & Electric Company was destroyed by fire on Dec. 29.

RICHMOND, VA.—The construction of a hydroelectric power plant in connection with a flour mill near Richmond is reported to be under consideration by the Shenandoah Milling Company, to cost about $350,000. Alfred M. Quick, Munsey Building, Baltimore, Md., is engineer.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 13, for construction of building and installing mechanical equipment and furnishing material for hygienic laboratory at Washington.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Eastern and Western yards, Schedule 3637—165,000 batteries for flashlights and 39,000 flashlights. F.o.b. works, Schedule 7600½—ventilating fans and spares; Schedule 7632½—fire airplane radio transmitting equipments. North Charleston, Schedule 3634½—three air-compressors. Norfolk and Brooklyn, Schedule 7608½—five electric ranges. Mare Island, Schedule 7619½—5000 ft. portable cable. Philadelphia, Schedule 7625½—ten non-synchronous rotary spark gaps. Newport News, Va., and Camden, N. J., and also Washington, D. C., Schedule 7630½—miscellaneous electrical auxiliary gear-elevating equipment. Applications for proposal blanks should designate the schedule desired by number.

North Central States

BESSEMER, MICH.—Bids will be received about Feb. 1 by the Board of Education, Bessemer, for construction of school building and power house, to cost about $125,000. C. Anderson of Ironwood is architect.

DETROIT, MICH.—Plans are being prepared for the erection of an eight-story addition, 75 ft. by 100 ft., to the plant of Frederick Stearns & Company at Jefferson and Bellevue Avenue, to cost about $200,000.

DETROIT, MICH.—The General Motors Company is reported to be considering the erection of a plant to manufacture electric lighting and starting systems in Detroit. The company is also contemplating establishing a plant for producing a low-priced truck.

DETROIT, MICH.—Bids will be received by the Board of Education, 50 Broadway, until Jan. 9, for the construction of a school building on Emerson Avenue, south of Jefferson Avenue, to cost about $275,000. Malcolmson & Higginbotham, 404 Moffat Building, are architects.

JACKSON, MICH.—Arrangements have been made by the Consumers' Power Company for a bond issue of $5,334,000, the proceeds to be used for current operation, including extensions and betterments. The company operates plants at Grand Rapids, Saginaw, Kalamazoo, Battle Creek, Lansing, Cadillac, and other places in the State of Michigan.

BUCYRUS, OHIO.—The Ohio Gas & Electric Company of Middletown is reported to be considering the erection of a high-tension transmission line from its plant at the falls of the Sandusky River at Ballville through Crestline to supply electricity to the Pennsylvania Railroad shops and thence west to Bucyrus. Investigations are being made here by the company with a view of supplying electricity for street lighting as well as for industrial plants in Bucyrus. The present street-lighting contract expires next June.

COLUMBUS, OHIO.—Bids will be received at Columbus, Ohio, until Jan. 6, for remodeling Memorial Building, including lamps, fixtures, switchboard, theater dimmers, and new fixtures and lamps. For further information address W. J. Herman, clerk of county board.

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LIMA, OHIO.—Plans for establishing an electric plant in Lima are under consideration by the city officials. The city has a bond issue of $56,808, authorized by a vote of the electors ten years ago for a lighting plant. It is believed by connecting the station with the municipal waterworks, where two generators are already in use, an expenditure of only about $100,000 would be necessary.

PIQUA, OHIO.—Preliminary steps have been taken by the City Council toward the installation of an ornamental street-lighting system as proposed by the Dayton Power & Light Company a year ago. The company has been authorized to begin work on Main Street from the Pennsylvania Railroad north to Green Street.

SANDUSKY, OHIO.—The original plans for improvements in the boiler plant of the Sandusky Gas & Electric Company have been revised to accommodate an additional 400-hp. boiler, which will be installed at once.

SANDUSKY, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 23, for wiring and lighting in the United States custom house and post office at Sandusky, Ohio. For details see Searchlight Section.

TOLEDO, OHIO.—The Standard Steel Tube Company, Fitchland Avenue and Detroit & Michigan Central Railroad, has purchased a site on South Detroit Avenue on which it proposes to erect a plant to cost about $500,000.

TOLEDO, OHIO.—The S. S. Royster Guano Company, Second National Bank Building, has purchased property adjoining its plant, on which, it is understood, it proposes to erect a sulphuric acid plant, at a cost of about $500,000.

WARREN, OHIO.—The Public Utilities Commission has granted the Trumbull Public Service Company permission to issue $1,200,000 in notes, the proceeds to be used for current expenses, general expansion and for reimbursements for improvements.

WELLSVILLE, OHIO.—Plans are under consideration by the Pennsylvania Lines West of Pittsburgh for the construction of new locomotive and car shops and new yard facilities at Wellsville, to cost more than $1,000,000.

JEFF, KY. — The Acup Creek Coal Company, recently organized, proposes to develop about 2000 acres of coal land. Electrically operated machinery will be installed. The proposed equipment will include two return tubular boilers, one 150-kw., 250-volt direct-current generating unit, directly connected; one 150-kw., 250-volt direct-current generator connected to a 225-kva., three-phase, 60-cycle, 2300-volt motor; 1100 ft. 1⅛ P. S. rope, and 00 Fig. 8 trolley wire. Arthur L. Ware is president.

LOUISVILLE, KY.—Tuck & Company, 1113 West Main Street, are contemplating the installation of additional equipment in their power plant.

LOUISVILLE, KY. — The Louisville Board of Public Works in its annual report to Mayor Smith and the Council recommends that the city establish a municipal lighting plant to be operated in conjunction with the Louisville Water Company. The city is now paying the Louisville Gas & Electric Company $200,000 per year, and when lamps are furnished in additional territory just taken in the rate will be about $250,000 per year. It also recommends that lamp standards replace arc lamps on Broadway from Shawnee Park to Cherokee Park.

WHITCO, KY.—The Whitesburg Coal Company is contemplating the installation of new electrically operated machinery at its local properties.

KOKOMO, IND.—F. T. Morrissey, engineer, care of Indiana Railway & Lighting Company, Kokomo, is reported to be interested in a water power development.

AURORA, ILL. — Extensive improvements, it is reported, are contemplated by the Western United Gas & Electric Company.

CHICAGO, ILL.—Plans have been prepared by A. S. Alschuler, architect, 28 East Jackson Street, for the construction of an eight-story factory building, 150 ft. by 200 ft., on Harrison and Pauline Streets, for the Philipsborn Outer Garment Company, 900 West Van Buren Street. The cost is estimated at about $1,250,000.

ROCKFORD, ILL.—The Rockford City Traction Company is reported to be contemplating laying a double track on Seventh Street, between Third and Eleventh Avenue. The cost is estimated at $39,000.

WAUKEGAN, ILL.—The North Shore Electric Company is contemplating extending its lines to Greenwood Avenue.

EAU CLAIRE, WIS. — The Chippewa Power Company of Eau Claire, recently incorporated with a capital stock of $200,000, is planning to develop a water-power site on the Chippewa River, and to construct a hydroelectric power plant north of Eau Claire.

EAU CLAIRE, WIS.—Contract (general) has been awarded by the Dells Paper & Pulp Company of Eau Claire for the construction of a new paper mill and power plant, to A. Larson & Company, 414 Main Street. The cost is estimated at $125,000. Plans were prepared by L. A. DeGuere of Grand Rapids, consulting engineer, who is purchasing power-plant equipment and paper-mill machinery. W. L. Davis, Sr., is president.

KAUKAUNA, WIS.—Plans have been prepared by W. B. Montgomery, engineer of Montgomery, for remodeling dam and for other improvements for the Green Bay & Mississippi Canal Company. The installation of new generator, waterwheels, gates, sluiceway, etc., is included in plans.

MARSHFIELD, WIS.—Plans have been completed by Childs & Smith, architects, People's Gas Building, Chicago, for the construction of the first unit of a new central continuation school. Bids will be asked by the Board of Industrial Education of Marshfield soon after Jan. 1. The cost of the building is estimated at $75,000. P. J. Kraus is secretary of the board.

MILWAUKEE, WIS.—The Standard Oil Company, Brumder Building, it is understood, will ask for bids in the spring for the construction of a garage on Thirty-second Street, and also a distributing station on Barclay Street, to cost $50,000 and $150,000 respectively. Schlinz & Bailey, 53 West Jackson Boulevard, Chicago, Ill., are engineers.

SHEBOYGAN, WIS.—Plans are being prepared by W. C. Weeks, architect, Sheboygan, for the construction of a telephone exchange for the Citizens' Telephone Company.

ROCHESTER, MINN.—A special election will soon be held to vote on the proposal to issue $300,000 in bonds for the construction of a new municipal electric light plant.

ST. PAUL, MINN.—Plans have been prepared by L. Bassindale, architect, Capital Bank Building, St. Paul, for the construction of a hospital building for the Cobb Hospital Association, to cost about $400,000.

CEDAR RAPIDS, IOWA.—The Iowa Electric Company of Cedar Rapids will soon complete its high-tension line connecting the hydroelectric plant at Anamosa with the steam generating plant at Maquokato. This line will serve the various systems of the company in eastern Iowa.

EXCELSIOR SPRINGS, MO.—The Excelsior Springs Light & Power Company is considering extending its electrical service to the towns of Holt, Kearney, Lawson, Polo and other towns in this section.

ST. LOUIS, MO.—Contracts will soon be awarded by the Christian Brothers College for the erection of a college building on Clayton Road, to cost about $200,000. H. P. Hess, 4811 Côte Brillante Avenue, is architect.

SPRINGFIELD, MO.—Plans are reported to be under consideration for an annex to the power plant at the Frisco Railroad shops for the Springfield Gas & Electric Company.

MUNICH, N. D.—Bonds to the amount of $3,500 for the installation of an electric lighting system have been authorized.

VOLIN, S. D.—The installation of electric light and water systems are under consideration, and bonds have been voted for them.

COLONY, KAN.—The Colony Electric Light Company, recently organized, is planning to install an electric plant here. Equipment for the power house, including a Fairbanks-Morse 25-hp. engine and a 15-kw. generator, has been purchased. The plant, it is expected, will be in operation within thirty days.

Southern States

LUMBERTON, N. C. — The Lumberton Fiber Company is considering the completion of a fiber mill to be equipped with electrically operated machinery. F. M. Huggins is manager.

SAVANNAH, GA.—Work has begun on the construction of a new electric power plant at the shipbuilding works of the Foundation Company at Savannah.

SAVANNAH, GA.—The City Council has approved the petition of the Savannah Electric Company to erect a new electric transmission line west of the city to supply energy to industries in that vicinity.

EAU GALLIE, FLA.—Steps have been taken to organize a company, to be known as the Eau Gallie Utilities Company, to establish an electric plant here. The company will be capitalized at $30,000. F. D. Fant of Savannah will be president of the company.

MEMPHIS, TENN.—The County Commissioners are considering the installation of a lighting plant at the court house to supply electricity for lighting the building and operating the elevators. The cost is estimated at about $12,000.

KNOXVILLE, TENN.—Plans, it is reported, are being prepared by Miller, Fullenwider & Dowling, 6 North Michigan Avenue, Chicago, Ill., for the erection of a gymnasium, to cost $170,000, for the University of Tennessee. The construction of an administration building, to cost $500,000, and an armory, to cost $150,000, at the university is also under consideration.

PASCAGOULA, MISS.—The construction of a new power plant is reported to be under consideration by the Pascagoula Street Railway & Power Company.

BENTON, ARK.—An ordinance creating an electric light improvement district has been passed by the City Council. As soon as possible the local plant will be taken over by the municipality.

LEVY, ARK.—Arrangements have been completed by the City Council for the installation of a new lighting system.

MUSKOGEE, OKLA.—Plans, it is reported have been completed for the construction of an electric railway to connect Muskogee, Oklahoma City and Tulsa, to cost approximately $10,000,000. All surveys have been made and the project financed, and the promoters, it is said, are waiting for more normal conditions. R. D. Long and Edgar Graham, both of Muskogee, are interested in the project.

OKMULGEE, OKLA.—Preparations are being made by the Okmulgee Ice & Light for extensions to its electric and ice plants, including the installation of a 1250-kva. turbo-generator and a 50-ton ice plant with two 400-hp. boilers, stack, etc. Most of the equipment, it is understood, is purchased.

TISHOMINGO, OKLA.—Plans, it is reported, are under consideration for the construction of a new electric light plant in Tishomingo, to cost about $18,000.

CISCO, TEX.—The Cisco Gas & Electric Company, it is reported, is contemplating the reconstruction of its buildings, including power and ice plants. The company is controlled by the American Public Service Company of Chicago, Ill.

FORT WORTH, TEX.—The Gulf Well Machinery & Manufacturing Company, it is reported, is considering the construction of a power plant in connection with its proposed new works, which will include machine shop, pattern shop, forge shop, foundry and other buildings.

FORT SCOTT, KAN.—The sale of the property of the Fort Scott Gas & Electric Company on Jan. 18 has been announced by Judge E. C. Gates.

HOUSTON, TEX.—Bids will be received by E. E. Sands, city engineer, until Jan. 10, for improvements to waterworks system, including seven deep wells, deep-well pumps, motor and electric generators.

SHINER, TEX.—The City Council, it is reported, has decided to lease the electric light plant. The city will retain the control of the water system and will secure energy from the lessee of the electric plant to operate the water system and to light the streets.

Pacific and Mountain States

BREMERTON, WASH.—At an election held recently the proposal to issue bonds for the installation of a new electric lighting system was defeated.

TWISP, WASH.—The Twisp Roller Mills & Power Company, recently incorporated, it is reported, will operate an electric plant in this vicinity. The company is capitalized at $30,000. H. C. Lewis and J. M. Pate are interested in the company.

LOMPOC, CAL.—The City Council has passed an ordinance granting the Santa Barbara Telephone Company permission to erect and operate poles and wires, etc., for the transmission of electricity, and for telephone and telegraph purposes in Lompoc.

PLACERVILLE, CAL. — The Western States Gas & Electric Company is considering a petition to extend its electric service to Diamond Springs. The company also contemplates considerable extension to its service in El Dorado County during the coming year. Twin Lakes and other power stations are under construction.

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SAN DIEGO, CAL.—The San Diego Electric Railway Company has begun work on the construction of an extension of its system to the local shipbuilding plant. The cost of the work is estimated at $50,000.

TRACY, CAL.—Plans are under consideration for the installation of electroliers along Central Avenue and the business section of Sixth Street. Electrical service is supplied by the Sierra & San Francisco Power Company of San Francisco.

CASPER, WYO.—At a meeting of the citizens held recently, a committee was appointed to submit a proposal to the City Council for the construction or purchase of a municipal lighting plant.

CASA GRANDE, ARIZ.—Plans are under consideration for establishing an electric power plant in Casa Grande.

BOULDER, COL.—The Cities' Service Company has purchased the control of the Western Light & Power Company, which operates in Boulder, Berthound, Fort Collins, Windsor, Superior, Loveland, Greeley, Louisville, Lafayette and other points in Northern Colorado. Improvements involving an expenditure of over $1,000,000, it is understood, are contemplated.

Canada

ROSSLAND, B. C.—The West Kootneay Power & Light Company is erecting a high-tension transmission line from its power station at Bonnington Falls to Northport and Princeton via Trail. The cost of the line is estimated at $1,000,000, and it will furnish electricity to smelting companies at Northport, Wash., and Princeton, B. C.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom, 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla. Annual meeting, Jacksonville, Jan. 5.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), Henry J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Detroit, Mich.

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MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, L. D. Gordon, Jackson Light & Traction Co., Jackson, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, H. C. Brown, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M. Annual meeting, Albuquerque, N. M., Feb. 17-19.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary H. A. Lane, 611 State National Bank Building, Oklahoma City. Annual meeting, Feb. 13, 14 and 15, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Annual meeting, Chicago, Jan. 28-30.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill. Annual meeting, Chicago, January.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, March 25-27.

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(Issued Nov. 26, 1918)

1,285,806. METAL-VAPOR RECTIFIER AND SIMILAR APPARATUS; Bela Schaefer, Frankfort-on-the-Main, Germany. App. filed July 23, 1912. To provide in connection with the vacuum chamber a simple and efficient externally situated cooling or condensing chamber or chambers.

1,285,809. ELECTRIC MOTOR AND TRANSMISSION SYSTEM FOR LOCOMOTIVES AND OTHER PURPOSES; S. S. Seyfert. App. filed Feb. 2, 1914. Permitting field and armature, or primary and secondary members of motor, to rotate in opposite directions, greatly increasing their relative speeds.

1,285,831. GALVANIC CELL; Howard A. Stofflet, Reading, Pa. App. filed Nov. 22, 1916. For primary batteries.

1,285,840. ATTACHMENT PLUG; George B. Thomas, Bridgeport, Conn. App. filed Dec. 6, 1915. Having an associated pilot light for indicating the condition of the plug circuit.

1,285,874. DYNAMO BRUSH HOLDER; Joseph L. Woodbridge, Philadelphia, Pa. App. filed Oct. 29, 1915. To eliminate any tendency to rock the brush or produce unequal pressure at different parts of the contact surface.

1,285,875. ELECTROPLATING DEVICE; John E. Woodbury, Worcester, Mass. App. filed March 29, 1918. Designed particularly for repairing copper-printing plates.

1,285,905. SECONDARY CLOCK; Lawrence O. Beard, Lancaster, Pa. App. filed March 7, 1917. Relates particularly to such as employ mechanism controlled and actuated by electromagnetic means.

1,285,911. ELECTRICAL MEASURING INSTRUMENT; Clarence A. Boddie, Pittsburgh, and William M. Bradshaw, Wilkinsburg, Pa. App. filed Sept. 10, 1915. To provide an instrument that is small in dimensions and economical to manufacture and that operates correctly on a wide range of load.

1,285,934. ELECTRIC SIGNAL; Eric O. Carlson, Cleveland, Ohio. App. filed Dec. 29, 1917. Relates especially to single-variation annunciators which close a circuit and actuate a signal when an overload occurs on the line wire or apparatus adjacent.

1,285,940. WIRELESS-TELEGRAPH POLE; Leon Chodakowski, Binghamton, N. Y. App. filed Dec. 22, 1917. Collapsible and for temporary use.

1,285,947. VAPOR-ELECTRIC APPARATUS; Frank Conrad, Swissvale, Pa. App. filed Sept. 18, 1911. Means are provided for preventing short circuits between the positive electrodes and also for preventing the occurrence of arcs between the positive electrodes and the casing.

1,285,962. ELECTRICAL CONNECTOR; Albert F. Esler, Rochester, N. Y. App. filed July 2, 1917. For coupling electrical appliances to a suitable source of supply.

1,285,965. VAPOR-RECTIFIER; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Oct. 31, 1914. Quiet, efficient and stable operation secured in vacuum vapor apparatus by the control of the relative temperatures of the electrodes.

1,285,966. CATHODE STRUCTURE FOR VAPOR CONVERTERS; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Dec. 2, 1915. Condensed cathode material may be cleansed from dirt and returned to a position for active use with little or no disturbance of the normal operation of the apparatus.

1,285,967. SHIELDING APPARATUS FOR VAPOR CONVERTERS; Sidney W. Farnsworth, Pittsburgh, Pa. App. filed Dec. 2, 1915. Arc may be effectively freed from all but current-carrying particles, and short-circuiting, reverse arcing and allied phenomena may be prevented.

1,285,969. TELEPHONE SYSTEM; Frank L. Fisher, Decatur, Ill. App. filed Jan. 24, 1916. Relates to prepay boxes designed for use in automatic signaling.

1,285,970. PREPAY BOX FOR TELEPHONE; Frank L. Fisher, Indianapolis, Ind. App. filed March 22, 1917. Coils control disposition of coin in automatic systems.

1,285,971. HATCHING APPARATUS; Charles S. Forbes, Strathdon, Scotland. App. filed March 8, 1916. Air entering two side compartments flows upward past the heating devices and the water inward over the upper edges of the partitions and down through the eggs, escaping from the intermediate egg compartment below the level of the eggs.

1,285,977. INDUCTIVE HIGH-TENSION TERMINAL; Harry D. Garrettson, New York, N. Y. App. filed May 28, 1918. A corrugated insulator with a bore containing an inductive resistance for protecting the transformer on which it is mounted from electrical troubles.

Record of Electrical Patents

Notes on United States Patents

1,285,986. RAIN ALARM; Russell D. Grafford, Marshall, Mich. App. filed Dec. 14, 1917. Does not operate under light showers.

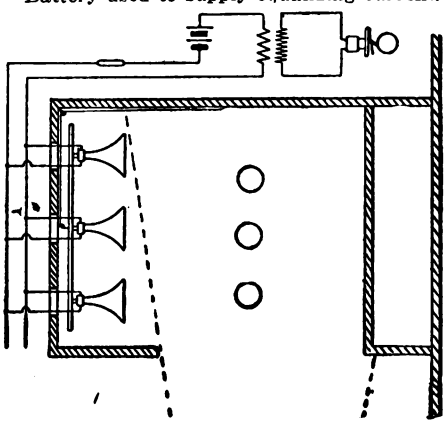
1,286,001. AUTOMATIC SWITCH; Henry A. Hoeschen and William H. Hoeschen, Omaha, Neb. App. filed April 2, 1917. For controlling an electric motor circuit or the like.

1,286,010. SUSPENSION DEVICE; Ray P. Jackson, Edgewood Park, Pa. App. filed Dec. 8, 1915. For insulators; may be readily assembled or separated without the use of tools.

1,286,013. ELECTRIC MOTOR; Harry W. Jeannin, Warren, Ohio. App. filed Sept. 18, 1916. The usual shell or frame is eliminated and the end plates are connected directly with the field.

1,286,030. REINFORCED HARD-RUBBER STRUCTURE; Edwin J. Kroeger, Akron, Ohio. App. filed July 25, 1918. Relates to mode of embedding a suspending plate in the wall of a hard-rubber receptacle, such as a large storage-battery jar.

1,286,034. VIBRATOR; Oscar M. Leich, Genoa, Ill. App. filed May 18, 1916. Battery used to supply equalizing current.



1,286,259—Means for Recording Sounds

1,286,050. RECTIFYING SYSTEM; Friedrich W. Meyer, Pittsburgh, Pa. App. filed March 24, 1915. When current from a plurality of independent circuits is rectified in one evacuated space, the rectifying arcs may be maintained entirely separate and distinct from each other.

1,286,062. METHOD OF ATTACHING FUSE TUBES TO HAND GRENADES OF THIN METAL; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 15, 1918. To make an integral joint between the parts and to avoid burning of metal.

1,286,063. METHOD OF MAKING ELECTRIC FUSES; Thomas E. Murray, New York, N. Y. App. filed Nov. 20, 1917. Fuse ends are plugged with plaster of Paris.

1,286,100. ELECTRIC FURNACE; Bjorn Raeder, Kykkerlsrud, Askim, Norway. App. filed Jan. 22, 1918. To provide means whereby the supply of the slag charge is easily controlled.

1,286,101. CIRCUIT INTERRUPTER; Karl C. Randall, Edgewood Park, and Howard G. McDonald, Murraysville, Pa. App. filed Oct. 21, 1916. To provide a single operating means for a plurality of circuit interrupters that shall be adapted to permit either simultaneous or successive closing and successive opening of the interrupters.

1,286,103. CONTACT SHOE FOR ELECTRIC CRANES; Luther P. Reed, Schenectady, N. Y. App. filed May 9, 1918. To maintain the contact device in proper sliding engagement with the conductor wire.

1,286,130. SUPPLY SYSTEM FOR RAILWAY VEHICLES; Karl A. Simmon, Wilkinsburg, Pa. App. filed Sept. 5, 1916. To eliminate vibration of vehicle.

1,286,131. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed Aug. 14, 1914. To perform automatically many operations now done normally.

1,286,135. APPARATUS FOR SUBJECTING GASES TO THE ACTION OF HEAT AND PRESSURE; Edward E. Somermeier, Englewood, Fla. App. filed April 26, 1917. Heated reaction chamber is inclosed in a strong pressure chamber.

1,286,148. SWITCH MECHANISM; William D. Throop, Norwich, Conn. App. filed May 14, 1917. Minimum amount of effort required to operate the switch, which has no dead center.

1,286,175. IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES; Albert Erickson, Chicago, Ill. Relates to the make-and-break type, wherein the ignition current is supplied by a magneto-generator of the plug oscillatory type.

1,286,180. AUTOMATIC TELEPHONE EXCHANGE; Alexander E. Keith, Hinsdale, and John Erickson and Charles J. Erickson, Chicago, Ill. App. filed May 4, 1903. Enabling the different subscribers of an electrical exchange to call each other by mechanism, preferably automatic, at the central exchange.

1,286,182. STARTING AND LIGHTING APPARATUS; Bennett M. Leece, Cleveland, Ohio. App. filed Dec. 22, 1913. For engine-driven vehicles.

(Issued Dec. 3, 1918)

1,286,207. INSULATOR BRACKET; Paul M. Benedict, New Haven, Conn. App. filed March 8, 1916. To provide means for effectively securing the pin or cob on the bracket.

1,286,221. ELECTRICAL PROTECTIVE DEVICE; Harold W. Brown, Ithaca, N. Y. App. filed March 18, 1914. Relay of the motor type has a large range of speed control. thus allowing either a definite or an inverse time limit in its operation.

1,286,230. ELECTRIC SOLDERING IRON; John G. Clemens, Buffalo, N. Y. App. filed Dec. 5, 1917. Tip is quickly heated by two spaced carbons.

1,286,239. ELECTRICAL PROTECTIVE DEVICE; Almon W. Copeley, Pittsburgh, and Jenjamin H. Smith, Turtle Creek, Pa. App. filed June 30, 1916. A time-limit relay having electrical means for obtaining its time-limit functions.

1,286,242. SOLDERING TOOL; Jasper F. Cullin, Detroit, Mich. App. filed April 4, 1918. Solder contained therein is melted by an electric current passing through the solder.

1,286,243. COMMUTATOR AND HOLDING MEANS THEREFOR; Charles W. Dake, Chicago, Ill. App. filed Sept. 21, 1917. Commutator supported and reinforced so that it will not fly out of position or be distorted under high-speed conditions.

1,286,247. APPARATUS FOR TREATMENT OF MAGNETIC ORE; Edward W. Davis, Minneapolis, Minn. App. filed May 18, 1916. Magnetite ore may be demagnetized and when once classified may be again magnetized and collected.

1,286,259. MEANS FOR RECORDING SOUNDS; Thomas A. Edison, Llewellyn Park, West Orange, N. J. App. filed March 6, 1913. Sound waves collected at a plurality of points are collected and transmitted to a single recording device.

1,286,316. ELECTRIC TRANSLATING APPARATUS; Peter G. Hewitt, Ringwood Manor, N. J. App. filed Oct. 20, 1913. Gas or vapor lamp may be started with a direct current of low voltage.

1,286,351. ELECTRIC SELECTIVE SYSTEM; Howard L. Krum, Chicago, Ill. App. filed May 31, 1910. For printing telegraphs and the like.

1,286,357. SWITCH; Sam G. Langley, Maplewood, N. J. App. filed June 18, 1912. Relates to an automatic switch adapted to act as a relay for apparatus carrying large currents.

1,286,364. RELAY; Harold S. Loomis, Wilkinsburg, Pa. App. filed July 23, 1917. Adapted for use in railway signaling.

1,286,373. METHOD OF AND APPARATUS FOR MAKING ELECTRICAL MEASUREMENTS; Ervan L. McDonald, Salt Lake City, Utah. App. filed May 8, 1914. Relates to an adjustable inductance coil adapted for use in connection with electric circuits connected to alternating or pulsating electromotive forces.

1,286,381. CONNECTING STUD AND BOND TERMINAL; George A. Mead, Mansfield, Ohio. App. filed June 14, 1917. To be secured within a hole in the rails by means of an explosive force within the stud or terminal.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Power Factor in Rates

CONSIDERABLE information has been given in our columns recently on the subject of power factor and on the methods of ascertaining it. Of course, if the power factor is to enter as such into customers' bills it is obviously necessary to get a pretty clear idea of what it is. Perhaps the commonest device thus far is the use of a graphic meter recording power factor, a device somewhat expensive and not always telling all that it is desirable to know, but yet fairly reliable and well enough adapted to rather large consumers. For general purposes of power-factor measurement, however, the situation is not so favorable, and, as we recently suggested, there is some doubt whether power-factor measurement is not a somewhat indirect method of getting at the kva. record. A meter for kilovolt-ampere-hours ought not to be at all a difficult proposition, and certainly an ampere-hour meter would come as near giving a fair average of the situation as any ordinary method of measuring the power factor and then combining this information with that delivered by the ordinary watt-hour meter. A somewhat rough-and-ready periodic power-factor test involves averaging one of the desired factors just as an ampere-hour meter would average another, and year in and year out the two schemes would probably be nearly on all fours. At all events, the time has come when more attention should be paid to this particular problem in metering, for with the rapidly increasing use of motors the situation is steadily growing more unsatisfactory.

Water-power resources are being roll-called for incoming legislatures, and popular interest in real conservation through development of plant and storage facilities is rising fast. Obstructive tactics by politicians cannot dam meritorious projects much longer.

The American Engineer Abroad

BLESSINGS in disguise are not always what they are cracked up to be. That is to say, benefits contingent on previous disasters do not always outweigh them at once or in the near future. Ultimately they may do so, the remoteness of the period being in exact ratio with the gravity of the disaster. In those sections of Europe devastated by the war, for example, it will be generations before the wounds of battle and invasion are healed and the scars forgotten. None the less, the healing will be hastened and the smart assuaged if on the ruins of the old order a better can be reared. Just as flood, fire and earthquake brought respectively a greater Galveston, a better Baltimore and a more splendid San Francisco, so the destruction of war should clear the way for progress in those trampled regions where conservatism formerly held sway.

Here surely is a chance for the American engineer abroad. Where factories have been destroyed, railroads torn up, transmission lines put out of business, machinery converted into junk, every consideration calls for the replacement of the ruined equipment with the best that modern practice can supply. Moreover, the opportunities for improvement and extension of still existing utilities and for starting public works where none have been before will be abundant. Particularly in the electrical field, where—in France and Italy, for instance—great water powers can be made to drive hundreds of industrial plants and illuminate thousands of homes, are the possibilities alluring. The day will come when the European farmer, like his American brother, will demand his electric car, his telephone connection and a tap line from the nearest transmission system to his farmyard and his residence. In the near future all over the civilized world tungsten must replace tallow and invisible energy supplement human exertion. Abroad as well as at home the electrical engineers of the United States have their part to play in speeding the coming day.

The delivery of night letters by mail carriers is a step backward, and the telephone should again be the last link in the time-saving mechanism formerly embodied in this service. Public opinion can compel a return to the efficient service of the past, which ought to be restored at once.

Electric Power in the Antipodes

THE great transmission plant for supplying the growing industrial needs of Tasmania, described in this issue by L. W. Alwyn-Schmidt, gives occasion for strenuous thinking. The average American, if he considers Australia at all, remembers it as a big island somewhere diametrically through the earth from us, or as the abiding place of a ferocious and hard-fighting tribe of Anzacs whom the Hun has learned to detest and fear. To settle down to the realization that it is a continent nearly as big as the United States with a growing population as hustling and independent as our own is an eye-opener to him. Tasmania, that outrider of Australia, is roughly the size of the State of Maine. When Mr. Schmidt casually mentions that a zinc-producing company in Hobart has taken 4000 hp. of transmitted power with an option on 26,000 hp. more one begins to recognize the possibilities of our antipodal kinsfolk.

The plant just completed has its source of supply in

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a lake far among the mountains of the interior, at a level near that of the top of the Adirondacks, where a storage of 50 square miles (260 hectares) has been impounded, sufficient to produce a minimum supply of 70,000 hp. Not the whole of the available head is yet utilized, but the water is taken from the storage lake to a reservoir, whence it drops through the pipe lines over 1100 feet (335 m.) to the power house. The house itself is of corrugated iron on a firmly set steel framework and is divided into two sections, one for the transformers, the other for the generating sets. These latter are at present three in number, of about 5000 hp. each. Power is generated at 6600 volts and stepped up to 88,000 volts for transmission. The transmission line to Hobart is 77.5 miles (124.5 km.) long, though there is an extension of a single circuit 14 miles (22.5 km.) further, and is of the lattice-steel tower type with two three-phase circuits of stranded wire and a grounded cable over all. The receiving station in Hobart is already being doubled in capacity by the addition of a 4000-kva. outdoor substation, and besides the zinc works already referred to, a carbide plant has contracted for 3500 hp. with an option on 6500 hp. more.

This ready access to a large power supply gives a fine opportunity for other enterprises besides the group of comparatively small ones already under way. No small part of the interesting equipment was derived from American sources, English competition being eliminated by war conditions.

Increased consumption of energy for lighting is helping the central station to offset in part the reduction in revenue accompanying the curtailment of war-plant power service. Lengthening days, however, are with us, and the time is ripe for intensive efficiency work in motor applications that save fuel, reduce maintenance cost and cut the expense of executive supervision.

Lessons of a Receivership

IT REQUIRES no particular virtue or wisdom to hammer a company that has just gone into receivership. The Brooklyn Rapid Transit Company was hammered all the way in, and it will likely be hammered for some time to come by those who do not care whether or not they display virtue or wisdom in so doing. We are not here to hammer. It is not a company connected with the central-station industry, but it is one of the several classes of public utilities, and as such its downfall is open to us to draw lessons from. In so doing we may be pardoned if we remind our readers again that conditions in the central-station industry are widely dissimilar from those in the electric railway industry. We do not mean merely the outward conditions, open to him who sees only the surface, but the underlying, the foundation principles of management and methods. You see this difference in such matters as the rate making, the growth of "wholesaling" of power in one industry contrasted with the retailing of single rides in the other, the steady extension of electric service year by year as against, especially in this instance, a great policy of expansion involving hundreds of millions of dollars and transit provisions for say twenty-five or fifty years. But these differences aside for the moment, we claim an interest in the fortunes of the electric railways as of the steam railroads because all utilities operate under somewhat similar laws, they are bound together by many ties of common ownership, they are vitally concerned in the issue of public ownership, of regulation.

Therefore we look to the Brooklyn Rapid Transit Company receivership to see what lessons it carries for the central stations which are seeking to preserve good relations, to maintain good service, to keep the treasury supplied with capital in order that needs for plant enlargement and extension may be met. It appears to us that the first lesson is the danger of staking the financial integrity of the property on a single rigid contract; the second lesson is the danger and weakness of the uniform rate of fare. The contract in this particular case was the franchise arrangement with New York City for a vast construction program, a dual plan whereby the city advanced enormous sums to assist in meeting the capital requirements. The contract was one that the city wanted; it was one that the company wanted. What happened is that the war enhanced costs, delayed construction progress, tied up capital without chance of return. Is a public utility so nearly infallible that it can afford not to protect itself by some such safeguard as the manufacturer uses, to the limits of its practicability in a competitive business, when he makes performance contingent upon the absence of untoward events? It is easy to argue in answer that the war will not occur again. But who will be so rash as to say that in the life of a long contract like the one in this case nothing will ever happen again that will cause distortion? Likewise, with the uniform rate of fare a company in effect gambles that there will be enough short riders to offset the long riders and provide a surplus profit. If, on top of this, there is no ready means for changing the rate of fare—down or up as conditions may justify—the hazard of the speculation is increased.

Now for the moral. So far as we are informed, there is no municipal contract in the central-station industry comparable with that providing for new transit lines in New York, nor is it likely that so extensive a program of construction would be necessary in a central-station property serving a single community. There are, however, existing contracts under which central stations furnish a material proportion of their output of power for the electric railway system of the community. Probably in the future we shall see many similar contracts under which central-station energy will be supplied for railroad trunk-line operation. In these contracts it is of great importance that the factor of revolutionary change in conditions shall be kept in mind. Change may mean up or down, but the lessening of the element of chance in this era of regulated profits is more likely to benefit than to harm the central station. Fortunately the central-station industry does not have to deal with the uniform rate. With a uniform rate the central-station industry, in our opinion, would never have reached the enormous size of to-day. But there is an element of danger in uniformity of rate by contract for different classes of consumers. The risk in this can and should be dissipated by introduction of coal clauses. And it may be advisable in the future to introduce variables to correct also fluctuating labor costs.

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The Use of Very Large Units

ONE of the striking characteristics of recent station design has been the increasing use of big generating units, often up to 20,000 kw. or 30,000 kw. and sometimes larger. In any electric supply system the size of the individual unit should bear some clear relation to the total load and to its fluctuations through the day. On the one hand, it does not pay to put too many eggs in one basket; on the other, there is a material disadvantage in an unnecessary multiplicity of units. The fundamental thing in a system is that there should be enough reserve supply so that no contingency reasonably to be expected can materially interfere with the output so far as the generating stations are concerned.

Thus it happens in the great transmission networks that by a proper system of load dispatching some stations may go out of action entirely at particular periods, leaving the load for others while surplus of water is accumulating, and the number of units per station is determined by local conditions rather than by any consideration of individual operation. In steam-driven systems this same general principle cannot be pushed quite so far, but the present tendency is working rather against the gigantic consolidated station and in favor of splitting the total capacity into two or more groups adapted to deal somewhat more advantageously with the total distribution of load in the network. Under these circumstances big turbo-generators can be applied to great advantage, the total output being dealt with as a whole irrespective of the particular situations in which it has proved wise for various reasons to install the generating units.

The cost of service must be met by the public at large if the people insist on having particular facilities which cannot be provided out of rates. It is for the public to decide what service it desires. Shutting down utilities which do not pay is a serious affair for states as well as for localities, and before the junk man is called in there should be no hesitation in making the taxation alternative plain.

Bettering the Steam Plant

THESE are times when every electrical supply station is hard up against the question of the efficient use of fuel and the improvement of its station practice all along the line. However optimistically one may forecast the general future of the business, one thing is certain, that pre-war fuel prices will be very slow in returning. Never is a long time; but it will take a very protracted period to recover from the effects of the inflation brought about by the war. Whether one wishes to burn fuel oil or coal the case is about the same—shortage in the general supply, enormously increased cost of labor and an added burden of transportation. In the long run the necessity of scientific economy replacing methods in many cases of almost unexampled wastefulness may prove to be a blessing in disguise, although the average station manager nowadays considers the disguise altogether unpleasantly effective. W. A. Shoudy, in last week's issue, very properly laid emphasis on the fact that there is no royal road to fuel economy. The operation of the prime movers with the minimum waste measured in B.t.u. is a thing which demands very close attention to detail, as well as generally correct lines of procedure.

As regards the electrical end of the equipment there is very little to hope for in the way of direct saving. The working efficiency of first-class modern generators is so high that gain by improvement here, so far as operating costs go, is rather insignificant. One must look back of the generator for his improvements. The three maxims which Mr. Shoudy lays down are, first, to keep the vacuum up; second, to carry no more idle boilers than are absolutely necessary, and, third, to look out for small wastes. To some of these latter we not long ago had occasion to refer, especially the very considerable losses that may come from improperly insulated or uninsulated steam pipes, which are a type of the lesser sources of loss. Most stations are fairly careful about carrying idle boilers. A certain amount of this has to be done as a protection against accident and suddenly varying loads. Perhaps the very fact that there is risk in too small a margin of available boilers tends to laxness. When a station is suddenly called upon at midday, as was one big plant not long ago, for load increasing at the rate of 1000 kw. a minute, it would be in a bad way indeed if it had been cutting too close to the limit of boiler capacity. The vacuum matter strikes us as being of extreme importance. The last-minute fractions of possible vacuum make a rather startling difference in steam-turbine performance, and while under favorable circumstances it may not be advisable always to install turbines planned for the highest possible vacuum, it is certainly true that, given a particular equipment of prime movers, the higher the vacuum can be kept the better. This implies very close attention to the auxiliaries, minute watching of temperatures, constant outlook for anything that may bring the vacuum gage below its appointed stage.

Steam pressure is generally fairly well kept up to standard, albeit that standard is very frequently lower than progressive engineering would indicate. We have for a long time preached high steam pressures, and slowly they are on the way; but a good vacuum well maintained will make up, temporarily at least, for ultra-conservatism in the steam pressure. The same in lesser degree is true of superheat. We have been very timid in this country in taking up degrees of superheat long in successful use elsewhere. While reciprocating engines were commonly in use it was well-nigh impossible to get a favorable response to specifications calling for anything above the most modest degree of superheat, and with the coming of the turbine the same conservatism stood in the way of progress. Most superheaters in this country are built into the boiler instead of being independently fired. This makes the superheat in large measure dependent on the rate at which the boiler is forced, and thus high superheat may mean a certain reduction in boiler efficiency. Data on the comparative performance of prime movers with modest superheat in the boilers and with high superheat outside of them are scarce; yet the fact that the latter has been fairly common outside of our own country would indicate that its merits should be very thoroughly considered in these days of big turbine units. In new plants all these things can be looked after. In old ones it is not so easy to push economies to their legitimate conclusion. One can always, however, watch out for the small losses.

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Engineering Aspects of Industrial Lighting—I

Industries Should Take Advantage of Studies Made Under Stress of War Conditions to Promote Efficiency of Production—Specific Data Now Available Which Aid in the Selection and Location of Lighting Units

BY C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

THE extreme conditions which have just been experienced under stress of war have been the cause for a careful survey of many factors affecting industrial activity. Whenever such a survey has been directed toward ways and means for increasing production and for rendering workmanship more effective through improvements in the physical environment of the industries, it is pretty safe to assume that the lessons learned under the extremities of war also contain the basis for some valuable conclusions relating to the efficiency of manufacturing methods in times of peace. In other words, the effort to obtain highly efficient results in the shortest possible time consistent with good workmanship is a topic of the most pressing importance now just as it was during the war, even if to a somewhat different degree, and it is confidently believed that many of the lessons of the past year or so of the war can be utilized in a way which will make them a potential asset not only during the reconstruction period now in evidence but beyond this into any period of more normal activity which may follow.

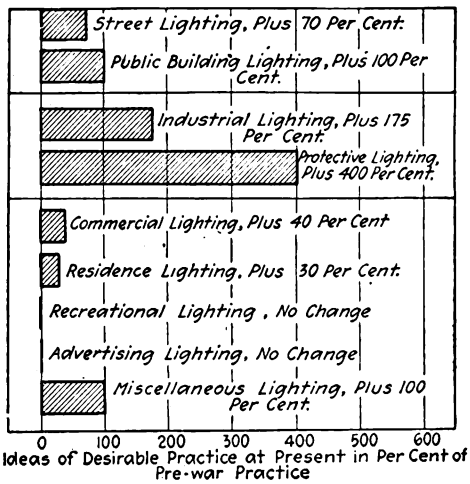

FIG. 1—COMPARISON OF PRE-WAR AND WAR-TIME LIGHTING PRACTICE

During the past months, while the war was in progress and when the highest efficiency possible was imperative in the conduct of the war industries, the Employment Management Section of the War Industries Board undertook as one of its activities the preparation of instruction courses for the intensified training of employment managers falling within the province of the board. This movement was directed primarily to the training of those who were called upon to manage the employment departments of the war industries, but it doubtless also had as a secondary and almost equally important object to influence the employees through the manager, for the purpose of rendering them better satisfied to follow one given line of work during the war, and to make them individually a better and more valuable part of the organization. This procedure should reduce the excessive labor turnover which was experienced here and there, due either to voluntary transfers of workmen from one plant to another or to enforced withdrawals on account of the need of replacing inferior with more effective workmen.

Among the topics attacked by the Employment Management Section was that of natural and artificial industrial lighting, this subject having been assigned to the writer. Valuable data were collected, and a portion of the accumulated information was used by the Employment Management Section. The complete program was abridged by the ending of the war, but the files of data have been placed at the disposal of the writer. The following notes are based, in general, on these data and are published with the permission of this section of the board, with the idea that such information is likely to be of interest to the profession at this time. It is perhaps only proper to state at the outset that where ideas may be advanced regarding specific types of equipment they must be accepted by the reader as the ideas of men in the field who have endeavored in the emergency to give specific opinions as an aid to the war industries. The writer cannot, under these circumstances, be held as either favoring or differing from such ideas on specific types of equipment, and he places these opinions before the reader merely for what they may be worth.

The three installments of the series on industrial lighting have been planned so as to limit the present article to a brief review of the studies upon lighting economies during the war, with references also to current data on factors governing the choice of lamps and reflectors and simple methods which have recently

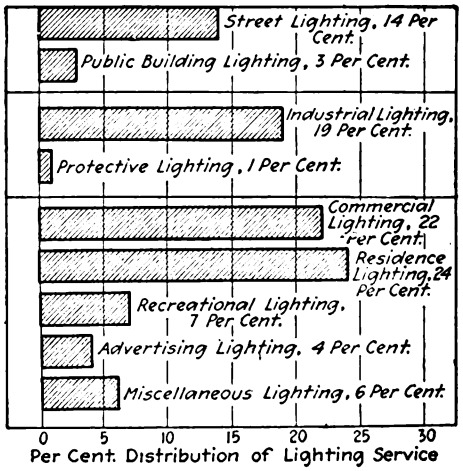

FIG. 2—RELATIVE PROPORTION OF DIFFERENT CLASSES OF LIGHTING SERVICE

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wholly, due to war conditions. Its interest at this time lies in some of the conclusions reached under pressure of the war emergency.

Mr. Millar's summary of the views of representative engineers on the adequacy of standards of lighting practice, as plotted graphically in Fig. 1, indicates a marked tendency to view the practice in the industries as very inadequate early in 1918. This was perhaps a natural conclusion because of the urgency of war work in this country, and lighting men were most likely to feel in all cases that good light could be made to contribute greatly to the success of all the pressing industrial efforts. The common opinion, indicated in Fig. 1, in favor of great increase in protective lighting is based on apparent needs felt at the time.

Figs. 2 and 4, also summarized from tables in Mr. Millar's paper, indicate (in Fig. 2) the approximate magnitude of the various principal classes of lighting service and show that industrial lighting holds an important place in the lighting field as a whole. The adjustments thought to be desirable in lighting practice early in 1918 are pictured in Fig. 4, and here again the industrial field is the only one where general opinion favored marked increases rather than curtailment.

These three charts point strongly to the importance of lighting to production, and, moreover, they may be taken to indicate that what was thought to be essential as a war measure in the form of increases in lighting, in spite of the fuel shortage, points with almost equal force to the needs of more careful attention to adequate standards of industrial lighting now that the war pressure is past. The interesting and timely fact brought home by this paper and by the data compiled by Mr. Millar is not so much the general consensus of opinion that the quantities of industrial lighting could advantageously go up rather than down in the face of an extreme fuel shortage, but that a study of the situation at such a time, and with public opinion so completely centered upon fuel saving as a war measure, should bring results showing that industrial lighting fell below desirable values the country over and ought to be increased for the good of the war.

The importance of better industrial lighting as brought to a head by the Millar paper, with its clear-cut possibilities of application during the present reconstruction period, need not be a cause for completely overlooking the ways in which actual and not virtual economies may be effected at all times. Mr. Millar has indicated that these fall in a general way under five heads which are listed as (a) avoidance of inefficient lamps, (b) avoidance of improper reflecting or diffusing equipment, (c) avoidance of faulty locations for the lamps, (d) careful maintenance, and (e) the prevention of wasteful burning of lamps. Economy in the use of light by these means is not to be confused in any sense with the bringing up of lighting values in the factory to a point where the maximum production, as far as it can be influenced by good light, is obtained.[2]

Information soon to be published by the Industrial Commission of Wisconsin and placed at the disposal of the Employment Management Section of the War Industries Board for public use in advance gives promise of some valuable new suggestions in the practical planning of factory lighting systems. These are mentioned briefly at this time because of the need which has been felt during the last few years for simple rules as an accompaniment for state factory lighting codes.

These notes of the Wisconsin commission appear to answer the question in a large measure by giving specific rather than general data on such questions as the determination of mounting heights and spacing distances for lamps under factory conditions, the sizes of lamps and the types of reflectors or globes to employ. In aiding the practical factory engineer thus not only to decide on the quantities of artificial illumination to use but also on the ways and means by which to secure desired results, the Wisconsin commission takes a step well in advance and contributes actively to the cause of better-lighted industries.

Special comment is directed in this connection to two charts prepared especially for the commission by Arthur J. Sweet of Milwaukee, by which it is proposed to give

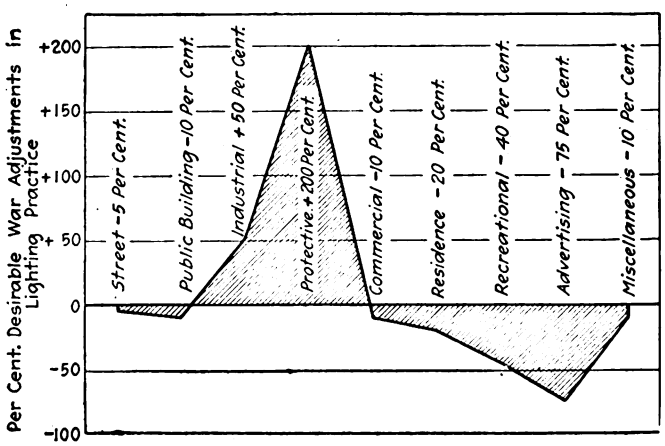

FIG. 4.—DESIRABLE ADJUSTMENTS IN VARIOUS CLASSES OF LIGHTING DUE TO THE WAR AND TO FUEL SHORTAGE

the practical factory departments a basis for selecting spacing distances and lamp sizes (both gas and electric) for a given ceiling height. The selection of auxiliary equipment for the lamps is aided by a table classifying or rating the shallow-bowl porcelain-enameled metal reflector, the deep-bowl porcelain-enameled metal reflector, the deep-bowl mirrored glass, the shallow-bowl porcelain-enameled reflector with a shield or cap fitted to the lamp, and the special prismatic glass industrial unit of the deep-bowl type, in terms of the following characteristics: (a) Efficiency with respect to horizontal illumination, (b) efficiency with respect to vertical illumination, (c) ease of maintenance, (d) non-liability to breakage, (e) non-liability to deterioration other than breakage, and (f) the relative avoidance of characteristics producing eye-strain.[3] Somewhat similar data (Table I) are herewith included from the data of Ward Harrison,[4] although the types of reflector equipment are not identical in the two cases.

The advantages of ready methods for the selection of lamp and reflector sizes have been apparent during

[2]Those interested in this subject are referred to Mr. Millar's paper in the *Transactions* of the Illuminating Engineering Society and also to the report on war-time lighting economies by the committee on war service of the Illuminating Engineering Society, made public Oct. 10, 1918. Mr. Millar was chairman of this committee.

[3]The two charts referred to above in the notes of the Wisconsin Industrial Commission, while submitted for publication to the War Industries Board, have not, as far as the writer is aware, been published by the Wisconsin commission as yet, and hence are not included at this time as part of this article.

[4]*Transactions* Illuminating Engineering Society, Vol. XII, No. 8. Nov. 20, 1917.

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the past months, and such simple rules will doubtless continue to be in demand indefinitely owing to the lack of training of those so often called upon to plan such systems. Table II contains suggestive information along these lines.[5]

TABLE I—FOR SELECTION OF FACTORY LIGHTING UNITS

	Dome Reflector, Clear Lamp	Bowl Reflector, Clear Lamp	Dome Reflector, Frosted Lamp	Dome Reflector, Opal Cup	Dome Reflector, Mirror Cap	Opal Globe with Reflector
Per cent clear lamp lumens — Total				68		70
lower hemisphere	77	66	72	66	58	57
Relative horizontal illumination	100	91	95	85	84	71
Relative vertical illumination	A	C	A	A	B	A
Direct glare	D	C	B	B+	A	B
Reflected glare	D	D	C+	B	A	B+
Shadows	C	D	B	B+	A	B+
Maintenance	A	A	B	D	C	C

A word of caution, similar to other comments which the writer has made upon such short-cut rules in the past, is perhaps in place. Discussion with factory architects shows a tendency to adopt some simple rule applicable to the typical factory section. Such a remark as "We place lamps in factories on so and so many feet centers and find they are satisfactory" leads those who have gone through innumerable difficulties in arriving at this same choice in given factory locations to view with some misgivings the attempt to reduce all cases to too hard and fast a rule. There are often peculiar circumstances which impose restrictions upon the set rule, and to safeguard against errors in such cases judgment should always be applied to rules or methods such as those just referred to. With a suitable element of judgment in the interpretation of such ready methods, they constitute a valuable addition to the available means at hand for planning out the industrial lighting system.

Fig. 3A, due to the Ivanhoe Regent Works of the General Electric Company; Fig. 3B, to the Edison Lamp Works of the same company, and Figs. 3C, 3D, 3E and 3F, to the Cooper Hewitt Electric Company, are included in the present article as representative views of successful installations submitted to the Employment Management Section of the War Industries Board for its educational activities.

[5]Found in Catalog 276, Invanhoe-Regent Works of General Electric Company, issued Aug. 15, 1918.

TABLE II—INTENSITIES IN FOOT-CANDLES RECOMMENDED FOR VARIOUS MANUFACTURING OPERATIONS, AND CORRESPONDING WATTS PER SQUARE FOOT REQUIRED WITH DIFFERENT TYPES OF REFLECTORS

Class of Work*	Foot-Candles	Watts per Square Foot Large Room†	Small Room†	Type of Reflector and Lamp
For rough manufacturing occupations, such as rough assembling, rough forging, rough woodworking, ice making potteries, lumber mills, tanneries, etc.	2-4	0.37	0.55	Dome type with clear lamp
		0.40	0.60	Dome type with bowl frosted lamp
		0.40	0.68	Bowl type with clear lamp
		0.43	0.65	Dome type with opal lamp
For medium manufacturing occupations, such as medium woodworking, rough machining, rough bench work, automatic machine work, meat packing, paper making, laundries, bakeries, etc.	3-5	0.56	0.95	Dome type with clear lamp
		0.60	1.00	Dome type with bowl frosted lamp
		0.65	1.05	Dome type with opal cap
		0.70	1.10	Bowl type with clear lamp
		0.75	1.20	Reflecto-cap diffuser
For fine manufacturing occupations, such as fine assembling, leather working, fine woodworking, fine lathe work, tobacco manufacturing, fine sheet metal working, manufacturing light-colored textiles, etc.	4-8	0.95	1.70	Dome type with clear lamp
		1.00	1.80	Dome type with bowl frosted lamp
		1.05	1.90	Dome type with opal cap
		1.10	2.00	Bowl type with clear lamp
		1.20	2.15	Reflecto-cap diffuser
For extra fine manufacturing occupations, such as: watch and jewelry manufacturing, engraving, type setting, shoe manufacturing, enameling, manufacturing, dark-colored textile, etc.	7 and upward	1.4	2.3	Dome type with clear lamp
		1.5	2.5	Dome type with bowl frosted lamp
		1.6	2.7	Dome type with opal cap
		1.7	2.8	Bowl type with clear lamp
		1.8	3.0	Reflecto-cap diffuser

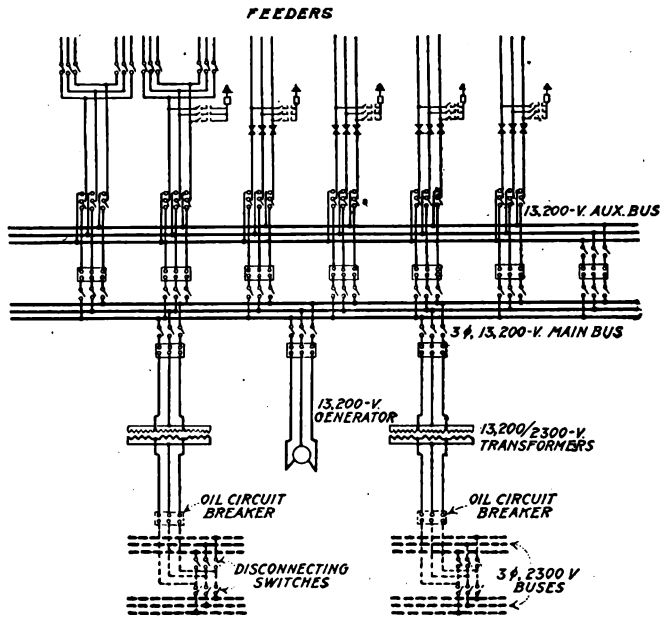
*The "reflecto-cap diffuser" is not recommended for installations where the polished cap is exposed to destroying elements.

†Rooms are considered large when their width is five times their height; rooms are considered small when the width and height are equal. Rooms intermediate in proportion require proportionate intermediate values of watts per square foot.

LAYOUT FOR A STATION WITH TWO BUS POTENTIALS

Details of Plan Which Permits Taking Advantage Not Only of Diversity of Loads but Also of Economical Combination of Generating Units

Engineers who are operating two separate bus systems at different voltages and those who have separate two-phase and three-phase buses may find points of interest in the diagram of connections which was worked



WIRING PLAN TAKING ADVANTAGE OF ALL DIVERSITY

out to meet a similar condition for the central station at Peoria, Ill. The plant supplies loads at 2300 volts and at 13,200 volts, and it has both 13,200-volt and 2300-volt generators. The connections shown in the diagram allow the plant to take advantage of the diversity between both classes of load and permit the operation of any combination of generators which may be desirable.

In general the plan consists of placing between the two sets of double buses two banks of 4500-kva., 13,200/2300-volt transfer transformers. To give further flexibility on the 13,200-volt system a combination of oil and disconnecting switches has been worked out which will permit any oil switch to be isolated.

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Getting Better Combustion of Indiana Coals

Description of Practical Methods by Means of Which Furnace Equipment Installed Years Ago Can Be Modified in Such a Way as to Produce Results Comparable with What Is Considered Good Modern Practice

BY T. A. MARSH
Chief Engineer Green Engineering Company

INDIANA is the fifth state in importance as regards tonnage of coal produced. With coal-producing states on either side, the coals of Indiana have not until recently had the wide distribution now existing. Indiana coal is used in many cases where its characteristics are somewhat unknown and where the existing furnaces are unsuitable for its use. Many plants reached either by West Virginia, Kentucky, Ohio or Indiana coals have

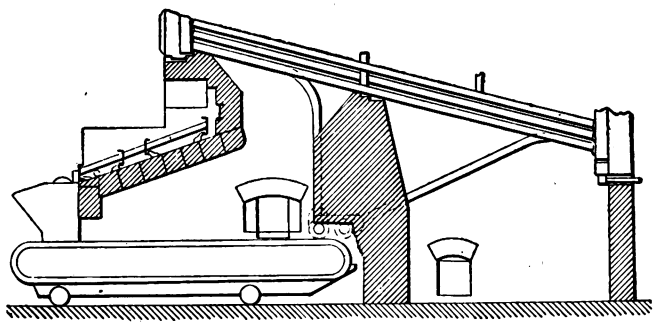

FIG. 1—TYPICAL CHAIN-GRATE SETTING UNDER VERTICALLY BAFFLED WATER-TUBE BOILER

no adequate provision for the use of the latter and are unable to get satisfactory results unless they use the higher grade of coals from the three former states.

THE CHOICE OF COALS

The standard coals in Indiana are found in four seams, Nos. 3, 4, 5 and 6. In addition a few special grades of coal are produced, but these do not come in a class with steam coals with which this paper deals and therefore are not considered. Steam-production engineers are interested almost entirely in the quality of the screenings. The table below gives the proximate analyses, heating values and sulphur content of typical screenings from the four Indiana seams. These analyses cannot be compared on an equal basis with samples of coal as usually submitted, because such samples are usually based on run-of-mine or lump coal. Screenings contain usually 4 per cent more ash than run-of-mine coal and approximately 6 per cent more ash than lump samples. Naturally the screenings are correspondingly lower in heating value. Screenings are the natural steam coal. Therefore it is on the screening analyses and values that conclusions should be based.

INDIANA SCREENINGS

	No. 3 Seam	No. 4 Seam	No. 5 Seam	No. 6 Seam
Moisture, per cent	10.8	12.4	10.1	11.0
Volatile matter, per cent	35.00	33.2	33.2	31.1
Fixed carbon, per cent	36.9	44.2	42.0	41.5
Ash, per cent	17.3	10.2	14.7	16.4
B.t.u. (commercial)	10,400	11,069	10,820	10,540
B.t.u. (dry basis)	11,670	12,610	12,039	11,730
Sulphur, per cent	4.55	1.75	4.27	3.50

The characteristics of the coal from the various seams are as follows:

No. 3 coal, while not high in heat value, has the highest percentage of volatile matter and therefore gives up its heat more quickly than No. 4, No. 5 or No. 6 in a furnace. It is an excellent coal to use for capacity in furnaces which are limited as to ignition arches or draft or both of these. The structure of the coal is soft, and it therefore disintegrates readily and is not good for storage coal. Its relatively high percentage of sulphur further complicates the storage problem, and the fusibility of the ash causes excessive clinker when the fuel bed is agitated. The tonnage of No. 3 coal produced is not large and the distribution is therefore limited.

No. 4 coal from commercial standpoints has the greatest utility of all Indiana coals. Its heating value is relatively high for a Western coal. Its sulphur content is low and the coal in this seam is of very uniform quality. The fixed carbon is of such good structure that this coal when used in by-product ovens makes excellent coke. Owing to the uniformity of No. 4 coal and its low sulphur content, it is in great demand at all times for special-process work, such as forge and heating furnaces, and commands a higher price than other Indiana coals. It is better adapted for stoker use than the other fuels mentioned, and this applies particularly to its use on stokers that agitate the fuel bed. With fireclay above and below a large portion of this coal seam the clinker produced is of a brittle "pottery" nature. In fact, many plants having clinker trouble are limited to the better grades of No. 4 coal. This is an expensive limitation, but is frequently a necessary one to obtain continuous operation, which is not possible with coals having a higher percentage of ash and a greater tendency for making clinker, due to lower fusing temperature of the ash.

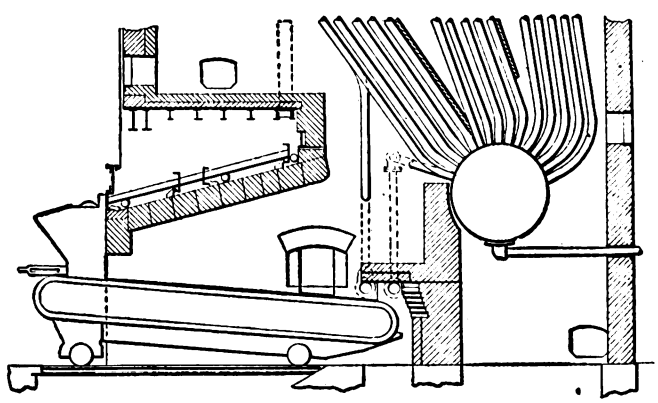

FIG. 2—MODERN FURNACE SERVING STIRLING BOILER

From the standpoint of steam production No. 5 coal is the most important of the Indiana coals. Its high

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percentage of sulphur makes it unsuitable for special-process work, but on account of the large quantity produced and assurance of supply, together with its uniformity and free-burning characteristics, it is recommended for steam power plants. The No. 5 coal burns more rapidly than No. 4 coal, inasmuch as the fixed carbon does not have the structure found in the No. 4 coal. Because of the low fusing temperature of the ash No. 5 coal is not readily handled if the fuel bed is agitated. A considerable portion of this seam has rock above and

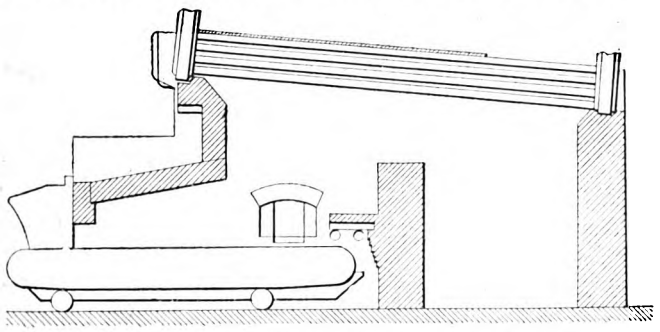

FIG. 3—CHAIN GRATE UNDER HORIZONTALLY BAFFLED BOILER

below so that there is no clay mixture to keep the clinker brittle, and although the coal is clean as regards earthy matter, the clinker produced is very vitreous. This coal is entirely suitable for chain grates, but the furnace design must be such as to give a good strong ignition, a point which in many instances in the past has been overlooked.

A higher percentage of ash than in any extensively used Indiana coal is found in No. 6 coal. Its moisture is slightly less than that of the No. 4 coal, and the heating value is approximately 5 per cent less, owing to the higher ash. The ash fuses at a low temperature, making it difficult to handle. Unless the proper type of stoker is used this coal should not be considered because of the large amount of clinker produced and its vitreous structure. No. 6 coal is still more limited in its use than No. 5 owing to the lower heating value and the greater amount of clinker produced. This coal is almost entirely limited to use on chain grates, and liberal grate areas must be provided together with long arches to provide ample ignition in order to get good steaming capacity from this coal with its relatively low heating value.

For the sake of economy in the purchasing of coal and in power-plant operation, plants tributary to Indiana coals should be able to burn coal from the four seams of Indiana and should particularly be able to handle coal from the No. 5 and No. 6 seams.

THE DESIGN OF FURNACES

The design of furnaces for these coals must be given the most careful thought. Many furnaces have been inadequate, owing in the main to lack of knowledge of the coal and of the proper furnace design necessary. Large grate surfaces should be provided, as these coals are relatively inert and even with high combustion rates the ratings obtained are not high unless the grate surfaces are large. Four things must be considered in the design of furnaces for such coals as Indiana Nos. 3, 4, 5 and 6, as follows:

Ample draft must be provided. These coals can be burned at combustion rates of 40 lb. to 45 lb. per square foot (19.5 gm. per sq. cm.) of grate surface per hour with a draft of 0.40 in. to 0.50 in. in the furnace. Long, high-pitched igniting arches should be provided. Grate areas should be liberal with coals so low in heating value. If high capacities are to be obtained, grate areas should be provided having a ratio surface to the heating surface of 1 to 40 or even larger. Furnace volumes should be large. In furnaces where 40 lb. of coal per square foot of grate surface per hour is to be burned, the furnace chamber should have a volume of 12 cu.ft. (0.33 cu.m.) per square foot of grate area. Furnaces even larger are desirable.

Large grates are an advantage, as they permit ratings as high as 200 per cent and upward with high efficiencies. A characteristic of chain grates seldom emphasized, but well known to combustion engineers, is the high efficiencies that can be obtained at ratings below normal. Some stokers cannot be operated appreciably below 100 per cent rating, owing to overheating, back draft or other difficulties. Still other types operate without trouble at low ratings, but with reduced efficiencies.

Chain grates reach excellent efficiencies at from 50 per cent to 75 per cent rating. With inferior coals, therefore, large grates should be installed as this will insure high ratings when desired and will also give high efficiencies at lower ratings.

Unfortunately, many of the chain-grate installations do not have these characteristics, and capacities and efficiencies are consequently limited. Modern settings, however, give combined efficiencies of from 70 per cent to 75 per cent when burning any one of the coals under discussion and develop boiler ratings of 200 per cent and over. With chain grates these coals are handled indiscriminately. There is no clinker formation, as the ash forms on the lower side of the fuel and there is no agitation of the fuel bed. Moreover, the ash is continuously discharged from the furnace, permitting no accumulation of refuse in the furnace, and air spaces are kept continuously clean by the staggered arrangement of links.

FURNACES RECOMMENDED

Some typical modern settings, capable of producing high ratings and high efficiencies, are shown in Figs.

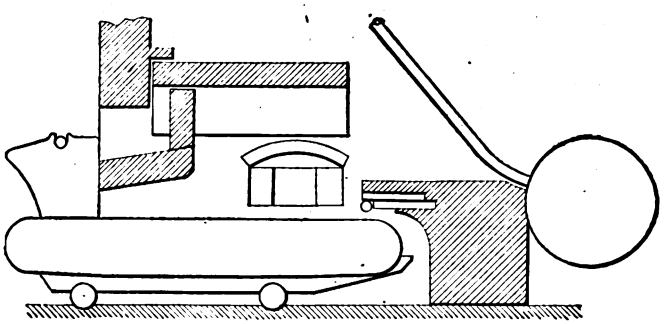

FIG. 4—FURNACE DESIGN TWELVE YEARS AGO

1, 2 and 3. Fig. 1 shows a modern chain-grate furnace with a Babcock & Wilcox or vertically baffled boiler. Notice that the length of arch is 75 per cent of the length of the grate and that the grate is 11 ft. long (3.3 m.). This may be increased to 13 ft. or 15

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ft. (about 4 m.) if the arch is lengthened relatively. Notice also that the arch is steeply pitched and that the face of the bridge wall is built up vertically. This furnace provided with drafts of 0.5 in. (1.2 cm.) will burn 40 lb. of Nos. 3, 4, 5 or 6 Indiana coal per square foot of grate surface per hour.

Fig. 2 shows the application of the same principles

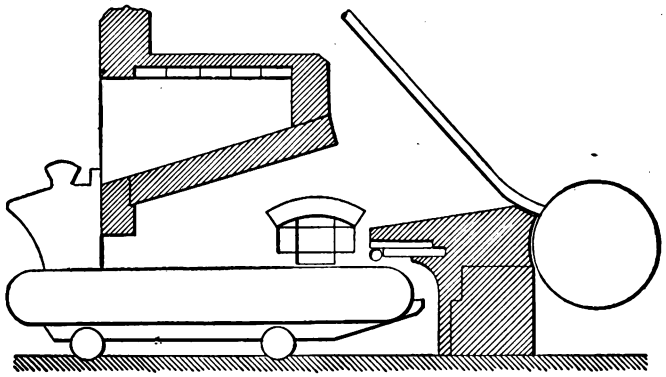

FIG. 5—REVISION OF FURNACE SHOWN IN FIG. 4

to a Stirling boiler. Fig. 3 shows the application of the same furnace to a Heine, or horizontally baffled, boiler. It will be noted that all of these furnaces have large volumes. The furnace volume per square foot of grate area in Fig. 1 (allowing for a grate width approximately equal to the furnace width) is 12 cu.ft. (0.33 cu.m.). The furnace volume as shown in Fig. 2 is 12 cu.ft. The furnace volume shown in Fig. 3 is 13 cu.ft. (0.36 cu.m.). The furnace volume commonly found in installations dating prior to 1916 was approximately from 3 cu.ft. to 6 cu.ft. (0.08 cu.m. to 0.16 cu.m.). The average length of arch was 4 ft. The average draft was 0.25 in. (0.6 cm.). Even under these conditions Indiana coals were handled without clinker trouble, but in a limited manner as regards efficiency and capacity. The results from modern furnaces, however, are far superior to those derived from the older type.

How to Improve Existing Furnaces

Fortunately, most existing furnaces permit revision which will greatly improve capacity and efficiency.

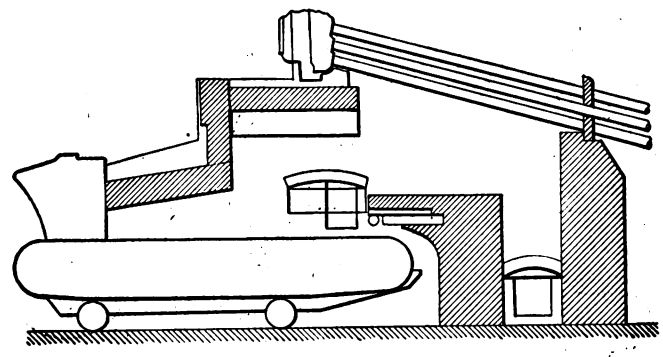

FIG. 6—OLD FURNACE EQUIPPED WITH SPRING ARCH

Modern arch construction can be installed. Arches can be set higher to give more furnace volume and thus improve efficiency. Longer arches can be installed, igniting greater quantities of coal and distilling the volatile matter off more rapidly. This gives better opportunity for the complete combustion of the fixed carbon. Bridge walls can be modified to reflect heat forward, helping the ignition and increasing the furnace temperature, which improves the combustion of the hydrocarbons.

A type of arch should be installed which will prevent air from immediately reaching the bottom surface and chilling it. This arch has a front row of tile set lower than the main arch surface. This greatly increases the furnace temperature at the front of the furnace. These and other modifications can be installed in most furnaces, and if at the same time an improvement can be made in the arrangement of boiler baffles to increase the draft, higher capacities and efficiencies can be obtained and the range of coals available can be greatly widened. Many plants have already revised their furnaces and have greatly improved their results. Some typical casts of revised furnaces are indicated in Figs. 4, 5, 6 and 7.

Figs. 4 and 5 represent the design of a furnace with a Stirling boiler installed twelve years ago and the recent revision of this furnace. With the original furnace only the better grades of Indiana coals could be used. In the improved setting the sprung arch is re-

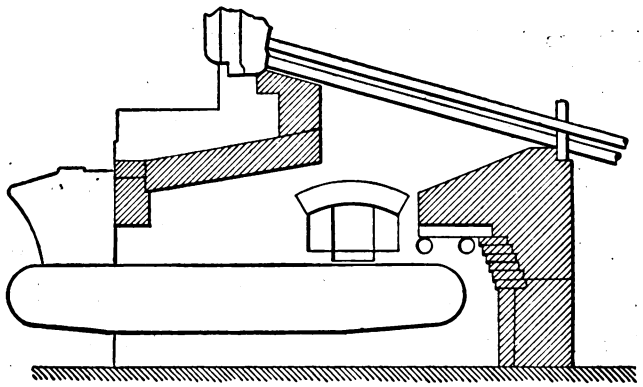

FIG. 7—REVISION OF FIG. 6 INCREASING CAPACITY AND RANGE OF COALS AVAILABLE

placed by one continuous arch, 7.5 ft. (2.1 m.) long. After this was done it was found that the lower grades of Indiana coals were entirely suitable, inasmuch as the draft and grate surfaces were adequate and the furnace formerly had been limited by the lesser ability to ignite these coals. Fig. 6 shows a furnace in connection with a vertically baffled boiler installed several years ago. Fig. 7 shows the revision of this furnace, an improvement which very materially increased the capacity and the range of coals available.

Conclusions

From this discussion the following principles are evident: (1) Indiana coals are being and will be extensively used. (2) The characteristics of some of these coals are: low fusing temperature of the ash, great tendency to clinker and large amount of clinker. (3) These coals give serious clinker trouble when the fuel bed is agitated. Continuous ash removal is preferable. With chain-grate stokers and modern furnaces high capacities and efficiencies can be obtained from all grades of Indiana coal. (4) Existing furnaces permit improvement. Each should be considered in the light of modern engineering knowledge and can be revised, widening the range of coals to include all Indiana seams and increasing the capacity and efficiency under all conditions.

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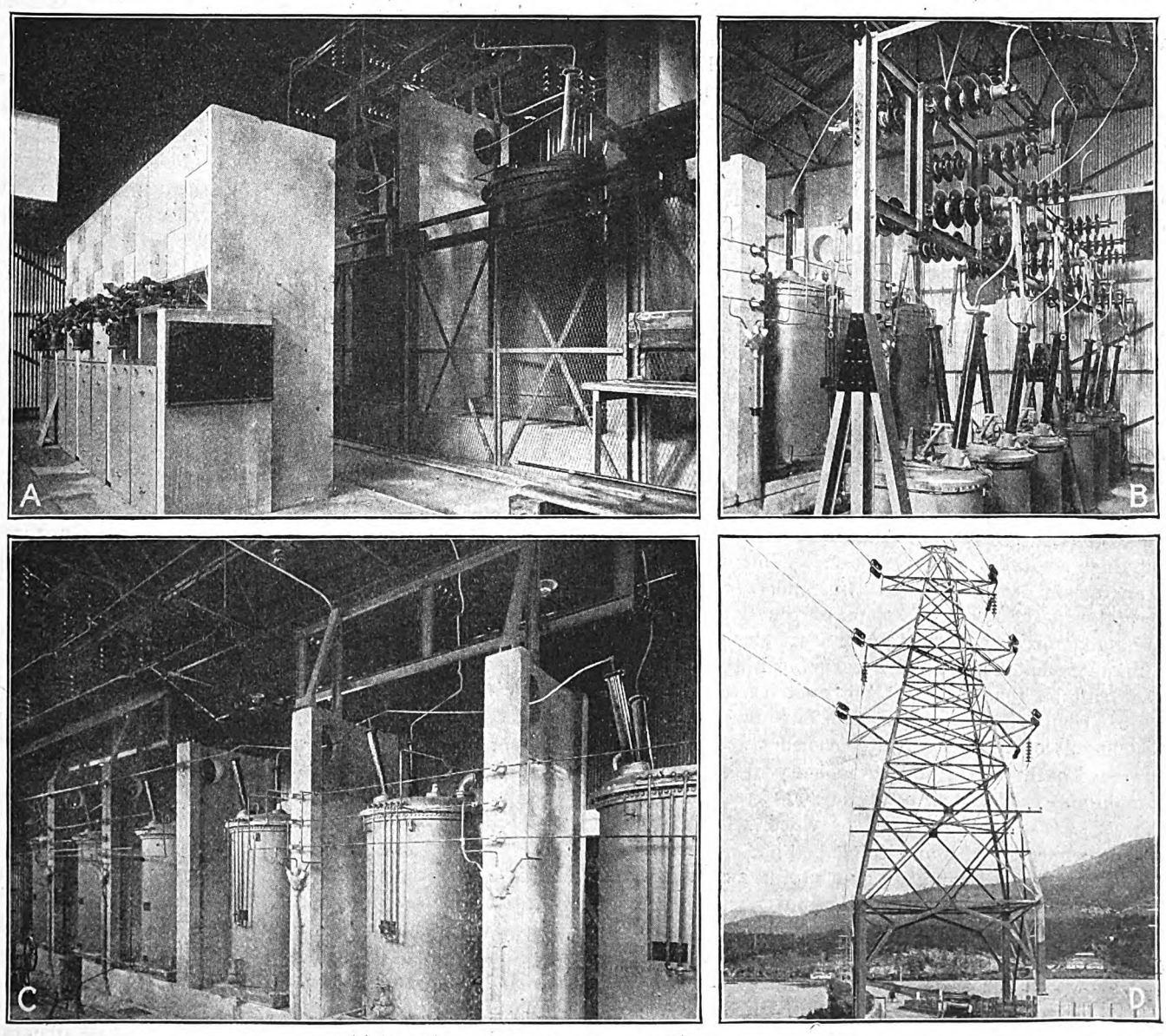
Recent Hydroelectric Development in Tasmania

70,000 Hp. Now Made Available and Other More Promising Development to Be Started—Electrical Construction Peculiar to That System—A New Field for Electric Apparatus Opened in the Antipodes

BY L. W. ALWYN-SCHMIDT
New York Economic Service Bureau

ONLY recently Tasmania completed an electric service system which has proved already of considerable value to the industrial life of the island. The power station on the Great Lake supplies power to the cities of Hobart and the Northwest Bay and has also made possible the growth of an electrochemical and electrometallurgical industry in Tasmania which could not be foreseen a few years ago. The war and the difficulties in obtaining the necessary machinery added largely to the construction expenses. Much of the copper, for instance, which was ordered for the transmission lines was commandeered and had to be placed at the then very high price. It is expected that the installation of big primary industries will soon be followed by supplementary industries. In this way Tasmania will become a new and important market for electrical material of all kinds, and its buying power will soon be felt in the United States. Part of the equipment needed for the extension of the facilities on the central stations in the Great Lake, in fact, was ordered in the United States, as an early supply could not be expected from European sources.

The Great Lake, the water of which is used as the motive power for the station, lies at an altitude of 3350



GROWTH OF HYDROELECTRIC ENTERPRISE IN THE ANTIPODES

A—Oil switch and bus compartments are readily accessible. B—High-tension oil switches and disconnecting switches supported on steel work, low-tension transformer wiring in the background. C—Transformers separated by concrete barriers and raised above floor of room. D—Special transmission tower at river crossing.

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ft. (1020 m.) above sea level in the center of the island. After the erection of the dams it had an area of 50 square miles (13,000 hectares), and it is estimated that at a minimum 70,000 hp. can be obtained. The water is led from the lake by way of the existing river bed of the Shannon and an artificial canal to a second reservoir, whence pipe lines carry it to the power station, a total drop of 1120 ft. (340 m.). The distance from the reservoir to the power station is 9800 ft. (3000 m.) and is covered in part by a double line of wooden 4-ft. (1.2-m.) pipes 5500 ft. (1675 m.) long. The remaining 4300 ft. (1310 m.) will be covered ultimately by a system of four lines of pipes, of which three will be steel and one wood. The pipe system is joined just outside the station and led through adjustment pieces to the main turbine-gate valves.

The power station consists of a steel framework building set on a heavy concrete foundation and covered with corrugated-iron sheeting. The building is divided into two sections, of which one holds the turbines and the other the transformers. Originally only two turbo-alternators were installed. These, however, are now supplemented by a third set. The turbines, which are of the horizontal Pelton-wheel type, were made by an English firm, have a normal rating of 4980 hp. and run at a speed of 375 revolutions. They are equipped with automatic pressure regulators consisting of cast-steel deflectors which direct the water jet into the wheel pit without touching the buckets and limit the increase in the water pressure to 15 per cent above normal. By-pass valves are provided on all gate valves and the distributing pipes. The turbine governors are fitted with electric motors which permit the speeding up or slowing down of the machines. The alternators generate at a pressure of 6600 volts, excitation being furnished by two 120-kw. auxiliary turbo-generators that also supply the power requirements of the station.

All electrical apparatus up to the transformers is controlled by means of a switchboard on the turbine floor. The alternator oil switches are in the other section of the building. The connecting cables are laid in ducts constructed in the foundation. From the switches tappings are taken to the low-tension side of the step-up transformer. All the cubicle (bus and switch shell) construction and back connections of the switchboard are arranged for easy inspection and are designed in such a manner that no apparatus carrying high-tension current can be touched until the switches controlling it have previously been opened. Two banks of 6600/88,000-volt oil-insulated, water-cooled transformers are provided each with a normal capacity of 4050 kva. and a maximum half-hour capacity of 6000 kva. Each transformer has a thermometer provided with a contact maker connected with an electric bell and indicator. The transformers are connected by a piping system with an oil tank which will allow rapid emptying of the tanks in case of necessity. The lightning arresters are outside the power house. Features peculiar to this plant are shown in the accompanying illustrations.

The principal distributing field of the station to-day includes the city of Hobart and the Northwest Bay, a total distance of 77½ miles (131 km.). J. H. Butters, chief engineer and manager of the station, gave the following details of the transmission lines in a lecture before the Electrical Association of Australia, which has also been drawn on for the description of the plant.

The transmission towers are of the lattice-steel type, supporting two circuits of stranded conductors by means of chain insulators. The standard span is 600 ft. (182 m.). The towers are anchored by means of special stubs and stub plates buried 7 ft. (2.1 m.) in the ground at each leg. The proportion of rock met with in construction was extremely high, approximately 80 per cent of the excavation being of this character.

Five 10-in. (25-cm.) disks are used for suspension chains and six for strain chains. The conductors are suspended in such a manner that they may safely swing an angle of 45 deg. from the vertical. All joints are mechanical. A galvanized-steel "earth" cable is provided the whole length of the line and is attached by means of a clamp to the pinnacle of each tower. The conductors are attached to the insulators by means of special clamps having an arc shield consisting of a strip of copper bent around the conductor at each suspension insulator and held in place by the clamp.

The effect of the new power source on the industrial life of Tasmania became apparent immediately. Contracts for additional power were made by a great number of industrial enterprises which were drawn to the islands by the prospect of obtaining power. The first of these contracts was with the Amalgamated Zinc Company (De Bavays), Ltd., which took 4000 hp. with an option for another 26,000 hp. when required. This company has erected extensive works at Hobart. Another important contract was made with the Hydro-Electric Power & Metallurgical Company, Ltd., of Melbourne, which is constructing works at Northwest Bay. The contract is for 3500 hp. with an additional option for 6500 hp. The latter will be used for power for carbide production. To supply this increasing demand for power it has become necessary to increase the station equipment. Besides extending the transmission and distribution facilities, the receiving station at Hobart is being doubled in capacity by the installation of an outdoor substation consisting of three single-phase transformers of 1333 kva. each and one spare transformer for emergency.

A one-circuit transmission-line extension has been built from Hobart to Northwest Bay, a distance of 14 miles (22.5 km.). The construction of this line differs from the main line in that it is of the wood-pole type.

As shown before, much of the material used for the extension of the plant has been ordered from America, and there is every indication that more will be bought. The war made it impossible for the English manufacturers to supply equipment promptly to Tasmania, and the orders for the new equipment, therefore, had to be given to American manufacturers who were able to make early shipments. This has provided an opening for the American electrical industry.

Following the completion of the Great Lake development, several other schemes will be taken up, one of which is said to be even more promising than that at Great Lake. With these other developments added to the present facilities Tasmania will have at its disposal a set of hydroelectric stations which, when interconnected, will give the country a permanent and cheap supply of electrical power.

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Promote the Welfare of the Community

All Forms of Autocracy Should Now Be Deposed in Our Own Country Also—Rule of Reason Necessary in Reconstruction, and Capital and Labor Alike Will Have to Abandon All Autocratic Methods—Reforms That Are Essential

BY CARL HERING

ONE of the most important lessons which this war has taught the world and which should be uppermost in the period of reconstruction is that the people will no longer submit to be controlled by autocratic powers. The world has decided against the unrestricted and selfish power of individuals over the people, when used autocratically. Right and justice must hereafter be taken into account in all dealings with the people. People living together in cities, states and countries are realizing that they form communities, and the only laws to which they will submit hereafter are those made by them for the benefit of the community and not for the benefit of individuals. We have spent lives and treasure in overcoming autocracy in parts of Europe, and the people of this country now will naturally no longer tolerate autocracy at home. The time has come for us to clean our own stables. The people will not longer permit fortunes to be made by our own autocrats, as in the past, by such principles as "the public be damned." The returning soldiers, and those in sympathy with them, will no longer tolerate at home what they have been fighting against abroad.

From One Extreme to the Other

The grave danger which confronts us is the tendency to go from one extreme to the other. The crushing of autocratic rule is very apt to be followed by the rule of an ignorant, excited mob whose stimulants are chiefly such degenerate principles as plundering, revenge, robbery, murder and aversion to work, such rule as now prevails in Russia, Germany and Austria and as prevailed long ago in France, where three thousand or more of those whom the mob held responsible for the former misrule of the people by might were guillotined. France has had a number of these oscillations. The people rebelled again in 1870, establishing the "Commune," when the people found that they had been deceived by their government regarding the war at that time.

The physicists prevent such oscillations between extremes by dampening them; that is, by removing the cause of the swing in the opposite direction. This method can also be applied as effectively to communities by taking away the ammunition of the mob and of the people in general. This ammunition consists of their just causes of complaint. Without the latter the vast majority of the people will not uphold and encourage mob rule, and the few anarchistic leaders then become impotent and can be dealt with by process of law.

To prevent the uprising of mobs in the coming period of reorganization the important point therefore is to remove all just causes of complaint of the people at large, and to show that we are really a true democracy in which the government is by and for the people and not, as in an autocracy, by and for the few who are in power to rule by might. The German Kaiser's attempt to get autocratic control over his own and other nations was the cause of his downfall; the autocratic power of the Russian Czar was the cause of his assassination. All autocratic power—that is, all power of a few over the many for the benefit of the former and at the expense of the latter—should now cease in this country also, and should be replaced by individual liberty and freedom, though, of course, only as far as these are not injurious to the community. The welfare of the community should decide all issues.

This applies alike to the trusts, labor unions, political and religious factions, prohibitionists and all other parties who attempt to rule the community by might or autocratic power. The rights of the people to do as they please, provided they do not infringe on the rights, liberty and welfare of others and do not injure the community, must now be respected, or else the much desired peace on earth and the ending of all wars, civil as well as international, will not be accomplished, and the millions of lives lost and the vast expenditure of two hundred billions of dollars of the people's money will have been largely in vain.

The power of trusts and of large capital to control by autocratic methods must cease or the people will rise against it. One of the most vicious principles of "big business" is to destroy goods, such as foodstuffs, or autocratically to restrict production, in order to create an artificial shortage for the purpose of raising prices. Another is to destroy by autocratic power healthy and perfectly legitimate competition. When capital and the energy of "big business" are applied to making better goods at lower prices the people will welcome, uphold and gladly patronize such business. The small competitor then suffers, but as the community has gained, there can be no just cause for complaint. Many years ago the first pin-making machines destroyed the occupation of a large number of men who had been making pins by hand, but the community benefited by getting much cheaper pins, and hence there was no just cause for complaint. The sewing machine and many other inventions or improvements introduced by capitalistic enterprise killed competition by furnishing better results at lower prices, and the community therefore welcomed such business, even if because of it some individuals had to suffer the loss of their occupations. The dollar watch (of which it is said five millions or more are made and sold annually), the cheap alarm clock, the Ford automobiles, the five and ten-cent stores, the "movies," etc., are all good illustrations of "big business" in which the success was due to the reduction of prices. When people feel that they are getting the worth of their money they spend it freely.

Moreover, producing better goods at lower prices develops the much larger markets of the whole world. Germany's rapid commercial growth prior to the war was

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due to this. Export trade enriches the community as it brings foreign money into the country. The vicious principle of selling more cheaply abroad than at home should be stopped by effective laws, as it means that the home community pays in part for the goods bought by the foreigners, thereby causing rebellious feelings in the home community.

Advocates of high prices also insist on a high protective tariff, which naturally also restricts exports of those protected products and taxes the community heavily for the benefit of a few individuals. A child needs a nurse to protect it as long as it is an infant, and it is generally better off for it; but if it needs such protection all its adult life it is an imbecile and an undesirable charge on the community. So with industries; the protection of an infant industry is very desirable and sometimes even essential, but if it needs such protection after it has had time to develop, it is an undesirable load on the community and, like the imbecile child, had better not have been born.

The world has grown smaller, in the sense that nations have become more closely allied and differences between them will tend to be leveled. Hence the cost of labor will also seek this natural level; where it is too high it will fall and where too low it will rise. The law of supply and demand is a law of nature and applies to labor as well as to goods. Attempts to violate this one of nature's laws autocratically must ultimately end in failure, as the engineer who attempts to violate other laws of nature knows too well. The wise engineer does not attempt it.

The right of a laborer to give up his job or to strike cannot be questioned since slavery has been abolished, provided, however, that he thereby does not become a charge on the innocent community. But to try autocratically to prevent another laborer from working when the latter is willing to work should from now on cease, as the world has now expressed itself against autocracy in any form and will no longer tolerate it. Demanding uniform wages for unequal skill is another form of autocracy which should cease.

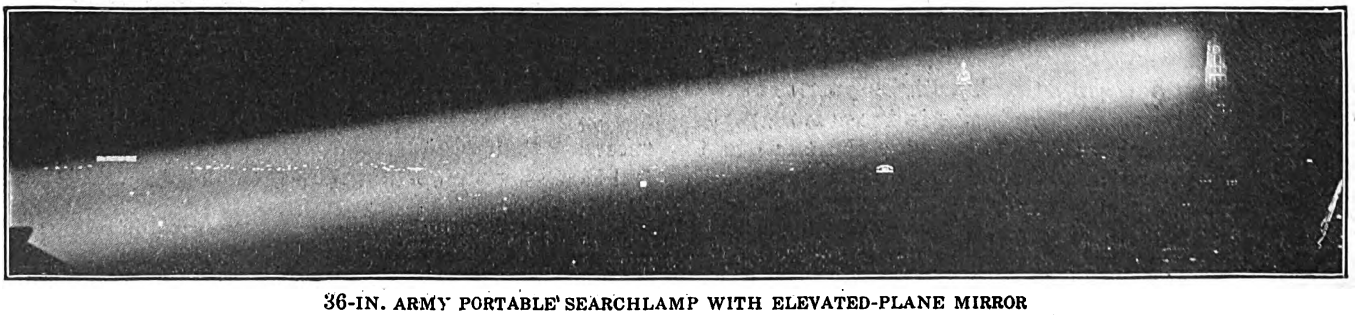
The price of labor must come down or else this country cannot enter the large and attractive markets of the world. The natural law of supply and demand, which it is foolish to shut one's eyes against, like an ostrich, will bring down the labor cost. But unless the cost of the essential commodities comes down in proportion a Bolsheviki uprising in this country, with all its horrors, will be sure to follow, when the millions of employees who have been intoxicated with prosperity and excessive wages will find no more employment. Disarmament in European countries will release an immense amount of labor which will flow into the industries and will lower costs.

The weakness in our business methods lies in part in the excessive overhead charges, often due to overcapitalization and to mortgaging property by bond issues; also in excessive selling costs. If raising the consumer's price a dollar makes it cost a dollar more to sell the goods, it is poor business, as the total sales will naturally be less. Well-made goods at low prices advertise and sell themselves. Quick sales enable one to turn over his capital more frequently during the year. Larger and quicker sales at lower percentage profits would in many cases yield larger annual profits and would open the large markets of the world to the goods; to forbid this is a form of autocracy.

The watered stock and overcapitalization of our railroads has been one of the most serious drawbacks to our progress and to our entering the markets of the world with our goods. Low railroad and shipping rates for freight, express and passengers, based, like the mails, on only the bare cost without profit, such as would result from proper government ownership and operation, and such as are the case in some foreign countries with whose goods ours must compete in the world market, would be one of the greatest possible stimulants to trade.

Another national weakness is that we are non-progressive in that we are too slow in the introduction of new inventions. Europe has in numerous cases been years ahead of us, making profits while we have been asleep. Capital, forgetting that to-morrow is coming, says, "We are making barrels of money now, so why make any changes?" Our method of standardizing goods is too apt to lead to stagnation when carried too far. There is no lack of inventive genius in this country, and we could become the most progressive of the large nations; but capital here does not encourage inventors. Large corporations have claimed that it is cheaper to steal a patent than to buy it; the profits then go largely to the lawyers, and the consumer ultimately has to pay.

The important problems in the present reconstruction period therefore are to depose all the many forms of autocracy in this country and to guard against the threatened Bolsheviki uprising following the very necessary reduction of wages, by reducing the living costs in proportion, and in general by not giving the people just grounds for rebelling. Overhead charges and selling costs should be reduced; overcapitalization and watering of stock should be prevented by laws which are really enforced; prices must be lowered in order to gain the large markets of the world; transportation costs should be lowered, as the mails are, to the bare costs, by government control; capital should turn more to improving our methods and goods, and to lowering their costs of production by developing new and improved processes and inventions; our patent laws should be reformed so as to encourage and protect the inventors more.



36-IN. ARMY PORTABLE SEARCHLAMP WITH ELEVATED-PLANE MIRROR

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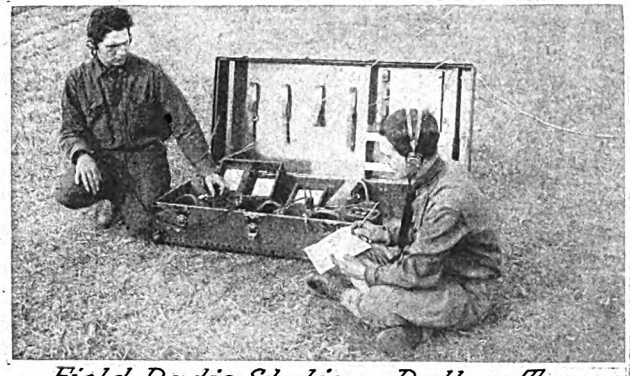
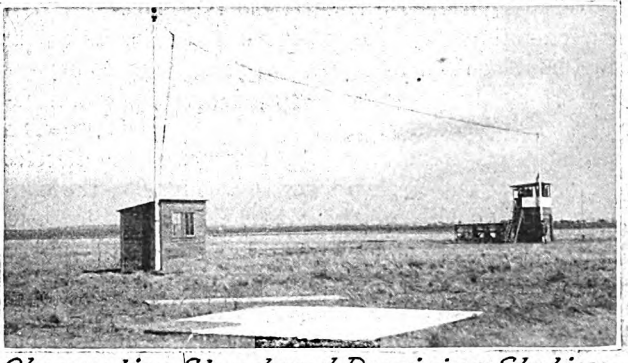
Left:
Pilot and Observer
Preparing for Flight

Right:
Testing Aerial
Before Flight

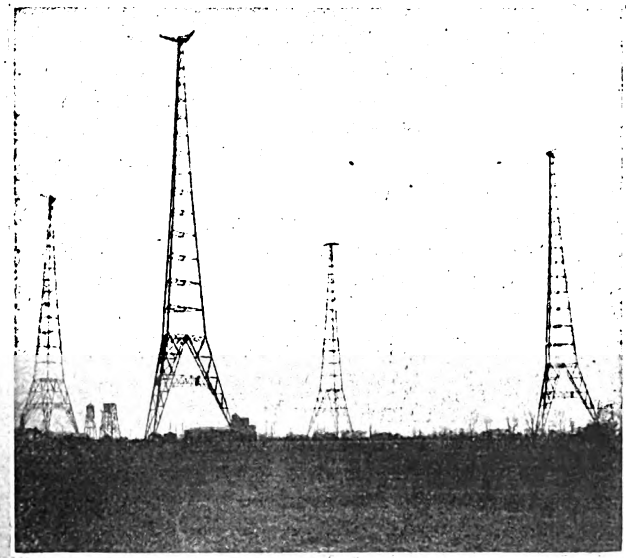
Radio Aero, Love Field, Dallas, Tex.



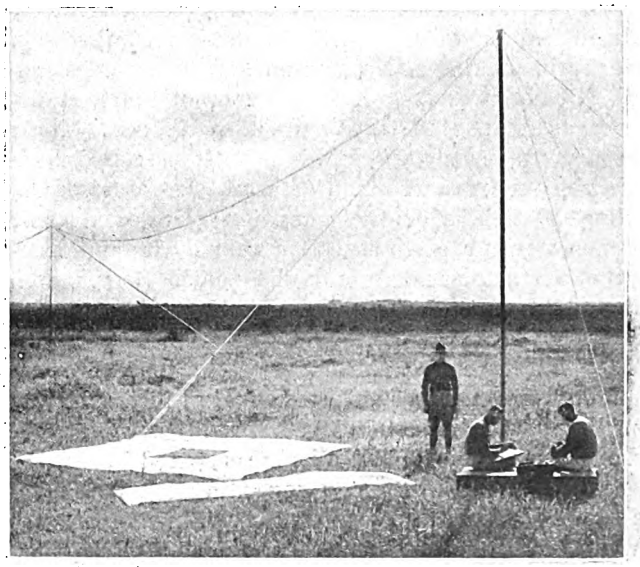
Field Radio Station, Dallas, Tex.



Observation Stand and Receiving Station



High Power Station, Annapolis, Md.



Field Radio Station, Dallas, Tex.

RADIO-TELEGRAPHY IN GOVERNMENT OPERATIONS

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Co-operative Advertising in California

Object of the Movement Is Twofold, Comprising, First, the Education of the Public and, Second, the Amalgamation of the Separate Interests of the Industry in Merchandising

BY S. M. KENNEDY
Secretary and General Agent Southern California Edison Company, Los Angeles, Cal.

WITH the objects of educating the public to the possibilities of better electric service through using electrical appliances and of "tying in" the various branches of the electrical industry in the state that have been working effectively during the war along the lines of practical coöperation, there was published in the last three months of 1918 in many of the newspapers throughout California a series of ten display advertisements covering what is known as the California electrical coöperative advertising campaign. This advertising campaign was worked up and operated by a sub-committee appointed by the advisory committee connected with this campaign. Central stations, contractors, dealers and other merchandisers of electrical apparatus in the various business centers in all parts of the state participated.

EVERY CENTRAL STATION IN THE STATE COVERED

As soon as the copy was prepared a letter explaining the advertising campaign and inclosing the set of ten advertisements was sent to every central station in California. Each advertisement was scheduled to appear on a certain date, the set covering ten weeks commencing Oct. 21 and ending the week before Christmas. The central stations were asked to instruct their district agents or local managers to get in touch with the contractors and dealers in their various territories and advise them in which papers and on what dates the central-station companies would insert the advertisements.

A similar letter and inclosure were also sent to each contractor and dealer, encouraging them to coöperate and take advantage of the advertising to be done by the utilities and to work with the local central-station manager in making the campaign successful and beneficial. Dealers were supplied with a set of fourteen display cards for use in stores and show windows. These were advantageously displayed in most cases. In addition the jobbers and manufacturers were advised regarding all details of the campaign plans, and their salesmen were urged to assist, principally by encouraging the contractor-dealers to do their part. Some manufacturers also inserted timely advertisements in periodicals published in the state. The field representatives of the California electrical coöperative campaign made numerous personal calls on those engaged in the various branches of the industry to create intensive interest and arouse enthusiasm. No effort was spared to see that all concerned were informed regarding the details of the campaign and the objects to be attained.

While it was in no sense a direct selling campaign, the copy prepared for the advertisements naturally emphasized the advantages of electric appliances, featuring them as a means of saving fuel and as practical Christmas gifts. It also recognized the fact that, under the stress of war, reconstruction conditions, transportation restrictions and embargoes on many kinds of materials used in electrical construction and extension, new business must be created by intensifying the use of existing installations. Throughout this publicity the consumer was urged as a patriotic duty to have all electrical appliances repaired and brought up to their utmost efficiency as a means of economizing fuel or its equivalent in electric power. The equally patriotic duty of using high-efficiency lamps was likewise woven into the educational fabric of the campaign.

The encouraging quickness with which the various branches of the industry "tied in" in this educational campaign made it possible to conduct the campaign on such broad and comprehensive lines that the work done cannot fail to result in a greater public interest in electrical goods than has heretofore been achieved by the sporadic advertising of the different interests. The pulling together of all branches of the industry in this campaign has had a marked influence on the newspaper publishers, many of whom have contributed freely very valuable reading notices regarding the campaign. The methods here used seem well directed to blaze the way for future campaigns having a similar object. With the restoration of peace, the resumption of normal conditions and the replenishment of appliance stocks, advertising conducted on these lines will have an opportunity of building an invaluable sales structure upon the educational foundation laid down by the present campaign.

Practically all central stations in the state and nearly all contractor-dealers have taken an active part in the campaign. The dealers were advised a week ahead when and where the advertisements would appear in their territory. Many dealers arranged to have their own advertisements alongside those of the central stations, while in other cases they were run the day following so as to keep up the interest of the public. The dealers further took advantage of the campaign by arranging attractive window displays, sending circular letters to selected lists of customers regarding the appliances advertised, distribution of manufacturers' advertising literature, lantern-slide advertising in theaters, house-to-house calls by solicitors and solicitation by telephone.

ONE COMPANY USED EVERY DAILY PAPER IN ITS FIELD

The central-station companies went into the campaign in a liberal manner, and most of them showed a sincere desire to do their full share in the effort made to bring about the desired coöperation in merchandising methods. One central-station company advertised in all the daily papers in its territory, each advertisement referring the reader to the contractor-dealers for demonstration and purchase of appliances advertised. Another

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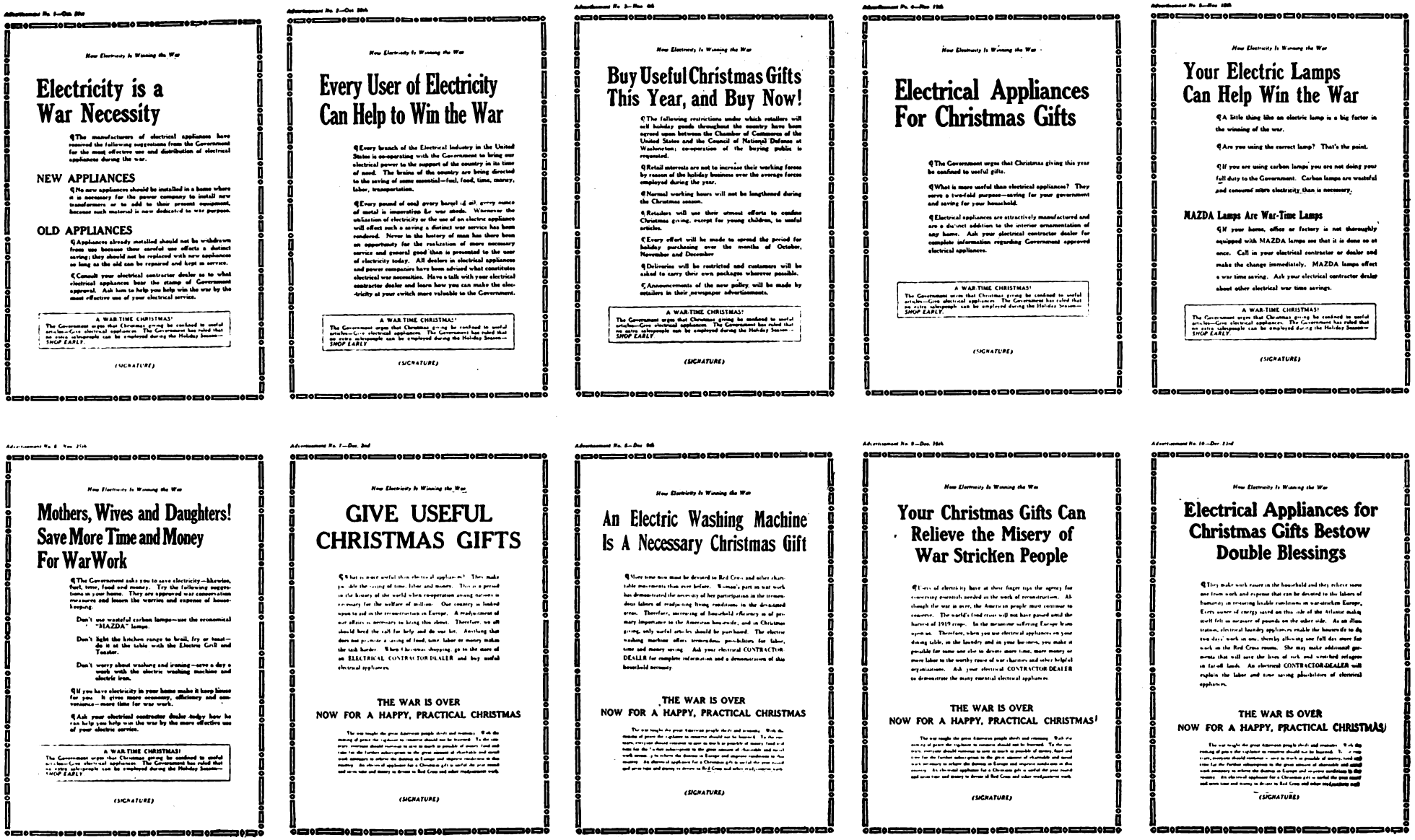

SERIES OF TEN ADVERTISEMENTS USED IN CALIFORNIA ELECTRICAL CO-OPERATIVE ADVERTISING CAMPAIGN

Copies of these advertisements were sent to every central station in the state for insertion in the local newspapers circulating in their respective territory. The response was very general, and the campaign was a success in the production of new business and promotion of coöperation with the contractor-dealers. Prepared before the signing of the armistice, the original copy for all the advertisements had a patriotic "win-the-war" character, but a change to "The War Is Over" was subsequently made. The coöperative advertising plan will be of equal efficacy in the time of peace that is to ensue.

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company, occupying a somewhat scattered territory, advertised in every town on its system in which there were one or more dealers. A smaller company agreed with the contractor-dealers to carry the advertisements week about—that is, one week the central station and the next week the dealers—during the campaign. One of the largest companies in the state turned over to the campaign all of its contracted newspaper space during the ten weeks' period and, in addition, in some localities purchased extra space. This embraced practically all the papers in ten counties, 135 in number. The amount of space contributed totaled 15,000 column inches, the value of which was in excess of $3,000.

When the committee prepared the copy the possibility of the war ending before the close of the campaign was not considered. As a consequence the slogan "Help win the war," conspicuously headlined on most of the advertisements and knitted into the text, was rendered useless with the signing of the armistice on Nov. 11. Three-fourths of the remainder of the series became obsolete, notwithstanding the fact that the fundamental argument for the use of electricity is fully as potent in times of peace as in war. Some of the companies, covering great areas of territory, had sent all of the copy to the publishers with date of publication, and forehanded printers had in many instances set it up as "time copy." Some very rapid revision became necessary, which, while in the main it probably did not detract from the value of the campaign, nevertheless took the appeal out of some cleverly constructed display lines.

Co-operation Between Central Stations and Contractor-Dealers Assured

Undoubtedly the advertising campaign will bring about closer coöperation between the contractor-dealer and the central station. It will demonstrate in an incontrovertible manner to the dealer that the central station is anxious to assist him in making a success of electrical merchandising and willing to spend time and money to carry on essentially instructive work. The advertising campaign should not only materially assist the contractor-dealer in his business but it should have an educational value in showing him effective constructive methods of increasing his retail sales. It will also increase the interest of many contractor-dealers in the retail side of their business.

It must not be overlooked that one of the principal objects of the whole plan of the California electrical coöperative campaign is to educate the contractor-dealer and make him a more aggressive, practical and progressive business man than he has generally been heretofore. The California campaign or any nation-wide campaign cannot be considered successful unless the contractor-dealer is brought to realize the importance of all the work that is being cheerfully done to help him and is willing and anxious to take full advantage of the assistance that is being offered and given him. Coöperation is not a one-sided affair, and the contractor-dealer must do his share in the coöperative plan and qualify himself as a graduated student in merchandising, so that he may be able to take up the commercial work which he asks the central station to lay down and carry it on with credit and profit to himself and continuing satisfaction to the central station.

ENGINEERING CHARGES ON OUTDOOR SUBSTATIONS

Allocation as Investment Attacked on the Ground that the Salaried Staff Is Maintained as an Operating Expense

The allocation of an engineering charge in the construction cost of an outdoor substation was attacked in a recent audit of central-station investment on the ground that the work was done by the company's technical salaried staff, maintained as an operating expense associated with the rendering of service. It was contended that the progress of the art of outdoor substation design had led to standardizations in practice requiring very little engineering in making such installations. The substation in question tied a 2300-volt network into a 22,000-volt transmission supply line; the installation cost about $1,200, and among the itemized charges were labor, $425, and engineering, $58.

In defending the principle of the engineering charge as a capitalizable item, the company pointed out that such a charge would necessarily have been included in the construction cost had the transformers and other equipment been purchased from one or more manufacturing companies installed and ready for service. The engineering charge in question was obtained from actual time slips turned into the office by company employees engaged in the design, layout and supervision of the installation. This work included a determination of proper soil and drainage conditions, proper pole heights, the best arrangement of wire racks, design of concrete foundations to carry the transformer, switching and lightning-arrester equipment, proper arrangement of fencing for the protection of the public and the apparatus, the most convenient assembly of apparatus and material, and the best local arrangement of lines. Another factor in the engineering cost was the relative inaccessibility of the substation from main lines of travel. Even if the engineering charges had not been itemized but had been prorated on a percentage basis, the company maintained their equity, pointing out that they were incurred in excess of normal operating tasks. Talented labor, it was held, is as much a part of construction cost as labor of the most unskilled grade.

AMERICA had almost reached the peak of production of war materials and supplies at the moment when the armistice was signed. The bills are now pouring in which require the government to pay the price of this great effort. The money paid to the government's creditors will find its way promptly back into the channels of commerce and trade and peaceful enterprise and back into the deposits of the banks. The welfare of the people depends no less in peace than in war upon the maintenance of the government's credits. The war is won; the war bills must be paid. The welfare and prosperity of this fair land of ours can only be preserved if the war expenditures of the government, now at their maximum, are promptly and ungrudgingly provided.—*Secretary of the Treasury Carter Glass.*

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

INCREASING EFFICIENCY OF BOILER-ROOM LABOR

Plant Managers Are Advised to Develop Practical Combustion Experts from Their Own Working Forces

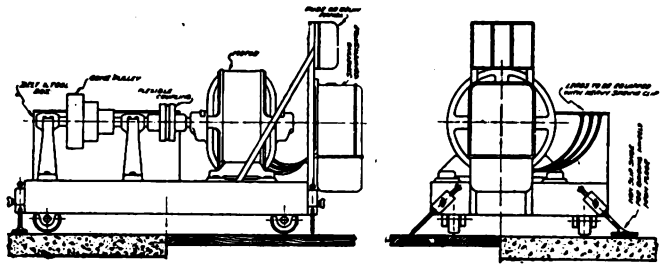
"Building up the standard of intelligence in the boiler room does not mean that one must go out and find combustion experts," said J. G. Worker of the Westinghouse Electric & Manufacturing Company before a recent meeting of the station operating committee of the Ohio Electric Light Association. "A good combustion operator need not be highly technical. Experience has shown that the practical man, with the proper training, is the best man for the job. Statements have frequently been made that certain ends can be attained in operation and economy by employing experts in certain plants. An analysis of such an organization will show that these experts were at one time in the boiler room firing coal. They were trained in combustion and gradually began to think for themselves along combustion lines until they became analytical and commenced looking around for the things that affect the economy of the plant. The building up of a boiler-room organization for any plant can best be accomplished by taking a good man in the organization and building him up for the job. Very little success will follow a plan of bringing outside men into the organization who have the reputation of being the ultimate authority on combustion work."

PRACTICAL SUGGESTION FOR EMERGENCY MOTOR SERVICE

Motor-Control and Power-Transmission Equipment Mounted on Truck so Service Can Be Restored Without Delay or Waste of Material

To enable the maintenance department to reëstablish service quickly in case of motor trouble, A. P. Lewis, Boston, engineer for the General Devices & Fittings Company, offers the following suggestion. The idea is intended to cover an emergency service in an industrial plant where most motors are mounted overhead and the power is transmitted by belt.

The scheme, as illustrated, embodies the following: A four-wheel truck, approximately 3 ft. (90 cm.) in width by 6 ft. or 8 ft. (1.8 m. to 2.4 m.) in length and of extremely heavy and substantial construction, is mounted on four swivel wheels of large diameter. On this truck is mounted a proper-sized, low-speed induction motor of suitable characteristics to fill the plant requirements. The motor is connected through a flexible coupling to a cone pulley, which has suitable steps to fill within certain limits the speed requirements of the line shafts where emergency service may be required. A compensator is provided with the usual protective devices and flexible leads therefrom, ending in high-capacity spring clips, which may be fastened to exposed live parts of the motor circuit in trouble. At the four corners of the truck, on the ends, are inclined holding plates in which pins are fastened with heavy wing nuts for holding them. For wood floors the pins end in points; for concrete floors swivel shoes of non-slip, stair-tread material are preferred. On the truck is a box containing a suitable length or lengths of belt



EMERGENCY MOTOR SET MOUNTED ON TRUCK

with patented splicing connectors for quickly joining ends. The box also contains a small jack.

With such an equipment it is feasible to restore complete service within a few minutes of notification of trouble to the maintenance department, and to do so with a minimum amount of labor and with no waste of temporary material.

RESULT OF EXPERIENCE WITH SUBMERGED COAL STORAGE

Coal Stored for One Year Loses Only 317 B.t.u. Out of 12,518 B. t. u. per Ton—Results Are Fully Satisfactory

In 1912 the Indianapolis (Ind.) Light & Heat Company constructed at its Mill Street station a concrete pit 300 ft. long, 100 ft. wide and 20 ft. deep (91 m. by 30 m. by 6 m.), designed to contain 13,000 tons of coal submerged. Recently the company constructed at its Kentucky Avenue station a reinforced-concrete coal pit which is 145 ft. long, 65 ft. wide and 32 ft. deep (44 m. by 19 m. by 9 m.), built on the same general lines as the former pit and holding 8000 tons. The company burns 500 tons of coal per day, and as the two pits have a total capacity of 20,000 tons submerged and 10,000 tons of coal above the water line, this means a sixty-day supply on hand if both pits are filled. The total cost of the two pits was $60,000, or $2 per ton of storage.

The results of under-water storage, according to T. N. Wynne, superintendent of power, have fully met the company's expectations in that it prevented fires and preserved the heating value of the coal. No trouble has been experienced with excessive moisture when burning pit coal if mine run is used. Screenings which have

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been stored under water burn with difficulty. Whenever coal from the pit is to be used on the stokers it is loaded into railroad cars and the water is allowed to drain off for about six hours before the coal is put into the bunker. The coal may also be drained by lowering the water in the pit sufficiently to uncover the coal required. It has been found in storing the coal that capillary attraction will take care of coal piled above the water level of the pit as much as 8 ft. or 10 ft. (2 m. or 3 m.).

COMPARATIVE TABLE—STORED VERSUS FRESHLY MINED COAL

Kind	No. of Samples	Moisture	Volatile Combustible Matter	Fixed Carbon	Sulphur	Ash	B.t.u. (Dry)
Freshly mined	502	14.68	35.98	56.39	2.14	7.63	12,518
Stored.....	741	14.05	34.98	55.99	2.34	9.03	12,201

The accompanying table shows comparative tests of freshly mined coal and coal which has been stored under water for approximately one year. The coal referred to in these tests comes from the same mine and the same vein. It will be noted that the coal has lost during storage only 317 B.t.u. out of 12,518 B.t.u. per ton.

PORTABLE SUBSTATION OF UNUSUAL CAPACITY

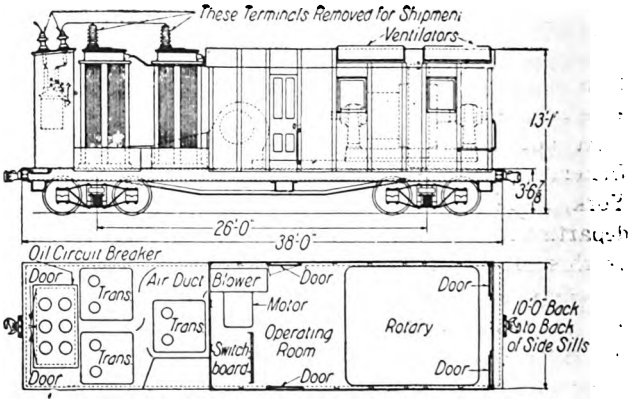
1500-Kva. Converter Installed on Car of Moderate Size—May Be Used in Any Substation or Along Railroad Line

One of the largest portable substations that have yet been produced is owned by the Long Island Railroad Company. It is shown in plan herewith and contains a 1500-kw., 650-volt, 25-cycle, direct-current Westinghouse rotary converter, three 500-kva. combination oil-insulated self-cooled and air-blast single-phase outdoor transformers, complete switching equipment and auxiliary apparatus. The transmission is at 11,000 volts, but the substation is arranged for 33,000 volts, which may be used in the future. The car is so constructed that it can be used for service both indoors and outdoors.

The permanent substations of the Long Island Railroad Company are constructed with a railroad siding entering each building. At the time when one of these stations is about to be subjected to a long-period overload which is beyond the capacity of its converting apparatus the portable substation is conveyed into the building, connections made to the high-tension line and the converter paralleled with the permanent units. The portable outfit is also available to take the place of any permanent unit which may be temporarily unusable. It can also be conveyed to any desired point along the railroad where the high-tension power is available and used as a separate substation during rush hours or holidays.

The over-all dimensions of the car, built by the Railway & Industrial Engineering Company, were restricted, and this caused many manufacturing difficulties. Its length was limited to 38 ft. (11.5 m.) owing to the fact that the permanent substations are equipped inside with railroad sidings on which the portable substation is established when operating in multiple with the permanent units. Owing to traffic regulations, the width was restricted to 10 ft. (3 m.). A height restriction was also recognized by the builders. In addition to these restrictions the apparatus of the substation had to be so distributed as to allow plenty of space within the car for proper attention to the converter and to switching. The arrangement permits four or five men to be with the operator without interfering with his work as far as space is concerned. The apparatus is so disposed as to concentrate all available space near the center of the car and so provide ample room for him.

The most difficult problem was that of the transformers, when it was necessary to bring the height and floor space within the required limits. Forced-air cooling is provided in addition to the self-cooling properties of these units. A small motor-driven fan, housed inside the main cab, which also contains the converter and switchboard, supplies the air, which is discharged into a duct surrounding the lower part of the transformer, where baffle plates and guides so direct it that an even distribution is obtained on all sides. Through a duct whose minimum height is 18 in. (45.7 cm.) the air is carried to the transformers. The normal radiation of the case is thereby increased over 25 per cent, permitting a material reduction in the size of tanks.



LARGE SUBSTATION READILY MOVED TO POINT OF OVERLOAD

With the addition of a leveling device the converter installed is entirely standard in construction. The function of the leveling device is to keep the machine level in case the car is standing with its floor at an angle. Four trap doors in the roof provide the ventilation. Each of the four doors is provided with a water-tight removable cover which is kept in place during outdoor operation. When the covers are removed, as they are for outdoor service, a total opening of 75 sq.ft. (6.7 sq.m.) is provided. Holes through the floor inside the converter bedplate provide ventilation in addition to the air which enters the doors and windows. The roof of the cab over the machine is composed of a removable section built upon a framework. This construction is necessary in order to place the converter in the car or remove it.

With the exception of using a Burke horn-gap high-tension switch, the switching equipment virtually follows the standard practice for portable substations. The car is provided with an oil circuit breaker, which is installed in a separate housing at the opposite end of the car from the main cab. The direct-current terminals are placed on opposite sides of the car in order to make more convenient connections with the direct-current bus of the permanent station.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

NECESSITY OF CULTIVATING THE LOCAL BANKING HOUSE

Talk Made Before Doherty Managers Points Out the Business Principle Involved in Asking for Neighborhood Money

Perhaps one of the most difficult tasks for the average central-station manager is that of interesting the banker and investor in the securities of the central-station property. As a rule there is a satisfactory national demand for large issues, but when it comes to the local demand it is another question. Yet it has been proved many times that local investment is of added value to a utility.

At one of the meetings of the executives of the Doherty Organization held a short time ago in New York, J. M. McMillin, assistant manager of the bond department of Henry L. Doherty & Company, took up this subject in a paper entitled "The Relation of the Property Manager to the Banker and Investor." The author spoke of the necessity of cultivating the local investors and of the way in which the local bankers should be approached. He said:

"In your efforts to perfect the understanding of our business and of our investment securities on the part of the citizens of your community your first endeavor should be directed toward winning the heart of every banker in your town. His good opinion has a local value which of course you understand. But you may not be aware that his impressions go very far afield, extending in a more or less definite way to every investment channel. You can also appreciate the importance of developing your local credit to simplify and minimize the problems of the main office in financing your needs.

"The measure of your banker's good opinion is a willingness to make your property loan, and it may therefore be worth while to call attention to some things which may be expected to come up in your talk with him when you are applying for financial accommodations.

"On the occasion of your first visit the banker may strike his hand and keep the matter from a decision while he puts you through a certain inquiry. He has certain answers and questions always for use in such emergencies. Show him, however, that he wants to do business and he will find the money.

"Incidentally it is worth while to mention that the banks must lend their money in order to make earnings themselves. Therefore they have loaned us money all the time, and to make a satisfactory impression it may be that you can use some part of this money a very good deal of the time. The banker wants good loan accounts as well as deposit accounts, and if you conform to principles of sound banking he will finally come to the conclusion that he does not ever wish to see you fully paid up for very long.

"You should take the position that your company is primarily essential to the welfare of the territory which supports his bank and as such is entitled to his consideration. You are not asking for a loan as a personal favor but simply as a matter of business and as a representative of an industry which is entitled to be heard. Its own future lies absolutely in that of the community and its industry."

CURTAILMENT OF METER TESTING IS A NECESSITY

Such Suspension of Activity, However, Should Be Considered with Special Reference to Types of Meters in Service

BY HALBERT R. THOMAS

Meter and Test Department, Southern California Edison Company, Los Angeles, Cal.

Some divisions of the central sation have been particularly hard hit by present conditions, and not the least among them is the meter department. This has been a favorite place for young men to serve their technical apprenticeship in the organization, and for that reason the draft has laid heavy hands upon it. Many companies which have hitherto maintained regular schedules for periodic meter tests have for some time been confronted with the necessity of curtailing or even suspending this work for an indefinite period.

Any such suspension should be considered with special reference to the types of meters in service. Whatever decision may be reached with respect to the induction type, the most strenuous efforts should be made to keep up regular tests on commutator-type meters. Experience has shown that such meters fall off rapidly in accuracy if calibrated at intervals of more than a year at most. Semi-annual tests are preferable on the larger meters, although they will probably keep their accuracy for longer periods if provided with diamond jewels.

Inspection as a substitute for testing may be found practicable on the induction type of instrument, the inspector merely cleaning the meter and replacing the jewel if necessary. In a commutator-type meter, however, a new jewel frequently shifts the position of the commutator slightly, altering the path of the brushes and throwing the meter badly out of calibration. Such a change is in this case a dubious procedure unless accompanied by a test.

In general, it must be realized that the effect of neglecting this work is an increasing aggregate of small errors, which has a very decided influence on the revenues, even though this may not easily be traceable to the proper source.

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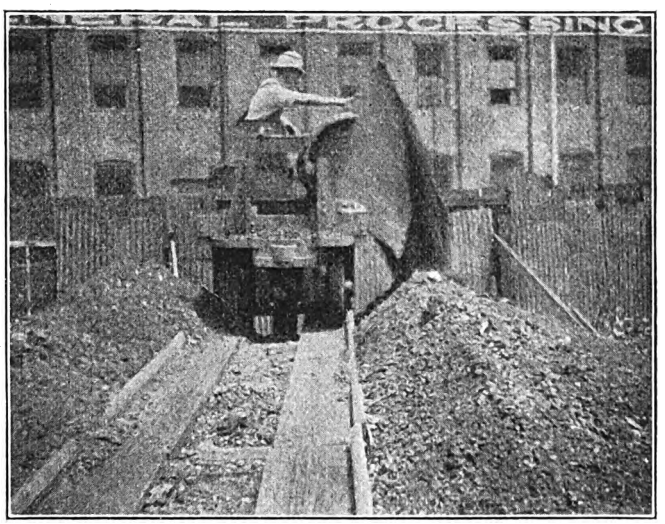
ELECTRIC TRUCK REDUCES THE COAL-HANDLING COST

Carpet Manufacturer Finds that Bigger Loads Can Be Hauled in Less Time and at 50 per Cent of the Cost of Manual Labor

By using a storage-battery truck fitted with a V-dump body of 1-yd. capacity to haul coal to boiler house and storeyard, coal-handling cost has been reduced about 50 per cent by C. H. Masland & Son., a carpet manufacturing concern of Philadelphia. Coal is unloaded by gravity from railroad cars into bins fitted with radial gates.

The truck is loaded in eight seconds with a ton of coal simply by opening a bin gate and allowing the coal to drop into the truck. When the loading was done by hand it took five minutes to do this work.

In the morning the truck hauls coal 300 ft. to the boiler house. In two hours sufficient coal is hauled to



HANDLING COAL BY ELECTRICITY

keep the boilers going all day. The truck then carries coal from the bins to the storage pile. With this method about 20 tons can be handled per hour.

The haul from bins to storage pile is about 115 ft. each way. The loaded truck makes the trip from bins to storage pile in forty-five seconds. The return trip (empty) is made in thirty-five seconds. The load is discharged in ten seconds.

To enable the truck to get on top of the storage pile a runway was built. The truck drives with all four wheels and has no difficulty in negotiating the comparatively steep grade.

By using this method railroad cars are released quickly and demurrage charges avoided. The storage-battery truck, moving heavier loads in less time than is possible with man power, keeps the receiving bins empty so that coal can be unloaded just as soon as it is received.

Analysis of data on several recent installations shows the daily operating cost of a Lakewood storage-battery truck, according to the manufacturer, the Lakewood Engineering Company, Cleveland, Ohio, to be $3.35, including mechanical maintenance charges, interest and depreciation on machine, lubricants, storage-battery maintenance and charging cost (based on 2 cents per kilowatt-hour), but not operator's wages.

QUARTERLY BILLING PLAN TRIED IN PHILADELPHIA

One-Third of the Bills to Go Out Each Month—Adoption of This Method Is Expected to Make Better Labor Conditions

Beginning with Jan. 1, the Philadelphia Electric Company will render all bills to residential customers quarterly. The terms of the contract will not be changed. The minimum charged residences, now 75 cents per month, will be $2.25 covering the three months' period. The added charge for failure to pay a bill within ten days will be calculated as at present. The only point in which the bills under the new system will differ from the monthly bills that customers have been accustomed to receiving will be in proportioning the present monthly charges and methods of computation to the three months' schedule.

The bills will not all be delivered in one month. Approximately one-third of the number of residence customers will be billed in the month of January, a third in February and a third in March. This will establish a quarterly basis which will thereafter be maintained.

The company does not expect to make any change in its guarantee deposit requirements. At present the average deposit for residential customers is $5, and it is believed that this will be ample under the quarterly plan.

The company does not expect the change to effect any appreciable reduction in its meter readings and billing expense at the outset. Departmental routine has necessarily had somewhat deferred attention during the war period owing to lack of help as well as to inefficient help. It is believed that the introduction of the quarterly billing plan will release the time of some of this help so that it may be employed upon other work which is somewhat in arrears.

EFFICIENCY AND RESPONSIBILITY OF PUBLIC UTILITY EMPLOYEES

New Year's Greeting of Dallas (Tex.) President Points Out the Importance of Harmony and Unstinted Service

Efficiency and responsibility formed the theme of the New Year's greeting of J. F. Strickland, president of the Texas Power & Light Company, Dallas Power & Light Company, Texas Electric Railway and Dallas Railway Company, to his "fellow workers." Part of the greeting is here quoted:

"During recent years we have heard and read a lot about 'efficiency.' All of us desire to be more efficient. It has always seemed to me that efficiency is just another name for coöperation. If you can't coöperate with your fellow workers, if you can't realize that their work is important as well as your own, then you are not efficient. When it comes to responsibility, we must not only be ready to assume it, but must also be willing to do the real work that responsibility brings with it. It is certainly true that responsibility comes to him who is capable of assuming it, and it will surely come to you if you are really ready for it. Increased responsibility means increased opportunities for service, and the one who would win great responsibilities must be ready and eager to seize such opportunities."

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Dimensions of Transformers.—A. R. LOW.—The object of this article is to classify the principal problems of transformer design and to compare certain assumptions, methods and results. Problems such as finding the minimum cost of losses when the power transformed is given are solved by the method of determinants.—London *Electrician*, Nov. 15, 1918.

Coil-End Leakage in Direct-Current Machines.—The methods of Arnold and Hobart for calculating the leakage reactance of the coil ends in direct-current machines are based on approximations and on the average results of experiments. The author makes a more accurate calculation and arrives at formulas by which the value of the leakage reactance of any machine may be easily computed.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, April 7, 1918.)

Eddy-Current Losses in Massive Armature Conductors at No Load.—L. DREYFUS.—The distribution of the slot field around the armature shows a wealth of higher harmonics even at no load, and in consequence heavy eddy-current losses are produced in the embedded conductors. The calculations of the magnitude of these losses now given show that the eddy currents react upon the flux density in the teeth, and that this reaction has the effect of setting an upper limit to the eddy-current losses. In fact, already, with moderate depth of the embedded conductors, the eddy currents force back the slot-leakage field into the teeth, so that the slot is freed more and more from the stray field, and the total copper losses decrease instead of continually increasing with the slot depth, as is commonly assumed. In conclusion, the author points out that the conditions at load are much more complex and have hitherto not been cleared up by theory or experiment. Tests made at short circuits are not adequate to elucidate this point, as only the armature leakage flux remains in the slots under this condition. On this account the investigations of Field may only be considered as giving a lower limit for the losses at full load. It is furthermore incorrect to add the no-load eddy-current losses to the short-circuit eddy-current losses in calculating the full-load losses, and there is room for the development of a theory embodying the theories set up for no load and short circuit.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Archiv f. Elektrot.*, 1918.)

Dynamical Theory of Electric Engines.—L. B. ATKINSON.—The paper was given before the Institution of Electrical Engineers as the tenth Kelvin lecture. The lecture developed some of the early work of Lord Kelvin on what may be called the lines adopted by Carnot in the theoretical investigation of heat engines. Assuming in every case an "ideal" engine without losses due to friction, leakage and resistance, he proceeded to develop the theory, showing the action and the theoretical attainable efficiency. "Engines," in the sense used in the title of the lecture, includes generators and motors. Such engines are classified by Mr. Atkinson under the heads of electrostatic, magnetic and electrodynamic, each head being subdivided into classes defining the essential differences of action.—*Electrical Times*, Nov. 14, 1918.

"Hydro's" Queenston Generator Specifications.—Specifications have been issued by the Hydro-Electric Power Commission of Ontario for the big generators needed for the initial installation at Queenston, which will probably total 200,000 hp. It is recognized, however, by the engineers of the commission that these specifications are tentative, and alternatives to be submitted by the tenderers will receive consideration. Each generator is to have a capacity of 45,000 kva. at a power factor 80 per cent lagging. The main problems in the design of these alternators are recognized as ventilation, temperature rise in the insulation, thrust bearing for the vertical shaft and the braking device required to stop the rotor when the turbine gates have been closed. It is said that the ultimate capacity of the station may reach 1,000,000 hp.—*Canadian Engineer*, Nov. 21, 1918.

Lamps and Lighting

Diffusion of Light and Its Definition.—N. A. HALBERTSMA.—The terms "diffusion" and "diffused" are loosely employed in practice. Sometimes diffused lighting merely implies absence of glare and severe shadow contrasts. When applied to globes it is, on the other hand, intended to convey the degree of uniformity of brightness over their surface, irrespective of the illumination. In other cases the terms are applied to convey degree of uniformity of illumination. The author now attempts to find a precise method of defining the diffusion of light by a surface, either by reflection or transmission. Light may be distributed (1) by refraction (prisms, cylindrical lenses, etc.), (2) by mirror reflection from polished surfaces, (3) by diffused transmission through media (opal glass, frosted glass, etc.) and by diffused reflection from more or less matte surfaces. The two former are designated "regular," the two latter "diffused" distribution of light.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, May, 1918.)

Use of Solid Angles and Flux of Light in Lighting Problems.—J. TEICHMUELLER.—Dealing with problems in illumination, we have a choice of two formulas, based respectively on the determination of illumination by the inverse square law at specified points and its determination in terms of the flux of light divided by the area illuminated. The author seeks to show that the latter method is more useful in practice than is generally recognized. To illustrate its application he imagines a

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lamp to be surrounded with a suitable globe, divided into zones, by the aid of which the flux of light in each zone is readily visualized. He then proceeds to show how the derived illumination can be calculated. The method is applied to several practical cases, and it is shown how the average and also the maximum and minimum illumination obtained from two lamps in a given position can be estimated. It is remarked that the method is more readily applicable in open spaces than in rooms, where reflection from walls and ceilings adds materially to the illumination on the working plane.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, June, 1918.)

Generation, Transmission and Distribution

Advantages Resulting from a Throttle-Piece at the Inlet of Reservoirs Destined to Diminish Water Hammer.—DE SPARRE.—The paper is entirely mathematical and proves that for a given pipe and a given value of water hammer a definite reduction in the volume of the reservoir can be brought about by a given throttle. The reduction of the kinetic energy in the water due to the compression is shown to be a definite fraction of the initial kinetic energy, so that the water oscillations are almost completely suppressed and the dangers of resonance eliminated.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Comptes Rendus*, July, 1918.)

Interconnection of Power Systems.—The article consists of a symposium dealing exclusively with Pacific Coast conditions. The subject was introduced by P. M. Downing in an article entitled "Technical Features of the Interconnections of Electric Power Systems of California." He reviewed the rapid growth of the loads on the various California systems, pointed out the increasing cost of fuel oil and estimated the future loads these systems will have to carry. Gaskell S. Jacobs continued the discussion in a paper, "Electric Power in Northern and Central California," in which he also reviewed the rapid growth of the load in these sections, the scarcity of fuel oil in recent times and the rising cost of electrical energy generated by the use of fuel oil. Other causes leading up to the power shortage were indicated as the curtailment of the expansion of generating and transmission facilities, the loss of a considerable portion of skilled labor attracted to more remunerative forms of activity, and finally the lack of rainfall and snowfall in the mountains and consequent depletion of stored water resources. The writer then reviewed the growth of the system in northern and central California and pointed out the prospective power developments in the section. Other papers presented were "The Function of the Pacific Gas & Electric Company in the Interconnected Operation of the Power Companies of Central and Northern California," by J. P. Jollyman; "California-Oregon Power Company and Northern California Power Company," by William M. Shepard, and "Fuel Conservation by Interconnections with the System of the Sierra & San Francisco Power Company," by J. E. Woodbridge.—*Proceedings* A. I. E. E., December, 1918.

Design of Turbine Runner Bands.—JOHN S. CARPENTER.—The article has special reference to high-speed runners. A detailed analysis of hydraulic conditions at the band is developed, giving a simple formula to determine the angle of the band with the vertical.—*Canadian Engineer*, Nov. 21, 1918.

Traction

The Hydroelectric Railway.—E. BELLONI.—A navigable canal joining Milan to the River Po, and consequently to the Adriatic Sea, is now being considered by Italian authorities. In the present article the author draws attention to the fact that this canal would be so expensive both as regards construction and operation that the water transport carried on by it would not provide sufficient support for ordinary railways to operate with it. The author therefore proposes the reduction of the scheme of a large navigable canal to a much smaller power canal energizing a certain number of hydroelectric stations feeding an electric railway running along the canal. Figures and data are given from which the economic convenience of the solution set forth by the author can be estimated.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Elettrotecnica*, September, 1918.)

Electrification of the Montreal Tunnel Zone.—WILLIAM G. GORDON.—The author describes the electrification of the tunnel through Mount Royal at Montreal which was built to give the Canadian Northern Railway entrance into the heart of the city. The tunnel emerges from the mountain several feet above the level of the city, and it is proposed to extend an elevated line at the same uniform grade to connect with the proposed viaduct on the lines of the harbor commission. The tunnel is 3.1 miles (5 km.) long, and the method of construction is described in detail. The power is purchased and delivered to a substation near the west portal of the tunnel. The equipment of the substation is described. At present there are six electric locomotives in operation having a one-hour rating of 1280 hp., and it is proposed to add multiple-unit motor cars for handling the local traffic. Details of the equipment and dimensions of both the locomotives and motor cars are given. The catenary system, which is described in detail, has a number of unusual features due to special local conditions and the extremely low temperatures which sometimes prevail in Montreal.—*Proceedings* A. I. E. E., December, 1918.

A Two-Unit Automatic Substation.—WALTER C. SLADE.—This article describes recent developments in the automatic control of railway substation equipment on the system of the Rhode Island Company and is devoted mainly to an account of the first two-unit rotary-converter automatic station wherein two machines are arranged to run singly or in parallel as required by the load conditions. Another automatic substation is installed at Harmony on the Chepachet line and is supplied with 60-cycle energy at 11,000 volts, purchased from the Narragansett Electric Lighting Company. The Oakland and Harmony substations had to be built to meet the demands of increased and adequate transportation service. The construction of the former allowed about 186,000 lb. of copper in the form of feeder wire to be removed. Automatic control was adopted mainly because of the assured saving in operating labor, and it is estimated that the annual saving in labor and inspection expense will amount to about $600 per year. The equipment of the Oakland substation is described and details of the cost analysis are given.—*Electric Railway Journal*, Dec. 14, 1918.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

MANUFACTURERS PUSHING THEIR PLANS FOR RECONSTRUCTION

Conference of Group Chairmen Held and Arrangements Initiated for Larger Meeting Later—End of General War Service Committee

At the call of the General War Service Committee of the Electrical Manufacturing Industry a meeting of chairmen of the groups composing the different branches of the industry was held at the Engineering Societies Building, New York, on Tuesday of this week. More than forty were present. In the unavoidable absence of A. W. Berresford, chairman of the committee, Clarence L. Collens, 2d, presided as chairman.

Mr. Collens reviewed the joint meeting of the General War Service Committee and the Electrical Manufacturers' Council, held on the previous day, at which the committtee made its final report, and outlined the matters for consideration. These were, in brief, the best form of organization, the best method of maintaining contact with the government, a closer definition of what the electrical industry is, and the plans for the larger mass meeting which is to be held a little later. The larger meeting, at which it is desired to have the entire electrical manufacturing interest represented, is to be addressed by several speakers of national prominence.

Talks were made by a number of those present, and after discussion the following resolution, passed at the meeting on the previous day, was read:

Whereas the General War Service Committee has completed the task for which it was appointed and made its final report to the Electrical Manufacturers' Council, now, therefore, be it

Resolved, that the Electrical Manufacturers' Council recommend to the Electrical Manufacturers' Club, the Associated Manufacturers of Electrical Supplies and the Electric Power Club that the resignation of the General War Service Committee as tendered be accepted; and further

Resolved, that the Electrical Manufacturers' Council and the General War Service Committee in joint meeting recommend to the chairmen of the various war service group committees that they continue the present group organization, such groups as at present form divisions of existing organizations reporting and acting through and with those organizations, such groups as are not at present members of any organization to join with an existing organization or to perfect one of their own as they may elect. Coördination of all to be effected by representation on the Electrical Manufacturers' Council, through which body the proper contact with governmental departments is to be effected; and they further recommend that no contact between individual divisions or groups and governmental departments or other associations be effected without reference first to the Electrical Manufacturers' Council.

The meeting approved this resolution as presenting its views of the action which should be taken. Steps will be taken promptly by the Electrical Manufacturers' Council to put in the hands of every electrical manufacturer a full report of the meeting and, in addition, to complete plans for the larger gathering to be held at a date in the near future.

STRIKING EMPLOYEES BACK AT GENERAL ELECTRIC WORKS

Most of Men Return to Work at Various Plants—Hearing by War Labor Board, Whose Jurisdiction Company Does Not Admit

A hearing was held in New York on Wednesday of this week by the War Labor Board in the General Electric Company sympathetic strike case. At its conclusion the board announced that it would take under consideration and state later whether or not it would assume jurisdiction in a case where one of the parties was unwilling to be bound by the decision. Most of the men are back at work.

On Jan. 2 Secretary Lauck of the board notified company and labor representatives that the Secretary of Labor had referred the matter to it as an "emergency" adding that under these circumstances the board would assume jurisdiction provided the men on strike returned to work immediately.

President E. W. Rice, Jr. of the company replied that the only controversy was at Erie, where 20 per cent of the employees went out because of alleged unfair discharge of ten men. Speaking of the Schenectady, Pittsfield and Fort Wayne works, he said:

As to these three plants, there being no controversy between the management and the employees, and awards or agreements having been made therein, we respectfully suggest, after consultation with the works managers, that there is no occasion for a hearing, as the company has performed and will continue to perform, notwithstanding the violation by the employees, the terms of all existing awards of the National War Labor Board. As to the controversy at Erie, Mr. Griswold, the manager of the Erie plant, who, under our method of organization, is the person in the company with full power to deal with labor problems at that plant, has advised you of his decision not to submit to the jurisdiction of the board. In that decision I concur. As a matter of courtesy to the board, however, a representative of the company will appear, if you still decide the hearing to be necessary, to give the board any additional information.

So far as work was available, the men at the various plants have gone back. At Schenectady, where about 15,600 went out, all but about 1000 have been taken back, and there was no work for these at the time. The situation is similar at Pittsfield and Fort Wayne. At Erie the men who were needed were taken. None were out at Lynn at any time. The men were taken in a preferential order, the general result being that first preference is given to those who had been in the government military or naval service, then those having dependents, etc.

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Efficiency and Economy of the New Mexico

Secretary Daniels and Commander Foote Testify Before Committee on Naval Affairs of the House of Representatives—"Country Has Cause to Be Proud of This Achievement in Engineering"

SECRETARY OF THE NAVY DANIELS and Commander P. W. Foote testified on Jan. 2 before the committee on naval affairs of the House of Representatives to the success of electric propulsion on the New Mexico. Secretary Daniels read a prepared statement. In introducing it he said that the committee of course was very much interested in the result of "what we all regarded as a great experiment in putting electric drive on the New Mexico." Mr. Daniels recalled that after that was ordered there was great opposition to it. A hearing was held before the House committee and also before the Senate committee, when a number of engineers and men who were interested in turbines and ship construction and propulsion appeared and said it would be fatal. There was a division of opinion among experts as to the wisdom of putting electric drive in so big a ship as the New Mexico. "But we studied it," added Mr. Daniels, "and I got the opinion of the best experts in the department and some outside, and decided upon that policy; and I have prepared a statement here showing that our policy has been justified." The Secretary then read his statement, as follows:

SECRETARY OF THE NAVY'S STATEMENT

"I recently paid a visit to the battleship New Mexico, which is the latest dreadnought to join the fleet and the first and the only one of any nation to have electrically operated propelling machinery. On this account she has been an object of surpassing interest to the officers of our own navy and to those of foreign navies as well, and to electrical engineers in general. You will remember that when we decided to equip the capital ships of the 1916 program with electric drive it was represented to this committee and to the Navy Department that we were making a great mistake and that we should think twice before embarking on such an unprecedented experiment. I did not regard it as an experiment, for we were in the fortunate position of being the only nation that had had any experience with this system of propulsion, and that experience was of such a satisfactory character that it would have been unpardonable if we had not profited by it to the fullest extent possible.

"The general board was unanimous in advocating its adoption because of the superior military advantages that its use would secure, and Admiral Griffin, chief of the Bureau of Steam Engineering, not only saw no objection to it from a technical standpoint but was strong in his advocacy of it. Added to this, the best advice that I could get outside of the Navy Department was so convincing of the efficiency of electric drive that I had no hesitation in giving my approval to its adoption.

"Under the circumstances it was but natural that I should have awaited the trial of the New Mexico with interest to learn how well her machinery had functioned—I never doubted that it would prove a success. The result was satisfactory from every point of view and confirmed the judgment of all who were in any way concerned in its design and adoption. There was not the slightest mishap with any part of it—everything worked to perfection, and the crew was as enthusiastic over the performance of the machinery as is the department proud in the possession of such an efficient dreadnought.

"The machinery was designed to develop 26,500 hp. at full speed, which it was expected would give the ship a speed of 21 knots. She actually developed more than 31,000 hp. and maintained for four hours a speed of 21¼ knots—and this when running at a displacement 1000 tons greater than her design called for. If she had been tried at her designed displacement, as is customary with all new ships, she would have made 21.5 knots without any trouble whatever, and what is still better, she could have kept up this speed as long as her fuel lasted, for, like all our later dreadnoughts, she is an oil-burner and there would be no reduction in speed due to the necessity of cleaning fires, which must be done in coal-burning ships after a run of four hours at top speed.

"When we entered into contract for the machinery of the New Mexico, we stipulated that, in addition to being capable of developing the maximum power, she should also give an economy at cruising speed very much superior to that obtainable with the turbine installations that we had previously used, and I am happy to say that this stringent requirement also was met. As a matter of fact, the New Mexico will steam at 10 knots on about 25 per cent less fuel than the best turbine-driven ship that preceded her.

"The shipbuilders who have contracts for electric drive ships were as interested in the trials of the New Mexico as we were, and I arranged that they should have representatives present to witness the operation of the machinery. All took advantage of the opportunity and were as much impressed with the ease and efficiency of operation as were the naval representatives.

"On the whole, I think the country has cause to be proud of this achievement in engineering, not alone because of the pronounced success in this particular instance, but because of the assurance it gives us of the superiority of our capital ships to those of foreign nations."

MR. DANIELS ANSWERS QUESTIONS

In replying to questions Secretary Daniels said that the New Mexico went into commission in October. The trial was last month.

Mr. Butler—Have you had any report from her since she went into commission?

Secretary Daniels—Yes. I was on the ship myself about a month ago.

Mr. Butler—How far has she run since?

Secretary Daniels—She had a trial; then she was at New York at the review and went up from Newport News to New York, and now she is going back to Newport News.

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Commander Foote—She had two sets of trials.

Secretary Daniels—Yes; she had two sets of trials.

Mr. Butler—But then she has been in commission only since October and has been on this coast?

Secretary Daniels—Yes, on this coast; she has not been abroad.

The Secretary asked Commander P. W. Foote to tell about the economy in fuel consumption and the technical operation.

COMMANDER FOOTE EXPLAINS TECHNICAL POINTS

Commander Foote—In the main, sir, the big advantage of the New Mexico over any other ship of her size is this: Of course, when you come to the big-powered ships of that class, the reciprocating engines practically reach their limit, in view of the size and diameter, and so forth, and there was a paper read by Admiral McGowan to the Society of Naval Architects and Marine Engineers a few years ago, showing the wisdom of putting reciprocating engines in the Texas and New York, after they were built as turbine ships, and there was great criticism for doing that. At the time she was built a direct-connected turbine did not get the efficiency; but when you went above those horsepowers, then you had to go to the turbine, and in that stage of the game the turbine was direct-connected. Now it is a fundamental principle of the turbine that its efficiency depends upon a high rotary speed, and the converse is true in regard to the ship's propeller; the ship's propeller to have a high efficiency wants a big diameter and low speed. Therefore, if you have a turbine running at its maximum efficiency, you have to have a high speed, and to have the propeller running at its maximum efficiency you have to have a low speed; and if you hook the two directly together, you get a very poor operating efficiency. At that time the mechanical reduction gear and the electric connection was devised. We had these turbine-driven ships, and England has had them; and then we had the Utah and that class of ships, where the turbine and propeller were hooked together. The North Dakota was an example. And you had to pull the speed of the turbine down as slow as you could and speed the propeller up as high as you could and hook them together; and you had a poor compromise because neither turbine nor propeller was running at its proper efficiency. That was the problem, to get this efficiency. With the mechanical reduction gear, with the ship always running at one speed, you could get a very high efficiency. If you have one of the big liners running back and forth at 21 knots, the mechanical reduction gear is a fine thing, and it is probably superior to an electric drive; because you can design the turbine to run at its very best efficiency and put in a reduction gear to step that speed down to get the best efficiency in the propeller, and have a very happy result.

Mr. Hicks—Isn't it a great waste?

Commander Foote—No; the efficiency of the reduction gear is 98 or 99 per cent; it is a beautiful thing. But when you come to a man-of-war ship, the battleship, which in ordinary times of peace won't operate at a greater speed than 15 knots, you want to be able to make top speed at any time or be able to maintain top speed for a long time, and you have a difficult matter where you are running except at a constant speed. And it is in that type of ship and the big battleships, where we want to operate at different speeds, where electric propulsion finds a very happy application, and that is accomplished in this way: The fundamental principle of the relation between the electric generator and the electric motor is this—I am speaking of alternating currents: The speed of the generator, which is the prime mover, of course, is as to the speed of the motor inversely as the number of poles. You know in the machines you have there are many electric poles. For instance, in the motor you have two poles and in the generator you have thirty-two poles, and your speed of the motor is as one to sixteen, so you step down your electric windings. Now, then, you can rig your motor so that you can throw a switch and have thirty-two poles in that motor, or you can have sixteen, or you can have sixty-four poles. Now that is where we utilize the principle in electric propelling machinery, because if we want to drive the propellers at low speed, which is the top speed of the ship, we throw the switch and have a certain number of poles in this motor. Of course, the poles of the generator remain fixed, you cannot change them; but you throw a switch which gives you the high efficiency of 21 knots, or if you want to step down from 21 to 15 knots, you throw a switch and you can maintain the same relation of the propeller to the mover and you get practically the same economies.

Mr. Hicks—If you keep on burning the same amount of fuel, there would be no economy?

Commander Foote—You turn a valve and cut off the oil. . . . You reduce the steam; the man out in the fire room is told to cut down to so much steam pressure and the engine man just draws it off.

After other questions the discussion was continued.

Commander Foote—To get the power from the motor you have four motor sets. . . . You have a motor over here, a motor over there, one here and another one there (indicating). In here you have your turbo-generating units; there is the turbine and here is the generator (indicating), and out here, of course, is the fire room. The engine room is very small and each one of those motor compartments is isolated in water-tight compartments. That is another thing I think Mr. Daniels is going to speak to you about later. He spoke about the many military characteristics, which are of great value, which you obtain in this type of machinery, due to the flexibility. We have four shafts, and on each shaft is this motor. These motors, of course, are simply connected by a wire, which you can lead around the corners and put in a heavy tube. Each one of these compartments is separated into water-tight compartments. Another beautiful thing is you can absolutely destroy half of your motive power, one of the two big generating units, and the other unit will drive that ship still at 17 knots; because you throw a switch and put either one or all of those four motors on both of them, or the four motors on one of them. And a torpedo could explode in this engine room and blow out this generator and the ship would still go on; or you could blow out this motor compartment or two of them and she could still go on. . . . Another beautiful thing about this machinery, which is superior

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to any other type, is the fact that you have just as much power to run your ship astern as you have to run your ship ahead.

Mr. Butler—How much more does this kind of machinery cost than the other?

Commander Foote—It costs less.

Mr. Butler—Did the machinery in the New Mexico cost less than the steam?

Commander Foote—Mr. Daniels thrashed that point out very thoroughly when he got the bids up.

Mr. Oliver—The claim was made by the turbine men that it would be very much more expensive?

Commander Foote—When we came to get the estimates from the New York yard, Mr. Daniels told them to make the bids on electric propelling machinery and direct-connected machinery, and very much to a great many people's surprise, the bid of the New York Navy Yard on that construction was less than on the other.

Mr. Butler—You do not consider this as an experiment then, any longer?

Commander Foote—No, sir.

Mr. Butler—I do wish, however, the Secretary would put this ship through 5000 miles and see what she would do, and that would silence all of this talk.

Commander Foote—I proposed that. The reason so many people had misgivings about electric propelling machinery was because they thought it was a great experiment. As a matter of fact it was not a great experiment, even on the big ships of her class; because what we are really doing is taking an electric power plant that has been running on shore for years, in principle, and putting it in a ship. There was very little new to be found out except in its application to the propeller; that is all.

The Chairman—You had worked it on the Jupiter, about a 15,000-ton ship, very successfully before that?

Commander Foote—Yes. But it was a new thing so far as putting it on a fighting ship was concerned; but really the only new thing so far as the principles of design of electric machinery goes, the only new thing in the New Mexico, was in our design of a motor. That was new in so far as a certain principle was applied to a motor of that size. It is quite a technical point; but in the New Mexico they had a type of motor which is called a double squirrel-cage motor, and that type of motor had not been built in big sizes before. But it was thoroughly tested out in experimental sizes and there was no question about the success of the design long before it was put in a ship. I happened to be at the General Electric Company's all the time this was tried out, so I know the details. In the Jupiter you had a motor of a different type. You take an alternating-current motor, you have to have a certain design to start that motor under load. You have to have a certain amount of resistance in your circuit; that is what it is, so that when you start the load you have something to push in. So that in the Jupiter the General Electric Company designed a very particular rheostat, a water rheostat unique in its design, and it worked wonderfully well. But it was big and heavy and filled up space in the engine room, so that when we came to lay out a design for a battleship motor they wanted to cut out weight, save space and so forth, so that they adopted this double squirrel-cage motor, which is called the Boucherot type. And it has two sets of windings, one of which has a high resistance and a low reactance and the other a high reactance and a low resistance. So that when you throw on your current the motor is self-contained with the low-resistance connection at the starting speed. For instance, in starting the machine under load, when that electric load comes up to high speed it is at its full power then, and the resistance of the two windings or, rather, the currents that project themselves between the resistances of the two windings and the motor operate this at higher efficiency, and the whole thing is self-contained. The big question with that type of motor is that it particularly lends itself to adaptation.

Mr. Oliver—You remember, at the time the decision of engineers was announced to install this electric propulsion, that the committee was deluged with opinions by expert engineers from all of the country that it was not only an untried experiment but it would prove very costly to install it—far more so than a continuance of the old style?

Commander Foote—I remember that quite well.

The Chairman—I might add this qualification to those opinions, that they came from one source.

Mr. Oliver—That is true. A great many of those opinions came from the steam-engineering people, and I think it is quite an achievement that you have been able to overcome those apprehensions which their opinions led us to believe might be expected.

Commander Foote—There is one thing always involved in this type of machinery, and that is that the particular type of machinery is only built by a small number of builders. And the whole thing, as I say, came to a show-down when the Secretary of the Navy required the navy yard at New York to submit estimates on the two types of machinery. For a year or two previous it had been the plea of many shipbuilders that the electric machinery would be so expensive that they could not tackle it. The Navy Department, I know, had always said to the different builders or, rather, to the advocates of electric propulsion: "When the shipbuilders propose and plan that electric propulsion, then we will push it along," and many of the shipbuilders came along and said they could not do that because it would be too expensive.

Mr. Butler—Do we contemplate putting this same style of propulsion on our new ships?

Commander Foote—Yes, sir; on the battle cruisers.

Mr. Butler—You are going to put it on the battle cruisers; how about the battleships?

Commander Foote—Oh, yes. I speak of the battle cruisers because they have to have so much horsepower.

Mr. Butler—I understand; but how about the battleships?

Commander Foote—Yes, that is the calculation.

Mr. Hicks—What current do you use, alternating currect or direct current?

Commander Foote—Alternating current, 2200 volts. Electric propulsion was about the only way to get the necessary horsepower in a battle cruiser. The battle cruisers have 180,000 hp.

Mr. Butler—I know we talk about all these shafts, and four shafts with 45,000 hp. in each shaft, and 180,000 hp. for the cruisers, and all that; but that is all

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guesswork. I desire to know whether the engineers of the navy are satisfied that we should put it in all of them.

Commander Foote—We only find the greatest enthusiasm.

Mr. Hicks—Horsepower for horsepower, how much economy is there found to be using this method of propulsion over the turbine?

Commander Foote—It is very striking; I can give you a picture. . . . Most people of the navy familiar with running ships will remember a ship like the Louisiana and Connecticut class—I used to be chief engineer on the Louisiana, and I know we used to think we were doing pretty well when we ran that ship 12 knots on 125 tons of coal a day. That is a very much smaller ship than the New Mexico. On the New Mexico I asked one of the engineers the other day what the consumption was in tons of coal per day at 12 knots, and he said about 85 tons. . . . I was speaking about the power to go astern. In turbine ships if you put in a duplicate set of reduction gears to run astern the same as to run ahead, of course that is a very different thing; but that would be difficult and you would not want to do that. What they do is to have about 40 per cent power for stern operation. With the electric gear all you have to do is to throw a switch and you have the same power to run astern as you have to run ahead. I remember in the discussion of the different types of propulsion many people to my mind used the rather high-sounding expression, "We do not build our ships to go astern; always to go ahead," which sounds perfectly good. But sometimes we can only get home by going astern. We have a very beautiful illustration in a case where the bow was cut off and the ship used her power to go astern. And there are many reasons why we want to run astern in maneuvering a ship in battle.

Mr. Hicks—How about the weight of the turbine-driven apparatus for corresponding horsepowers?

Commander Foote—The weight is a little bit in favor of the reduction—you are speaking as compared with reduction operation?

Mr. Hicks—Yes.

Commander Foote—Of course no one any longer compares power with direct connection.

Mr. Hicks—I mean at reduction.

Commander Foote—At a certain speed, counting your installation, the weight is a little in favor of the reduction; but you have to take into consideration so many other things.

Secretary Daniels—How much space do you save?

Commander Foote—Oh, the space saved is very striking. I wish I had a picture here which shows you the layout; because in an engine room, either direct-connection turbine or a reduction-gear turbine, you have to have a number of steam turbines. If you had a shaft like that, four shafts, you would have one or two turbines on each shaft, and you would have to have a head and a stern, you know. That means a mass of steam piping running in each one of those turbines, steam piping running from the turbine of the big condensers, and the engine room is one mass of steam pipes, which means a large amount of space. Now with the electric gear you simply have two turbo-generators, one steam pipe there and one leading to the condenser, another one coming here and another one coming here to the condenser (illustrating), and if you compared the pictures of a plant, you would have a very wide comparison. I had the drawing of an engine-room plant layout and a complete layout of reduction gears, and that whole engine room looks like a forest of steam pipes; and if you lay alongside of it your electric drive, you have a big open space engine room with the engine-setting here (illustrating). And the space comparison is very striking. Mr. Daniels, I remember, spoke of it when he inspected the New Mexico awhile ago. That turbo-generator is about 21 ft. long, I think—that may be a little short—but that whole ship can be driven by this comparatively small unit, set in that small compartment.

Mr. Peters—What is the minimum-size ship on which you use this power?

Commander Foote—Of course to-day the Jupiter is the smallest we use for experimental work. Outside of that, I believe the battleship is the lowest one. They have made a study of the layout for putting it in destroyers, but I think on the whole the reduction gear has been adopted more generally.

Mr. Peters—You do not think it will come down to destroyers eventually?

Commander Foote—I doubt it. It finds its highest adaptation in this big ship of big force, when you want to operate at different speeds, where you have to save space and so forth.

The Chairman—To save the great storage space for fuel and machinery?

Commander Foote—Yes, sir.

Commander Foote—Another thing is the General Electric motor, which is another good military point. In building fighting ships, of course everything has to be secondary to the military features, and the question of whether a certain type of machinery will be a little more economical is secondary to the military characteristics, where it is a fighting machine. And instantly the point comes up in connection with this machinery, that no matter how heavily your ship is pitching, you won't get any racing in the propeller. That, of course, is also a characteristic thing of the electric propulsion, due to this same fundamental principle of the relation of the poles of the generator to the poles of the motor. Those motors are what we call synchronous motors, which means the motors always run at certain speeds in direct ratio to the prime mover, whether or not that propeller is running in air or water.

Mr. Britten—Isn't there a material strain on the shaft, though, when the propeller comes out of the water?

Commander Foote—No, the load would come off. Now, you see what happens in a reciprocating engine, direct-connected steam-engine propeller operation, for instance; if your ship pitches her tail out and the engine speeds up, that is what breaks your shaft.

Mr. Britten—That is different under electric drive?

Commander Foote—With the electric drive it does not speed up; that is the point. You do not have this danger of speeding up; it runs at the same speed, and of course, the load coming off, there is no breaking strain. . . . The power comes down automatically. That is done by your governor on your turbine.

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CONGRESSIONAL INERTIA ON WATER-POWER LEGISLATION

No Real Reason Why, Even Now, the Conference Committee Should Not Be Able to Adjust Differences Between Senate and House Bills

There remains less than two months of the present session of Congress in which to hope for the passage of the water-power bill now in conference between the two houses. The Washington representative of the ELECTRICAL WORLD reports, nevertheless, that, after a careful examination of the two bills now in conference by those who have made a study of the subject, there is no real reason why, even at this late date, the conference committee should not be able to adjust the differences between the Senate and the House bills and report out a bill which could be agreed to by both houses and become a law before Congress ends on March 4.

At the time this dispatch was filed in Washington Senator Shields of Tennessee, who has been ill at his home, was still absent, and inasmuch as he is the chairman of the Senate conferees, and an agreement was made among the conferees that nothing would be done until his return to Washington, no action had been taken by the conferees and none was in sight. Up to the time this was written the conferees had held but one meeting, and they had not actually begun their work. But, it is being pointed out in Washington, unless the water-power bill is passed before March 4, it will die in the present Congress, and much new work and many studies will be required in the new Congress by new committeemen. If that happens, it is stated, the result will obviously be due solely to the inertia of Congress, or, rather, in this instance, to the inertia of the conferees placed in charge of this important legislation.

There are leaders in Congress, even among the conferees, who are endeavoring to avoid the situation which will be created if the conferees allow all the work of the present Congress in this vital matter to come to naught.

THE THREE MAIN POINTS OF DIFFERENCE

This is especially true, the Washington representative of the ELECTRICAL WORLD reports, when it is realized that the so-called three apparently insurmountable obstacles, referred to hereafter, which prevented the conferees on the Shields-Adamson bill from coming to an agreement in the previous Congress, have now disappeared. These are:

First, the House (Sixty-fourth Congress) insisted that each separate application for a permit for water-power development should be approved by Congress, and this the Senate would not agree to. In the bill which recently passed the House and which is now in conference the House receded from this position.

Second, the House (Sixty-fourth Congress) insisted upon a charge or tax for privileges granted, for revenue purposes, and the Senate would not agree upon the ground that the federal government has no constitutional right to make any charge beyond a fair return for the use of government lands and to cover expense of investigation and supervision. While the bill passed by the House and now in conference provides that the licensee shall pay to the United States reasonable annual charges in an amount to be fixed by the commission, yet the Secretaries of War, the Interior and Agriculture each state in their testimony before the House water-power committee that it was not the purpose of those who framed the bill to make it a revenue-producing measure, and they advocated limiting the charges to an amount sufficient to cover cost of administration. During the time the present bill was under consideration by the House amendments to fix charges of from 50 cents to $2 per horsepower per year, and also to revise charges every ten years, were defeated. The Senate bill provides that the United States shall be reimbursed for costs of investigation and supervision and that the United States shall be paid for the use of government lands. Thus, it is pointed out, the House bill is admittedly not intended as a revenue measure, and as the Senate bill provides for payment to the United States of administration expenses and for the use of government lands, all ground for controversy could be eliminated by limiting charges to an amount sufficient to cover cost of administration plus any excess received for use of government lands.

Third, the Shields-Adamson bill of the Sixty-fourth Congress provided that the United States might purchase power developments after fifty years by paying their "actual cost" less "any intangible elements," which experts estimated might not return the grantee over 60 per cent of his actual investment. The Senate bill, on the other hand, provided that the United States should pay "just compensation" if it took over the property. The present Senate bill provides for payment of "just compensation." The House bill provides for payment of the "net investment" of the licensee, which would insure repayment of the money actually invested but no more. The House bill also provides that the government may take over the property at any time upon payment of "just compensation," and therefore if at the end of the license the property is not worth the amount represented by the "net investment," the government would only have to pay "just compensation" as determined by the courts.

Thus, it is shown that one of the three principal differences which formerly existed between Senate and House has been entirely eliminated and a basis for prompt and equitable adjustment has been provided for the other two.

The other principal differences in the bills now in conference are as follows: First, proposed federal power commission; second, amortization, and, third, renewal of license. As to these the following may be said:

First, the Senate bill covers only navigable streams and empowers the Secretary of War to issue permits for water-power developments which are made in connection with navigation improvements. The House bill creates a federal power commission consisting of the Secretaries of War, the Interior and Agriculture, giving it authority to issue licenses for water-power developments in navigable streams, in the national forests and in the public domain, thus assembling under one authority jurisdiction over all phases of water-power development. As the scope of the work of the commission is intended to include investigation of all the hydro-

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electric possibilities of the United States, it would seem as though the coördination of the three great departments of the government in supervision of the development of the nation's greatest resource would tend to promote a degree of efficiency and economy that could not be obtained if the three departments were to work separately in issuing permits for development of the water powers under their jurisdiction.

Second, the House bill provides for establishment of amortization reserves, while the Senate bill has no such provision.

The sole reason for amortization, it is pointed out, is that the cost of the property, if purchased by the government, after fifty years, should be lessened by the amount amortized. The cost of amortization must of necessity come out of the consumer of electricity in the form of added charges. Thus the question to be settled is, Shall the cost of amortization be borne by the present generation for the benefit of those who come after?

The building of hydroelectric systems never stops, it is pointed out. Additions to capacity, new machinery, new requirements of many kinds call continually for new capital. Power companies cannot borrow the full amount required for these expenditures, and they rely upon earnings to make up the portion that cannot be borrowed. Many believe that no portion of earnings should be required to be set aside for amortization reserves during the first ten lean years of operation. After that, it is pointed out, the operator could, if required, probably set aside say not to exceed 25 cents per horsepower per annum for amortization purposes; but to do so would be at the cost of the present-day consumer in additional charge for electric energy.

Third, the Senate bill provides that after the termination of the license the licensee may continue the operation of the property under the terms of the original lease until the government either purchases it for itself or for a new licensee or grants a new license to the original licensee or to a new licensee. The House bill abruptly terminates the right to the original licensee to operate the property after fifty years, thus leaving him a tresspasser upon his own property pending the time that the property is purchased or a new license issued. It is said in Washington that it is so manifest that this clause in the House bill must be remedied if any develoments are to take place that the House conferees will undoubtedly yield the point.

There are other minor differences between the Senate and House bills, but they are of a technical nature and should be easy of adjustment.

The water-power bill passed the United States Senate Dec. 14, 1917, and the House of Representatives Sept. 5, 1918, and was then sent to conference in order that the differences between the Senate and House bills might be adjusted. The conferees, who are among the most able men of the Senate and House, are:

Senators—John K. Shields of Tennessee, chairman; John H. Bankhead of Alabama, Knute Nelson of Minnesota, Henry L. Myers of Montana, Key Pittman of Nevada, Reed Smoot of Utah.

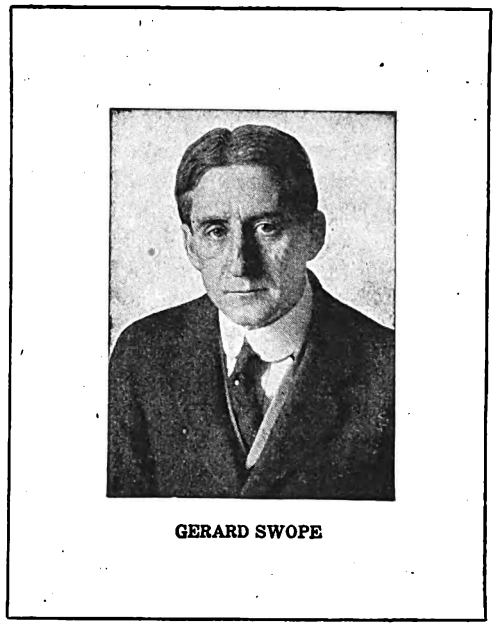
Representatives—Theus W. Sims of Tennessee, chairman; Scott Ferris of Oklahoma, Asbury F. Lever of South Carolina, John J. Esch of Wisconsin, William L. Lafollette of Washington, Gilbert N. Haugen of Iowa.

Senator Shields is momentarily expected back in Washington, and it is known that his colleagues on the conference committee are awaiting only his arrival or the receipt of his views before attempting to reconcile the opposing views of the House and Senate bills, which might be done along the lines above suggested.

FORMING NEW INTERNATIONAL GENERAL ELECTRIC COMPANY

Gerard Swope to Become President of a General Electric Company Foreign Trade Subsidiary—Charles Neave Chairman of the Board

A new corporation, probably bearing the title of the International General Electric Company, will be formed as a subsidiary of the General Electric Company to develop foreign trade. Gerard Swope has resigned as vice-president of the Western Electric Company to become the president of the new organization. Charles Neave of Fish, Richardson & Neave, attorneys, will be chairman of the board. M. A. Oudin, manager of the foreign department of the General Electric Company, will be vice-president of the new company.



GERARD SWOPE

At present the General Electric Company has a well-developed selling organization with offices in many parts of the world and separate subsidiary companies in South America and in other quarters of the globe. While the plans for the new organization are not fully made, it will be a large company.

Mr. Swope, who is announced as the president of the new company, was graduated from the Massachusetts Institute of Technology in 1895 and in the same year entered the employ of the Western Electric Company at Chicago. After spending a year in various departments of the shops he became designing engineer in the power apparatus engineering department. In January, 1901, he organized the St. Louis branch and was its first manager. He was transferred to Chicago in 1906 as power apparatus manager. Two years later he was made general sales manager with headquarters in New York. He was elected vice-president in 1913.

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WELDING BY ELECTRICITY IN SHIPBUILDING INDUSTRY

Comfort A. Adams, President of A. I. E. E., Outlines Activities of Institute Committees and Gives Facts About Welding Practice

Speaking before a joint meeting of the Chicago Section, American Institute of Electrical Engineers, and the electrical section of the Western Society of Engineers at Chicago on Dec. 30, Comfort A. Adams, president of the American Institute of Electrical Engineers, gave some first-hand information concerning the use of electric welding in shipbuilding. He first outlined the history of the activities of those committees of the American Institute of Electrical Engineers which have assisted in the development of electric welding practice in the shipbuilding industry. He predicted that the life of the Emergency Fleet Corporation will be shorter than is generally supposed, which, of course, means that the future work of the American Institute committee is also doomed to be short-lived. The speaker stated unofficially that the committee is planning to publish a full account of its work some time in February. This publication may include something about the development of a new type of cast-steel anchor chain which is the first development in this particular line for many years. The present specifications for the new anchor chain are 40 per cent higher than for the wrought-iron chain used formerly. The quality of this chain is produced by careful heat-treating in which electric furnaces play some part.

Electric welding as applied to shipbuilding is of two sorts, namely, arc welding and spot welding. The phenomena surrounding the passing of the metal across the arc in arc welding are not fully understood, and on this point there is opportunity for considerable research work. The speaker expressed the opinion that in arc welding the major factor to be considered is the skill of the operator. He stated that, in spite of the claims of the various manufacturers, the type of current regulation employed is of comparatively small importance as long as it is possible for the operator to hold the arc. Tests of fifteen different makes of equipment showed almost no appreciable difference in the strength of the welds produced. All of these welds showed at least strength 94 per cent as great as was possessed by the plate itself. Apparently it makes no difference whether the arc is produced by alternating current or by direct current. It is apparent, however, that there is some definite relation between the current strength employed and the resulting tensile strength of the weld. Tests show a consistent tendency for stronger current to produce stronger welds. The tensile strength is also a function of the kind of plate employed.

Apparently, however, it makes no difference whether the electrode used is of absolutely pure iron or of a type of iron containing impurities, since the characteristics of the metal apparently change in going across the arc. In the investigating of all these phenomena there is an opportunity for much research. At present tests are being made to determine the effect of vibration to decide whether metal in welded ships will fail through fatigue. In making any of these tests the work required is enormous on account of the great number of variables involved. In making one set of tests now under way the committee is using 20 tons of samples.

The cost of arc-welding apparatus now varies from $100 to $1,200 for the direct-current units and is around $600 for alternating-current units. The efficiencies of almost all of these sets, the speaker said, are comparatively low. For appreciation of the importance of arc welding, however, it should be understood that with riveting the efficiency of a joint can only be from 50 per cent to 70 per cent, depending upon whether one, two or three lines of rivets are employed, while with electric welding joints which are 94 per cent efficient can be consistently made.

Spot welding is very different from arc welding in that very heavy machinery is required. For welding ½-in. (1.25-cm.) plate the equipment required will weigh about 3 tons and will utilize about 30,000 amp. at 3 volts to 3½ volts. The time of making the weld of course varies with the strength of the current. As compared with arc welding, spot welding requires less time and less labor but more power. This machinery must necessarily be heavy because it is necessary to produce pressures around 25 tons on the plates which are to be welded if ½-in. stock is being worked and electrical ratings around 400 kw. are employed. On account of these facts the application of spot welding is more or less limited. The largest commercial spot welder is now rated at 700 kw. It is the largest in the world except for an experimental machine rated at 2000 kw. Since these machines all operate on single-phase energy, it is usual practice to supply this power through a motor-generator set with a three-phase motor and a single-phase generator, steadied in its action by a large flywheel that will take up a part of the fifteen-second peak usually occurring with welding.

As for the success of electric welding in shipbuilding, the speaker appeared very optimistic. The approval of the Classification Society, which passes on vessels before they are insured, has been secured for arc welding for the minor parts of ships, of which there are about 500,000 on each of the ordinary ships produced in yards like Hog Island. He pointed out that the saving on the first 125-ft. (38-m.) barge which was built completely by electric welding was about 20 per cent over riveted barges of the same character built in the same yard. He also pointed out that it required only about one-tenth of the time to repair the German ships by the electric welding processes that would have been required to put them in shape by any other process.

Perhaps the strongest argument for the adoption of electric-welding processes in shipbuilding is to be found in the comparative cost figures for constructing American ships and English ships. At present it costs America's shipbuilders about $200 per dead-weight ton, while English yards have recently offered to produce all of the ships America desires at a cost of $100 per dead-weight ton for the completed ship. With such facts apparent it must seem necessary for American shipbuilders to adopt every possible means of effecting economies that may be discovered. Since electric welding requires the use of less steel, produces vessels of less weight and hence of greater storage capacity, and effects a considerable saving in labor, electric welding may be a factor in reducing the cost of ships.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Electric Club of Chicago.—At the weekly meeting of the Electric Club of Chicago held on Dec. 26 Prof. Ralph B. Dennis of Northwestern University gave a talk on "Russia in Revolution."

Electric League of Cleveland.—"Hog Island—Its Relation to American Merchant Marine" was the subject of a talk by John Penton of the Penton Publishing Company, given before the Jan. 2 meeting of the Electrical League of Cleveland.

A. I. E. E., Detroit-Ann Arbor Section.—A paper by Prof. H. H. Higbie of the University of Michigan on "Alternating-Current Circuits" was the feature of the meeting held on Dec. 27 by the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers.

A. I. E. E., Schenectady Section.—C. A. Kelsey of the power and mining engineering department of the General Electric Company addressed the Jan. 3 meeting of the Schenectady Section, American Institute of Electrical Engineers, on "The Sugar Industry," his lecture being illustrated by lantern slides and moving pictures.

A. I. E. E., New York Section.—Under the auspices of the American Institute of Electrical Engineers a lecture was given on Friday evening, Jan. 10, in the Engineering Societies Building, New York City, by Major-General George O. Squier, Chief Signal Officer of the United States Army, on "Aeronautics in the United States from the Beginning of the War to the Present Time." The lecture was illustrated by motion pictures.

A. I. E. E., Cleveland Section.—At the Dec. 16 meeting of the Cleveland Section, American Institute of Electrical Engineers, held in Nela Park, John E. Randall of the National Electric Lamp Works gave a talk on the history and development of incandescent electric lamps. Lantern slides were used to illustrate the talk, and a motion picture showing the process of lamp manufacturing from the raw material to the finished bulb was shown.

I. E. S., New England Section A. I. E. E., Boston Section.—A unity meeting was held by the New England Section of the Illuminating Engineering Society and the Boston Section of the American Institute of Electrical Engineers on Jan. 7. M. Luckiesh, of the Nela Research Laboratory and chairman of the camouflage committee of the National Research Council, gave an illustrated talk on "The Principles of Camouflage for Land, Sea and Air."

A. I. E. E., Detroit-Ann Arbor Section.—H. D. James of the Westinghouse Electric & Manufacturing Company was the speaker at the Jan. 10 meeting of the Detroit-Ann Arbor Section, American Institute of Electrical Engineers, giving a talk on "The Development of the Industrial Controller," illustrated by lantern slides showing the history of present-type controllers and the advantages of various designs.

I. E. S., New York Section.—Following an informal dinner held by the New York Section of the Illuminating Engineering Society on Jan. 9 papers were presented by Clifton W. Wilder and Albert F. Allen, Public Service Commission of New York, First District, on "Urban Rapid Transit Lighting," and by W. F. Little and A. C. Dick, Electrical Testing Laboratories, on "Illuminating Notes—Intensities in Hotel Rooms."

Wisconsin State Association of Electrical Contractors and Dealers.—The annual state convention of the Wisconsin State Association of Electrical Contractors and Dealers will be held at the Hotel Pfister in Milwaukee on March 24, 25 and 26. A trade exhibit will be conducted in connection with this meeting, to which a considerable number of manufacturers, jobbers and dealers have already pledged their support. Detailed information regarding the plans may be obtained from John A. Piepkorn, 108 Sycamore Street, Milwaukee, Wis.

San Francisco Electrical Development League.—The Nov. 25 meeting of the San Francisco Electrical Development League was "Old Timers' Day," almost a score of the 135 members present having been in the electrical industry more than thirty years and three having had more than forty years of work to their credit. These latter were Samuel H. Taylor, John A. Britton and Frank Smith. Some of those who reviewed experiences of the early days in the industry were John B. Miller, John A. Britton, Dr. Thomas Addison, A. G. Wishon, Samuel H. Taylor, E. B. Strong, Frank Smith, F. J. Cram and S. Ickelheimer.

American Society of Civil Engineers.—The sixty-sixth annual meeting of the American Society of Civil Engineers will be held on Jan. 15 and 16 in the Engineering Societies Building, New York City. The program for the first day includes the election of officers, business sessions and a luncheon. Brigadier-General R. C. Marshall, Jr., U. S. A., will give an illustrated address at the afternoon session about construction work carried on in this country during the war. A reception to the president will be held in the evening at the Biltmore. On Thursday the society will visit the Brooklyn army supply base and the Newark Bay shipyard of the Submarine Boat Corporation, while in the evening Brigadier-General S. A. Ansell will speak on "War and the American Soldier," followed by an informal smoker.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Service Charge Upheld.—That a service charge is proper as a means of insuring that no individual gas or electric utility customer is served at an actual loss to the company was set forth by the New Hampshire Public Service Commission in a gas rate case, its comments being in part as follows: "The service or ready-to-serve charge is generally regarded by students of utility rates as preferable to the minimum charge, but there is a wide difference of opinion as to how much of the fixed costs should be included in the service charge. To the average user the size of the service charge is not important as a large service charge involves a correspondingly small price and vice versa. With a given plant, interest on the investment and taxes does not depend upon the amount of service rendered, and this is largely true of depreciation, and generally the output may be largely increased without anything like a proportional increase in the cost of operation. It has been found in some instances that the output and capacity costs are about equal. In such cases it would be theoretically correct to assess one-half the costs of operation on the basis of the demand or meter capacity, and the other half on the basis of the amount of service actually rendered. This is a fair and logical basis for rates and would be the best method were the cost of rendering the service the only factor to be considered. But the two extremes, the very large and the very small users, require special attention as the value of the service is often the controlling factor in these cases. The very small user will not take a particular kind of service if it costs him more than would some other equivalent service. The same is true also of the very large user, with the additional feature that he may be able to set up his own plant and is therefore independent. . . . The possible consumer determines what he can afford to buy rather than supply himself, or how much he can afford to pay and set up a manufacturing or other business in a particular locality with a prospect of successfully competing with others. It is then the vital question to the utility whether the proposed low price will give some margin beyond out-of-pocket cost of rendering the service. The best and fairest way to secure such a responsibility on the part of every customer is by the use of a service charge which shall be only sufficient to make sure that no individual consumer is served at an actual loss to the company."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Engineering Award to Hoover.—The Washington award established by the fund provided by John W. Alvord of Chicago has been bestowed by the Western Society of Engineers of Chicago on Herbert C. Hoover for distinguished engineering and human service during the past year.

A Summary of Illinois Rate Cases.—The Illinois State Electric Association has issued a bulletin summarizing all the rate cases which came before the Public Utilities Commission of Illinois between the dates of Jan. 1, 1918, and Nov. 1, 1918. The bulletin gives the number assigned to the case by the Public Utility Commission, the name of the company involved, the locality in which it operates, the class of service under consideration, the date of the commission's order, and remarks on the finding of the commission in each case. Similar information regarding all gas cases handled by the Public Utilities Commission of Illinois in 1918 is also contained in the supplement.

Municipal Lighting Department Increases Rate.—An advance in the net lighting rate from 10 to 12 cents per kilowatt-hour, effective Jan. 20, has been announced by the municipal gas and electric lighting department of Wakefield, Mass. Gas rates are also to go up from $1.20 to $1.35 net per 1000 cu.ft. The town purchases its electricity from the Edison Electric Illuminating Company of Boston and distributes it locally. An advance in the Edison wholesale rate took effect Oct. 1, 1918, and in an announcement to the public the municipal lighting department of Wakefield called attention to the increased cost of labor and materials as the necessary cause of the advancing price.

Copper Production for 1918.—The production of copper in the United States in 1918 was slightly larger than in 1917, according to preliminary figures and estimates collected by B. S. Butler of the United States Geological Survey, Department of the Interior, from all plants that make blister copper from domestic ores or that produce refined copper. At an average price of about 24.75 cents a pound the output for 1918 has a value of $473,000,000, as against values of $510,000,000 for 1917 and $190.000,000 for 1913. The supply of refined copper (electrolytic, Lake, casting and pig) from primary sources, domestic and foreign, for 1918 is estimated at 2,450.000,000 lb. compared with 2,362,000,000 lb. for 1917 and 1,615,000,000 lb. for 1913.

Commission Orders Temporary Increase.—The Illinois Public Utilities Commission has ordered the Rankin Electric Company to increase its general lighting and power service rates until Dec. 1, 1919. The top step of the rate is 20 cents per kilowatt-hour for the first 20 kw.-hr. used per month. On a sliding scale the cost declines to 8 cents per kilowatt-hour for all energy over 350 kw.-hr. per month gross. A prompt-payment discount of 1 cent per kilowatt-hour is stipulated. The minimum bill is to be $1 a month.

Lead and Zinc in 1918.—The domestic mine output of lead and zinc decreased in 1918, according to C. E. Siebenthal, in a statement issued by the United States Geological Survey, Department of the Interior. The lead and the recoverable zinc of ores mined was approximately 563,000 tons and 627,000 tons, as compared with 651,156 tons and 711,192 tons in 1917. The average price of lead at New York was 7.6 cents a pound and of spelter at St. Louis 8 cents a pound.

Demobilization and Peace Training at Stevens.—With demobilization of the army and navy units of the Students' Army Training Corps at Stevens Institute of Technology, Hoboken, N. J., completed, there are left nearly 500 men who will go on with the regular mechanical engineering course, only about seventy having withdrawn. This is regarded as an exceptional record and leaves the total college attendance close to the highest record of previous years, which was 520. Even this may be surpassed by the return of men who left in the early days of the war.

Doing Honor to Veterans of the Edison Service.—Gray-haired annuitants were the guests of honor at a luncheon given by the Commonwealth Edison Company of Chicago on the last day of the old year. The beneficiaries of the company's service annuity system are retired employees who have earned the privilege of resting and are carried on the pension payroll of the company. A number of the executive officers, heads of departments and older employees were invited to meet these men and swap reminiscences. Eighty-five were in attendance. The luncheon and reception were given in the new rest room and refectory fitted up for women employees on the eighteenth floor of the Edison Building. The food was cooked by electricity and served by members of "Electra," an organization of women employees. Music was given by an orchestra of young men employed by the company. Letters were read from annuitants who were unable to be present, and a brief address was made by Samuel Insull, the president of the company. The service annuity system has been in existence for seven years. Employees make no contribution whatever to this fund, which is a voluntary recognition on the part of the Commonwealth Edison Company that long-time employees are entitled to some reward for faithful service in addition to their regular wages.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Death from Charged Street-Lamp Cable.—In an action against an electric light company for death due to contact with a charged cable used for the purpose of raising and lowering a street lamp, evidence was held by the Supreme Court of New York, Appellate Division, to show actionable negligence on part of the company, in Freedman versus Buffalo General Electric Company. The electric light company was not necessarily relieved from liability for death caused by contact with cable used for raising and lowering street lamp, which cable had become charged with electricity, by the fact that deceased of his own free act touched the cable without any knowledge of its dangerous condition.

Liability for Furnishing Appliances.—A city owning a light plant which furnished material and wired buildings for owner is subject to the same liabilities for neglect of wiring as any other electric contractor, according to the Supreme Court of North Carolina (97 S. 378). A city furnishing electric energy to bottling works and having installed wiring therein, but not furnishing lamp bulbs, is not liable for death caused by bottling works company's failure to screw the bulbs in far enough. The city was not liable for moist condition of floor nor for the placing of a belt and pulley and could not have foreseen that a metal soaker would be used as a stepladder in replacing the belt, thus requiring a different light socket for safety in handling light.

Safe-Place Doctrine.—A telephone company is not bound to furnish a lineman a reasonably safe place to work, as against dangers inherent in the work of repair, though it is liable if the danger arises incident to the place where the work is done, made dangerous by adjacent electric power wires, the Kansas City Court of Appeals held (206 S. W., 430). If a plasterer hired to mend broken telephone wire was ignorant of danger, the employer cannot escape liability on the ground that the safe-place doctrine is inapplicable. It is the duty of a telephone company specially hiring a plasterer to mend a broken wire which has fallen across power wires and become electrically charged to warn him of the danger. Where a telephone company for years permitted wires to be so strung that if they broke they would fall upon power wires and become electrically charged, it could not escape liability to a workman injured by such current on the ground of ignorance of the danger.

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Charles F. Gray, consulting electrical engineer, has been elected Mayor of Winnipeg, Manitoba, by a majority of almost 5000. Mr. Gray is a member of the American Institute of Electrical Engineers.

J. Lee Pottes, formerly superintendent of the Amherst Gas Company, has been appointed successor to Charles S. Spaulding, resigned, as superintendent of the Newburyport (Mass.) Gas & Electric Company.

Charles L. Spaulding, for twenty years superintendent of the Newburyport (Mass.) Gas & Electric Company, has been appointed general manager of the Wakefield (Mass.) municipal light plant, succeeding Sidney L. Cole, who has resigned on account of his health.

C. W. Koiner, general manager and electrical engineer of the Pasadena (Cal.) light and power works, has returned to his regular duties at Pasadena after serving for a period in war work with the engineering section, power department, of the Emergency Fleet Corporation, looking after technical work and general power problems.

W. J. MacPherson, recently discharged from the army with the rank of captain, has been appointed superintendent of one of the divisions of the Public Service Company of Northern Illinois to succeed H. K. Mitchell, who resigned. Mr. MacPherson was superintendent of one of the public service company's plants before he joined the second officers' training camp.

H. R. Palmer, formerly general superintendent of the Virginia Railway & Power Company, operating in Richmond, Norfolk, Petersburg, etc., has been appointed general manager of the Harrisburg (Pa.) Light & Power Company, succeeding C. M. Kaltwasser, who has resigned to go into other business. Mr. Palmer started in the public utility business in 1890 at Morristown, N. J., and in 1894 entered the employ of the Virginia company, with which he has been ever since. Mr. Palmer is a graduate of the New York State Normal School.

William W. Plattner, who for the last ten years has been superintendent of the North Attleboro (Mass.) Electric Light & Water Department, has resigned in order to devote his full attention to his duties as a member of the State Legislature. Mr. Plattner was born in Ohio in 1883 and for more than twenty years has been associated with public service work. Previous to his connection with the North Attleboro plant he was superintendent of the Board of Public Affairs at Bluffton, Ohio. Previous to that he was associated with the Commonwealth Edison Company, the Calumet Lighting Company, the Northwestern Elevated Railroad Company and the Milwaukee Electric Railway & Light Company. During the past eight years he has acted in addition as a consulting expert for various municipalities on matters taining to franchises, utility rates, etc.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

H. W. Clapp has been promoted from general superintendent to general manager of the Columbus (Ohio) Railway, Power & Light Company. Mr. Clapp was born in Australia and for four years before coming to America was superintendent of motive power of the Brisbane Tramways. In 1902 he became connected with the General Electric Company as engineer in the New York territory, and during his connection of five and one-half years with this company was intimately associated with the electrification of the New York Central Railroad. In 1907 he entered the electrical engineering department of the Southern Pacific Railroad. About four years later he became assistant electrical engineer in charge of construction of the Trans-Bay Electric Lines of the Southern Pacific Company. It was shortly after that that he resigned to become general superintendent of the Columbus system.

H. W. CLAPP

N. L. Snow, formerly vice-president and sales manager of the Terry Steam Turbine Company, Hartford, Conn., has been elected vice-president and general manager of that company.

James H. Wilkerson of Cook County, Ill., has been appointed a member of the State Public Utilities Commission of Illinois, having taken office on Jan. 1, to succeed Commissioner Sterling, who assumed the duties of State Treasurer at that time. Mr. Wilkerson is a former member of the Legislature and was United States District Attorney for the Northern District of Illinois during the term of President Taft. For two years he has been First Assistant Attorney-General of the state.

Charles Spaulding of Newburyport, Mass., has been appointed manager of the Wakefield (Mass.) municipal gas and electric department. The appointment became effective Jan. 1.

F. N. Boyer, district manager for the General Electric Company, with which he has had more than twenty-eight years of active service, has retired from active business life. Older men in the electrical industry will remember Mr. Boyer as general manager of the Edison Electric Light & Power Company of Reading, Pa., from 1884 to 1891 and as incandescent lamp specialist under John I. Beggs for the Edison General Electric Company in Chicago in 1891. Mr. Boyer was born at Reading, Pa., Sept. 9, 1855. Thirteen years later he entered the employ of the Philadelphia, Reading & Pottsville Telegraph Company as messenger boy and in 1869 was promoted to be telegraph operator. He was wire chief in charge of all telegraph wires of the Philadelphia & Reading Railroad Company from 1884 until 1891, when he entered the employ of the Edison General Electric Company. On Feb. 1, 1892, Mr. Boyer was appointed manager of incandescent lamps and of the wire and cable department. A few months later, when the General Electric Company was organized as a consolidation of the Edison and Thomson-Houston interests, this position was abolished and Mr. Boyer was made assistant manager of the supply department in Chicago, becoming Chicago manager of this department in 1895. In 1908, on the retirement of B. E. Sunny as manager of the Chicago district and the appointment of James W. Johnson as his successor, Mr. Boyer was appointed assistant district manager, and in 1912 he was made district manager for St. Louis. He is a member of the General Electric Quarter Century Club, the Old-Time Telegraphers' and Historical Association, the American Academy of Political and Social Science, the National Geographic Society, the American Asiatic Association, the Engineers' Club of St. Louis, the Jovians and many other organizations in St. Louis.

Obituary

Murray Copes Conley of the Lorain County Electric Company died at Elyria, Ohio, on Dec. 21.

Robert C. Bacon, former chairman of the Vermont Public Service Commission, died at Brattleboro, Vt., Jan. 2. Mr. Bacon was born at Washington, D. C., in 1874, and was educated at Dartmouth College and the Boston University and New York University law schools. He was admitted to the Vermont bar in 1899. In 1911 he was elected president of the Central New Hampshire Power Company of Maine, and in 1913 was appointed chairman of the Vermont commission by Governor Fletcher. After resigning from the board he was engaged in private law practice.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FOREIGN INTEREST GROWS IN AMERICAN ELECTRICAL GOODS

Many Requests Are Being Received for Agencies in Europe, in the East and in South American Countries

Interest in American electrical goods is growing very rapidly in Europe, the Far East and South America. Each week a number of requests are received in this country for foreign agencies. The Italians are especially active in this connection. As a rule these foreign concerns do not handle electrical goods alone but in conjunction with a quantity of other merchandise.

There are also a number of representatives of foreign importing houses here wishing to handle American electrical goods abroad on a commission basis. Also, there are some foreign buyers in this country.

In most instances the foreign houses that wish sole representation are willing to buy the goods cash against shipping documents. Very few concerns are asking for credit.

$10,000,000 WORTH OF HEATING APPLIANCES SOLD IN 1918

In Actual Volume the Production of Last Year Was in the Neighborhood of Twice the Production for 1914

From being what was popularly known as a specialty a few years ago the electric heating device has pushed ahead until the business is now one of the leaders in the electrical field. Accurate figures are not available, but estimates by those in a position to be best informed place the total output of electrical heating devices for 1918 at $10,000,000. Of this about $8,000,000 probably represents the production of domestic appliances and $2,000,000 the production of industrial devices.

Figures from the reports of the census give the comparable output for 1914 as $3,500,000 roughly and $1,600,000 for 1909. However, in making comparisons it must be remembered that 1918 prices were on the average from 50 to 75 per cent higher than those that prevailed before the war. With this in mind, it is probably true that the volume of the 1918 output was somewhere double that for 1914.

The demand last year, on the other hand, was much greater than the supply. Some careful estimates place at $13,000,000 what would have been the probable 1918 output had it been possible to obtain sufficient raw materials and labor. Furthermore, there are many who state that the high prices prevented numerous sales. It is doubtful if the curtailment program in any way reduced the output of heating devices. The war was over before this measure of conservation had a chance to become effective.

Manufacturers appear to be optimistic over the outlook for the year, especially for the development of range sales. During the past year the electric range had many unfavorable conditions, not of its own making, to meet. These, it is understood, are being removed, and an excellent year is expected.

Many developments are in the process of perfecting, and some new types are about to be brought out.

Standardization is expected to make rapid strides this year, and it has been intimated that standards of appliance plugs and receptacles can be expected. This has been wished for for many years, but the manufacturers have not been able to come to any agreement. A committee of the National Electric Light Association has been trying to bring about some standards in this connection, but there is still a very great number of different types.

JOBBERS ARE NO LONGER KEEPING LARGE STOCKS

Now That Deliveries Are Better Supply Men Will Again Make Shipment on Large Orders from Manufacturers' Stock

On large orders jobbers prior to the war as a rule made shipments from manufacturers' stocks. The stocks carried by the jobber were utilized to take care of the every-day local retail stock replenishment and small building needs.

When, however, deliveries became very undependable, the jobber saw the necessity of increasing stock so as to be able to serve from stock any of his customers. It was not uncommon during the past year for a jobber to deliver 3000 ft. to 4000 ft. of iron conduit out of his own stock.

Conditions, however, are again swinging back toward normal, and jobbers are again reducing stocks. This does not mean that stocks are going to be allowed to run down. Rather does it mean that manufacturers' stocks are again going to be drawn on for large orders. Local stocks will be kept up to the extent necessary to satisfy the immediate local demand with a sufficient margin of safety. The savings that will result to the jobber are by no means small.

Conduit stocks are rapidly getting into shape. Wire stocks are much better, and unless incoming shipments are reduced or a larger volume of business placed there may result some cases of an overstock of wire. Moreover, manufacturers of appliances may find difficulty in persuading jobbers to stock up early. This will not apply so strongly to lamps because the jobber has no stock investment.

LARGE SYNCHRONOUS MOTORS ARE NOW IN GOOD DEMAND

Orders for the Smaller Sizes Are No Longer Coming in for Large Quantities—Inquiries Are Picking Up Steadily

Motor sales have been falling off for the past two months. This was to be expected. Nevertheless, a very satisfactory volume of business is being placed. Not all lines of industry are buying, to be sure, but then again in some instances industries that were curtailed as a conservation measure are now in the market.

Current sales are for a smaller number of motors than were called for a few months ago. Then it was no uncommon thing to get requests for forty or more motors on a single order. Now orders are for a much smaller number.

A number of sales of large synchronous motors have been made in the last few days. The demand for large induction motors, however, is very small. Shipments of the former can be made in a few weeks, but large induction

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motors can be had only in five months. This is better by two months than the time which the manufacturers quoted in October last.

Stocks of small motors are rapidly being built up, although they are still very spotty. Stocks of 3-hp, motors of one manufacturer, for instance, are still very low owing to the large demand that has been made for this size. Generally speaking, however, motors up to 50 hp. can now be obtained readily out of stock in quantities sufficient to satisfy any reasonable demand that might be expected at the present time.

Direct-current stocks are low, it is reported. Before the war efforts were made to use the alternating-current motor everywhere. As a result the sale of direct-current motors fell away down. Since the war started the direct-current demand has come up by leaps and bounds. From now on, however, direct-current sales are not expected to be nearly as large.

Motor prices show no tendency as yet to weaken. The drop in iron and steel prices would hardly be expected to affect motors, but the combination of this with the drop in copper has raised the question of a probable lower motor price. Manufacturers, however, point to their stocks of raw material, laid in when prices were high, and to their labor costs, which have not come down, and they ask if buyers are justified in holding out for lower prices. One Middle Western concern stated early in the week that it was hard to see how prices could be lower for at least three months to come—possibly longer.

METAL MARKET SITUATION

Copper Production Being Cut as a Result of a Lull in Buying That Has Taken Place

The dullness that has characterized the past few weeks is still hanging over the market. Prices are being jockeyed about in an attempt to find a level on which business can be done.

Copper is lower than it was. Some of the producers have already begun to curtail production, both of the raw product and of the refined metal. As the price goes down other mines will have to close because it will be unprofitable to do business. Wire base, which apparently advanced a cent a pound this week, practically receded from its high price of a few weeks ago many points.

Tin is still quiet. Indications pointed this week to the probable absorption before very many weeks of the government stocks.

Dealing in other metals was more or less spotty. There is no demand apparently for scrap metal. Dealers are holding back waiting to see what the future will bring forth.

Prices in the past week stayed remarkably steady, but the tendency was to weaken.

NEW YORK METAL MARKET PRICES

	Dec. 30	Jan. 7
Copper:	£ s d	£ s d
London, standard spot	112 0 0	96 0 0
	Cents per Pound	Cents per Pound
Prime Lake	23.00	23.00
Electrolytic	23.00	20.62½
Casting	23.00	19.00
Wire base	28.75	29.75
Lead, trust price	6.00	6.00
Antimony	7.62½	7.75
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	13.00	13.00
Spelter, spot	8.15	7.90
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.50	16.00 to 16.50
Brass, heavy	9.00 to 9.50	9.00 to 9.50
Brass, light	8.00 to 8.25	7.50 to 8.00
Lead, heavy	4.50 to 4.75	4.50 to 4.75
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

THE WEEK
IN TRADE

CUSTOMARY winter dullness continues. Few orders are being placed, but inquiries seem to be getting better. A larger volume of business is confidently expected to develop before long.

Except for wire, which dropped about 20 per cent, the market is exceptionally free from changes. One increase—namely, 25 per cent or more on fans—is reported.

Local stocks are being filled by shipments on back orders, many of which had no cancellation clause. Deliveries are much better everywhere, but especially so west of the Mississippi. The mild and open winter has been very helpful in this respect.

It is interesting to notice the rapidity with which the ranks of salesmen are being filled up. The industry is again actively soliciting business where a few weeks ago buying was discouraged and no new business desired.

NEW YORK

While there is very little incoming business, every one seems very optimistic and there is a genuine feeling that big business is on its way. This season as a rule is quiet, and the local distributers see no reason for feeling blue just because things aren't steaming along at a high rate of speed.

Prices are holding remarkably firm. Wire is about 20 per cent lower owing to the lower price of copper, but other commodities have not reflected the drop yet.

There is little that can be said. Shipments are coming in on back orders and are going into stock. Jobbers are not placing any orders for the present. All along the line there is just at present a hesitancy to do much in the way of building, as better prices are expected. The drop in price of steel and copper has led buyers to expect a corresponding revision of prices of finished products. There is a growing volume of new building under estimate. Some municipal projects are contemplated, including a rather comprehensive school-building campaign.

MOTORS.—Published prices show no change, but here and there where stocks are large and the business good salesmen are cutting under somewhat to make a quick sale. Inquiries are better than they have been.

CONDUIT.—Although plumbers' pipe decreased 3 points in price on Jan. 1, no change has been made, so far as could be learned on going to press, in the quotation for rigid-iron conduit.

HEATING APPLIANCES.—Local stocks are picking up rapidly. The shortage of irons and heaters in distributers' stocks is expected to be cleared up this week. In some places an overstock is developing. Dry-goods stores are cutting prices to clean up stock left over from Christmas trade. The cold weather has made some demand, it is reported, on heater stocks. Some business on all lines is coming in. No central-station campaign contracts have yet been placed, so far as could be learned.

FANS.—The new price lists made their appearance in New York this week and show, on the whole, an increase of around 20 per cent on the desk and oscillating types and 25 per cent on the ceiling fans. This, however, is by no means so large an advance as had previously been decided upon. Had war continued the advance would probably have at least 35 per cent.

WIRE.—As a result of the drop in copper price wire has fallen many points. Of ten prominent manufacturers three were quoting on Monday 27 cent base on rubber-covered, two 28 cents, four 30 cents, and one 32 cents. Considering

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discounts, however, rubber-covered base is probably between 27 and 28 cents, a drop of six to seven points. Quite recently one or two manufacturers have stopped selling on base, and they are now selling on cost.

ARMORED CONDUCTOR.—The prices current on Tuesday for No. 14 two-wire Realflex, full coil, was $70 per 1000 ft.; other sizes and kinds, 35 per cent discount; armored lead conductor, 35 per cent discount, and lead and armored cable, 28 per cent off.

SCHEDULE MATERIAL.—There has been considerable speculation locally regarding the effect of lower copper prices on sockets, switches, etc. Prices, however, are remaining firm, and representatives of the factories say that it is hard to see how prices can be lowered at present. Copper for current production was purchased at the high prices, and labor is still as costly as ever.

CHICAGO

Inventories, the closing of books, sales conferences and other usual first-of-the-year activities have combined to make this a quiet week. Events continue to indicate, however, that the next business will come from the central stations. The Commonwealth Edison Company has applied to the Public Utilities Commission of Illinois for authoirty to issue $4,000,000 of first-mortgage bonds. The Public Service Company of Northern Illinois is selling a bond issue, and the Michigan Light Company, a constituent company with the Commonwealth Power, Railway & Light Company, is offering $700,000 of 5 per cent bonds. Jobbers are watching this situation carefully. When one of them received an order this week from a central station for 500 large cross-arms he was particularly elated since it indicated that something in the way of a real buying movement is starting.

The railroads also are looked upon as a source of large business in 1919. Inquiries which are now out for material seem to presage a heavier volume of business from the railroads in 1919 than has come from them in many years. Some of Chicago's larger industrial plants are going ahead buying, but this demand on the whole is not what it has been.

Prices have not yet yielded materially. Except for copper there has been no serious decline. Certain kinds of steel have been reduced, but this may not have a great effect in the electrical trade.

Stocks of material in jobbers' hands are now adequate. If any particular jobber is short on any item, it is probably through his own neglect.

CONDUIT.—There was no change in the price of conduit on Jan. 1 as had been expected.

COPPER WIRE.—Since the drop in copper prices was announced the wire market has been engaged in a "spreading-out process." All prices were pretty well in line before that time and will no doubt again reach a common level soon. Just now bare copper wire is quoted at from 25 cents to 26 cents, weatherproof wire ranges from 28 cents to 29 cents, and rubber-covered wire has a spread of 3 cents a pound, ranging from 32 cents to 29 cents in one case.

SCHEDULE MATERIAL.—If the expected building boom comes in the spring, the jobbers will be found to have ample stocks of schedule material.

INCANDESCENT LAMPS.—Nearly every one reports that lamp sales are of good volume.

BOSTON

Trade still reflects a waiting attitude on the part of the public with sound underlying conditions. Prices are fairly steady, though here and there there is a tendency toward reduction in order to maintain material movement. An excellent holiday trade in appliances is reported. A beginning in building construction is evidenced by applications for permits in various cities. The Poli interests are about to build a new theater at Hartford, Conn., costing about $250,000 equipped. Three public garages, to cost about $150,000, are scheduled for early construction at Worcester, Mass. Contracts totaling over $382,000 have been awarded by the Ordnance Department at Washington to Worcester manufacturers. Electrical contractors are doing more estimating than for some time, and not a little mill reconstruction is in progress. Stock increases are in contemplation by one or two Massachusetts central stations, and a relaxation of regulations regarding financing electric extensions is also under consideration in public utility circles, though no general break in policies is expected at this time. Collections are still a little slow. Deliveries are improving in most lines, and stocks are in excellent condition as a rule. Labor conditions are easier, and work has been resumed generally at the Pittsfield works of the General Electric Company, following the strike to which reference was made in previous issues. The company has reclassified its employment schedule and has so far declined to take back many of the strikers.

CONTROLLING EQUIPMENT.—The demand is increasing for apparatus in the smaller sizes. The market for large equipment is quiet. Prices hold firm and deliveries are improving.

INDUSTRIAL ELECTRIC TRUCKS.—Prices are about the same. Deliveries are reasonably good, and inquiries and sales hold up well. The high cost of labor is a vital factor in the success of this class of equipment. Some difficulty is reported in securing motors promptly for truck service, and this seems to be largely a matter of transportation congestion. To overcome this delay one of the leading makers of industrial trucks recently sent a man to the motor factory and checked the motors back to the truck factory.

STORAGE BATTERIES.—The demand for automobile batteries is excellent. Stocks are increasing, although there are still gaps which cause annoyance in local stores. Prices are expected to remain firm for the present.

FIXTURES.—The portable-lamp business of the holiday period is reported better than in 1917 by a leading dealer, and a brisk trade was enjoyed by retailers in this line at Christmas time. A fair year-around business in portables is developing, with silk floor lamps showing great popularity at this time. The fixture market is still rather quiet, but the outlook is better than of late. The mills are not able to stock up much. Prices are holding firm.

INSULATING FIBER.—Raw material is freer, and manufacturers of the vulcanized type with cotton base are in better shape to make deliveries. The domestic and government demands are both reduced. Prices are steady, and sales managers are looking expectantly toward foreign markets.

HOUSE WIRING.—Contractors are doing more or less house wiring now at Bath, Me., Worcester, Mass., and Concord, N. H. A much larger business in this line is anticipated in the late winter or early spring.

MOTORS.—Factory stocks are not increasing very fast, and prices are somewhat erratic. The demand is spotty at present, and stocks are uneven. The smaller sizes up to 50 hp. are now fairly easy to obtain for immediate delivery. Labor is getting easier.

VACUUM CLEANERS.—Manufacturers, jobbers and retailers are doing a rushing business. One Massachusetts factory reports that it is so far behind on orders that it is working nights. One of its distributers reported not a cleaner on his floor a few days ago. No price changes are expected for the present. Factory labor and material supply are reported plentiful. Manufacturers will soon complete their war contract work and be able to devote their entire production energies to their regular products.

WIRE.—Prices are shading downward by 2 to 3 cents per pound, compared with a fortnight or so ago. Buying is light and factory stocks are increasing.

INDUSTRIAL SWITCHBOARDS.—Government orders are falling off and domestic business is at present rather dull. Labor is easier and lower prices are anticipated before long in some circles.

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ATLANTA

The present outlook is bright for a revival of building operations. Meager reports from a few cities show that a number of building permits have been issued covering a substantial volume of construction. Contractors are of the opinion that if material prices do drop off it will be a very gradual decline and that wages will remain at the present standard for some time to come. On the other hand, a great deal of uncertainty exists as to the outcome of building for government account. The hopes of a number of towns and cities for new government buildings appear to be blasted. Construction work has been held up since 1914 on some buildings, and on all sides since the United States entered the war. And now, according to Treasury officials, high cost of materials apparently will prohibit contractors from bidding for the jobs at the prices fixed by the government. A few by scaling down the plans can be brought within the limits.

The spirit of optimism which now prevails among the building interests is reflected to some extent to the electrical jobbers and manufacturers. One jobber, whose volume of sales for 1918 exceeded that for 1917 by 40 per cent, has comprehensive plans for a year of great activity. Soon after the armistice was signed a number of buyers shut off on all purchases, awaiting a big slump in prices, but this policy of hesitancy has vanished more or less and purchases are being made more freely. On the whole, the dealers are looking forward to a good business during the year and are filling in on their normal sixty-day stocks. Holiday sales were away above expectations.

The army supply base at New Orleans will cost about $15,000,000. This, together with municipal belt lines, grain elevators and wharves, will total approximately $27,000,000. Some expansion is noted in the textile industry as indicated by new structures and additions. The Model Mill, Spartanburg, S. C., will be equipped throughout with electric drive. The Georgia Railroad Commission has granted an increase in street-car fares from 5 to 6 cents for Rome and Athens and an increase in electric light and power rates for the Athens, Rome & Panola Light & Power Company, at Conyers and Lithonia, Ga.

SOCKET APPLIANCES.—The volume of sales in washing machines is increasing month by month. For a time shipments were curtailed, but deliveries are improving. New dealers are not looking for any sharp decline and are buying quite freely. Vacuum-cleaner sales for this season are very satisfactory. Deliveries are getting better. Prices are firm. Dealers report an excellent business in flatirons. The present cold wave has exhausted local stocks of radio heaters. There has been a standing demand during the past two winters which the manufacturers and dealers have been unable to supply. The dealers who have been fortunate enough to secure reasonable quantities of heaters have made quick turnovers and substantial profits.

FLASHLAMPS.—The holiday demand has not diminished, and transactions are being handled that exceed by far anything compared with the same period a year ago. Battery shipments have reached the point where very little difficulty is being experienced, and reshipments are going forward in good time.

SEATTLE—PORTLAND

Business is comparatively quiet with both jobber and dealer, the usual low after-holiday sales being experienced. Jobbers are closing up the books for the year, and while the actual results of the year's business have not been announced, it is safe to say that the volume in the aggregate will exceed by far any previous year in the Northwest. In spite of decrease in sales both jobbers and dealers feel but little apprehension as regards the future.

Many prospects are reported by electrical contractors for new and reconstruction work. Demand for substantial residences continues unabated, and the indications point to renewed activity in residence building. Tacoma reports that residence building has shown no material falling off during the past month, and announcements of construction of new residences are being made daily. Reports from Portland state that business for the holiday week was good, but conditions in the electrical field have very materially slowed up since that time. The past week has been largely given over to inventory work, and there is little to report in the line of new business. Recently the commission of public docks of Portland opened bids on wiring of one section of the new municipal docks that are being constructed in connection with the municipal grain elevator. Bids are averaging $20,000 with no awards to date. The Northwest Steel Company of Portland is completing a new marine outfitting plant in which approximately thirty motors will be installed, aggregating 300 hp. More than $200,000,000 will be spent by the French government in Seattle, Tacoma, Portland and Vancouver, B. C., if the government approves of the contract for 174 ships recently awarded by the French government to the Foundation Company of Tacoma and Portland.

The expenditure of this sum in the Northwest ports means an even greater prosperity and activity in industrial lines than has heretofore prevailed. Ships ordered from the Foundation Company are to be of steel ranging from 2500 tons to 10,000 tons dead weight. The government is still in the local market for quantities of ship timbers for Eastern shipbuilders.

WIRE.—A decrease in price of rubber-covered wire is noted. This did not affect local dealers particularly, as a shortage of stocks has been experienced for some time. The demand for this commodity in all sizes is well sustained, owing to continued activity in shipbuilding and other building operations.

DOMESTIC APPLIANCES.—Since the holidays sales have decreased materially, especially in washing and sewing machines, percolators and flatirons.

SAN FRANCISCO

The present electrical attitude is one of watchful waiting. Orders are comparatively small and more in the nature of immediate needs than of stock, especially on standard material. There are many bids, however, from the government, mostly for small quantities of standard electrical wiring devices. The State of California and the Southern Pacific Railroad are also calling for bids on a lot of material. San Francisco and Los Angeles jobbers report that the prevailing epidemic of influenza has seriously hit their forces, especially in the sales departments. New building contemplated includes a hundred-thousand-dollar machine shop for Los Angeles, a large housing proposition in Clarkdale, Ariz., new schools and wharves for San Francisco, a projected 100-room tourists' hotel in Las Vegas, N. M.; a government radio station at Mare Island and a two-million-dollar religious temple in Paradise Valley near Phoenix, Ariz.

LAMPS.—Deliveries are fair, and considerable relief for customers whose stocks are low has been secured by carefully gleaning the stocks of other dealers who have plenty on hand.

WIRE AND CABLE.—Rubber-covered wire and cable has lately dropped to the 30-cent base and this has affected lamp cord as well. Jobbers are again selling standard sizes such as No. 14 single-braid in less than coil lots. There is very little business for waterproof wire and cable.

SCHEDULE MATERIAL.—Marine schedule material is in great demand, and several of the large manufacturers are supplementing their regular lines with emergency lines manufactured on the Pacific Coast by several firms. This business will continue unabated for many months. There has been a sharp drop in the price of standard sockets and push and snap switches of about 10 to 15 per cent.

CONDUIT.—Local stocks of conduit have been recovered, and once again it is possible to make coast shipments.

WASHING MACHINES.—The stock situation is better. The demand is not so good, however, as it was a few months ago.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71 00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160 00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
2 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.44 to $0.45	$0.44 to $0.45
12 to 50	.38 to .39	.38 to .39
50 to barrel	.35 to .362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
1	50	13.00
1¼	50	21.00
1½	50	26.00
2	25–50	35.00
2½	25–50	45.00
3	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75 00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
1	.12	1¾	.47
1¼	.15	2	.55
1½	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00–50.70	$24.60–35.20	$23 00–30.25
½-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00
½-in.—	65.00	32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb	7% to 7.1%	9% to 9.1%
2500 to 5000 lb	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb	+5.5% to +3.5%	+3.5% to +1.5%
2500 to 5000 lb	+2.5% to +0.5%	+5% to +1.5%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$7.00 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List, each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted:		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.47—$40.77
Coil to 1000 ft.	27.42— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$38.00
Coil to 1000 ft.	28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$30.00 to $33.00

OUTLET BOXES

	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%	10%
$10.00 to $50.00 list	30%	20%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17 85– 21.00
Standard package, 2200. List per 1000,	20.00– 21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 5½ N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$16.00	$32.00
1/5 to std. pkg.	13.60	27.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 5½ N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$13 00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
¾-in. cap key and push sockets	500	$0.33
¾-in. cap keyless socket	500	.30
¾-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.60
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5 to %5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	70
10-amp. double-pole	50	70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list.	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.55– $0.66
No. 18, full spools	.53– 56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.75
No. 18, full spools	.435 to .635

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00–$25.00	$12.50–$17.00	$12.50–$15.00
12	23.40– 27.09	21.06– 23.22	17.55– 23.22
10	32.14– 32.40	28.92– 32.40	23.14– 27.45
8	40.32– 45.72	36.96– 45.72	32.26– 38.10
6	58.52– 72.36	53.20– 60.30	51.07– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$24.00–$25.00	$17.50–$18.00	$15.00–$15.50
12	30.48– 31.44	30.48– 31.44	26.67– 31.44
10	42.32– 43.84	42.32– 43.84	37.03– 38.36
8	59.36– 61.76	59.36– 61.76	51.94– 54.04
6	97.68–101.28	85.47– 88.62	85.47– 88.62

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$38.75
25 to 50 lb	38.75
50 to 100 lb	37.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$35.76 to $39.75
25 to 50 lb	34.76 to 38.75
50 to 100 lb	33.76 to 37.75

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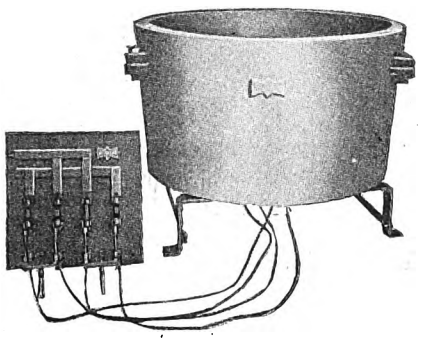
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Large Electric Melting Pot

A 30-gal. (113-l.) electric melting pot for industrial use in heating glue, wax, pitch and other materials is now being made by the Simplex Electric Heating Company of Cambridge, Mass. The pot, which is of cast iron, is surrounded by ample insulating material held in place by a galvanized-iron cas-



THREE HEATS ARE PROVIDED

ing, and has a diameter of about 28 in. (71 cm.) and a depth of 12 in. (30 cm.). The heating element is attached to the bottom of the pot and is designed so that a maximum temperature of not less than 350 deg. Fahr. (175 deg. C.) may be generated. Three heats may be obtained—a high heat requiring 7 kw., sufficient to bring the contents to the proper working temperature quickly; a medium heat taking 4.3 kw., and a low heat using 2.3 kw. Depending on the nature of the material being heated, either the medium or the low heat is used to maintain the proper temperature. Heat control is provided through the use of a switch panel having inclosed fuses.

Non-Water-Tight Receptacles for Marine Use

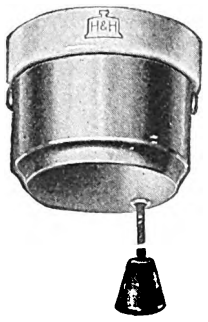
"Spartan" interchangeable-type receptacles and plugs for marine use where non-water-tight extension cord outlets are desired in cabins, staterooms and for other similar installations are being marketed by the Bryant Electric Company of Bridgeport, Conn. Especially advantageous, according to the maker, is the use of these plug-type receptacles since they fit the plugs furnished with every fan motor, practically all table lamps and many other appliances.

A composition material described as unbreakable is used for the bases of these receptacles as in all other Bryant marine devices, while the top section is composed of hard-white-glazed porcelain. A bottom diameter of 1¾ in. (4.45 cm.), a top diameter of 1⅜ in. (3.49 cm.) and a height of 1⅛ in. (4.6 cm.) are the dimensions of these receptacles, which have a groove of ample size in the bases for wires to pass through or to permit wire entrance from the bottom of the box.

One plug, the K. D. cap, is intended for use with small-size flexible cords not over ⅜ in. (1.03 cm.) in diameter, while for heavily insulated or metal-armored cables up to 9/16 in. (1.43 cm.) in diameter, the M. K. cap is best suited, as it is provided with a strain relief clamp and cord grip. As both these caps are made of unbreakable composition, they will withstand severe service.

Heavy-Type Ceiling Snap Switch

The Hart & Hegeman Manufacturing Company, Hartford, Conn., is now producing a heavy type of ceiling snap switch rated at 2-10 amp., 250 volts.



SUITABLE FOR MANY KINDS OF SERVICE

This switch can be furnished to give single-pole, double-pole, three-way, two-circuit and three-circuit connections. Nickel-finish covers are provided and 10 ft. (3 m.) of black cord is furnished with each switch.

Spray-Type Dishwasher of Large Capacity

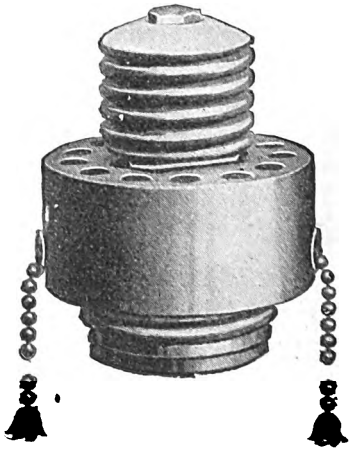
The "Champion" electrically operated dishwasher for hotels and restaurants has a capacity of about 12,000 dishes per hour and is being manufactured by the Hamilton-Low Company, 145 East Forty-second Street, New York City. Dishes are fed into one end of the machine, travel on a belt conveyor, sprayed from above and below by washing and rinsing water, and come out cleaned at the other end.

A 2-hp. motor is directly connected to the driving shafts of two centrifugal pumps, which elevate the washing and the rinsing water to the sprays from two cast-iron tanks below the dish conveyor. The belt has power transmitted to its shaft by means of two sets of worm and gear. The machine is said to be easily operated since the water is renewed automatically, the operator's duties consisting of feeding and unloading the dishes.

No baskets are used for the dishes, these being placed directly on the conveyor, but mesh-wire baskets are used for washing the silverware. Removable doors inclose the entire mechanism, glass windows being provided in front so that the operation of the machine may be observed by the attendant. Beneath the conveying belt are placed perforated screens which catch all particles of food washed from the dishes. Another and finer screen is placed over the pump channel to prevent foodstuffs from being drawn into the pumps and sprayed back on the dishes. All moving parts of the machine are bronze or steel, according to particular requirements, and everything has been done, according to the makers, to insure durability and facilitate easy cleaning of the washer.

Light-Regulating Socket

The "Anylite" regulating lamp socket, by which it is possible to have twelve different intensities of light from the same bulb, has been placed on the market in an improved form by



UPPER END SCREWS IN SOCKET WHILE LAMP IS INSERTED IN LOWER END

the Anylite Electric Company of Fort Wayne, Ind. The regulator, which is inserted in a lamp socket, consists of an Edison screw-shell attachment plug, a resistor in series with the lamp terminals and a pull-chain regulator, and a medium-base brass shell socket

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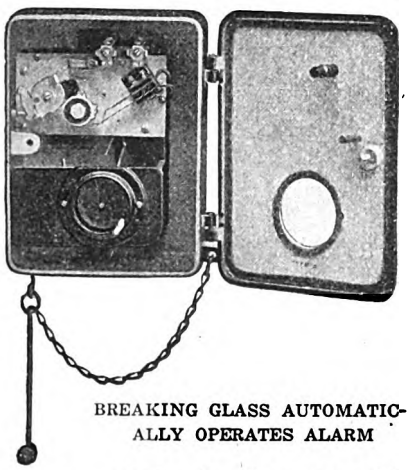
which is of the shade-holding type. The different parts are well insulated and ventilated, and the highly polished brass shell gives the device an ornamental appearance. The regulator is rated at 125 volts and 40 watts. Pulling one of the chains changes the light from 40 watts when the light is on full to 5 watts when most resistance is used. The other chain reverses the order, gradually changing the intensity from low to high.

Interior Fire-Alarm Apparatus

Fire-alarm mechanism arranged for operation in conjunction with the standard "Autocall" signaling system manufactured by the Autocall Company of Shelby, Ohio, or for separate use, is being marketed by this company. When used in connection with the Autocall system this fire-alarm apparatus saves the cost of separate signaling systems, since the fire-alarm calls are transmitted on the signaling instruments of the Autocall system, a device for summoning any one wanted, in whatever part of a building he may happen to be at the time. The fire-alarm equipment consists of fire boxes, which may be placed in the various rooms of a building, and a control board designed to automatically give the fire-alarm signals precedence over all other Autocall signals and so prevent the confusion which might occur were both systems operating at the same time.

The fire boxes are of the code-ringing type, installed in series on a closed circuit and connected to the signal circuit of the Autocall system through the dual control board. By breaking the glass in one of these boxes an alarm entirely different from the ordinary Autocall signals is transmitted on all the signaling bells, whistles or horns of the Autocall system. The alarm signals, which are given four times, consist of a preliminary or warning alarm of ten or more rapid taps followed by a code signal corresponding with the number of the fire box from which the alarm is turned in, this denoting the location of the fire. The boxes are designed to permit silent testing of the mechanism.



BREAKING GLASS AUTOMATICALLY OPERATES ALARM

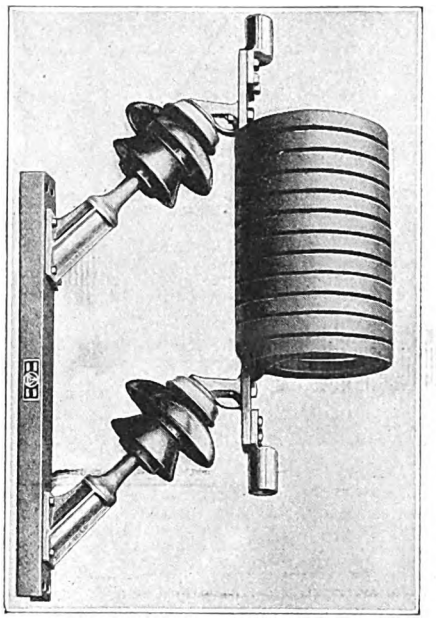
When a fire box is operated the control board instantly cuts out the Autocall central sending station, preventing ordinary calls from being turned in while the fire alarm is in the process of transmission. A time element on the board "holds out" the Autocall central-sending station until the fire signal has been repeated four times, when that station may complete an interrupted ordinary signal or transmit new calls. As a precaution against trouble the fire-box circuit is supervised by a small flow of supervising current. In case of a malicious or accidental interruption to any part of the fire-box circuit a trouble bell sounds a warning signal and continues ringing until the trouble is relieved. As the signaling instruments are constantly used by the Autocall system for ordinary signals they are under constant test and therefore do not require supervision. In this way, the maker states, the dependability of the fire-alarm service is assured.

Portable Radiant Heater

The "Cosy-Glow" electric heater being manufactured by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., may be used, it is said, to great advantage in homes, ticket booths and train cabs, for keeping frost from store windows and wherever electric heat is desired. A heavy cast-iron base insures firmness and yet allows the heater to be carried from place to place. The easily removable heating unit is wound on a porcelain cylinder and is placed perpendicular to the radiating surface. The reflector, which throws the heat in the same way as the searchlight reflects its rays of light, is made of polished copper and attractively finished. To clean the reflector the heavy copper wire guard which protects the heating unit can be removed. The heat rays may be turned in any direction since the reflector swings upward and downward as desired A handle for carrying and tilting purposes and a length of heater cord with a lamp socket plug complete the radiator.

High-Capacity Choke Coils for Outdoor Substations

For use with large-capacity outdoor steel-tower substations, the Delta-Star Electric Company, 2433 Fulton Street, Chicago, has developed a unit-type choke coil of high capacity. The choke coil proper is of long-turn cylinder form and of proportions to insure proper rigidity. The insulators are interchangeable and are so designed that flash-over occurs before puncture. To meet individual wiring requirements terminals for either flat or round conductors are supplied.



COIL IS LONG-TURN CYLINDER TYPE

Notes on Recent Appliances

Stoker for Small Plants

The Cokal stoker is being manufactured by the Cokal Stoker Company, 48 Division Street, Chicago, to meet the requirements of small boiler plants.

Motorless Electric Vibrator

For operation on alternating current a motorless electric massage vibrator with three applicators is being made by the Fitzgerald Manufacturing Company, Torrington, Conn.

Washing Machine with Twin Tilting Tubs

An electrically driven washer with two tubs which can be tilted to facilitate draining has been placed on the market by the Woodrow Manufacturing Company of Newton, Iowa.

Solderless Insulated-Wire Connector

An insulated-wire connector for use with fixture outlets and motor leads and which needs neither tape nor solder to install has been placed on the market by the Walger Connector Company, whose sales agent is C. Jackson, 22 College Street, Toronto, Canada.

Arc Welder for Alternating Current

Alternating current is taken from the line and transformed to a low voltage suitable for arc welding in the new welder being marketed by the Arcwell Corporation of 42 Broadway, New York City, thus eliminating a motor-generator. Different sizes of these outfits may be had ranging from a 75-amp. set for garage work to a 600-amp. type for heavy foundry work.

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Trade Notes

Foreign Trade Opportunities

A firm in Italy (No. 27,909) wishes an exclusive agency among other things for electrical supplies and equipment. Terms thirty to ninety days' credit, or 2 per cent off for cash in thirty days. Correspondence in Italian.

Consul J. Paul Jameson includes in a short list of goods most needed in Tchita, Siberia, electrical apparatus and supplies of all kinds, including lamps, wire and motors, for 220 volts direct current.

L. K. Leon, 10 Tiberton Lane, off Killiney Road, Singapore, Straits Settlements, has written to the ELECTRICAL WORLD making inquiries regarding electric wiring supplies of American manufacturers. Communications should be direct and in English.

A man in Italy (No. 27,690) desires an agency for the sale of electrical machinery. Correspondence should be in French, Italian, Spanish or Portuguese.

A firm in Norway (No. 27,963) wishes an agency for electric stoves and electrical supplies. Correspondence may be in English.

An American (No. 27,948), with established connection in Mexico City, who is to leave for that country very soon, desires exclusive representation, among other things, for electrical supplies. Terms, cash against documents.

ITALIAN STATE LAMP MONOPOLY.—According to a report in the London *Electrical Review* from Milan, electric lamps have been declared a state monopoly in Italy.

BOSCH MAGNETO BUSINESS.—Plans are afoot for the organization of a corporation by the banking house of Hornblower & Weeks, Boston, to take over the business and assets of the Bosch Magneto Company, recently offered for sale by A. Mitchell Palmer, custodian of alien enemy property. The plant is at Springfield, Mass., and the company has been manufacturing magnetos and other motor accessories for years.

FEDERAL TRADE COMMISSION CITES ENGINE PACKING CONCERN.—Declaring that it has reason to believe the concern is engaged in the practice of giving to employees of its customers and prospective customers, as an inducement for them to influence the purchase of supplies, gratuities such as cash bonuses, commissions, cigars, meals, presents and entertainment, the Federal Trade Commission, "in the interest of the public," has issued formal complaint against the M. P. L. Packing & Supply Company, New York City. The concern, which sells packings and supplies for engines and engine rooms, was cited to appear before the commission in Washington on Jan. 29.

FEDERAL TRADE COMMISSION ISSUES ORDER IN SALE OF SPARK PLUGS.—The Federal Trade Commission has ordered the Silvex Company, Hellertown, Pa., maker of automobile spark plugs, to discontinue representations that its "Bethlehem Aviation" spark plug has been "certified by the United States Bureau of Standards." The commission found that while large numbers of Silvex plugs had been furnished the government and had been subjected to the usual Bureau of Standards tests, the "Bethlehem Aviation" plug had not been "certified" by the bureau, as represented in a circular letter sent out by the company. The commission's order was issued by agreement with the company, which waived right to introduce testimony in support of its act.

CRANE COMPANY'S CHRISTMAS GIFT FOR 1918.—For the eighteenth year since the Crane Company of Chicago adopted the plan of making cash Christmas gifts to its co-workers, the company last month distributed approximately $1,600,000, making a total for the eighteen years of $10,000,000. The basis of distribution for 1918—as for the last sixteen years—was 10 per cent of the year's earnings for each worker. About 13,000 co-workers shared in this distribution throughout the offices and works in Chicago and Bridgeport and the offices, warehouses and salesrooms in fifty-three cities of the United States and Canada. Crane men who had left the service of the company temporarily for that of the United States during the war shared in the cash distribution the same as if they had continued at work for the company. A Christmas greeting from the company accompanied each gift.

THE WESTINGHOUSE AUTOMOBILE EQUIPMENT DEPARTMENT MOVED TO NEWARK.—The Westinghouse plant at Newark, N. J., is now devoted to the making of electrical equipment for automobiles, this department of the company's works having been located previous to the war at Shadyside, Pittsburgh. The increasing demand for automobiles has given an added impetus to the manufacture of equipment. Besides a number of accessories, the plant is manufacturing lighting apparatus, an ignition system, a self-starting device and a generator and storage battery to supply power for these.

R. & M. MANAGERS MEET.—Managers of the Robbins & Myers branch offices and some of their assistants held their annual sales conference at the factory in Springfield, Ohio, on Dec. 16, 17 and 18 with the usual program of business addresses, discussions, individual conferences and entertainment features. The officials of the company pointed out that, while the last year has been a sellers' market in which demand from the factories for all commodities was in excess of supply, the resumption of normal business will mean the return to a buyers' market in which the producer and seller will meet competition. It was later pointed out by C. C. Miner, auditor, that while the outlook appears bright at the present time, caution must be exercised in the matter of credit. He stated that "in the immediate future we may look for business. Go after it and try to beat the other fellow, but don't let your desire for business prompt you to offer to consider anything other than the soundest of terms."

HYGRADE LAMP COMPANY EMPLOYEES FORM BENEFIT ASSOCIATION.—Employees of the Hygrade Lamp Company, Salem, Mass., have formed a mutual benefit organization to be known as the Hygrade Employees' Association, J. C. Carter being the first president. In case of sickness or disability the association will pay to any member who has been ill for a week, beginning with the eighth day of disability, $7.50 per week for each week of disability, not to exceed in all ten successive weeks in any twelve consecutive months. A death benefit of $250 will be paid to the registered beneficiary of any person insured under this plan while in the employ of the Hygrade company. The company is contributing a dollar for every dollar paid in by the members of the association and is represented on the executive committee by three members by vote of the association. At the end of the first week's enrollment 85 per cent of the company's employees were listed in the membership.

REVISED SPECIAL EXPORT LICENSE FOR SAMPLES.—The War Trade Board announces that W. T. B. R. 323, issued Nov. 23, 1918, and the Special License No. RAC-55, issued in accordance therewith, have been withdrawn, and that a revised special license, under the same number, (RAC-55), effective Dec. 24, 1918, has been issued. The revised special export license has been granted to the Post Office Department and to the customs service, authorizing the exportation, without individual export license, of samples of any commodity and advertising matter to be used therewith, regardless of whether the same are shipped by mail (subject, however, to the postal regulations), by freight or by express, in passengers' baggage or otherwise, when destined to any country. Under this license the term "samples" is construed to mean articles or portions thereof intended for use in soliciting orders and is not construed to include any article or portion thereof which is itself intended to be sold as an article of commerce.

NEW PROCESS GEAR CORPORATION CHANGES HANDS.—John N. Willys has purchased outright the New Process Gear Corporation of Syracuse, N. Y., taking over all of the $3,000,000 capital stock of the concern. There is no change contemplated in the nature of the product the company will manufacture, although it is naturally expected that material expansions in the old field will result. It is the intention of the company to solicit gear business of all kinds, and particularly in so far as the manufacture of gears relates to differentials and transmissions for the automobile trade. Thomas W. Meachem and other members of the Meachem family connected with the corporation have retired, having sold their interests to Mr. Willys. On the latter's part this step represents complete acquisition of a plant in which he previously had been partially interested. No change of active management has been intimated, immediate control of the enterprise being in the hands of J. Allan Smith. The new officers of the company are: J. N. Willys, chairman; J. Allan Smith, president; J. E. Kepperley, vice-president; C. A. Neracher, vice-president; E. J. Quintal, treasurer and assistant secretary.

ARTICLES STILL SUBJECT TO MEXICAN TARIFF.—By the degree of Aug. 27, 1918, machinery of all kinds unless otherwise specified, as well as separate parts, will be admitted free of charge into Mexico. Subsequently, however, by the circular of Oct. 21, 1918, the Director General of Customs of Mexico directed that exceptions be made in the case of certain articles which will continue to stay at the old rate of 45 cents per 100 lb. gross weight. Included in the articles still subject for duty, as transmitted by Vice-Consul Joseph W. Rowe of Mexico City, are telephones and telephone apparatus of all kinds, elevators, motor cars for railway use, electric batteries, carbon and zinc cylinders for electric batteries, lightning rods, clamps for electric batteries, circuit breakers for electric arc lamps, porcelain or glass battery cells, zinc in rods or cyclinders or plates for electric batteries.

WESTINGHOUSE MARINE WORKS WILL EXPAND TO FOUR TIMES PRESENT CAPACITY.—Officials of the Westinghouse Electric & Manufacturing Company's Works at Essington, Pa., have answered the question regarding their peace policy by immediately beginning the expansion of their works to four times the present capacity. Not only will they retain in their employ their operating force of 3500 skilled mechanics and laborers, but they definitely plan to increase their force to 5000 men at once, and later to 12,000. Contracts are now held for 250 ships for the Emergency Fleet Corporation, to be equipped with the Westinghouse marine system of propulsion machinery, besides other contracts with the United States government for destroyers, cruisers and other naval units. Whether the present policy of a bigger navy stands or not, the enormous demand for merchant ships will now force the completion of the plans originally made by the company for execution at South Philadelphia. Contracts with the government for marine equipment are expected to stand, and the broad policy of this country to develop a great merchant marine is beginning to assume definite proportions, so that business is practically assured for the Essington plant for some time to come; but even though these prospects should not materialize, the Westinghouse company needs the new developments for the expansion of its general electrical business. The parent works at East Pittsburgh have completely covered all of the available space, and Essington will have to take over some departments of the industry. The company is now carrying out its specifications for a town site for its employees. The program calls for 1400 cottages. Sixteen are already completed and occupied.

THE WAR TRADE BOARD announces that electric lamps have been removed from lists of restricted imports.

THE WAR TRADE BOARD has removed from the export conservation list, effective Jan. 4, mica and mica splitting.

DWIGHT P. ROBINSON & COMPANY, INC., constructing and consulting engineers, announce the opening of their offices at 61 Broadway, New York City.

THE WELLMAN-SEAVER-MORGAN COMPANY of Cleveland, Ohio, has opened a San Francisco office at 415-417 Rialto Building, in charge of Norman S. Ross. Business originating from California, Nevada west of the 115th meridian, Lower California and the counties of Josephine, Jackson and Klamath in Oregon is in this territory.

HORACE N. TRUMBULL, who has recently received his discharge from the Engineers Officers' Training School at Camp A. A. Humphreys, Va., has been appointed advertising manager of the Wellman-Seaver-Morgan Company. Before entering the service, Mr. Trumbull was advertising manager of the SKF Ball Bearing Company of Hartford, Conn.

LANDERS, FRARY & CLARK'S Danbury (Conn.) plant, which has been devoted to the manufacture of electric ranges, is being moved to New Britain, Conn., where it will be operated in connection with the main factory of the company. The Danbury factory was formerly owned by the National Electric Utilities Company of New York City.

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THE AMERICAN CONDUIT MANUFACTURING COMPANY, New Kensington, Pa., has appointed R. S. Wakefield, 1312 Great Southern Life Building, Dallas, Tex., as its Southern rigid-conduit agent.

J. L. FINNICUM, formerly connected with the Doubleday Hill Electric Company of Pittsburgh as manager of the industrial and power department, is now district manager of the Chicago district for the Electrical Products Company of Cleveland, Ohio, with offices at 1064 People's Gas Building, Chicago.

THE ELECTRICAL MANUFACTURING COMPANY and the Safety Meter Box Company have moved from their former quarters at 112 Hamilton Avenue to 4149 East Seventy-ninth Street, Cleveland, Ohio. In their new quarters these concerns will have 200 per cent more floor space and will install improved machinery to increase production 200 per cent.

WALTER N. POLAKOV, consulting engineer, announces the founding of Walter N. Polakov & Company, Inc., consultants in power production methods, industrial investigations, labor problems, scientific record systems and production accounting, with offices at 31 Nassau St., New York City. With the close of hostilities a number of capable engineers formerly associated with him have joined the staff of the corporation.

THE SANFORD RILEY STOKER COMPANY, Worcester, Mass., and the Murphy Iron Works, Detroit, Mich., have announced that W. L. Bigelow will take the position of Eastern sales manager directing the sales and services of both the Riley Underfeed Stoker and the Murphy automatic furnace, with offices at 1226 Woolworth Building, New York City. Mr. Bigelow's duties began on Jan. 1. For the past nine years he has been district manager for the Murphy Iron Works at Pittsburgh, Pa.

THE FIRST NATIONAL BANK OF BOSTON is sending two of its senior officers to Australia and the Far East to establish further foreign banking conections. C. F. Weed, vice-president of the bank, and D. A. de Benocal, vice-president of the First National Corporation, will leave Boston about Jan. 20, sailing from San Francisco directly to Australia. After a few weeks in Australia, to be spent principally in Sydney and Melbourne, they will go to China and then return by the way of Japan.

E. ERICHSEN, formerly of New York, manager of the Allied Machinery Company of America, has now joined the Youroveta Home & Foreign Trade Company, Inc., 165 Broadway, New York, as vice-president and manager of the New York office. Mr. Erichsen was born in 1882 in Bergen, Norway. He was educated at the Bergen Technical College and at the Charlottenburg University in Berlin. He has had extensive engineering exporience in America and Norway, and from 1909 to 1914 he was managing director of important stamping and enameling works in Bergen.

THE ELECTRIC MACHINERY COMPANY, Minneapolis, Minn., announces a new line of 60-cycle, 600 to 800-r.p.m., two-phase and three-phase induction motors, ranging in size from 20 hp. to 500 hp., with both squirrel-cage and wound-rotor windings in 220, 440, 550 and 2200 volts. Ball and roller bearings exclusively, closed frame, free-air ventilation and open-slot starter construction are claimed by the manufacturers as features. For a number of years the company has been planning to bring out a line of induction motors designed to supplement the field of E-M synchronous motors.

DICK, KERR & COMPANY, LTD., of London, at its annual meeting, Nov. 14, gave out a statement that an alliance has been made with Siemens Brothers & Company, Ltd., by which much economy can be effected through the amalgamation of selling organizations and coördination of designs and products. There is no competition in manufacture as Siemens Brothers & Company made cables, dynamo machinery, telephones, etc., while Dick, Kerr & Company have specialized in apparatus for railways and tramways, steam turbines and the larger classes of electrical machinery. It has also been decided to establish companies in France and in Japan to exploit manufacturing rights in connection with apparatus for railways and tramways. In the belief of the chairman there would be a large after-war demand for all classes of electrical machinery, especially large-sized steam turbines, and he assured the shareholders that the company's facilities for taking care of this demand would be ample.

Trade Publications

GRAPHIC POWER-FACTOR INSTRUMENTS.—The Esterline Company, Indianaplois, Ind., has issued bulletin No. 388, describing its new line of graphic recording power-factor instruments.

KITCHEN MACHINES.—General descriptions of its three-speed mixers for hotel, restaurant and other large kitchens are given in a recently prepared booklet of the Read Machinery Company of York, Pa.

WASHING MACHINE. — The Henrici clothes washer for use in hospitals, commercial laundries and hotels, and marketed by the Troy Laundry Machinery Company, Ltd., of Troy, N. Y., is the subject of a booklet distributed by this company.

PEELING MACHINE.—Electrically operated vegetable-peeling machines which use an abradant and water to produce indirect friction are described in a circular of the Hamlin Peeling Machine Company, 430 Eleventh Avenue, New York City.

LIGHTING FIXTURE. — Standard and period styles of the "Four-in-One" light, which is dust-proof and "bug-proof" are listed and illustrated in a recently issued catalogue of the Black & Boyd Manufacturing Company, 17 East Forty-seventh Street, New York City.

MIXING AND BEATING MACHINES.—Harvey Brett, 141 West Thirty-sixth Street, New York City, has issued a twelve-page folder which contains descriptions and illustrations of the "Reliance Mixobeater" machines for use in the kitchens of hotels, restaurants, etc.

SILVER-BURNISHING MACHINE.—H. G. W. Young, 61 Hanover Street, Boston, who distributes the "Imperial" silver burnisher for flat and hollow silver ware, has printed a booklet containing illustrations and general descriptions of these motor-driven machines for jewelers, hotels and restaurants.

DISHWASHING MACHINES. — Dishwashers which use belt or gear connected electric motors not only to operate the washing mechanism but to raise and lower the baskets of dishes as well are shown and described in a recently distributed booklet of the Insinger Company, Wayne Junction, Philadelphia.

X-RAY TABLES.—Bulletin No. 25, prepared by the Kelley-Koett Manufacturing Company of Covington, Ky., illustrates a line of portable and base-hospital X-ray tables, such as are being used in France and in army cantonments. The magnetic filament regulator for Coolidge tubes which is also a product of this company is the subject of a blotter recently issued.

STORAGE BATTERIES.—"The Theory of the Storage Battery," technical bulletin No. 28, issued by the General Lead Batteries Company of Newark, N. J., contains sixteen-pages of useful information on recent developments in storage-battery construction and operation. Practically no advertising matter is contained in this publication, which devotes itself to a simple exposition of the principles of the storage battery.

LIGHTING FIXTURES.—"The Unit of Day Brightness" is the title of a twelve-page catalog, No. D-5, just published by the Beardsley Chandelier Manufacturing Company, 216 South Jefferson Street, Chicago. In it are set forth the general advantages of the "Denzar" glareless, shadowless and dustproof lighting unit as well as the individual features of different pendent and ceiling types which are illustrated, described and priced.

MINE DUTY SELF-STARTERS.—The sliding-control and the magnetic-switch type of mine-duty self-starters, which are especially adapted for automatic control of motor-driven pumps in damp locations and which are made by the Cutler-Hammer Manufacturing Company of Milwaukee, have been made the subject of publication No. 408 from that company. Space in this bulletin is also devoted to unit-charging racks for miners' electric lamps in which a battery can be readily placed.

COAL-HANDLING APPARATUS.—A recent publication of the Link-Belt Company of Chicago is its book No. 333, the eighty-eight pages of which are devoted to the subject of equipment for handling and preparing coal at mines. Illustrations not only of the Link-Belt apparatus itself but of various installations form a considerable part of the book, which also describes the construction, uses and operation of various coal carriers, loaders, hoists, crushers and other coal-mining equipment.

SILVER BURNISHER.—In "The Silver Service—Its Care," a folder printed by the American Laundry Machinery Company, 134 West Thirty-seventh Street, New York City, two models of the "Tahara" automatic silver burnisher for hotels and restaurants are shown and described.

STORAGE BATTERIES.—The Atlas Electric Storage Battery Company of Greenville, Mich., has prepared and issued its thirty-two-page bulletin No. 2. As explained in the preface, the purpose of the booklet is not only to tell the amateur or layman what a storage battery is and how it is constructed, but to give him information for selecting the proper battery for lighting and ignition on his automobile. Accordingly all makes and models of automobiles are listed, together with the proper "Atlas" battery for use with each.

AUTOMOBILE STORAGE BATTERIES.—The Perfection Storage Battery Company, Rhodes Avenue and Fortieth Street, Chicago, has recently issued catalog No. 17, a sixteen-page publication on storage batteries for automatic starting, lighting and ignition. Besides general descriptions of these batteries and directions for their operation and upkeep, all makes and models of American cars are listed together with the proper "Perfection" battery for use with them. Other tables of battery information are also included in this catalog.

WIRES AND CABLES.—The Eugene F. Phillips Electrical Works, Ltd., of Montreal, Canada, have recently published a 270-page handbook entitled "Phillips' Wires and Cables." The book, which is pocket-size and handsomely bound in leatner, is printed on coated paper, is illustrated and comprises five sections. The subjects of these are electrical conductors, bare and weatherproof wires and cables, magnet wires and cotton-covered wires, rubber-insulated wires and cables and flexible cords, paper-insulated power cables and telephone cables and varnished-cambric insulated cables, and general information. Aside from the complete information furnished about the company's many different varieties of wires and cables, tables of wire weights and diameters and other very useful information to the wire user are given.

New Incorporations

THE CARLOCK (ILL.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $15,000 by W. L. Carlock, J. K. Esh, J. E. O'Hara and S. E. Maurer.

THE ADVANCE ELECTRIC COMPANY of St. Louis, Mo., has been incorporated with a capital stock of $50,000 by Edward Bretch, A. L. Canavan and D. J. O'Keefe. The company will make electrical machinery.

THE KANT BREAK SPARK PLUG COMPANY of St. Louis, Mo., has been incorporated with a capital stock of $30,000, to manufacture and deal in electrical supplies. The incorporators are J. M. McKernan, D. M. Hutchinson, John White and others.

THE ELECTRIC SCALING COMPANY of New York, N. Y., has been chartered with a capital stock of $100,000 by O. C. Olsen, G. Sunseth and P. Baumer, 1 Broadway, New York City. The company proposes to operate a ship repair and scale cleaning plant.

THE FLETCHER ELECTRIC COMPANY of New York, N. Y., has been incorporated by J. C. Mills, J. M. Lyon and D. C. Keefe, 660 East Twenty-third Street, New York City. The company is capitalized at $24,000, and proposes to manufacture electrical specialties.

THE CHIPPEWA POWER COMPANY of Eau Claire, Wis., has been incorporated with a capital stock of $200,000 by P. D. Kline, Donald Boyd and V. S. Hillyer. The company proposes to develop a power site on the Eau Claire River and construct a hydroelectric power plant north of Eau Claire.

THE WARD ENGINEERING & BATTERY COMPANY of Miami, Fla., has been incorporated with a capital stock of $30,000 to carry on a storage-battery supply and repair business. The officers are: R. E. Ward, president; R. M. Moffatt, vice-president, and R. G. Ward, secretary and treasurer.

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New England States

NEWMARKET, N. H.—The Newmarket Electric Company and the Rockingham County Light & Power Company have filed a joint petition with the Public Service Commission whereby the Newmarket company asks permission to sell and transfer its property to the Rockingham County company. The latter company also asks for authority to supply electricity in the towns of Newmarket, Newfields, Epping and Durham.

BRATTLEBORO, VT.—The Brattleboro Retreat has entered into a contract with the Connecticut River Power Company to furnish electricity for lamps and motors for the retreat. Under the terms of the contract the Connecticut company secures the right to flow the meadows to a higher point than before.

RUTLAND, VT.—The Rutland Railway, Light & Power Company has been awarded contract by the Rutland Railroad Company for additional energy. The company has also been awarded contracts by the American Fork & Hoe Company and the Wallingford Manufacturing Company for supplying increased electrical service.

BOSTON, MASS.—Plans are under consideration by the Trustee Electric Garage, care of A. F. Bowditch, engineer, 44 Bromfield Street, Boston, for the construction of a garage at 57-93 West Dedham Street, to cost about $175,000.

LOWELL, MASS.—The Lowell Electric Light Corporation has petitioned the Gas and Electric Light Commissioners for permission to issue 2941 shares of capital stock at $125 per share, the proceeds to be used to meet the cost of improvements to its plant.

WESTBORO, MASS.—Steps have been taken by the Board of Trade to secure action relative to improving the street-lighting system.

WEYMOUTH, MASS.—The Massachusetts Highway Service Company, known as the "trackless trolley company," has petitioned the Selectmen for permission to erect and maintain poles and wires for the purpose of operating a motor trackless trolley system upon certain streets of the town.

WORCESTER, MASS.—The directors of the Worcester Electric Light Company have voted to petition the Gas and Electric Light Commission for permission to issue 4000 shares of capital stock at $185 per share, increasing the capital stock from $1,600,000 to $2,000,000.

WARREN, R. I.—The Warren Manufacturing Company is installing additional electric generating equipment in its power plant.

BRIDGEPORT, CONN.—The lamp committee in its annual requisition to the city auditor asks for $9 081 for new work in a total budget of $117,314. The proposed new work includes the installation of sixty-nine new ornamental lamps, forty-seven arc lamps and thirty tungsten lamps.

HARTFORD, CONN.—The Jewell Belting Company 55 Trumbull Street, Hartford, is contemplating the construction of a factory in Parkville, to cost about $100,000. H. Wolcott of Elmwood is engineer.

WINDSOR, CONN.—With a view of developing its water-power privileges at Rainbow, the Farmington River Power Company, controlled by the Stanley Works of New Britain, has purchased the mill and other property in Windsor, including the Rainbow Paper Company's plant, known as the Vernon mills, the Hartford Paper Company's so-called No. 2 mill and land and water rights on both sides of the Farmington River to the present plant of the Farmington company at Oil City. Ultimately it is planned to develop the power for transmission to New Britain over a high-tension line 25 miles in length. The Stanley Works are at present supplied with electricity from a water-power plant on the Farmington River operated by the Farmington River Power Company.

Middle Atlantic States

ALBANY, N. Y.—Three shop buildings at the foundry department of the plant of Rathborne, Sard & Company, North Albany, were destroyed by fire recently, causing a loss of about $75,000. The company manufactures electrical specialties, ranges, stoves, etc.

BROOKLYN, N. Y.—Notice has been filed by A. Arnesen, Inc., 312 Court Street, of an increase in capital stock from $10,000 to $50,000. The company operates an electrical business.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

GENEVA, N. Y.—The contract for electrical work in connection with alterations to be made at the County Hospital at Geneva has been awarded to Bennet & Phillips of Holcomb.

NEW YORK, N. Y.—The Spilger Electric Company, 78 Warren Street, has been awarded contract for electric wiring, etc., in connection with the new Young Men's Christian Association building, now under construction, at 181st Street and University Avenue.

NEW YORK, N. Y.—The E. J. Electric Installation Company, 221 West Thirty-third Street, has been awarded a contract by the United States government for electrical work in connection with various improvements and alterations being made at the Brooklyn Navy Yard, at $4,668.

NEW YORK, N. Y.—Plans are being prepared by F. G. Frost, architect, 19 West Forty-fourth Street, for the erection of a garage, warehouse and storage plant to be erected on a site between Thirty-sixth and Thirty-seventh Streets and Second and Third Avenues, for B. Altman & Company, to cost about $250,000.

NEW YORK, N. Y.—Arrangements have been completed by the board of trustees of Bellevue and Allied Hospitals for the proposed alterations and improvements in the power house at the hospital building at Lenox Avenue and 136th St., which will include the installation of new ash-handling and other equipment. L. Gottlieb, 225 East 138th Street, is contractor.

SAYVILLE, N. Y.—Contract has been awarded by the United States government to the Hennebique Construction Company, 1170 Broadway, New York City, for the erection of a transformer building at the local station.

CAMDEN, N. J.—Arrangements have been made by the city officials for appropriations of $13,500 and $105,000 in the annual budget to be used for the operation of the city electrical bureau and municipal lighting purposes repectively.

JERSEY CITY, N. J.—The lowest bid for the installation of the proposed new electric lighting system on the Boulevard, commencing at the Morris Canal and extending to Manhattan Avenue, was submitted by Walter J. Coleman, 29 Willow Court, at $9,400. The commission, it is said, has under consideration the installation of new lamps of larger candlepower in various sections of the Boulevard in the near future.

WEST NEW YORK, N. J.—Plans have been completed by the Hudson County Board of Freeholders for the construction of a power house heating and lighting plant at the county institution at Laurel Hill. The building will be about 100 ft. by 185 ft. O. S. Auf der Heide, Court House, Jersey City, is chairman.

HARRISBURG, PA.—Plans are under consideration by the city officials for improvements to the electric street-lighting system in various sections of the city. It is proposed to erect new lamp standards, new arc-lighting units and make other improvements in the system in the Fourteenth Ward.

HONESDALE, PA.—The electric plant of the Honesdale Consolidated Heat, Light & Power Company was recently destroyed by fire, causing a loss of about $50,000.

LANCASTER, PA.—Plans are under consideration by the Conesoga Traction Company for the construction of a branch electric railway to Marietta and Maytown to provide transportation for the works at the proposed new railroad shops to be erected at Marietta by the Pennsylvania Railroad Company. Work, it is understood, has begun on preliminary surveys.

PHIALDELPHIA, PA.—Notice has been filed by the Electric Furnace Construction Company, Finance Building, of an increase in capital stock from $100,000 to $300,000, to provide for expansion.

PHILADELPHIA, PA.—Plans are being prepared by the Navy Department, Washington, D. C., for the construction of a new power plant at the League Island, Navy Yard, to cost about $35,000.

PHILADELPHIA, PA.—Plans have been prepared for the erection of a one-story shop building and office building at 926 North Third Street by George Sachsenmaier & Company, 145 North Third Street. The company manufactures dynamos, etc.

BALTIMORE, MD.—The Magneto & Machine Company, 1031 Cathedral Street, is planning to construct a machine shop, 22 ft. by 55 ft.

ST. HELENA, MD.—Arrangements have been completed by the Dundalk Company for the erection of three new buildings at the local pumping station. The cost of the entire work is estimated at about $25,000.

SPARROWS POINT, MD.—In connection with new construction work now under way at the local steel works of the Bethlehem Steel Company, which include a new plate mill, coke ovens and by-products recovery plants, considerable electric equipment will be required, including electrically operated derricks, cranes and railways in the ore pier of the company and for other departments.

MARTINSBURG, W. VA.—The new water-power development of the Hagerstown & Frederick Railway Company at Dam No. 5, on the Potomac River, is nearly completed. The new plant and dam cost between $400,000 and $500,000 and will develop about 1500 hp.

ALEXANDRIA, VA.—A movement has been started by the retail merchants' bureau of the Chamber of Commerce to secure improvements to the street-lighting system.

STAUNTON, VA.—Arrangements have been completed by the Staunton Community Association to install an electric lighting system in Staunton.

WASHINGTON, D. C.—Plans are under consideration by the Ordnance Department, Washington, D. C., for the erection of a new electrical shop at the local ordnance works.

WASHINGTON, D. C.—Contract has been awarded by the Washington Railway & Electric Company for the construction of an electric substation, to cost about $3,000, to Lake Stone of Washington.

WASHINGTON, D. C.—Bids will be received in the near future by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at Brooklyn, N. Y., under Schedule 7657½—8000 ft. of interior cable; Schedule 7659½—wave changers, loading coils and inductance system. Application for proposal blanks should give the schedule desired by number.

North Central States

ANN ARBOR, MICH.—The Detroit Edison Company has submitted a proposition to the City Council offering to install an entire new street-lighting system for the city.

LANSING, MICH.—Valuable water rights, including farms, along the Grand River in the vicinity of Portland are among the assets of the Michigan Power Company which are to be sold at auction by the receiver at Lansing on Jan. 18.

AKRON, OHIO.—The Riggs Boiler Works Company is considering an extension to its plant, which, if carried out, will require a 15-ton electric traveling crane and a hydraulic riveting machine.

WARREN, OHIO.—The Taylor Welder Company of Warren is planning to extend its activities in the electric welding equipment field. The company is bringing out an electric welding outfit using alternating current.

YOUNGSTOWN, OHIO.—The installation of between fifty and sixty new street lamps in various parts of the city will be recommended to the City Council by the lighting committee.

YOUNGSTOWN, OHIO.—Plans have been prepared by the Youngstown Steel Car Company for the construction of a new plant, involving an expenditure of about $2,000,000. The company has acquired a site near the plant of the Standard Boiler Company. William Wilkoff is president.

DECOURSEY, KY.—Contract has been awarded by the Louisville & Nashville Railroad Company to Romwell Brothers of Louisville for erection of a roundhouse in Decoursey, to cost about $150,000.

WHITCO, KY.—The Whitesburg Coal Company would like to receive prices on a complete power plant of 150 kw. capacity, 250 volts direct current. J. Henry Hall of Whitco is manager.

CHICAGO, ILL.—Plans have been prepared by Henshein & McLaren, engineers, 1600 Colony Building, for the erection of a building at 925 West Thirty-seventh Street for the Illinois Packing Company, to cost about $125,000.

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CHICAGO, ILL.—Bunte Brothers, 730 West Monroe Street, are contemplating the erection of a candy factory on Franklin a..d Ohio Streets, to cost about $1,500,000.

CHICAGO, ILL.—Application has been made to the Illinois Public Utilities Commission by the Commonwealth Edison Company for authority to issue $4,000,000 in bonds to finance extensions during the coming year. Samuel Insull is president of the company.

QUINCY, ILL.—The question of establishing a municipal electric light plant in Quincy is under consideration by the City Council.

JANESVILLE, WIS.—Work will soon begin on the construction of the second unit of the new farm-tractor manufacturing plant of the General Motors Corporation in Janesville. The building will be 200 ft. by 500 ft. and will be used for foundry. Contracts, it is expected, will be awarded to the same companies erecting the first unit, which is nearly completed.

SUPERIOR, WIS.—Preparations are being made by the City Council to purchase the lighting plant of the Superior Water, Light & Power Company under the authority conferred through a recent election authorizing the purchase of the plant, to be owned and operated by the municipality.

MINNEAPOLIS, MINN.—The Dispatch Motor Car Company, Fourteenth Avenue, is considering extensions to its automobile plant ,to cost about $100,000.

WELLS, MINN.—The municipal electric light plant and water facilities were put out of commission recently by the collapse of the city water tower, which crushed the light and power plant.

SIOUX CITY, IOWA.—The Western Terminal Elevator Company, recently incorporated, is contemplating the construction of a 1,000,000-bushel elevator, to cost about $650 000. M. King, Davidson Building, is president.

CONCORDIA, MO.—Plans, it is reported, have been prepared by Charles F. May, Merchants' Laclede Building, St. Louis, for the installation of a power plant at St. Paul's College.

KANSAS CITY, MO.—The Kansas City Light & Power Company has purchased a site at Thirty-first and Cherry Streets on which it proposes to erect a substation.

ST. LOUIS, MO.—The Union Electric Light & Power Company, 315 North Twelfth Street, is contemplating the construction of a boiler house, to cost about $15 000.

ST. LOUIS, MO.—Contract, it is reported, will soon be awarded by the Warren Steel Casting Company for the construction of a new machine shop. Electric motors and other equipment will be required.

ST. LOUIS, MO.—Plans have been prepared by the General Motors Corporation of Detroit, Mich., for the erection of a three-story factory and heating plant on Natural Bridge Road and Union Street, to cost about $1 000 000. Standish Backus, Boyer Campbell Building, Detroit, Mich., is secretary.

BERESFORD, S. D.—Application has been made to the City Council by a local business man for a franchise to install an electric light plant.

BURKE, S. D.—Bonds have been authorized for the installation of a municipal electric light plant in Burke.

OMAHA, NEB.—Plans are being prepared by J. H. Craddock & Company, architects, Farnum Building, for the construction of a cold-storage building for the Higgins Packing Company. The plans in progress are for a three-story and basement building, 100 ft. by 50 ft., with final size four stories and basement, 100 ft. by 270 ft. The total cost of the structure is placed at $600,000.

Southern States

ANDERSON, S. C.—Arrangements are being made by the Anderson Cold Storage Company for the installation of a 35-ton ice plant and cold storage facilities for which electric power will be used. Machinery, it is understood, has been purchased.

CHARLESTON, S. C.—The Navy Department, Washington, D. C., is considering the following construction work at the Charleston Navy Yard: An oxyacetylene plant, to cost about $25,000; fuse house $3,000; refrigerating plant, $100,000; fire protection work, $50,000; service building, $30,000, and garage, $25 000.

ATLANTA, GA.—The electric light and telephone committee has recommended to the finance committee that the report submitted by R. C. Turner, city electrician, recommending that $70,000 be included in next year's budget for the construction of an electric plant for the purpose of utilizing the steam which is going to waste at the city crematory, be adopted.

SAVANNAH, GA.—The Forest City Ice Cream Company, 241 Whitaker Street, is planning to erect a plant, to cost about $100,000. B. J. Ford is manager.

MEMPHIS, TENN.—Bids will be received at the office of the Mississippi River Commission, First and Second Districts, Custom House, until Feb. 4 for furnishing turbines, pump set, feed-water heater, boiler and electric light plant for hydraulic grader No. 1820. For details see Searchlight section.

NATCHEZ, MISS. — The City Council has engaged an engineer to prepare an estimate of the cost of establishing a municipal electric light plant in Natchez.

ARANSAS PASS, TEX.—Arrangements are being made by the France & Canada Oil Transport Company of New York, N. Y., for the construction of facilities for building concrete fuel barges on Harbor Island, to cost about $1,000,000. The work now under construction includes special wharf 1100 ft. long, three standard 55,000-barrel concrete fuel-oil storage tanks, machine shop, woodworking shop, toolhouse, stock room, drafting plant and electric light plant. Contract for barge building has been awarded to the MacDonald Engineering Company, 53 West Jackson Boulevard, Chicago, Ill.

McALLEN, TEX.—The Rio Grande Public Service Corporation is reported to be considering extensions and improvements to its local electric plant, waterworks system and ice plant. New machinery to double the output of both plants, it is understood, will be installed. R. F. McCord is general manager.

PALACIOS, TEX.—The city has voted to purchase the local electric light plant and to operate the lighting system in connection with the waterworks.

Pacific and Mountain States

OAKVILLE, WASH.—Frank Leisner, owner of the local electric light plant, it is reported, will dismantle and remove the equipment of the plant.

CALEXICO, CAL.—Investigations are being made by the City Trustees relative to the installation of a municipal electric light plant in Calexico. Electricity is now supplied by the Southern Sierras Power Company of Denver, Col., over a transmission line 500 miles long.

FRESNO, CAL.—The San Joaquin Light & Power Company has begun work on extensions to its system in Madera County involving an expenditure of from $45,000 to $50,000, which will include the erection of a new substation 5 miles west of Chowchilla on the Robertson Boulevard to supply the district south and west of Chowchilla, and the erection of a 60,000-volt transmission line 9½ miles long.

HANFORD, CAL.—The State Railroad Commission has authorized the Mount Whitney Power & Electric Company to issue $200 000 in capital stock to purchase the stock of the H. G. Lacey Company, which furnishes light, heat and power in Hanford.

HOLLISTER, CAL.—The Coast Valley Gas & Electric Company is planning to extend its electric transmission lines from King City to the New Idria mines in the near future. The cost of the proposed line is estimated at about $85,000.

IMPERIAL, CAL.—The Holton Power Company is planning to rebuild its local substation, recently destroyed by fire.

LOS ANGELES, CAL.—Plans are being prepared by A. C. Martin, architect, Higgins Building, for the erection of a steel plant on Santa Fé Avenue, to include machine shop, foundry, warehouses, etc. The cost is estimated at about $100,000.

LOS ANGELES, CAL.—In a special report submitted to the Public Service Commission by E. F. Scattergood, chief electrical engineer, he recommends that the city offer to purchase the distributing lines of the Southern California Edison Company now serving Municipal Pier No. 8, Smiths Island, and the fish harbor in the harbor district. Some time ago the Harbor Commission notified the Edison company to remove its wires from the municipal poles serving the harbor district. The company maintains that it does not have to remove its wires and that the city's extensions have been in violation of the operating agreement between the city and the company. In order to settle the controversy it is proposed to purchase the distributing lines of the company.

SACRAMENTO, CAL.—Contract has been awarded by the Northern California Milk Producers' Association to the Clinton Construction Company of San Francisco for the construction of a new plant, which will include a cold-storage plant, power house and a 30 000-gal. fuel oil tank. The cost of the plant is estimated at about $125,000. Henry M. Ellis is manager.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company is contemplating rebuilding its distributing systems at both Bryon and Brentwood, with an independent substation at each place, on a 110-220-volt circuit. The plans provide for a lighting district in each town if the property owners so decide. C. S. Northcutt of Modesto is district manager.

SAN FRANCISCO, CAL.—Application has been filed by Dudley Moulton of San Francisco with the State Water Commission for water rights on the Pitt River in Shasta County, one estimated to cost $1,250,000, and the other $1,500,000. The first application asks for 2000 cu.ft. per second. A dam will be built 185 ft. high, 600 ft long at the top and 80 ft. long at the bottom. The second is for water from the same river, which contemplates the construction of a dam 150 ft. high, 800 ft. long at the top and 100 ft. long at the bottom. It is planned to carry 5000 ft. per second.

OGDEN, UTAH.—The City Council is considering the question of establishing a municipal electric light plant.

CHANDLER, ARIZ.—Permission has been granted to the Chandler Water & Light Company by the Arizona Corporation Commission to issue $5,000 in bonds for improvements to its system.

HOLBROOK, ARIZ.—W. H. Clark of Los Angeles, Cal., it is reported, is head of a group of capitalists who contemplate a power project in a large lignite coal field about 72 miles southwest of Holbrook and the erection of transmission lines to Globe and Miami, 75 miles to the southward, to points on the Santa Fé Railroad, and even to the mining districts around Prescott.

Canada

SQUAMISH, B. C.—A hydroelectric plant, it is reported, will be installed in Squamish by the government in connection with other extensive improvements here.

VANCOUVER, B. C.—Contracts have been awarded to the C. H. E. Williams Company, electrical contractors, for the installation of electrical equipment on twelve 1500-ton and ten 3200-ton schooners under construction by the Northern Construction Company, Ltd., of Vancouver and the New Westminster Construction & Engineering Company, Ltd.

ANCASTER, ONT.—The installation of a distribution system to supply hydroelectric power in Ancaster is under consideration. The cost is estimated at about $17,000.

CARLETON PLACE, ONT.—The City Council is considering the purchase of the local electric light plant, owned by H. Brown & Sons, to be owned and operated by the municipality.

TORONTO, ONT.—The City Council has adopted a by-law authorizing an expenditure of $650,000 for extensions to the hydroelectric system.

UXBRIDGE, ONT.—A by-law will soon be submitted to the ratepayers authorizing improvements to the local electric light plant, involving an expenditure of about $7,000.

Mexico

SANTA ROSALIA, MEX.—Arrangements, it is understood, are being made to complete the large hydroelectric and irrigation project of the Mexico Northern Power Company within the next few months. The work includes the construction of a large dam across the Conchos River at a point about 18 miles from Santa Posalia, the installation of a power plant to develop about 150,000 hp., the building of a system of canals and ditches, and reclaiming about 200,000 acres of valley lands by means of irrigation. Several millions dollars, it is stated, have already been expended on the project. J. W. Thompson is superintendent.

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(Issued Dec. 3, 1918)

1,286,394. METHOD AND APPARATUS FOR ELECTRIC HEATING BY HIGH-FREQUENCY CURRENTS; Edwin F. Northrup, Princeton, N. J. App. filed Sept. 19, 1917. To transfer electric energy into a continuous mass by electromagnetic induction and there to convert the electric energy into thermal energy by means of high-frequency currents.

1,286,395. OSCILLATION-CURRENT METHOD AND APPARATUS; Edwin F. Northrup, Princeton, N. J. App. filed Nov. 25, 1916. To utilize the heating effect of electric currents having the natural frequency of a freely oscillating electric system from a condenser discharging through a gap.

1,286,403. AUTOMOBILE SIGNAL; Charles R. Piggins, Racine, Wis. App. filed June 2, 1916. May be swung out from the side of the automobile to indicate the intention of the drive to make a turn.

1,286,415. TORQUE REGULATOR; Forrest E. Ricketts, Baltimore, Md. App. filed May 25, 1911. To compensate for the increasing torque in an alternating-current meter where the torque varies as the square of the current.

1,286,418. OUTPUT INDICATOR; Harry D. Rohman, New York, N. Y. App. filed Dec. 1, 1915. Primarily for use on dynamos of the slipping-belt type, as employed in electric train lighting, heating and ventilating systems.

1,286,429. THERMO-ELECTRIC GENERATOR; Frank D. Shindel, Northampton, Pa. App. filed Oct. 29, 1915. The couples of dissimilar metal are heated and cooled to produce a current of maximum strength for an apparatus of minimum size.

1,286,466. WRAPPING MACHINE; Charles B. Whittelsey, Hartford, Conn. App. filed March 20, 1916. Has mechanism for applying to the surface of the wrapper a tearing device in the form of an adhesive tape.

1,286,498. ELECTRIC WATER HEATER; Robert P. Barnstead, Boston, Mass. App. filed May 6, 1918. As the water is turned on or off the heating device will have its current automatically cut in or out.

1,286,511. MAGNETIC PULLEY SEPARATOR; John P. Bethke, Milwaukee, Wis. App. filed Jan. 31, 1918. Used in connection with a conveyor belt to separate magnetic from non-magnetic material.

1,286,512. GAS-ENGINE PRIMER; Wilbert T. Bintliff, Plainfield, N. J. App. filed June 4, 1915. Is heated electrically and may be attached directly to the engine manifold or associated with the carburetor in such a manner that the vaporized liquid at the necessary temperature passes therefrom to the chamber wherein it is mixed in the air before entering into the cylinder.

1,286,576. THERMOSTATIC CIRCUIT CLOSER; Thomas B. Frean, Leonia Borough, N. J. App. filed March 17, 1913. For use with constant-temperature baths of the type designed for chemical laboratory ovens, bacteriological incubators and other similar apparatus.

1,286,577. PROCESS FOR MANUFACTURING GASES; Herbert F. Frueler, Walla Walla, Wash. App. filed June 6, 1916. Has particular reference to the production of carbon monoxide and hydrogen.

1,286,587. DIRECT-CURRENT APPARATUS; Charles W. Girvin, Philadelphia, Pa. App. filed Aug. 26, 1915. Adapted to operate in connection with currents of high potential.

1,286,590. PORTABLE ELECTRIC LANTERN; William Grether, Dayton, Ohio. App. filed June 27, 1918. Uses a storage battery and has an airtight and gas-proof reflector compartment.

1,286,592. ELECTRICAL CONNECTION; Ansel F. Gurney, Natick, Mass. App. filed Jan. 21, 1918. Particularly for use with the protective flexible armored cable commonly used for protecting electric wire in automobile.

1,286,596. METALLIC-FILAMENT LAMP; Herman J. Jaeger, Weehawken, N. J. App. filed Dec. 15, 1916. Dispenses with the glass rod or support and thereby greatly reduces the liability to blackening of the lamp.

1,286,604. FURNACE DOOR; Julius R. Hall, Oak Park, Ill. App. filed April 4, 1918. Equipped with an electrode holder which is durable and permits manipulation of the electrode in a desirable manner.

1,286,605. OUTLET-BOX FITTING; Oscar E. Hallstrom, Stratford, Conn. App. filed July 5, 1917. Adapted to be mounted in a one-gang outlet box, and through which both switched and unswitched connections may be established between the wires leading to the box.

Record of Electrical Patents

Notes on United States Patents

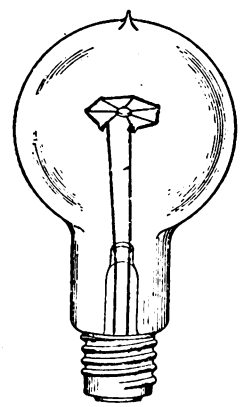
1,286,624. CLAMP FOR WIRES; George W. Henry, New York, N. Y. App. filed Nov. 18, 1915. Wire can be readily inserted and removed.

1,286,652. PROCESS FOR RECOVERING COPPER FROM ORES AND ORE PRODUCTS; Gustaf N. Kirsebom, Copenhagen, Denmark. App. filed Dec. 5, 1917. Consists in smelting a sulphide ore rich in copper with a roasted sulphide ore containing copper in the presence of silica and of a quantity of coke sufficient to effect the reduction of ferric oxide to ferrous oxide, the smelting operation being effected in a resistance-type electric furnace.

1,286,671. SYSTEM OF DISTRIBUTION; William H. Lieber, Milwaukee, Wis. App. filed July 21, 1915. Has particular relation to devices for regulating generators connected to supply variable loads.

1,286,705. PERMUTATION ELECTRIC SWITCH; Matthew E. Meskill, Jersey City, N. J. App. filed April 25, 1918. Has particular reference to switches or circuit breakers that are intended to provide means whereby an authorized person only may close the circuit.

1,286,750. DRY-CELL BATTERY; Herbert R. Palmer, Cleveland Heights, Ohio. App. filed Feb. 8, 1918. To increase the efficiency of a cell of the Leclanché type without materially increasing the volume or weight.



1,286,596—Metallic-Filament Lamp

1,286,751. DEVICE FOR INDICATING THE FAULTY OPERATION OF IGNITION VALVES AND CARBURETORS OF INTERNAL-COMBUSTION ENGINES; Otto T. Papke, Joliet, Ill. App. filed March 26, 1918. Each and all of the circuits leading to the spark plugs may be opened or short-circuited by grounding.

1,286,782. CORE CONSTRUCTION FOR ELECTRICAL APPARATUS; George L. Ringland, Norwood, Ohio. App. filed Feb. 19, 1917. Provides for the required mechanical strength and efficient ventilation of the core.

1,286,794. ELECTRIC FURNACE; Olof Sahlin, London, England. App. filed May 1, 1918. Electrodes are arranged so that the arc is either formed between the two electrodes or between the upper electrode and the bath of metal or other conducting material.

1,286,795. MEANS FOR IMPROVING THE COMMUTATION IN ROTARY RECTIFIERS; Henry K. Sandell, Chicago, Ill. App. filed May 29, 1916. Commutation effected in a substantially sparkless manner, and the necessity for minute exactness as to the time of breaking between the brush and its segment is obviated.

1,286,800. BATTERY-LIGHTING OUTFIT; Walter B. Schulte, Madison, Wis. App. filed June 25, 1918. The lamp carrier may be fitted on the head, arm or other portion of the body of the user, and the hand lamp inserted in a conveniently located pocket, leaving both hands free.

1,286,803. HYDROCARBON MOTOR; Herman G. C. Schwarze, Detroit, Mich. App. filed Nov. 20, 1915. To provide an ignition system for high-speed multi-cylinder internal-combustion engines.

1,286,806. LOCKING SWITCH; Edson O. Sessions, Chicago, Ill. App. filed June 23, 1916. Particularly for use with alternating currents of large volume.

1,286,815. ELECTRICAL PROTECTIVE DEVICE; Benjamin H. Smith, Turtle Creek, Pa. App. filed July 12, 1915. Means provided for materially increasing the range of the time element of definite time-limit relays.

1,286,841. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed Feb. 20, 1918. When an emergency application of the brakes is made the service magnet valve, even if stuck in an open position, cannot supply fluid to the brake pipe.

1,286,842. ELECTROFLUID-PRESSURE BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed Feb. 23, 1918. Number of train circuits required is reduced by providing means for controlling both the application and the release of the brakes through common train circuits.

1,286,844. ELECTROLYTIC CELL; Fayette D. Vorce, Sandwich, Ontario, Canada. App. filed April 2, 1918. Provides readily assembled and disassembled construction.

1,286,850. CURRENT-REGULATING APPARATUS; Julius B. Wantz, Chicago, Ill. App. filed July 24, 1916. For use under conditions requiring relatively close regulation of the current throughout relatively wide variations.

1,286,855. SELECTOR SWITCH; Harry G. Webster, Chicago, Ill. App. filed Sept. 4, 1915. The circuit terminals may be relatively rigid contact pieces assembled in removable banks relatively distant from the actuating bars or shafts.

1,286,882. ELECTRIC TRANSLATING APPARATUS; Peter C. Hewitt, Ringwood Manor, N. J. App. filed April 16, 1918. To reduce the necessary voltage for passing current to a far lower limit.

1,286,885. TELEPHONE RECEIVER; William H. Riess, Cincinnati, Ohio. App. filed Jan. 29, 1917. When receiver is laid down it will always "right itself" or tip so that mouth or trumpet end is exposed or open, permitting notice to be given to the user that his receiver is off hook.

(Issued Dec. 10, 1918)

1,286,899. SYSTEM OF POWER TRANSMISSION; Stanley B. Arnold, Chicago, Ill. App. filed Nov. 8, 1916. Relates to an electric generator comprising armature and field members and acting as a clutching, releasing, starting and stopping medium between the prime mover and its load.

1,286,917. TELEGRAPH SYSTEM; John H. Bell, East Orange, N. J. App. filed July 12, 1917. Relates to telegraph transmitting apparatus and systems wherein current changes imparted over a single-line conductor may be readily recorded either in code or in printed form at a properly equipped receiving station.

1,286,919. SEPARABLE ATTACHMENT PLUG; Reuben B. Benjamin, Chicago, Ill. App. filed Dec. 9, 1914. Comprises an insertible member adapted to be screwed into a lamp socket or the like and a binding terminal-carrying member which is separably connected to the insertible member.

1,286,959. PRINTING TELEGRAPH SYSTEM; Amos F. Dixon, Newark, N. J. App. filed May 24, 1916. Apparatus for testing automatic transmitters and selecting mechanisms, such as those employed in printing telegraphs.

1,286,960. ELECTRIC MOTOR-CONTROL SYSTEM; Samuel R. Dodds, Wilkinsburg, Pa. App. filed July 1, 1916. A master controller primarily operates a subsidiary shunt circuit to close the switch for the main current, but is thereafter relieved of the duty of maintaining such switch closed.

1,286,961. CIRCUIT CONNECTOR; Harry A. Douglass, Bronson, Mich. App. filed April 4, 1917. Is of particular service when employed in the manufacture of headlights, tail lights, etc.

1,286,965. MAGNET CORE; Gustaf W. Elmen, Bogota, N. J. App. filed April 6, 1916. Particularly useful in connection with cores for loading coils for telephone circuits.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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The New Work for the N. E. L. A.

IT IS gratifying that the National Electric Light Association can now begin to resume the work through committees and sections on the large scale which it was able to follow before the war. The industry will be benefited by the exchange of ideas and the discussion of practice bearing on present conditions. With the stress of war over we can see that matters of physical operation, of financing, of broad public policy need attention. Those questions were secondary when the thought of winning the war dominated the nation. Organization of the N. E. L. A. committees and sections has been carried thoroughly into the different fields of central-station management, and its advantages are cumulative. The break in the normal schedules of meetings due to the war was fortunately not very long in duration, and it will require only time to give the varied activities impetus. Those who meet to prepare for the annual convention will bring to the conference an experience enriched by surmounted difficulties of war-time operation. They will have new solutions to offer for the new problems which the industry will meet.

Do we realize the advertising value that the simple word "electric" still carries? In the early days of the application of the art it was a term to conjure with. It has undying power. Use it as much as we like, it still carries an appeal. No one tires of it, it still suggests the wonder-worker, the miracle of mighty powers.

A Useful Auxiliary Plant

ONE of the interesting transmission systems of the eastern half of the country is that of the Appalachian Power Company in West Virginia. It is altogether unusual in that it was designed in no small measure for the specific purpose of delivering power for coal mining in the very important West Virginia coal region. Bringing electric power to the mouth of a mine seems almost like "carrying coals to Newcastle," but as a matter of fact it pays in a good many cases, and never better than in this instance, where the coal is of such grade that the worst of it is better than the best from many mines that are profitably worked. Before the system of the Appalachian Power Company was made available, small and wasteful steam plants, with their usual failings, were the source of power. The change has brought about a very large reduction in the amount of otherwise useful fuel burned for power purposes, besides reducing the labor costs of the cruder power supply. The Appalachian Power Company has two hydraulic stations, of considerable interest in themselves, with a combined rating of 30,000 hp. and roughly 50 miles (80 km.) from the coal fields. There are also interconnections with the hydroelectric system at Roanoke, Va., and with a steam plant for railway service at Bluestone, West Va.

Now the total connected load of the system is about 50,000 hp., and up to 1917 this could be furnished without fear of trouble. Then rapidly increasing load and the evident necessity of rushing the output at the coal fields and in the industrial plants served made it desirable to take further steps. The auxiliary station which H. S. Slocum describes in another column was therefore started in September, 1917, and is just going into service. The location chosen was Glen Lyn, Va., the nearest point to the coal fields at which ample water for condensation was available. The design was laid out for 60,000 kw., of which one unit of 18,500 kw. is now in place. Nevertheless the installation is of more than passing interest on account of some of its details. In the first place it was fully realized that at present one generator was enough, since it is really a single unit in a system containing many, and it does not make the slightest difference whether it is supplied from a generator in one place or another, or whether that generator is driven by steam or water. On such a system the reserve generating power is wherever it happens to be available, and no provision at any one particular point has to be made. Another point worth noting is that the usual type of overhead coal bunker is abandoned in favor of a large bunker adjacent to the boiler room to which the coal is delivered by a screw-conveying system. This arrangement lightens the superstructure of the boiler room, and the erection of the bunker does not interfere with the installation of other machinery now or at any future time.

The boilers are four in number and represent an advance on conventional practice in that they are designed for 300 lb. (21.1 kg.) pressure and 200 deg. Fahr. (93 deg. C.) of superheat, which figures show that the world does move after all, though it is sometimes painfully slow about it. The power is generated at 13,200 volts and is transformed to 88,000 volts for the transmission. The whole high-tension equipment is installed out of doors and feeds a 30-mile (48-km.) transmission line which connects with the hydraulic system at Switchback, West Va. The electrical equipment is of the simplest character, and the steam plant represents advanced practice of a kind which may well be imitated in other situations. It may only be added to enforce this moral that at 14,000 kw. load the guaranteed steam consumption is 10.45 lb. (4.75 kg.) per kilowatt-hour, a figure which requires no further comment.

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Natural and Artificial Lighting

ONE of the outstanding problems in illumination is the adjustment of lighting, and particularly industrial lighting, for the succeeding conditions of daylight and darkness. In many factories one finds the daylight conditions much better than those prevailing under artificial illumination, while occasionally the reverse is true. Prof. C. E. Clewell's consideration of this subject in a recent issue is worth attention. The fundamental propositions which he sets forth as regards natural lighting are that each employee should have light sufficient for the best workmanship, that a well-lighted factory is more valuable than a poorly lighted one, and that a factory badly lighted by day requires the auxiliary use of more artificial light than would otherwise be the case. These things are self-evident, and yet the significance of them is often disregarded. To his injunctions we would add a fourth to the effect that no space should be occupied for factory purposes in which either the artificial or natural lighting is at any time inadequate for efficient working. And what is true of factories as such is also true for many other spaces occupied for industrial purposes. A modern factory is altogether likely, if designed for factory purposes, to have either monitor or saw-tooth roof sufficient to supply fairly adequate lighting from above.

This is not the case with many of the older buildings. In fact, it may be said with entire security that a large proportion of the working spaces which depend on side windows are improperly and inadequately lighted so far as natural light is concerned. It is not at all uncommon to find floors of large area occupied for miscellaneous business or clerical purposes which are so badly lighted by day that they require a considerable expenditure for artificial illumination to make them even tolerable. In order to get in sufficient natural light upon a large floor space from side windows alone it is necessary that these windows not only should be very large in area but also that they should be high enough to let in light at a fair angle of incidence. Light directed almost horizontally, even if by the aid of prismatic glass, is not effective for illumination upon a horizontal plane, and if the windows have sufficient height to overcome this difficulty there is a waste of room vertically which decreases the value of the building as a whole for the purposes of its use. Even when the working space has fairly good illumination from windows, it is by no means sure that it will continue in this suitable condition. One over and over again finds large spaces used for various purposes in which machines or cabinets or file cases or storage space have been so thrust in without regard for illumination that the light received laterally is practically extinguished. Then it becomes necessary to supplement it by artificial light, usually at a large disadvantage, since a mixture of natural and artificial light is somewhat confusing, and there is a constant tendency toward the use of the latter by daylight to an extent which is entirely unnecessary.

Professor Clewell's emphasis on the desirability of overhead lighting is extremely well deserved. He shows in addition how proper account can be taken of the available natural lighting in an endeavor to discover what the artificial requirements may be. The process of determination is really a very simple one, to obtain illumination readings simultaneously in the various parts of the interior space and in the free air outside. The ratio of these quantities is the "daylight factor" which shows the lighting reasonably to be expected at various hours of the day and various seasons of the year. The comparison by good rights should be made at times both of high and low sun and of no sun at all, the better to get an average daylight factor which will be reasonably applicable at any time. Now, the general daylight illumination under given circumstances has been fairly well established by investigation, so that if the factor be known for any particular building the periods during the day at which the natural illumination is likely to become inadequate appear at once, and consequently the relative amount of artificial lighting which must be added. The principles here laid down are as applicable to an office building as to a factory, with the proviso that in the former case more extensive measurements through various hours of the day will be necessary. In either case the result is a fairly clear idea of the artificial lighting which will be demanded. This given, one can form a fairly satisfactory estimate of the economics of the situation.

The proposal for five-year extension of government railroad control may be regarded by some as a compromise between immediate public ownership and immediate return of the properties. Visualized at the end of the five years, however, it is less easy to see it as a compromise plan than as a permanent public ownership plan. Politics and pure economics are both in the struggle at Washington, and at this stage it is too early to see which will come out eventually on top.

The Havard-Technology Coöperative Plan

AS WAS announced in our issue of Dec. 28, the Harvard School of Engineering has been reorganized in accordance with a ruling of the Massachusetts Supreme Court and has been opened at Harvard University.

Harvard University opened a school of engineering in the Lawrence Scientific School as early as 1849 and continued the teaching of engineering until 1914. When the Massachusetts Institute of Technology was about to move from Boston to new and extensive buildings in Cambridge, a short distance from the university, an agreement was entered into between these two for their future coöperative effort. According to that agreement, the university's teaching staff and equipment were transferred to the new Technology buildings and were merged with the institute in such a manner that the faculties were combined and the students became enrolled as belonging to both institutions, receiving degrees from both on completing their courses of study.

As it was proposed by the university to apply to the cooperative plan the funds derived from the Gordon McKay bequest, the agreement was submitted to the Massachusetts Supreme Court for approval. In November, 1917, the court decided that the expenditure of McKay funds in the manner called for by the agreement between the two institutions was not in accordance with the will of the testator, and that consequently the agreement was invalid so far as related to that mode of expenditure.

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As the university funds applicable to applied science have been mainly derivable from the McKay bequest, it was decided to break up the coöperative agreement between the two institutions and reëstablish a school of engineering under the immediate administration of the university, in order to comply unhesitatingly with the decision of the court. This is the new step which has already been taken.

We are not informed as to what the next procedure will be on the part of the university, and the policy to be pursued will no doubt have to be shaped in accordance with the needs and condition of the time. It is, however, earnestly to be hoped that students of applied science in Massachusetts will be permitted to avail themselves, in some way, of the facilities for education offered by both of these large institutions of learning. It will be a great disgrace to engineering and to the spirit of the age if a student shall have to be cut off from the privileges offered by one of these institutions if he enrolls in the other, when the two sets of buildings are almost within each other's view.

Applied science has become so large and has so many branches that no single institution can cover all of the fields of teaching or learning which it presents. Every technical college naturally tends to develop specialties, either through the bent of its instructors or through the nature of its equipment. It is earnestly to be hoped that the governing boards of the two institutions will work out some plan of coöperative effort, within full authority of law, whereby their students may be interchanged, their courses of instruction mutually alternated, and scholarly work done at one accepted toward the degrees offered by the other. Such a plan should not only be mutually helpful and mutually economical but also be of enormous benefit to applied science.

Listening to calamity howlers aids and abets Bolshevism. Work is the best remedy for economic inflammation, coupled with the application of the Golden Rule.

Protecting the Employee

PROTECTION to those working on electrical circuits is a serious necessity. While under many circumstances it is entirely practicable to avoid work on live circuits, conditions frequently arise when it becomes necessary either to take a chance at handling live wires or to see the service go down and out. It is for emergencies such as these that special protective devices for the linemen become necessary. The rubber glove was very naturally the first aid to safety which was extensively employed, followed by rubber-handled pliers and other tools. Gradually the field has developed until shields, rubber blankets, rubber armlets, boots and shoes, hats and coats are in fairly common use. The vital question to be asked about all such appliances is at what voltage they can be used with reasonable security, and by reasonable security we mean that the chances should be very large indeed against the failure to protect—so large that under all ordinary circumstances a lineman may feel absolutely certain that if he is reasonably careful he can go about his task with impunity. Once in a hundred or a thousand times rubber protectors may fail from some entirely unforeseen cause, but if there is one failure in ten or twenty times the protection can be considered as negligible from a moral standpoint and had better be thrown aside.

It is pleasant to be able to record that on the whole the various rubber protectors are pretty reliable. They are in common use at the ordinary primary voltages up to 6600 and more rarely up to double that pressure. At higher voltages than these protecting gloves and the like are generally discarded and methods of working employed which do not require anything approaching personal contact with the conductors.

The important thing considered at some length in the article on this topic in a recent issue is the testing of everything of this sort prior to its acceptance from the source of supply, and periodically, to insure its being in good condition. Gloves which are subject to more wear than other rubber protectors require not only thorough preliminary testing but periodic tests during usage. They generally get a fairly stiff test with voltages from 4000 to 10,000, with frequent inspection for faults and less frequent repetition of an actual potential test. Recently leather or canvas gloves have been not uncommonly supplied to wear over the rubber gloves on occasion, merely to protect the real insulation against mechanical injury. Such additional gloves should be quite independent of the rubber ones and removed from them when not in use. Rubber gloves may last from a few months to several years, and the uncertainty of effective life is sufficient reason for frequent test.

Protective devices like rubber shields and blankets to prevent contact with the wires to which they are attached require less persistent testing than the gloves, but periodical examination will generally disclose faults more easily than in the case of a more pliable and intricate form like a glove. Testing these larger articles is generally carried out by throwing them over one electrode and testing them with another, frequently at pretty stiff voltages, sometimes up to 50,000. Shields and blankets are somewhat commonly used up to 13,000 volts or 14,000 volts and very extensively at primary voltages of 2300 to 4000. All these devices have proved their usefulness over and over again, but all require thorough and frequent testing if they are to be used at anything except very modest pressures. Unless such testing is rigorously carried out, the effect is likely to be the same false sense of security which has frequently caused accidents in handling so-called insulated wires. Just where the line of safety lies over which it is imprudent to work on live circuits is pretty difficult to state, for it varies with general and special weather conditions and with the nature of the work to be accomplished. A surprising amount of repairs can be made on very high-voltage circuits by means of special handling appliances, but this statement does not apply to the case of distribution circuits where the wires must literally be handled by the linemen. One is probably within conservative limits in stating that any voltage suitable for general distribution can safely be worked on when alive if—and here is the important matter—there are ample supplies of the various devices to which we have referred, rigorously inspected and tested. On the other hand, voltages which would be classified as transmission voltages as contradistinguished from distribution are generally over the safe limit and must either be cut out for repairs or dealt with by indirect methods of handling.

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An Operating View of High-Tension Insulators

Severe Operating Conditions That Have Caused Failure of Line Insulators—Later Designs of Pin and Suspension Types Promise to Solve Insulator Problem for Some Years to Come

BY P. ACKERMAN
Electrical Engineer Toronto Power Company

RECENT improvements in insulator design and manufacture have resulted in the production of insulators which appear to meet the severe tests of operation on the line with reasonable success. The porcelain disks or petticoats of modern design are thicker and of such shapes that better distribution of the electric field is obtained, decreasing the possibility of destruction from power arcs and abnormal voltages. It is thus the opinion of the writer that so far as design is concerned the problem of the line insulator can be

FIG. 1—APPEARANCE OF THREE PIN INSULATORS AFTER A LIGHTNING STORM

considered as solved for a considerable time to come. In the matter of quality, also, owing to improvements in design and manufacturing, a more lasting insulator should be obtained than any produced in the past.

The functions of line insulators may be stated as follows:

(1) To resist flashover under the worst possible weather conditions and under the most serious overvoltage which may be set up due to internal surges.

(2) To resist puncture direct from line wire to pin through the head, whenever flashover of the insulator is inevitable because of severe lightning surges.

(3) To resist power-arc destruction whenever lightning flashes over the surface of the insulator.

(4) To resist all possible mechanical strains from abnormal weather conditions.

To appreciate more clearly the importance of these functions it will be necessary to review the abnormal operating conditions to which line insulators may be subjected.

SEVERE CONDITIONS IMPOSED ON LINE INSULATORS

Internal surges are set up owing to switching, accidental grounds of one phase on non-grounded three-phase systems and sudden load changes in a long-distance transmission line. Such surges may for a brief period cause a voltage rise up to twice normal. To avoid line short circuits and service interruptions it will be necessary therefore to provide an insulator which will not flash over under the most trying weather conditions at less than twice normal operating voltage.

Lightning surges may be of any magnitude, so that it is impossible for commercial reasons to provide sufficient insulation to resist lightning flashover. It has been found that it requires more than 300,000-volt insulation before immunity from lightning flashover can be expected. Since rain is always combined with lightning storms, it means therefore that the line insulators will have to have a wet flashover in excess of 300,000 volts before immunity from lightning flashover is possible. This insulation value, however, is only reached by insulators used for systems operating at 100,000 volts and above, and it will be at once realized that no such excessive insulation can be applied to lower voltage systems merely for the sake of immunity from lightning flashover. Systems operating at less than 100,000 volts will thus have to submit to occasional flashover from lightning, and it is essential therefore to provide such insulators that this flashover will not do sufficient harm to disable the line permanently. To attain this object the first necessity is that the insulator be puncture-proof; in other words, that the insulator be built in such a way that it will flash over around the outside, through the air, rather than pierce a hole through the porcelain directly from wire to pin. A puncture will invariably result in such severe destruction of the insulator that the line will be disabled until the insulator is replaced, which may mean hours of service interruption—the time necessary to locate and replace the insulator.

The destruction from flashover, with properly de-

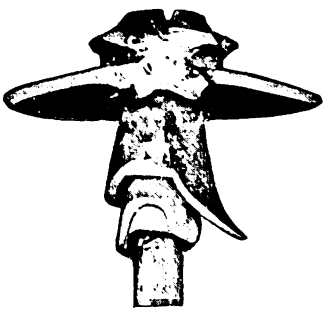

FIG. 2—PIN INSULATOR DESTROYED BY POWER ARC OF 500 AMP. LASTING FIVE SECONDS

signed insulators, will generally be limited to broken skirts, leaving sufficient flashover distance to withstand normal operating voltage after the arc has been extinguished by momentarily interrupting the line; as a result service can be quickly restored, causing a few minutes' interruption only. The better the insulator is able to resist the power arc, the less danger of permanently disabling the line will exist.

*Taken from a paper presented by the author at a recent meeting of the Toronto Section, A. I. E. E., with slight revision.

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Weather conditions greatly influence the flashover value of insulators and accordingly have to be seriously considered in determining the necessary safety factor of flashover to normal operating voltage. Rain will reduce the flashover considerably compared with dry conditions. Localities with dust and smoke may cause a coating on the insulators which in itself is not conductive but may cause flashover in the presence of rain or mist.

Sleet and wind chiefly determine the mechanical requirements of the insulator.

Temperature changes from the severe winter cold to the summer heat, or the concentrated heat of the sum-

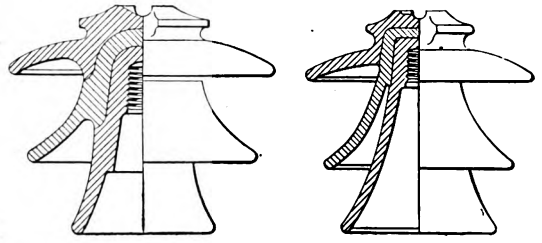

FIG. 3—OLD AND NEW DESIGNS OF PIN INSULATORS (NEW ONE AT LEFT)

mer sun striking the insulator on one side only, or sudden cooling of porcelain from rain after extreme heat, all put severe internal stresses on the porcelain, tending to crack the individual shells.

Moisture in the atmosphere may penetrate into surface pores or gradually work its way through complete channels of capillary porosity in the porcelain, and this finally will cause puncture.

It thus follows that an insulator, to be considered satisfactory from an operating viewpoint, should have a wet flashover of not less than twice normal operating voltage. It should resist puncture and power arc and withstand all weather influences without weakening electrically or mechanically.

In the following paragraphs it is attempted to review in detail the causes and possible remedies of puncture and power-arc destruction, although it must be said that such review must remain very incomplete for the reason that many causes are obscure and in regard to others the opinion of engineers varies greatly, depending on their local experience.

CAUSES OF AND REMEDIES FOR PUNCTURE

In the early days of insulator design it happened quite often that the flashover distance over the insulator was made greater than the thickness of the porcelain permitted with the result that the porcelain would puncture rather than flash over. Moreover, many insulators of the older designs had such bad electrical stress distribution that severe corona was noticeable at comparatively low voltages, causing a gradual redistribution of the electrical stresses, individual skirts being overstressed and punctured when subjected to flashover voltage. With the practice of testing each insulator for at least momentary flashover, such bad designs are no longer tolerated, and it may be said therefore that with very few exceptions all insulator designs found on the market to-day are provided to stand at least momentary flashover.

Porcelain cannot be manufactured with accurate uniformity of product. The result is that even with an ample design no assurance exists that the individual insulators will actually come up to the expected puncture strength. No insulator can be trusted therefore to flash over rather than puncture unless actually tested. In former days insulators had a routine test below flashover before leaving the factory, and in most cases the test they received was in regard to the future operating voltage rather than the flashover voltage. As a result they offered no assurance of resisting puncture in case of lightning. To-day the standard practice is to subject any insulator for a shorter or longer period to flashover voltage so that failure of the later type of insulators in case of flashover cannot possibly be attributed to a too easy factory test.

It happens, however, that even insulators which have withstood momentary flashover at the factory may be found to puncture in service without any apparent reason. The causes of this apparent deterioration in service are not quite cleared up yet despite exhaustive investigations of late years. Still, some of these causes have been established. For others some theories have been advanced based on the appearance of the defects. Doubtless similar troubles occur on both pin and suspension insulators, but the suspension insulator seems to be particularly sensitive to deterioration.

The following are the best known causes and theories explaining deterioration:

1. Unglazed porcelain seems to be all porous. The porosity may be slight surface porosity only extending from very fine surface cracks toward the inside, forming when filled with moisture projected needlepoints and thus reducing the effective puncture value or it may be capillary porosity forming capillary channels extending through the whole porcelain thickness, the pores being so fine that it takes considerable time, possibly years, until moisture works its way through and finally causes puncture; or again porosity may be so great, owing to improper firing or bad clay, that the moisture from

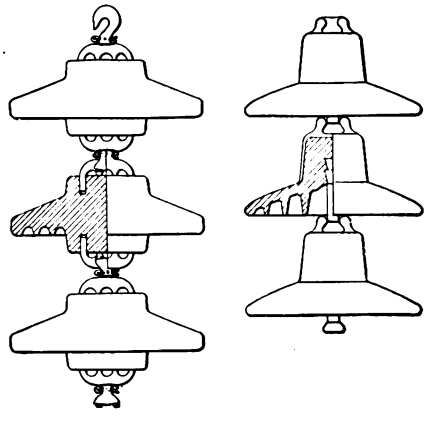

FIG. 4—RADICAL CHANGE IN DESIGN OF SUSPENSION DISKS (AT LEFT)

the cement will instantly form a moisture path detectable by the megger.

Unfortunately no means exist to determine the exact state of porosity, and although a severe flashover test after assembling will weed out all the badly porous material, it does not offer a permanent assurance that the material will be non-porous, as capillary porosity may appear only after years of service. Opinions among

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engineers differ widely as to the importance of this cause. It is the experience of the writer that porosity is one of the most important factors to be considered, although it may be said that the porcelain of the last few years seems to be considerably improved. A remedy to eliminate moisture penetration into pores can be found in glazing the vital head part, thus making it moisture-proof.

2. Observed cracking of porcelain may be due to various causes. The most advanced theory is that it is caused by the unequal expansion of porcelain, cement and iron due to extreme temperature changes. This has no doubt been a serious trouble in suspension insulators of past designs. However, it does not explain the puncture of later designs, in which provision has been made for pin and cap expansion and setting of the cement in a steam bath, and which show in design tests the ability of resisting successive temperature changes from iced water into boiling water.

Another theory is that the swelling of cement, when filling with moisture, may crack the porcelain. This could possibly happen in a very damp climate. However, the writer has been unable to find any evidence so far to support this theory. He had opportunity on several occasions to examine carefully the cement on insulators which have been in service for over ten years and has always found the fine radial cracks in the cement which apparently had formed during the shrinkage when originally set. Should any swelling take place, we should expect this space to disappear. But, assuming that any such effect could result, the proper remedy should be thick porcelain and small cement space so that the force of the swelling cement would be small and the mechanical resistance of the porcelain great.

Continuous mechanical vibrations and sudden shocks from wind and whipping wires may largely be the cause of cracks observed. This theory appears plausible, particularly in consideration of the fact that the combination of iron, cement and porcelain, as used in pin and suspension insulators, forms an extremely unelastic arrangement, and in addition porcelain is very sensitive to shocks.

A link between porcelain and cross-arm giving a kind of cushion effect to dampen the shock would be very desirable to eliminate such trouble. In pin-type insulators this remedy is found by applying steel pins with a lead thimble and in suspension insulators by using some kind of alloy in place of the cement.

Natural internal stresses in the porcelain due to drying and firing may offer an initial weakness which, aggravated by any of aforesaid causes, may develop cracks. Such internal stresses should be eliminated by avoiding sharp bends in shaping the individual porcelain pieces. This may be one of the principal reasons why the standard suspension unit is frequently found cracked in the corner where disk and head join.

Avoiding Power-Arc Destruction

It appears that far too little attention has been given to this subject in the past as a large number of troubles with pin-type insulators during lightning storms could be traced to power-arc destruction rather than to puncture.

The old designs of pin insulators, and to a large extent also later designs, are absolutely unfit to resist a heavy power arc for any length of time. The only thing that saves them from very severe destruction is the fact that the wind generally blows the arc away from the insulators.

The main reason for this sensitiveness to power-arc destruction is the thin shells and the very steep and narrow skirts in which the hot gases get caught, finally breaking up the petticoats.

The short-circuit current on transmission lines will vary greatly according to location of the short circuit relative to the power house, the generating capacity of the system and the operating voltage; but on any larger system it will exceed 1000 amp. and in effect may amount to many thousand amperes, so that it will readily be understood that the heat of the arc will be very considerable.

The most severe destruction is experienced if the arc-over takes place in quiet air. Under these conditions the arc will persistently envelop the whole insulator and usually break up all petticoats.

Fortunately the arc is very easily moved by the least wind into its own direction, thus bending the arc out and carrying the bulk of the heat away from the insulator. With the wind blowing at right angles to the line the danger of heat destruction is still quite pronounced because the arc terminals remain persistently at top and bottom of the insulator, endangering particularly the bottom petticoat. The least damage from power arc is generally experienced with wind in the direction of the line. In this case the arc is blown along the line wire; that is, the grounded arc terminal stays on the cross-arm and the other one moves rapidly along the line wire, thus stretching the arc and moving the flame away from the insulator. With heavy wind the arc has even a chance to extinguish itself.

With only the slightest wind blowing there is generally a fair chance to save the insulator from total destruction. After the arc has been extinguished sufficient insulation may be left to resist normal operating voltage, provided that the circuits are cleared instantly after the short has developed and provided the insulator is sufficiently rugged to resist power-arc destruction.

It will be realized that thick porcelain will be of prime importance to resist power arcs, as the heat will only affect the surface, and the more massive the body the better the porcelain will resist cracking.

For years there have been means suggested to deflect the power arc away from the insulator before any damage is done. Nicholson's arcing ring was one of the first of these devices. Horns of various forms and in different positions also have been suggested and partly put in use. They have, however, never found extensive use, this being probably due chiefly to the complication involved in mounting and because most of the troubles in the past were punctures and not plain power-arc destruction. But even with the development of puncture-proof insulators it is unlikely that this device will find extensive use since thick porcelain insulators assisted by instantaneous relay protection and arc extinguishers will be able to withstand flashover.

Comparison of Old and New Designs

In order to show the striking difference between old and new designs of pin insulators the following features are pointed out: (1) Thick shells assure greater

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resistance to power arc, temperature changes, handling, etc. (2) Rounded heads should reduce internal stresses from firing and thus reduce danger of cracking from external forces. (3) Sanded joints permit smooth surfaces and accordingly reduce danger of surface cracks. (4) Small cement space coupled with thick porcelain eliminates danger from swelling cement if any such danger exists.

The present type of suspension insulator has caused extremely severe trouble, and despite the many improvements which have been made and suggested it appears that the insulator will retain certain inherent weaknesses. A new insulator of this type has been put on the market, however, which promises to become a serious competitor to the suspension insulator now in use, as it embodies many important features.

The advantages of this new suspension insulator over older designs may be summarized as follows: (1) the disk is of extremely heavy bulk and accordingly should resist power-arc destruction. (2) The design is such that temperature changes should have very little effect. (3) The iron spider is cast into the porcelain body by means of some low-melting and comparatively soft alloy which should act as a damper of shocks. (4) The electrostatic field is so nearly ideal and the puncture thickness between electrodes so excessive that the unit should be puncture-proof with porcelain of fair quality.

The mechanical strength of the unit is somewhat lower than that which is obtained from the ordinary type of suspension unit, but it offers, on the other hand, the advantage that its guaranteed strength can be verified on each unit before leaving the factory. This cannot be done on the cemented insulator.

Pin and Suspension Insulators Compared

The general opinion among engineers not closely connected with the problem of line insulators is that the pin-type and suspension-type insulators are competitors. This assumption is not quite correct as they supplement rather than compete with each other, excepting in the application for line voltages of 70,000 volts to 110,000 volts. In this application it depends largely on the local conditions, the judgment of the engineer and, it might almost be said, the taste of the engineer which type will be adopted. Below 60,000 volts pin insulators are used almost exclusively except in cases where the line may be prepared for future higher voltage. Above 110,000 volts suspension insulators are used almost exclusively.

It may be of interest to indicate why the two types are suitable for different voltage ranges. Pin-type insulators when built for wet flashover values exceeding 160,000 volts become extremely large, heavy for handling and expensive, and the increase in weight and cost seem to be far out of proportion compared with the increase in the wet flashover value. Suspension insulators, on the other hand, can be built for practically any wet flashover value up to 400,000 volts at a proportional increase in weight and cost by the addition of extra units. Whenever a wet flashover of more than 160,000 volts is considered necessary one will be forced, therefore, for reasons of practicability and economy, to adopt the suspension type.

The pin-type insulator is generally recognized as preferable because fewer troubles are experienced from wind and sleet, due to the rigidity of the support. The suspension insulator therefore may be termed a necessary, though undesirable, substitute for the pin insulator where wet flashover voltages in excess of 160,000 volts are required, as in the case of lines operating at voltages above 100,000.

As pointed out previously, the suspension insulator is found cataloged for wet flashover voltage values as high as 400,000 volts. There does not appear to be any reason why this value could not be increased to 450,000 volts or 500,000 volts by increasing the length of the string. At a safety factor of two this would correspond to an operating voltage of 225,000 volts to 250,000 volts, so that it may safely be said that the line insulation problem is solved for operating voltages as high as 250,000 volts, which is rather more than is anticipated at this time.

Materials for Insulators

The serious trouble experienced with porcelain insulators, their uncertain quality when leaving the factory and the brittleness and low mechanical strength of porcelain have always inspired the engineer to find some substitute of more ideal qualities.

Molding materials, which are so successfully used for indoor insulating purposes, have often been suggested for line insulators. The reason why such materials will never be satisfactory on the line is because they will not stand a power arc without charring, and as a result whenever flashover occurs the line will become disabled until the insulator is replaced. Surface leakage in rainy weather may also be sufficient to char the surface of the insulator and thus leave a permanent leakage path which finally will cause trouble.

This indicates clearly that the insulator surface must be made of refractory material if the insulator is to be lasting at all. Various kinds of glass, boro-silica, fused quartz and other materials have been recommended; but the cheaper glasses, which possibly could compete with porcelain in regard to price, are generally more brittle and cause more trouble, while boro-silica and fused quartz, though in many respects advantageous, have so far been too expensive to come into serious consideration.

Considering the improvements made in the manufacture and design of porcelain insulators and the cheapness of manufacture, it is the opinion of the writer that porcelain will maintain its position as the first and almost only material for line insulators.

THE conditions now confronting us are so unprecedented that we must guide ourselves rather by the eyes of prophecy than by what has been done in the past. We can hardly expect large reductions in the prices of material and labor for some time because the prices of labor always fix the cost of material. Consequently public utilities must depend upon expert management for the present.—*Henry L. Doherty.*

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Investigation of Maine Water Powers

Public Utilities Commission Sends to Governor and Council the Result of an Exhaustive Study of Water-Power Resources—Hydroelectric Systems, Power Sites, Plant Locations and Storage Conditions Dwelt On

AN EXHAUSTIVE investigation of the power resources of the principal rivers of Maine has just been completed by the Public Utilities Commission of the state and has been embodied in a 420-page report made to the Governor and Council. The investigation covers the legal, engineering and administrative phases of water-power development, and the report is designed to serve as a foundation for any policy which the state may wish to adopt in reference to the utilization of its hydraulic assets. This subject is expected to occupy the attention of the 1919 Legislature, the question of state ownership and development being one of the most important matters to be considered at this session.

ENGINEERING FACTS AND POSSIBILITIES

The investigation of the commission and those upon whom it has called for coöperation and expert assistance furnishes a solid base of engineering facts and possibilities upon which to discuss state policies and conservation programs, and brings into the compass of a single volume an extraordinarily comprehensive view of the principal water-power resources of the state, existing and prospective developments, storage accomplishments and possibilities, costs of hydroelectric power production, steam power and transmission lines, flowage and run-off data, rates charged by the principal electric utility companies, and market conditions for hydroelectric energy.

In his letter of transmittal, Chairman B. F. Cleaves of the commission points out that the funds available have not been sufficient to make a complete engineering study of all streams in the state. Some of the more important rivers have been selected, including the River St. John, the Fish, Allagash, Presumpscott, St. Croix, Union, Kennebec, Saco, Androscoggin and Penobscot Rivers. The commission presents data covering from 80 to 90 per cent of the total head available for power purposes on each stream studied. The commission has had access to studies of these rivers made by water, hydroelectric and manufacturing interests, all of which coöperated freely in the supplying of information, and in addition reports on certain important streams are presented by engineering experts specially familiar with them.

Paul L. Bean, chief engineer of the commission, planned and conducted the investigation, and the outside contributors include H. W. Foster, A. F. McAlary, H. K. Barrows and H. S. Boardman. Lucilius A. Emery, former Chief Justice of the Supreme Court of Maine, has contributed a report on "Legal Aspects of the Water-Power Investigation," and R. A. Parker, chief accountant of the commission, presents data upon the unit cost of power among the more important public utilities of the state. F. J. McArdle, chief of rates and schedules, has compiled data bearing upon the prices of electricity of thirty of the principal companies, and Mr. Barrows has added a report on the "cost of power" which embraces the principal economic factors in hydroelectric production, with general and specific data of importance.

A map of the state, showing the principal hydroelectric systems, power sites, plant locations and storage conditions, is included in the report and is reproduced on the oposite page.

The transmission systems of Maine, as shown on this map, are confined with one important exception to the southern half of the state. They are operated without much regard to interconnection, and the lines in general follow the more important river basins from the Penobscot to the Piscataqua. There are six principal transmission systems, excluding several hydroelectric developments of great local value industrially which supply paper-making and chemical concerns, but which do not include extended transmissions.

These systems include the Maine & New Brunswick Electric Power Company and Gould Electric Company, along the Canadian border of Aroostook County; the coördinated systems of the Bangor Railway & Electric Company and the Bar Harbor & Union River Power Company in the Penobscot and Union River valleys; the Central Maine Power Company, with the largest transmission system in the state, extending nearly from Moosehead Lake through the Kennebec valley to the coast at Bath; the Androscoggin Electric Company, with lines radiating from the Lewiston-Auburn district; the Cumberland County Power & Light Company, with plants on the Saco and Presumpscott Rivers and lines centering at Portland and supplying energy in general from Yarmouth to York Harbor, and the Western Maine Power Company, operating in the upper Saco valley. The Twin-State Gas & Electric Company, with headquarters at Dover, N. H., and the Rockingham County Light & Power Company of Portsmouth, N. H., also supply energy to Maine points.

MAINE SYSTEMS MAINLY HYDROELECTRIC

The Maine systems depend largely on hydroelectric plants for energy, and while various auxiliary steam plants are held in readiness for service during low-water periods or in emergencies, only an insignificant proportion of the combined yearly output is generated by steam.

The oportunity for further conservation of fuel and water by interconnecting these various systems is significant. At present there are no tie lines between the major systems which could be considered important in a comprehensive program of electrical interchange. The present systems exhibit the advantages of consolidating many small adjacent properties into unified systems, and a logical step will naturally be the interconnection of systems to secure the benefits of diversified water supply, load apportionment and surplus capacities in plants and lines.

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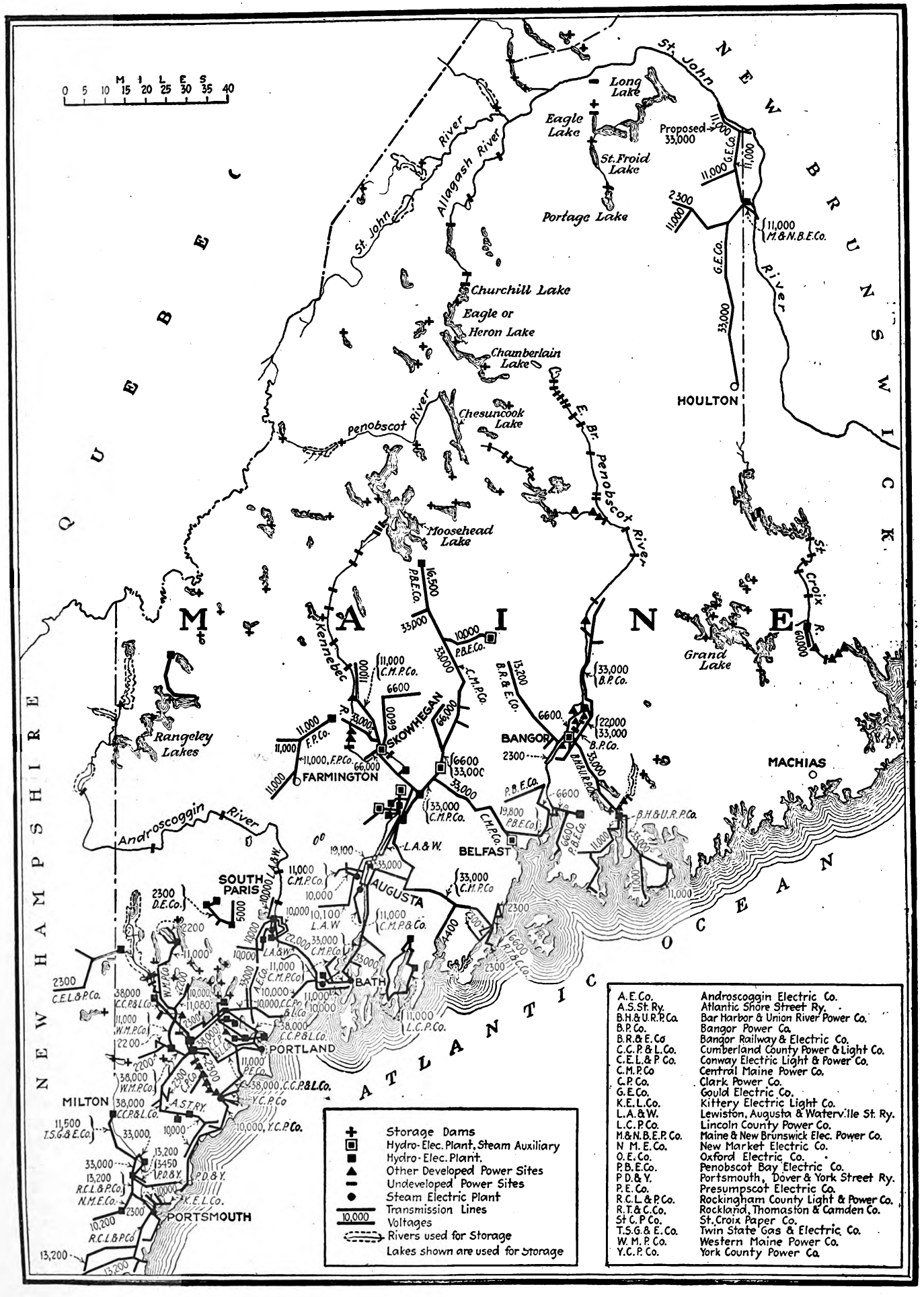

HYDROELECTRIC MAP OF THE STATE OF MAINE

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LEGISLATIVE RECOMMENDATIONS OF MASSACHUSETTS COMMISSION

Gas and Electric Light Commission Seeks Enlargement of Its Powers—Street-Lighting Contracts, Depreciation and Other Matters

IN ITS recommendations for legislation in 1919 the Massachusetts Gas and Electric Light Commission asks for increased power of regulation with respect to limitation of dividends in cases where corporate resources are being abused, in regard to the validation of street-lighting contracts, recommendations regarding depreciation allowances, and contracts for the purchase of gas and electricity under a common ownership. The board points out that a district characteristic of the Massachusetts system of regulation of gas and electric light companies is the absence of any express limitation of dividends, but such a limitation has been implied and has resulted in widely varying dividend rates as between different companies and has as a rule been effective in keeping at a minimum the capital burden borne by the consumers. Unfortunately, the report says, some companies have failed to observe the spirit of the law and are depleting their reserves by the declaration of excessive dividends. In the absence of complaints of the prices charged by such companies the commission has no authority to prevent this abuse. Moreover, the board states, the proper remedy may lie not in lower prices but in protecting the company from the greed or the short-sightedness of its own management. The board believes that it should be authorized to check this abuse in proper cases, prescribing such limitations of dividends and for such periods as the circumstances warrant.

A year ago the board called the attention of the Legislature to the advisability of requiring the board's approval of contracts for street lighting for periods of more than one year. This recommendation did not receive favorable consideration, owing in part to a feeling that it might prove an embarrassment rather than a help to the local authorities having this matter directly in charge. Experience is demonstrating, however, says the board, that such contracts for more than a year at a time are of little practical advantage either to the municipalities or to the companies supplying the service. Moreover, there has always been considerable doubt of the authority of departments of cities and towns to incur liability beyond the appropriation available. And yet, if the city or town requires some new type of lamp or new arrangement of lamps on the streets, the expense may be so great as not to justify the company in making the change unless assured of their use for some definite period. In order to cure this doubt and to relieve the local authorities from the necessity of negotiating new contracts unless some changes in the street-lighting requirements are contemplated, the board recommends that cities and towns shall not make contracts for street lighting for periods other than the current municipal year without the approval of the commission after due notice and a public hearing.

The growth of a feeling of uncertainty and distrust with respect to all public service securities has been intensified by the discovery from time to time of instances of the gross inadequacy or entire lack of provision for depreciation. The board has consistently refrained from laying down rules with respect to depreciation, believing that the requirements of different companies, even of the same class, vary widely. But it has as consistently insisted upon returns which shall exhibit what the companies have or have not had available for this purpose and what has become of it. Some instances have come to the board's attention in which companies under its supervision, although ample provision for depreciation has been included in the rates charged, have chosen to divide rather than to husband this essential resource. Unless the tendency is checked such companies will soon become so weakened in their credit as to be no longer efficient public servants until reorganized with substantial losses to their stockholders. The board therefore recommends that it be given authority to lay down and enforce such general or specific requirements as to depreciation as may from time to time seem necessary.

The tendency to concentrate the production of gas and especially electricity into large, well-located generating plants has made many companies distributers merely and not producers of gas and electricity. The terms upon which such distributing companies purchase gas or electricity are becoming a matter of vital interest to the customers dependent upon them. Where the companies involved are independently owned, self-interest may well be relied upon to insure proper terms. Where, however, the selling and purchasing companies have a common ownership, this element is wanting and serious injustice may result not only to the consumer but also to one or the other of the companies which are parties to such transaction. The board therefore recommends that contracts for the purchase and sale of gas and electricity between companies having a common ownership require its approval.

The commission points out that the unsettled and extraordinary financial conditions of the last two years have led the companies under its supervision to resort to the issue of bonds rather than of stock to a far greater degree than ever before. It is not unlikely that such issues will be even more frequent in the immediate future. The statutory restrictions relative to such bonds are such as to make them high-grade securities which should command the best rates and a wide market. The interest of the managers and stockholders of the companies and of the public as well is obviously to secure their issue upon the most favorable terms. But the novelty of this form of security and unfamiliarity with the agencies for placing them with investors have frequently made managers hesitate over resorting to them. Moreover, the commission states, while savings banks may invest in bonds or notes of gas or electric companies payable within one year, they are not permitted to invest in their bonds of longer terms, although more amply secured than many of the railroad and street-railway bonds in which investment is permitted. The board therefore recommends that the bonds of gas, electric and water companies be disposed of by tender to the highest bidder and that the discrimination against them in the savings bank law be remedied.

A further recommendation is that managers of municipal gas and electric plants be brought under the civil service.

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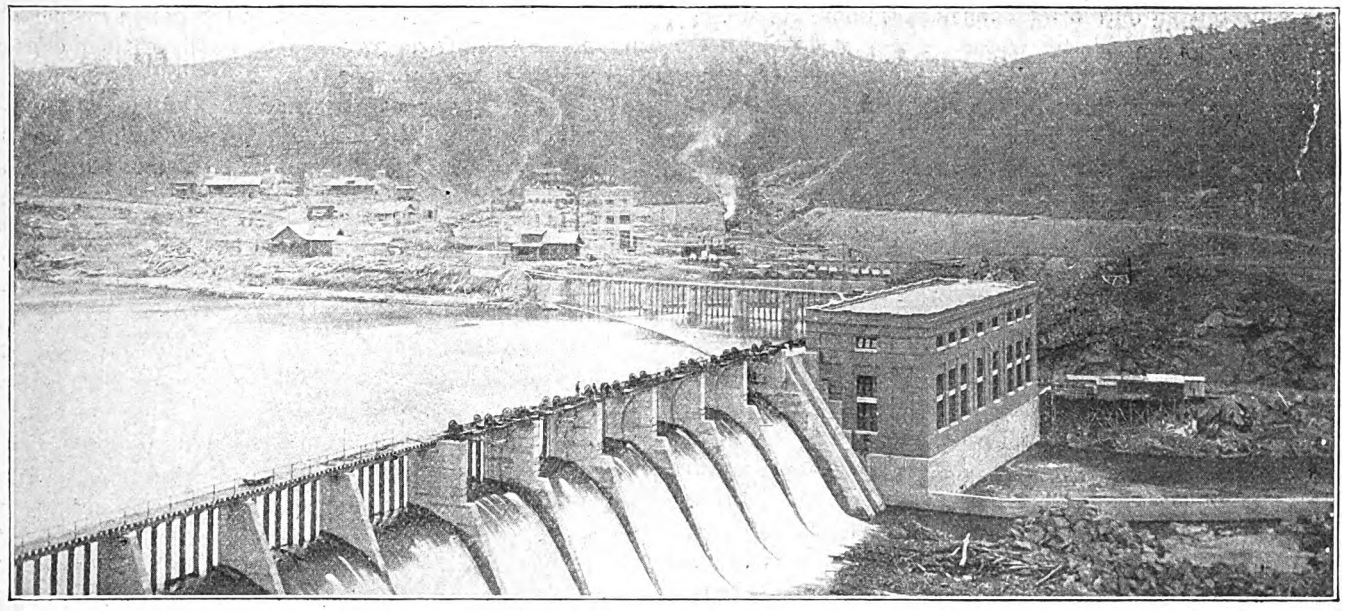

FIG. 1—HYDROELECTRIC PLANT NO. 2 ON THE NEW RIVER

New Plant of the Appalachian Power Company

Steam Station Rated at 20,000 Kw. Just Completed to Supplement Hydroelectric Plants in Meeting Heavy Industrial Requirements—Development of Rich Mining District Due Largely to Central-Station Power Supply

BY H. S. SLOCUM
Engineer with Vielé, Blackwell & Buck

INTRODUCTION of electric service in the industrial and mining districts of southwestern Virginia and southeastern West Virginia has done much to develop the business of that section, which abounds in coal, manganese, iron, zinc, gypsum, salt, alkalis, silica and limestone. Of first importance are the great semi-bituminous coal mines in what is classed as the Pocahontas district. Electrification of these mines has resulted in the speeding up of production and the introduction of operating methods that brought increased efficiency and economy. Previous to the advent of electric service to these mines they were operated by small isolated steam-power plants which were more or less inefficient and unreliable. Since then, however, the big mine managements have found it cheaper and more satisfactory to purchase hydroelectric power and that generated in steam stations. Fifty to 75 per cent reduction in coal consumption has been effected by this change in bituminous regions and about 90 per cent in anthracite regions, to say nothing of elimination of duplicated effort, according to Fuel Administrator Garfield.

Power is being supplied in this district by the Appalachian Power Company, which started the development of two of its several power sites on the New River in 1911. These two stations have a combined rating of about 30,000 hp. and are about 50 miles (80 km.) southeast of the coal fields. Besides having several steam plants upon which to fall back when water power is insufficient, the company is interconnected with the Roanoke Railway & Electric Company at Roanoke, Va., and also with the Norfolk & Western Railway's steam plant at Bluestone, W. Va. The latter connection is made through a frequency changer.

The total connected load of the Appalachian company system is approximately 50,000 hp. With scientific management the interconnections have made it possible for the power company to meet the unprecedented demand from the coal fields and industrial plants in all parts of the area. In 1917, however, in order to meet the rapidly increasing load and to do all possible to prevent the threatened coal shortage the company decided to build an additional steam auxiliary plant. Such a station was decided on because it could be completed in

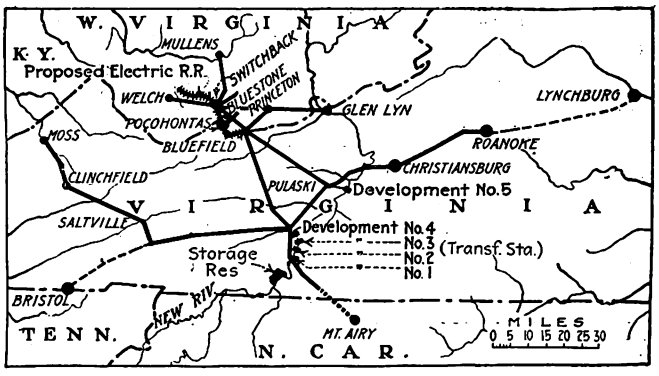

FIG. 2—MAP OF DISTRIBUTION SYSTEM AND POWER HOUSE

a shorter period than a hydroelectric plant and furthermore because it would permit the utilization of the maximum water power and allow operation of the system at its maximum efficiency. In other words, it is intended to use as much hydroelectric power as possible

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without counting on storage, depending upon the steam auxiliary in times of low water. Later it is planned to build a third hydroelectric plant for the next source of power and follow this with another steam unit, and so on.

The construction of a 20,000-kw. station with an ultimate rating of 60,000 kw. was started in September, 1917, at Glen Lyn, Va., which site is the nearest of the coal fields at which an adequate supply of water suitable for condensing purposes was available. It has the additional advantage of being on the main lines of the Norfolk & Western Railway and the Virginian Railway. Simplicity was the keynote of the design, ease and economy of operation and ample space for apparatus being other ruling considerations.

A coal siding leads from the Norfolk & Western main line to a point back of the boiler room. In the future another siding will run from the Virginian Railway to practically the same point but higher in elevation. When desired, coal may be stored on the ground paralleling these sidings and rehandled by a locomotive crane.

From the cars the coal will be dumped into a steel track hopper and by means of plate feeder and grizzly fed to a crusher driven by a 25-hp. induction motor, all of which apparatus is housed in a reinforced-concrete building. The fine coal is taken by means of a Robbins belt conveyor, rated at 50 tons per hour, to a reinforced-concrete coal bunker of 800 tons capacity outside of the boiler room. The bunker proper is circular in form and has 12-in. (30-cm.) heavily reinforced walls. Crickets with a 45 deg. slope made of hollow tile for lightness, with a smooth concrete cover, lead the coal to the four bottom gates.

This type of bunker has several advantages over the bunker suspended in the boiler room: It permits of much lighter superstructure steel in the boiler room, allows an unobstructed passage for the breeching, makes a lighter, better ventilated boiler room, and can be constructed without interfering with the erection of boilers and other apparatus at a time when the boiler room is necessarily much crowded.

To convey coal from the bunker to the boiler furnaces use is made of four screw conveyors, each of them capable of delivering 25 tons per hour and driven by two 25-hp. adjustable-speed motors. More than one conveyor can serve each boiler, hence breakdown of one conveyor will not cripple a boiler. The motors and driving gear for the conveyors, also a small motor-generator set furnishing direct current for magnetic separators

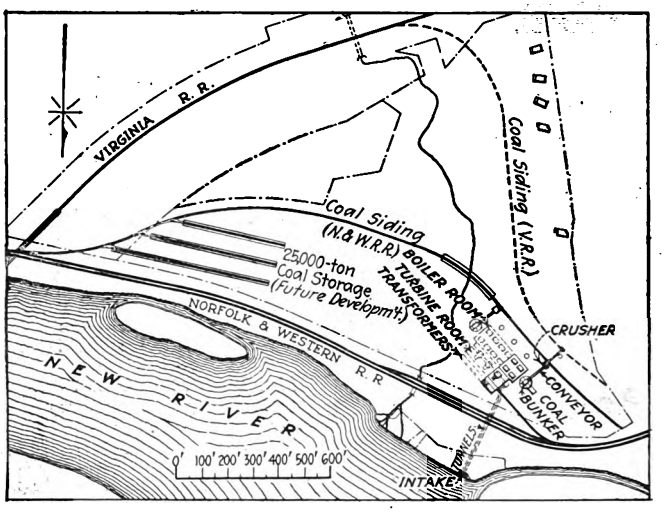

FIG. 4—LAYOUT OF 20,000-KW. STEAM PLANT AT GLEN LYN

(used to clean coal), are housed under the wood structure covering the bunker.

The generator and boiler room floor was fixed about 6 ft. (1.8 m.) above the high-water mark of 1916, and the reinforced-concrete substructure was made with 10 per cent of hydrated lime to make the walls impervious to water. Open drains will lead water which may seep through the walls to a sump in the power house from which it is removed by motor-driven centrifugal pumps. The superstructure walls are of hollow tile, which will be stuccoed when the next unit is added. Gypsum slabs were chosen for the roof on account of their lightness and heat-resisting properties. Skylights are provided in the boiler room in addition to windows.

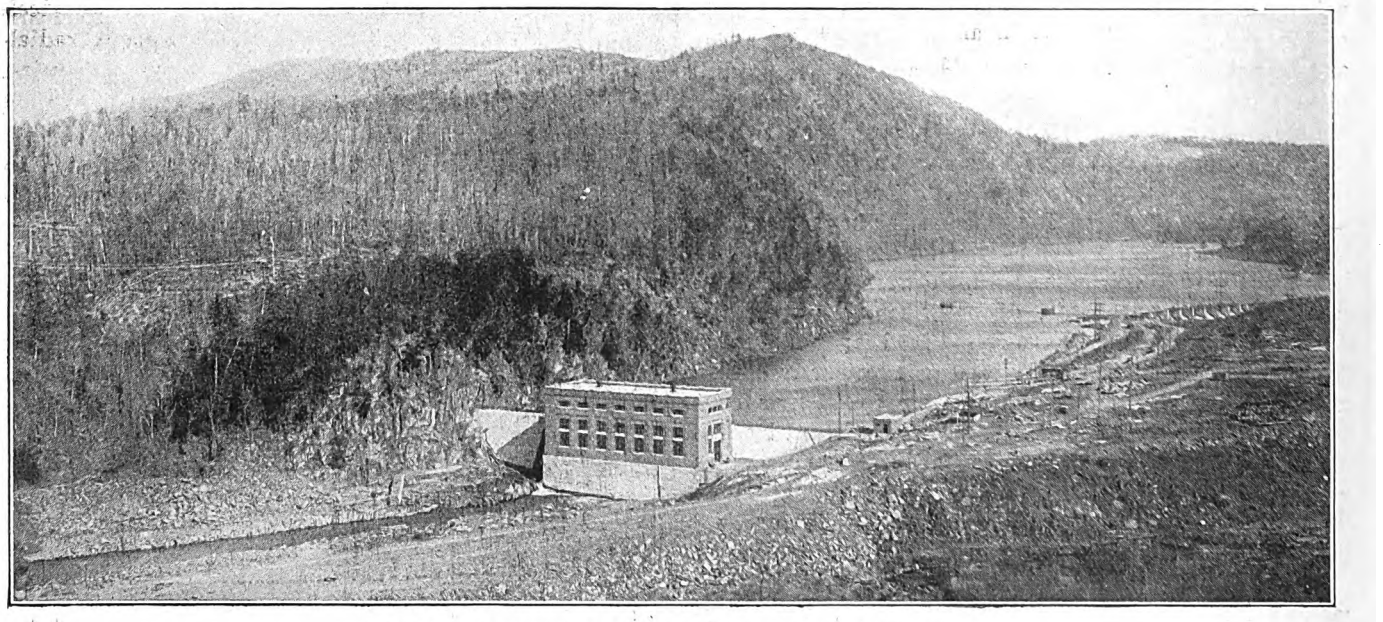

FIG. 3—HYDROELECTRIC PLANT NO. 4 ON THE NEW RIVER

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At present four B. & W. marine-type, cross-drum boilers having 12,322 sq.ft. (1145 sq.m.) of heating surface are installed. They are designed for 300 lb. (21 kg.) pressure and 200 deg. Fahr. (93 deg. C.) superheat and are steel-incased and insulated by ¼-in. (6-mm.) asbestos mill board and 4-in. (10-cm.) asbestos blocks. The drums and top circulating tubes are in-

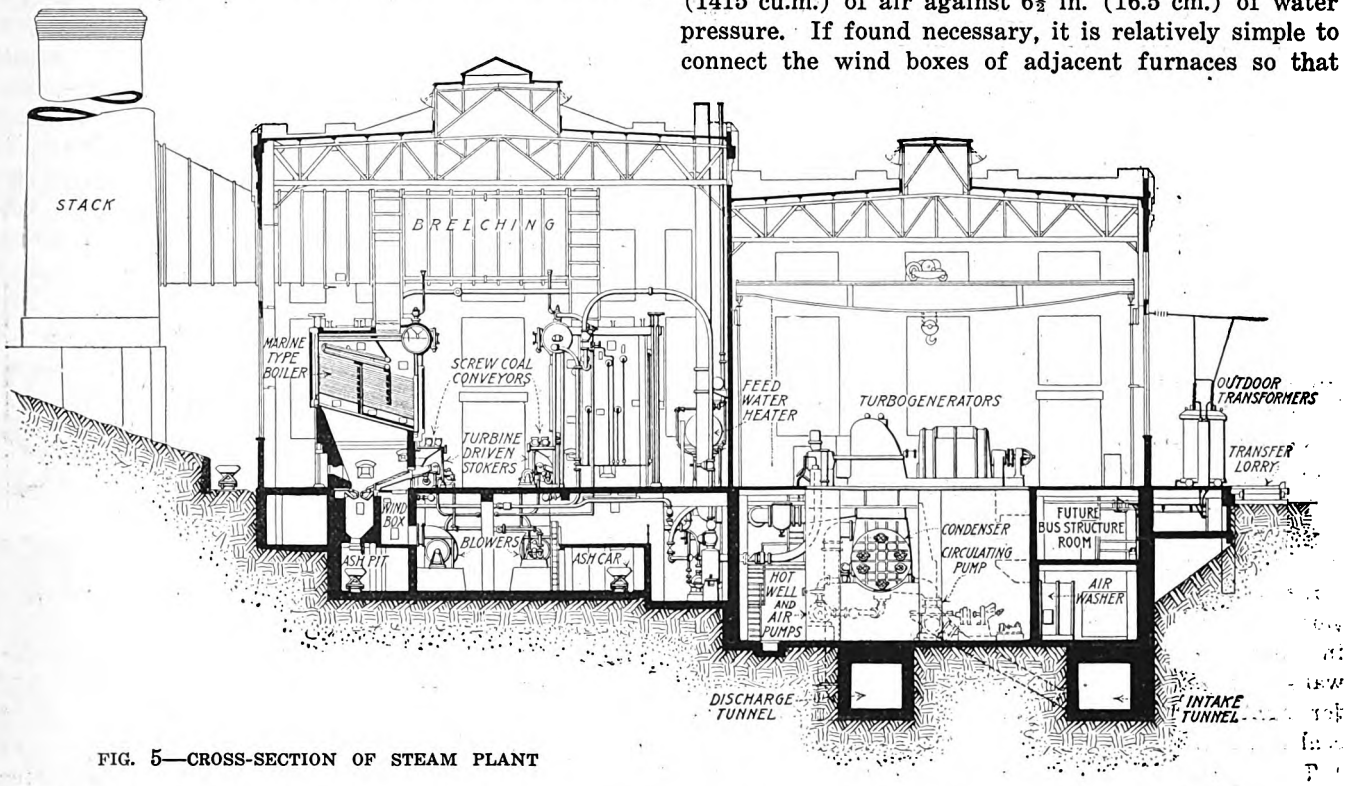

FIG. 5—CROSS-SECTION OF STEAM PLANT

sulated with asbestos. Independent steel columns are used for supporting the boilers, which are not attached to the superstructure steel in any way. Foster superheaters and Diamond soot blowers are employed.

The marine type of boiler was primarily designed

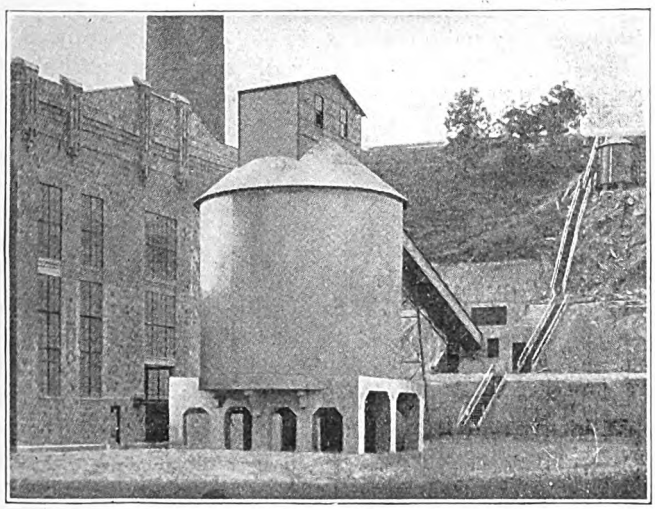

FIG. 6—PARTIAL ELEVATION OF POWER HOUSE AND OUTSIDE COAL-HANDLING SYSTEM

for maximum steam capacity in small space, with high rate of evaporation and high pressures.. A longitudinal-type boiler of this capacity would require six drums, with corresponding multiplicity of joints and connections, greater head room and higher cost. The steel case and asbestos insulation prevents air leakages through the setting and is a saving in heat losses.

Each boiler is served by a fourteen-retort Westinghouse stoker driven through gears by a steam turbine mounted on the boiler-room floor. Air to support combustion of the fuel is supplied by four turbine-driven concoidal fans each capable of delivering 50,000 cu.ft. (1415 cu.m.) of air against 6½ in. (16.5 cm.) of water pressure. If found necessary, it is relatively simple to connect the wind boxes of adjacent furnaces so that one fan can supply air to two units instead of one. The products of combustion are delivered through a steel-plate breeching (asbestos-covered) to a Kellogg radial-brick stack with top 225 ft. (68.5 m.) above the grates.

The ashes are dumped into a firebrick-lined concrete pit under each boiler and by means of 1-cu.yd. (0.75-cu.m.) cars and an electric hoist and telpher at the end of the building are taken to the yard and utilized at present for filling in the low places around the property. Later the ashes will be deposited in a hopper and taken away by cars.

A Booth water-clarifying plant with capacity of 4000 gal. (15 cu.m.) per hour is used for treating boiler-feed water, which carries considerable matter in suspension during flood season. From the clarifying plant the treated water is taken by gravity to a clear-water well, and thence pumped into a feed-water heater which also receives the exhaust steam from all the auxiliaries. Since the plant is run at full load, practically all the time steam drive was used almost exclusively for auxiliary drive as the exhaust steam is fully utilized.

Two Lea-Courtenay four-stage, single-suction boiler-feed pumps capable of delivering 500 gal. (2 cu.m) per minute against a pressure of 350 lb. (25 kg.) are installed in the boiler-room basement directly under the feed-water heater. They are directly connected to 180-hp. General Electric turbines operating non-condensing at a speed of 2500 r.p.m.

Condensing water is obtained from the New River, which, while furnishing an adequate supply, carries an

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unusual amount of débris at certain times of the year. As a result extra efforts have to be taken to prevent clogging of the condensers. To facilitate clearing away débris that collects in front of the intake mouth duplicate screens and hoists are provided so one may be cleaned while water is passing through the other. Stop

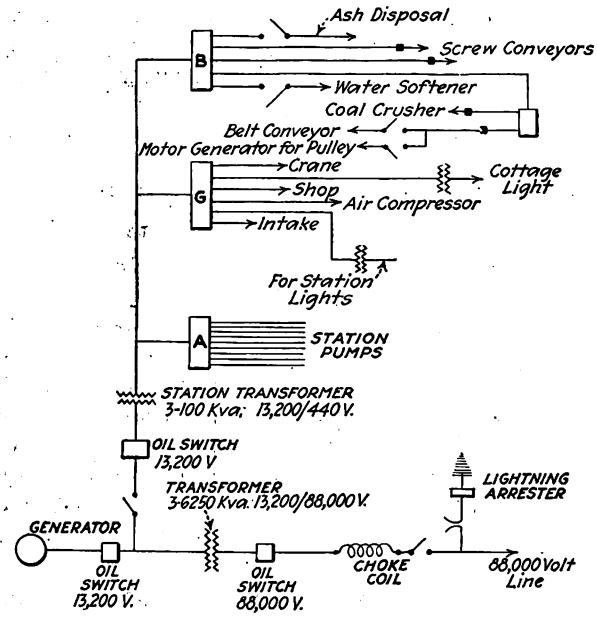

FIG. 7—SINGLE-LINE WIRING DIAGRAM OF POWER-HOUSE CIRCUITS

logs may be inserted in grooves of the tower for cleaning tunnels when necessary.

Since the station is to be operated in conjunction with a system of many units, one turbo-generator was installed instead of two or more units of smaller rating. The machine is an 18,500-kw., 60-cycle, three-phase, 13,200-volt horizontal General Electric unit provided with a direct-connected exciter. At 14,000-kw. load the

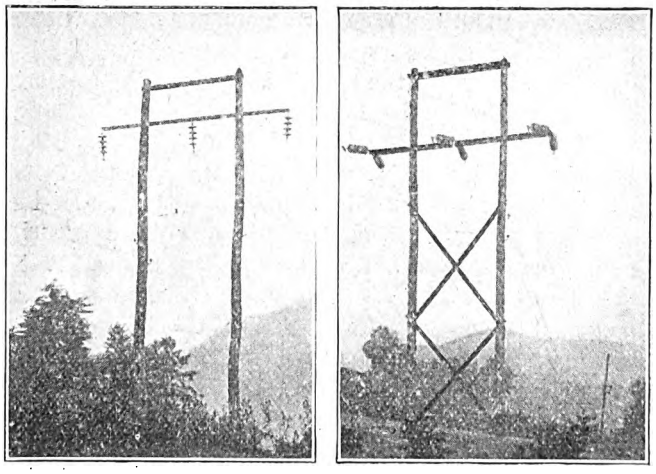

FIG. 8—STANDARD AND STRAIN TOWERS OF TRANSMISSION LINE

guaranteed steam consumption will be 10.45 lb. (4.8 kg.) per kilowatt-hour. For cooling and cleaning the ventilating air to the generator an air washer is used. An oil cooler and an oil filter are also employed.

Underneath the turbine, mounted on heavy helical springs, is a Wheeler surface condenser having 30,000 sq.ft. (2787 sq.m.) of cooling surface. A turbo air pump and a two-stage centrifugal pump, both of the Wheeler type, remove the non-condensable vapors and condensate respectively. The cooling water for the condenser is circulated by a 30-in. (75-cm.) centrifugal pump. All of these pumps have bronze impellers and are driven by turbines, direct connection being used in the first two cases and a herring-bone reduction gear in the last.

As the plant has but one generating unit at present and is interconnected with a system with several sources of power, the switching apparatus and electrical equipment is simple, although it will be more elaborate in the future, after more units are added. The 13,200-volt generator leads run direct through a 15,000-volt, 1200-amp. H-6 automatic motor-operated oil circuit

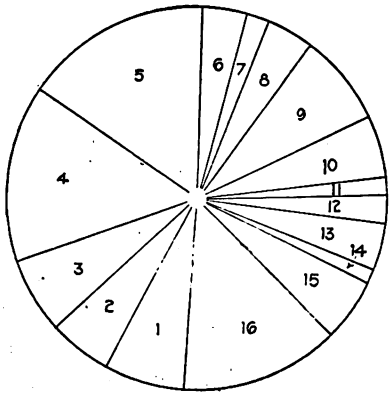

FIG. 9—DIAGRAM SHOWING PROPORTIONAL COSTS OF DEVELOPMENT

1—Substructure, including excavation. 2—Superstructure. 3—Circulating tunnel and intake. 4—Turbo-generator and accessories. 5—Boilers and feed-water heater. 6—Stokers. 7—Superheaters. 8—Breeching and stack, including foundation. 9—Condenser. 10—Piping, valves, and covering. 11—Miscellaneous pumps, piping, tanks and water clarifying. 12—Coal siding. 13—Coal bunker, coal and ash handling. 14—Traveling crane. 15—Electrical equipment. 16—Real estate, operators' cottages, construction plant, general expense, engineering, etc.

breaker to the main transformers, which are installed outdoors and rated at 6000 kva., 13,200/80,000 volts each. Taps from these leads are taken through a disconnecting switch and a 15,000 volt, 300-amp. K-2 automatic hand-operated oil-circuit breaker to a bank of 100-kva., 13,200/440-volt outdoor-type transformers which supply energy for station motors. Another set of transformers supply energy for station lights. The high-tension circuits run from the main transformers through a 110,000-volt, 150-amp. K-22 non-automatic solenoid-operated oil circuit breaker, also installed outdoors. Lightning arresters, choke coils, etc., are employed as usual. The arrangement of switches mentioned and illustrated makes it possible to feed back from the line in case the generating unit is shut down and also to furnish power for the auxiliaries at times when power is shut off the transmission line.

Owing to the fact that there is but one unit no low tension bus is needed, but space has been provided for concrete cells, which will be built when the station is extended. The outside switching arrangements are temporary, being intended for the present installation only. When the extension is added provision will be made for other outgoing lines, when a steel structure will be built. No reactors have been provided for this installation as it was thought that the length of line would cushion any disturbances that might occur. How-

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ever, they will be provided when the next unit comes to be added.

A 30-mile (50-km.) transmission line connects this plant with the system at Switchback, W. Va. This line is constructed with wooden poles (steel poles at railroad crossings), copper conductors and suspension insulators designed for 88,000 volts. A telephone circuit is carried on the same poles.

The plant was designed and constructed by Vielé, Blackwell & Buck, 49 Wall Street, New York, and the writer was resident engineer in charge of the work at Glen Lyn.

INTERCHANGEABILITY OF GENERATOR FREQUENCIES

Machines Quickly and Economically Converted from 25 Cycles, 9000 Volts, to 60 Cycles, 12,000 Volts, as Changes in Load Occur

THAT necessity is the mother of invention is so well recognized that the proverb to that effect is centuries old. War makes its necessities known with great urgency, and the exigencies of warfare and of supplying the requirements of warfare sharpened

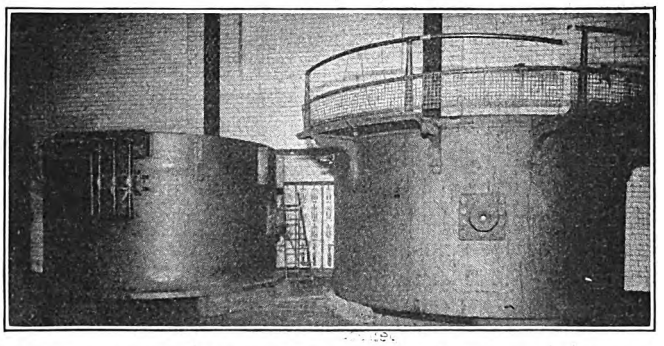

FIG. 1—A VIEW SHOWING 25-CYCLE AND 60-CYCLE ARMATURES TO BE INTERCHANGED—25-CYCLE STATOR ON THE RIGHT

the wits of engineers, both military and civil. There is a vital relation, of course, between what is needed at the front and the output of the workshops at home. Electric power from central stations was demanded in greatly increased volume to manufacture the munitions of war and the myriad of indirect requirements of war. It became necessary to use the generating machinery of the central stations to the utmost extent that its capacity would permit.

The present article gives an account of an expedient devised or adapted by the engineers of the Commonwealth Edison Company of Chicago to obtain frequencies of either 25 or 60 cycles from the same prime mover. The frequency-interchangeability plan to be described was worked out a short time before the United States entered the war, but the necessity of economy in investment by central-station companies had become apparent in the early days of the war in Europe, or even before that. The entry of the United States into the war emphasized the situation, and it was then that the plan was developed not only as between generators in the same station but as between different stations. In other large central stations there have been installed generators having double-frequency armatures; but that method of meeting the situation would seem to lack the flexibility of the interchangeable plan and to entail a greater amount of idle investment than that involved by the latter method.

As is the case with many other large central-station organizations, part of the generators of the Commonwealth Edison Company produce 25-cycle alternating current and part produce 60-cycle alternating current. The reason for this variance is found largely in the history of the development of the art, modified to some extent to meet the needs of the Chicago company, which supplies a large proportion of its output to surface and elevated railways.

"TECHNICAL STORY OF THE FREQUENCIES"

In a paper read at a section meeting of the American Institute of Electrical Engineers in Washington, D. C., B. G. Lamme of Pittsburgh told "The Technical Story of the Frequencies." He showed that nine standard frequencies have been in use in this country at various times, the radical changes in frequencies being due to the fundamental changes in the applications of alternating currents. Of these frequencies two have survived, having practically succeeded all the others. These are the 60-cycle frequency and the 25-cycle frequency, and the present-day tendency appears to be toward a single standard of 60 cycles.

But while the alternating-current apparatus of the future may be designed for 60 cycles to a constantly increasing extent, it is the fact that at the present time there are both 25-cycle and 60-cycle machines in the great generating stations of the Edison central-station companies in the large cities. Furthermore, the war-industries demand was not altogether unfavorable to 25-cycle energy. In Chicago the principal plants are the Fisk Street, Quarry Street and Northwest stations. All three are large all-turbine stations, with generating units ranging from 10,000 kw. to 35,000 kw. In the Fisk Street and Northwest stations there are both vertical-shaft and horizontal-shaft units. The more modern units in these stations are horizontal. At Quarry Street all the machines are of the vertical type.

To make the output more flexible as to frequencies, the 20,000-kw., 60-cycle, 720-r.p.m., 12,000-volt generator which has been in service on the turbine of Unit No. 1 (vertical) at the Northwest station was designed so that it could be installed to replace the generator of any of the vertical 25-cycle, 750-r.p.m. units either at the Northwest station or the Quarry Street station. At the time this generator was purchased it was foreseen that changes in load conditions would probably require changes in the 60-cycle capacity at either the Northwest or the Quarry Street station, and for that reason the dimensions of the generator were made such as to permit interchangeability. The slight difference in dimensions of the generators was compensated for by the use of an adapting ring between the turbine and the armature. A ten-pole, 60-cycle field was also made interchangeable with the four-pole, 25-cycle field. It is to be noted that it was fortunate that there was approximate equality of speeds between the 60-cycle units (720 r.p.m.) and the 25-cycle units (750 r.p.m.). The difference, about 4 per cent, has small effect on thermal efficiency.

The rapid increase of 60-cycle, 12,000-volt load in

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the district served by Quarry Street, due to new large industrial customers, made an increase in the 60-cycle capacity of this station a necessity. As conditions did not permit any increase in the size of the building or the installation of additional units, it was decided to change Unit No. 4 at the Quarry Street station from 25-cycle, 9000-volt service to 60-cycle, 12,000-volt service by replacing the present 25-cycle generator with the 60-cycle generator of Unit No. 1 at Northwest. As the installation of two 30,000-kw., 60-cycle, 12,000-volt units at the latter station made it possible to release this generator, it was replaced by the 25-cycle generator which was originally part of the unit.

The 60-cycle armature, which weighs 66 tons, and the field, which weighs 57½ tons, were loaded on cars of the Belt Railway Company of Chicago and transported to Quarry Street, a distance of about 15 miles (24 km.) by train. Owing to the size of the armature, which is

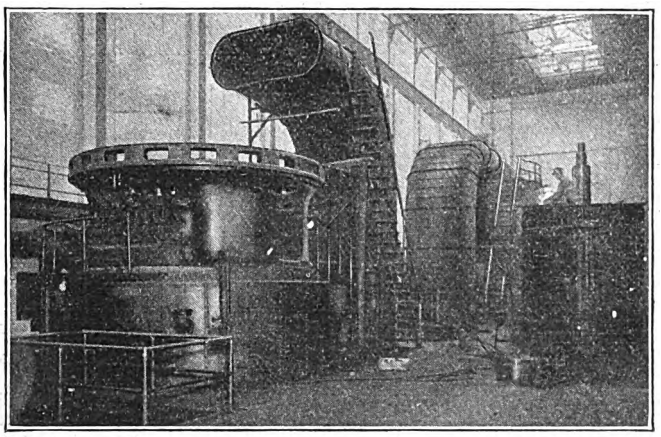

FIG. 2—VIEW IN THE QUARRY STREET STATION; IN THE FOREGROUND IS SHOWN NO. 4 GENERATOR WITH ADAPTING RING FOR 60-CYCLE ARMATURE

14 ft. (4.27 m.) in diameter and 7 ft. 9½ in. (2.36 m.) high, it was necessary to use a special car in order to give the necessary clearance under bridges and viaducts. As the general dimensions of the top bearing bracket of the 60-cycle generator and the 25-cycle generator originally in service on unit No. 4 at Quarry Street were the same, it was not necessary to transfer the top bearing bracket of the 60-cycle generator from Northwest station to Quarry Street.

In order to make the change in generators at the Quarry Street Station, a change in the step bearing was necessary on account of the increased weight of the 60-cycle field, and the height of the air duct was increased 12 in. (30 cm.) on account of the difference in height between the 60-cycle and the 25-cycle generators.

A transfer of cable connection from the 25-cycle to the 60-cycle bus and the installation of a comparatively simple arrangement of bus connections, together with the necessary changes in control and instrument wiring on the benchboard in the operating gallery at the Quarry Street station, completed the change, permitting the connection of the 60-cycle generator to the 60-cycle system. As to the time required to make this change, where all the parts are in one station, it is given as one week. However, the operating department of the Commonwealth Edison Company asserts that on an emergency basis it can make the change in as little as seventy-two hours.

ASKS FOR JURISDICTION OVER CONTRACT AND SCHEDULE RATES

New Hampshire Public Service Commission Points Out Advantage of Coal Clause with Adjustment Either Up or Down

In the opinion of the New Hampshire Public Service Commission, as expressed in its biennial report to the Governor and Legislature, recently issued, all utility rates should be under the jurisdiction of the board, whether contract or schedule. Discussing the course followed by electric rates in the state under war conditions, the commission points out that as a large part of the energy used is generated by water power, there has not been a general request for increases in rates, though all companies have been affected by increases in the price of labor and materials.

Seventeen of the seventy-three electric companies have filed schedules containing some increases in rates, and all but one of these schedules went into effect without opposition after thirty days' notice. Objection was made in one case, and a full investigation resulted in the allowance of a general increase. Wholesale rates to large users have been most affected, as the margin of profit was in many cases necessarily small, and in some cases the contract rate had been found to be less than the out-of-pocket expense of producing the electrical energy.

In some cases the only increase has been a coal clause or a rider attached to power contracts, in which the price of energy is linked to the price of coal; *e.g.*, starting with coal at $4 per ton and a current rate for electricity of 2 cents per kilowatt-hour, a change of 40 cents per ton in price of coal automatically changes the price of energy by 0.045 cent per kilowatt-hour. The commission points out that this type of schedule has the very satisfactory feature that it is self-regulatory and adjustable in a downward as well as in an upward direction.

In nearly every case in New Hampshire where schedules of rates were increased to meet obvious increases in costs consumers have waived contracts for the time being. A most important question, the commission says, however, is raised in the filing of new rate schedules, viz., whether the new schedule abrogates any rate contracts based on or independent of the rate schedules superseded. This raises the question whether the Public Service Commission has authority over all public rates or only those not covered by contract. It is a fundamental question and lies at the foundation of rate regulation. By Chapter 164, Laws of 1911, the commission may not fix a rate period exceeding two years, but a utility may make a contract with a customer for a period exceeding two years at rates which are lawful at the time of contract.

The commission would not allow a contract to be made whereby a customer would be served at a loss, which would have to be made up by other customers, and it does not seem fair to allow the same condition of loss to come about by change in market conditions, and for the commission to be helpless to make the fair adjustment, the report says. Therefore, in the opinion of the commission, all utility rates should be under its jurisdiction, like contracts being obtainable by all customers under like conditions.

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Developments in Radio Apparatus*

Application to Radio Intercommunication of the Vacuum Tube—Improvements During the War—Airplane Radio-Telephone and Radio-Telegraph Sets

BY MAJOR-GENERAL GEORGE O. SQUIER
Chief Signal Officer U. S. A.

THE vacuum tube was known in various forms before the war. Following extensive experiments with the so-called "Edison effect," Fleming produced the well known Fleming valve—a current-rectifying device, capable therefore of being used as a detector of radio signals. This device contains two elements—an incandescent filament emitting electrons and a plate upon which an alternating voltage is impressed, both placed within an evacuated bulb. Later Dr. Lee De Forest introduced an important modification by placing a wire mesh or "grid" between the filament and the plate. A small voltage variation on this grid produces the same current change through the tube as would a much larger voltage variation on the plate, thus adding amplifying properties to the detector characteristics of the Fleming valve. De Forest called his device the "audion." Later, with superior facilities for evacuation available and with a more intimate knowledge of the laws of thermionic emission from hot bodies, improvements and modifications were made in the audion or vacuum tube by both the General Electric Company and the Western Electric Company, the latter designating its product as a "vacuum tube" and the former its as the "pliotron."

Other Functions of Vacuum Tubes

In addition to acting as detectors and amplifiers, as mentioned above, vacuum tubes can function in two other important ways:

1. As oscillators: In properly designed circuits containing inductance and capacity they will act as radio-frequency generators, for use in transmitting or receiving radio signals.

2. As modulators: By suitable connection to an oscillator circuit or antenna they can be made to vary the power radiated so that the envelopes of the waves transmitted shall have any desired wave form, as, for example, the speech waves from an ordinary telephone transmitter.

The most striking use made of vacuum tubes prior to the time we entered the war was the transmission of speech by radio from Washington to Paris and Honolulu during the experiments carried out by the American Telephone & Telegraph Company and the Navy Department. Vacuum tubes were used as the radio-frequency generator for transmitting, and for detector and amplifier in receiving.

When the United States entered the war vacuum tubes already were in use by the Allied forces for various signaling purposes. The French particularly had been quick to recognize the military value of vacuum tubes and had, previous to June, 1917, developed very creditable tubes and apparatus. In America tubes were in limited use as "repeaters" on telephone lines and as detectors and amplifiers in laboratories and radio stations. The total production, however, in this country did not exceed three or four hundred a week.

Early in our participation in the war it became evident that vacuum tubes would be required in very large quantities in order to meet the growing demands for radio communication and signaling. It was equally evident that service conditions not hitherto anticipated would require great mechanical strength, freedom from disturbance under extreme vibration and uniformity of product sufficient to make possible absolute interchangeability of the tubes in sets without the necessity of readjusting when changing tubes. To these conditions must be added that of minimum size consistent with dependable operation.

Present State of the Art

To make such a device, with its complicated yet accurately constructed metallic system, within a practically perfect vacuum is no small problem even when made in the laboratory, on the individual unit basis, by a skilled operator who appreciates the delicacy of the job. To turn out tubes by the thousands by factory methods involves almost infinitely greater difficulties. How well certain companies, in collaboration with the Signal Corps, have succeeded in solving these difficulties is indicated by the fact that recently the total rate of production in the United States of high-quality standardized tubes was considerably in excess of a million a year. This rate of production could be made many times greater on short notice.

As an example of the difficulties which this quantity production has involved may be mentioned that of evacuation. The degree of vacuum required is such that unusual methods of exhaust are necessary. The heating of the tubes in electric ovens is supplemented by heating of the elements of the tube by excessive filament and plate electrical power input. Molecular pumps are employed, necessitating an extremely large number of pumps to handle quantity production. Special treatment of metal parts prior to assembly is employed to reduce the gas given off during the exhaust process.

Another problem is that of making the complicated metallic structure of all tubes exactly alike, in order to insure identical electrical properties. As an indication of progress in this direction, it may be stated that one company is prepared to manufacture in quantity a certain tube in which the clearance between filament and grid is only three-hundredths of an inch, the allowable variation being of course a small percentage of this.

Manufacturing in quantity involves careful inspection. The problem of specifying definitely the required performance of tubes, the development of adequate testing specifications, the placing of standardized test-

*Part of a lecture given before the A. I. E. E. at New York on Jan. 10 on "Aëronautics in the United States from the Beginning of the War to the Present Time."

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ing and inspection methods, personnel and equipment in the various factories, so that tubes manufactured at different times and places would after passing inspection be uniform and interchangeable—these questions were entirely new and have been solved almost entirely by the Signal Corps engineers.

Tubes developed by the Signal Corps may be divided into two general classes—the tungsten-filament types as developed and manufactured by the General Electric Company and the De Forest Radio Telephone & Telegraph Company and the coated filament or Wehnelt cathode types as developed and manufactured by the Western Electric Company. The coated filament tubes so far have proved superior to the tungsten-filament tubes for Signal Corps use. Both classes have been standardized as regards base, exterior dimensions, filament current and voltage, and, in addition, plate voltage and output for transmitting tubes and amplifying power and detecting power for receiving tubes. Except in certain special cases, the Signal Corps uses two types of tubes, one for transmitting and another for receiving.

Vacuum tubes are now employed for electric wave detection, radio-frequency and audio-frequency amplification, radio-telephony, particularly in the airplane radiophone, continuous-wave radio-telegraphy, voltage and current regulators on generators, and for other miscellaneous purposes. However, varied as are the applications at present, the uses, actual and potential, growing out of war development work have proved that the art of vacuum-tube engineering and the application of its products to radio-engineering, telephone and telegraph engineering, and particularly to electrical engineering in general, are still in their early infancy.

The engineering advancement accomplished in less than two years represents at least a decade under the normal conditions of peace, and our profession will, it is hoped, profit by this particular salvage of war, which offers perhaps the most striking example extant of a minimum "time lag" between the advanced "firing line" of so-called pure physics and applied engineering.

The Chief Signal Officer considers that the work of standardization and quantity production of vacuum tubes accomplished during the last eighteen months under the pressure of military necessity represents an advance in the art of electrical engineering which will prove of inestimable industrial and scientific value to this country and to the engineering world at large.

AIRPLANE RADIO-TELEPHONE AND TELEGRAPH SETS

Prior to April, 1917, a few experiments had been made in which speech had been transmitted from airplane to ground by radio methods, but the apparatus involved was hopelessly crude. On May 29, 1917, the Chief Signal Officer called a conference in his office at which the project of evolving a "voice command" equipment for airplanes which should meet all the severe requirements of the military service and which should be thoroughly standardized for quantity production was definitely set in motion against time. The plan for accomplishing this was the same as in the evolution of the Liberty engine, and from the beginning this project was regarded as one of the major creative efforts in the development of the American Air Service. The present airplane radiophone, therefore, is the result of a period of intensive development work begun shortly after we entered the war. The services of the Western Electric engineers were enlisted, and under the direction of the Signal Corps rapid development resulted in successful tests as early as August, 1917. Speech was exchanged between airplanes 25 miles (40 km.) apart in October, and sample sets were sent at once to the army in France for trial. Several thousand sets were ordered and have been completed and distributed to flying fields here and to the air service in France.

The satisfactory performance of this apparatus has resulted in a new type of military unit known as a voice-commanded squadron. The commander of an air fleet directs the movements of the individual units in any manner desired. The effectiveness of the squadron as a military machine is thereby enormously increased.

Other uses are in communicating information from airplanes to ground stations and in directing one or more airplanes from a ground station. Innumerable applications will evolve as possibilities are realized.

The essential elements of the airplane radiophone are the power equipment, the radio equipment and the antenna.

a. The power equipment includes a double-voltage direct-current generator driven by an air fan, with a vaccum-tube voltage regulator.

b. The radio equipment consists of the vacuum tube transmitting and receiving set and the special telephone transmitters and receivers.

c. The antenna orginally consisted of a flexible copper wire several hundred feet long, unreeled by the aviator and trailing almost horizontally behind the airplane. Modified antennas using much shorter wires fixed to the framework are now used.

The operation of the sets is extremely simple, all adjustments being made before leaving the ground. The only manipulation required of the aviator is that of the change-over switch to change from talking to listening.

The principal use of radio communication made during the war was in sending radio-telegraph signals from observation airplanes for controlling artillery fire. The French developed a set which consisted of several units, making the installation and operation complicated. The Signal Corps developed a self-contained set, which has been demonstrated to be far superior to any other airplane set.

It consists of three units—first, the 200-watt, 900-cycle alternator, driven by a regulating air fan and containing in a steam line case attached to the generator all the elements of the radio set. This radio apparatus is of the synchronous-spark type, with four spark tones and nine wave lengths. The weight of the complete unit is only 23 lb. (10.4 kg.) and size only 6 in. by 6 in. by 20 in. (15 cm. by 15 cm. by 66 cm.). The regulating air fan maintains the speed of the generator within four per cent of 4500 r.p.m., with air velocities between 60 and 200 miles an hour.

The remaining units in the complete set are a variometer or tuning coil, with antenna ammeter attached, and the antenna system, comprising a reel, insulated bushing and training antennas. When it is realized that voltages of 30,000 or more are produced by this set, the difficulties of insulation in such restricted space will be appreciated. Ranges of communication of 100 miles (160 km.) have been accomplished with this set.

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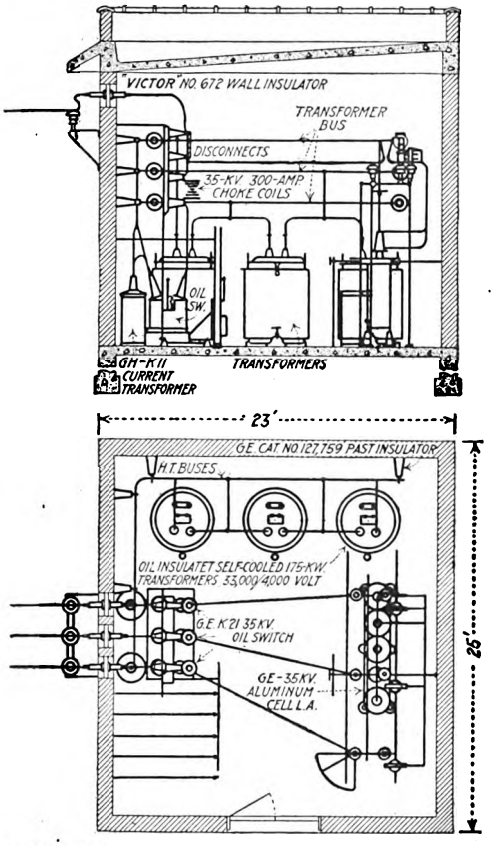
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

HOW SCATTERED INDUSTRIAL LOAD IS SERVED IN IOWA

In Deciding on Substation Policy Company Expresses Preference for One Large Substation Rather than Several Small Ones

Near Scandia, Iowa, were several mines and brickyards desiring electric power. They lay within a 3-mile (4.8-km.) radius and offered a total connected load of 900 hp. This load was to be served from a nearby transmission line of the Iowa Railway & Light Company of Cedar Rapids. When the business came up for consideration, the engineering department was faced with



SUBSTATION DESIGNED FOR COMPACTNESS AND RELIABILITY

the problem of deciding whether to install a separate small substation at each plant to be served or to install a large substation to serve all plants. In spite of the growing favor of small outdoor installations, a single indoor substation was chosen. This decision was reached mainly because of a desire to give continuous service.

The type of substation which was erected for this work is shown in the accompanying drawing. It receives energy at 33,000 volts, three-phase, 60-cycle, and steps it down to 4000 volts to serve a star-connected, four-wire system. The substation building, which is built of brick, measures 25 ft. (7.6 m.) by 23 ft. (7 m.) and stands 21.5 ft. (6.5 m.) from the floor to the top of the parapet wall. The circuit enters the building through three wall insulators, spaced on 2-ft. (0.6-m.) centers. Inside the building the high-tension circuit passes through 35-kv. disconnecting switches, 300-amp. choke coils and a K-21, 35-kv. oil switch on its way to the three 175-kva. Allis-Chalmers oil-insulated self-cooled transformers. The high-tension bus work is supported on post insulators which provide a clearance of 15 in. (38 cm.) from the wall. The transformers themselves are spaced on 6-ft. (1.8-m.) centers and are placed with their center line 4 ft. (1.2 m.) from the nearest wall. Protection for them is provided by aluminum-cell lightning arresters. The secondary leads from the transformers are taken through an oil switch to a 4-kv. bus mounted on a panelboard, from which the feeders to the various industries are carried out.

The problem of attendance was considerably reduced in importance by the installation of a company's telephone and bell alarm in one of the nearby industries which the substation serves.

In spite of its very compact design this station has been providing excellent service and is considered by the electrical engineer for the Iowa Railway & Light Company, John M. Drabelle, to have afforded a better solution of the problem than could have been secured from several small stations.

RULES FOR PREVENTION OF LADDER ACCIDENTS

Although the Ladder Is Called One of Civilization's Most Dangerous Devices, Simple Precautions Will Render it Safe

The Bureau of Safety recently issued a statement to the effect that the ladder in its various forms has been called one of civilization's most dangerous devices. Statistics show that a great number of accidents have happened with its use. Following are suggestions for reducing accidents arising from this cause.

Take care in placing ladders before using them. If there is danger, have some one hold the ladder. Do not place ladders too straight or at too great an angle or they may fall, break or slip. Never place ladders in front of doors opening toward the ladders. Ladders should never be placed against window sashes; screw a board across top of ladder to give bearing on each side of window. Stepladders should be fully opened out in all cases before any one steps on them. Never slide down a ladder. Never use broken or weak ladders or ladders with missing rungs. When defects of construction develop to such an extent that the ladder is discarded, it should be destroyed. Ladders withdrawn from service for repairs should be sent to the repair

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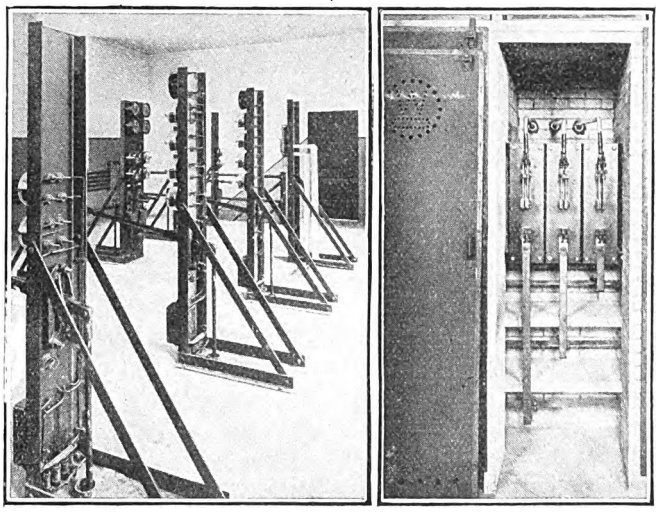
shop or tagged "Dangerous—do not use." Where necessary see that ladders have safety feet at the base or safety hoops at top. Short ladders should not be spliced together, as they are usually not strong enough to be used as long ladders. A good method to follow is to number and classify all ladders as an aid to regular and careful inspection.

SWITCHING PANELS OF THE SKELETON DESIGN

Cost of This Type Is Kept Low by Using Channel-Iron Frame and by Mounting Disconnecting Switches on Buses

Unit-type switchboard panels mounted on channel irons so as to permit the operators to pass between them are used with considerable saving in investment in a substation in Worcester, Mass. One row of panels controls 13,200-volt oil switches and the other one



EACH PANEL IS MADE OF A SINGLE LARGE CHANNEL WITHOUT MARBLE OR SLATE

controls the 2300-volt installation on the floor below. The channels supporting the panels are diagonally braced and bolted to angle irons fastened to the concrete floor. It is planned to replace the long switch-operating handles by short sections provided with sockets into which a wooden rod can be inserted when the operator wishes to set a switch, thus increasing the aisle space between the panels and improving the appearance of the room. The use of channel irons in place of slate or marble panels will further reduce the cost of the installation when it is completed.

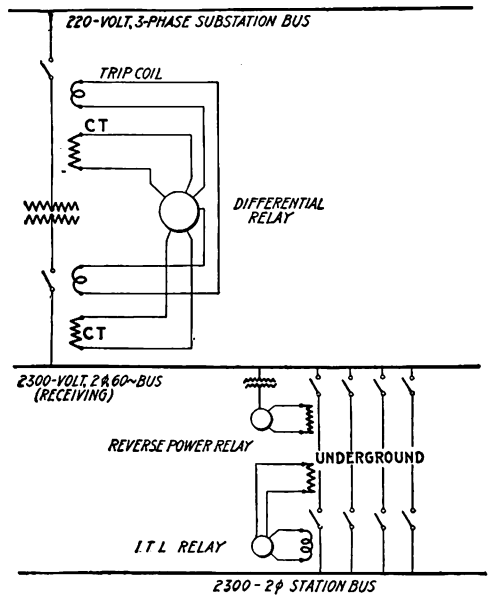
Another feature of this substation is the method of supporting the disconnecting switches. They are mounted on individual panels within the 2300-volt bus structure, the panels being bolted at the top and bottom to a horizontal strip of metal running along the front of the concrete barriers. The holes were drilled and tapped in the facing bars before the buses were made alive and were lined up vertically and horizontally with care to keep the spacing and alignment accurate. This construction made it unnecessary to cut the usual vertical holes into the concrete shelf back of the edge to support the switch mounting, and enabled rapid and satisfactory assembly of switches to be accomplished readily.

PROTECTION OF LARGE INDUSTRIAL SUBSTATION

Arrangement of Relays Between Power-House Bus and Substation Bus Where Latter Carries 20,000 Amp. at 220 Volts

On account of the complication of a two-phase to three-phase transformation and because of the care exercised in properly protecting all apparatus and also owing to its large size, an industrial substation at Cedar Rapids, Iowa, is of more than usual interest. It is in the plant of the Quaker Oats Company and is served from the station of the Iowa Railway & Light Company.

The distance between the power house and the substation is less than a mile, but the lines were nevertheless placed underground to insure continuity of service.



PROTECTIVE RELAY SCHEME PROVIDED TO INSURE RELIABILITY OF SERVICE

At the power-house end of these lines an inverse time-limit relay was installed on each 2300-volt, two-phase circuit, the station generators being wound for 2300 volts, two-phase. Then at the substation just ahead of the 2300-volt, two-phase, 60-cycle receiving bus reverse-power relays were installed on each circuit. In the substation two banks of 1875 kva., 2300-volt, two-phase, to 240-volt, three-phase transformers were installed. This phase transformation was necessary because the mill was already equipped with three-phase motors. These transformer banks are protected by differential relays. The 220-volt, three-phase bus is notable for the size of copper employed in it. It is laid out as a ring bus capable of carrying 20,000 amp. at 220 volts. The section consists of four bars of 8-in. by ¼-in. (20-cm. by 0.6-cm.) copper.

The substation building measures 82 ft. (25 m.) long by 42 ft. (13 m.) wide and is two stories high. All transformers and high-tension gear are on the first floor, and the switchboard and low-tension gear are on the second floor. Electric service is supplied by lines coming directly from the central-station company's main power house. The general wiring scheme is indicated in the one-line diagram which is published with this article.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

SERVICE EXTENSION AGREEMENT WITH 60 PER CENT REBATE

Little Rock Utility Makes Refunds to Customers on Different Bases According to Character of Service

A new form of service extension agreement has been adopted by the Little Rock (Ark.) Railway & Electric Company. Under its terms the consumer finances the line and is reimbursed by the company, which rebates a stated portion of each lighting bill to the extent of 60 per cent of the expenditure, 40 per cent being allowed to the company as a loss on account of war wastage. The company agrees to make this refund to the consumer in a stated percentage of the amount of the consumer's net payment to the company for electric service during the first twenty-four consecutive months after the connection is made.

The amount of the refund is calculated and paid on Jan. 1 and July 1 of each year. On retail lighting this refund will be paid on the basis of 50 per cent of the monthly bills, on commercial power and lighting on the basis of 25 per cent of the monthly bills. On wholesale power and wholesale lighting the rate will be figured on 50 per cent of the capacity charge. This arrangement, the company states, has proved most acceptable to the public and very little trouble has been experienced, for the matter was carefully explained to the consumer.

Government work in Little Rock is continuing in spite of the signing of the armistice, and it is unofficially reported that Camp Pike will continue to be used for some time to come. Work on the aviation warehouse has not been stopped and it is now about two-thirds complete, while everything is running full blast at the picric plant.

INCREASING EFFICIENCY OF CENTRAL-STATION LABOR

Wage Scale to Remain Where It Is While Methods Are Employed with the Object of Getting Better Efforts Out of Each Individual

One Ohio plant manager has adopted what he believes is a logical plan of increasing the efficiency of his power-plant labor that might apply equally well in many other parts of the system. As the labor supply becomes more plentiful in his community owing to demobilization he replaces the least efficient employee with a man of higher grade at the same pay that others are getting on similar work. Gradually this process is to be continued, each time replacing the least efficient one, until the general standard of the force has been raised to a satisfactory standard. Of course, the natural result of this process will be that as the general efficiency of the force increases the uselessness of some of the less efficient employees will become more and more apparent. So eventually it will be possible to get along with a smaller number of men, and the cost of operation can thus be reduced without reducing the wage scale. This manager believes in the soundness of this policy, particularly because the wage scale he is paying is none too high, he thinks, to attract the best operating labor in the community, and that he feels is what the central-station company should have.

The war has forced managers now to pay wages that will attract the best workmen, whereas before central-station operating labor was generally poorly paid. But now that the higher wage scales, along with higher rates that made higher wages possible, are here, they should be maintained, he feels, in order that the company whose business it is to make power may be able to employ the men in the community who know best how to do that sort of work.

TO CLEAN UP EXISTING POWER-FACTOR CONDITIONS

Attention to This Matter on Two New Installations Increases Plant Power Factor About 10 per Cent.

With a new power-factor clause in its rate schedules for retail power service, the Alliance (Ohio) Gas & Power Company is starting out to improve the power factor of its entire system. The first step in the campaign was made when synchronous motors were strongly recommended on two new installations which were being put in. The following rate clause assisted in showing the value of this recommendation:

"The demands shall be taken as the total connected capacity of the motors or heating devices installed, or at the option of the customer shall be determined by taking the average of the three greatest observed five minutes' integrated demands occurring during any thirty-day period as determined by a curve drawing or integrated wattmeter at a power factor averaging 80 per cent. If the power factor is greater or less than 80 per cent, the demand shall be taken as the average of the three greatest five-minute integrated demands as above determined multiplied by 80 and divided by the average of the simultaneous power-factor readings. The demand when so determined shall stand as the minimum billing demand for the period of the contract. The company reserves the right to measure the demand at any time and to increase the billing demand to conform to such measurement."

When the two installations referred to above started the power factor at the power plant was noticed to have improved 10 per cent.

The company's old customers will be the next to be-

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come educated on the matter of power factor. It is the plan that each power installation shall be studied carefully to get the exact facts as to the power-factor conditions. The two-watt-hour-meter method will be employed for this. Then the customer will be billed on the basis of his existing power factor. If this creates dissatisfaction, the customer will be told how he can improve his power-factor conditions and earn a better rating on his demand.

HEATING LOAD OF FUTURE WILL EQUAL MOTOR LOAD

Suggestion Is Made that Decline in Energy Output Due to Lessened Power Loads Can Be Entirely Offset by Promoting Electric Heating

"During the war the demand for conservation of materials was secondary to only one other demand. That was the demand for production. It was realized in many cases that a saving could be made if the method of production could be altered. But, owing to the extreme urgency of the war demands, it was not permissible to do anything that would interfere in the least with production. Hence all such projects had to be deferred until a more opportune time.

"Now that the war is over, attention is again being directed to these propositions, and the indications are that the time has arrived for the installation of labor-saving, energy-saving and material-saving devices on a scale heretofore unthought of. There is no single development which presents such possibilities for conservation of energy, labor and material as the development of electric industrial heating. It will, therefore, find a place in this program."

This outlook on the future of electric industrial heating was taken by Wirt S. Scott of East Pittsburgh, Pa., before a recent meeting of the new-business men of the Ohio Electric Light Association. Mr. Scott continued:

"The remarkable increase in the industrial electrical heating load, particularly that made possible by the low-temperature applications, has resulted in some of the larger electrical manufacturers and central stations making surveys of the field in order that they may know in a general way the prospective business in sight, or the business that may reasonably be considered obtainable, provided the necessary electrical equipment is available to supply the heat in the manner and at the temperature required.

"Those who have had an opportunity to study the situation within the past year are unanimous in their conclusion that the central-station industrial heating load ultimately will equal the motor load.

"All indications point to a very rapid increase in the amount of power used for electric heating. One large managing corporation operating over quite an extensive territory in this country has made an exhaustive survey of all power users, present and prospective, in its territory, of the present power consumption, motors and heat under present operating conditions, also on the basis of complete electrification. These reports show that the available heating load compared to the available motor load is three times as great.

"It was only a few years ago that we spoke of lighting plants, and correctly so. Why? Because the lighting load at night was the main load and the motor load was an off-peak load; consequently the entire plant's operation centered around the lighting load. Within a short period a complete reversal has taken place. The motor load is now the main load and the lighting load the off-peak load."

RESULTS OF DAYLIGHT SAVING AT AURORA, ILL.

The Average Lighting Bill Was 26 Cents Less in the Summer Months of 1918 than in the Previous Year

Comparative operating and income data for the summer months of 1917 and 1918 taken from the books of the Western United Gas & Electric Company, Aurora, Ill., are given in the accompanying table. The data show that the average lighting customer's bill was 26 cents per month less in the summer of 1918 than in the summer of 1917. This is directly attributable to the daylight-saving movement. The amount of coal burned in the summer of 1918 was nearly 700 tons greater than in the same period of 1917, in spite of the fact that 136,000 kw.-hr. more was generated in the 1917 than in the 1918 summer period. This, however, is probably due in large part to the inferior grade of fuel which the company was able to secure. That the company's output for power purposes was less in 1918 than in 1917 is explainable since the company did water pumping for the city of Aurora in 1917 but did not in 1918, the city in the interval having added to its pumping facilities and no longer needing the power.

RESULTS OF DAYLIGHT SAVING AT AURORA, ILL.

		Lighting		Power		Tons Coal	Number Meters in Use — Lighting		Power	
		Kw.-Hr.	Amount	Kw.-Hr.	Amount	Used	Meters	Average Bill	Meters	Average Bill
1917:	May	168,434	$12,758.16	284,951	$7,726.36	1,783	4,463	$2.86	267	$28.94
	June	163,535	12,246.65	291,649	7,912.97	1,628	4,473	2.74	266	29.75
	July	148,740	11,314.90	315,436	8,728.76	1,653	4,501	2.51	264	33.06
	August	156,588	11,518.35	309,393	7,955.02	1,660	4,549	2.53	260	20.60
	September	179,485	13,014.54	279,451	7,803.94	1,657	4,584	2.84	260	20.02
	October	210,949	15,267.11	280,702	7,996.13	1,978	4,595	3.32	274	29.18
	Total	1,027,731	$76,119.71	1,761,582	$48,123.18	10,359	Av. 4,528	$2.80	265	$30.25
1918:	May	171,455	$12,832.00	279,861	$8,126.47	1,790	4,777	$2.69	277	$29.34
	June	152,112	11,684.14	269,712	7,929.40	1,748	4,809	2.43	274	28.94
	July	143,390	10,964.54	286,054	7,977.86	1,722	4,832	2.27	272	29.33
	August	155,671	11,815.96	284,987	8,086.79	1,849	4,888	2.42	267	30.29
	September	167,451	12,809.17	276,450	7,781.75	1,912	4,977	2.57	271	28.71
	October	182,845	14,155.84	283,048	7,952.13	2,032	4,897	2.89	273	29.13
	Total	972,924	$74,261.65	1,680,112	$47,854.40	11,053	Av. 4,864	$2.54	272	$29.29

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Initial Current Rush of Transformers.—M. VIDMAR.—The high voltages and saturation of modern transformers lead to initial conditions that cause excessive current rushes to be produced when switching them on in an unloaded state. The danger is greatest in the case of transformers of small sizes. If the resistance R of the primary winding is neglected, it is shown that the density of lines B in the iron at time t after switching on is given by $B = B_o + B_m$ [cos a — cos $(a + wt)$] if B_o is the remanent saturation, B_m the maximum saturation at normal running, and a the phase angle of the voltage when the switch closes. It will be seen that B_o has an important effect on the transient densities reached and that the highest densities are obtained for the smallest values of a; that is, the smaller the voltage at the moment of switching on. The most dangerous conditions hold when $a = 0$, $wt = \pi$, and $B_o = B_m$. When these relations are satisfied we obtain $B = 3B_m$. The current at threefold saturation would, however, be so great that the limiting effect of the primary resistance (hitherto neglected) would have to be taken into account. From a consideration of the effect of this resistance it is concluded that in the most unfavorable case the initial maximum current rush can only exceed the normal current in the same ratio as the line voltage exceeds the voltage drop in the primary winding at normal load. Accordingly the initial current rush may be far higher than the short-circuit current. The limiting action of the primary resistance indicates that the distribution of the copper losses between the primary and secondary windings is not immaterial, and that initial current rushes will be reduced by designing the transformers with an increasing proportion of the copper losses in the primary winding. As the size of transformers increases the flux increases with the square of the dimensions, the length of the magnetic path with the first power of the dimensions, and the resistance drop amounts to a decreasing percentage of the applied voltage. Thus the greatest current rushes are to be expected with the largest sizes of transformers.—*Science Abstracts, Section B,* October, 1918. (Abstracted from *Elektrot. u. Maschinenbau,* June, 1918.)

Transformer Oil.—W. S. FLIGHT.—Oils may be roughly divided into fixed oils and straight oils. The former give trouble through the formation of sludge. The latter are much more free from this defect. For use in transformers it is necessary to take into account viscosity and the gravity, dielectric strength and other properties. Examples are given of the variation of specific gravity and viscosity, and the methods of determining the latter are stated. Flash point is also another important property that must be stated. In specifying dielectric strength great care must be taken that the presence of moisture does not enter into the figure, and in practical use care must be taken that the oil does not take up moisture. The carrying out of dielectric strength tests is described, and the effect of dirt, air and circulation of the oil is considered. The author then discusses the formation of sludge and the practical methods of preventing it. Lastly minor tests are described, such as the iodine value, acidity, evaporation, sulphur, etc.—London *Electrician,* Nov. 29, 1918.

Erecting a Large Vertical Generator.—N. L. REA.—The writer explains how some interesting problems were met in the erection of a waterwheel generator of which the revolving parts weighed 275 tons. The author discusses particularly plumbing the shaft, leveling the armature and assembling the field.—*Power,* Dec. 24, 1918.

Tests on a Joint in the Stator Windings of a 12,000-Kva. Generator.—The tests were carried out on a sample sweated joint from the stator windings of a 12,000-kva. generator, the object being to ascertain the reason why such joints have melted out. It was found that the resistance of the joint is actually only about 70 per cent of the resistance of an equivalent length of solid stator bar. The temperature coefficient of the joint as obtained from the direct-current resistance curve is 0.00422.—London *Electrician,* Dec. 13, 1918.

Lamps and Lighting

Graphical Presentation of Light Distribution.—GERHARDT.—Describes a method for showing graphically the total light flux from a lamp in the form of a curve giving an approximate representation of the polar distribution. The flux within a cone of total apex angle a is $2\pi Ia$ $(1 - \cos a)$ where Ia is the mean intensity over the cone. Now the area of a sector of a circle of apex angle $n°$ is $\pi R^2\eta/180$ where R is the radius of the circle. Hence if a polar diagram be drawn in which at an angle n given by $n = 90$ $(1 - \cos a)$ the radius vector R is given by $R = 2\sqrt{La}$, then the area of the polar diagram is proportional to the total flux from the lamp, and the diagram exhibits the polar distribution to the extent that $a/90$ approximates to $(1 - \cos a)$.—*Science Abstracts, Section B,* October, 1918. (Abstracted from *Elektrot. u. Maschinenbau,* August, 1918.)

Generation, Transmission and Distribution

Extra Losses by Distortion of Current Flow in Conductors Carrying Alternating Current.—F. NIETHAMMER.—The author determines the losses in parallel conductors in air carrying alternating currents, taking into account the increase of the losses caused by the distortion of the lines of current flow. The calculations are made for conductors of round and rectangular section and for various relative positions of the outgoing and return conductors. Cases are also considered for subdivided circuits consisting of numbers of conductors carrying the current in parallel. The results are applied

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to copper and iron conductors.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, Jan. 28, 1917.)

On the Division of Currents Between Transformer Coils When Coupled in Parallel.—P. GIRAULT.—When a single-phase transformer has several secondary coils connected in parallel the currents in the coils are different, those coils which are closer to the primary winding having the larger current. The equations to determine the currents in these coils are given. Other equations deduced from them are found to be identical with the equations ordinarily given to find the skin effect in a conducting plane. The effect of this unequal division of the currents is to increase the i^2r losses of the transformer, and this loss increases the more the greater the number of the secondary coils. This problem is of importance to electrometallurgists. The author indicates how to diminish these losses by symmetrical grouping of the conductors.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Comptes Rendus*, July 28, 1918.)

Steam Generating Equipment of Steel Plant.—GORDON FOX and F. E. GRENLEY.—In the new Mark plant of the Steel & Tube Company of America the coal and ash handling method, combination gas and coal furnaces, firing methods and individual stacks are some of the interesting features.—*Power Plant Engineering*, Dec. 15, 1918.

A Spanish Hydroelectric Undertaking.—It is of considerable interest to note the establishment of a hydroelectric plant in the coal-mining district to transmit energy more than 50 miles and still compete with steam-driven plants in the north of Spain. The company, "Saltos de Agua de Somiedo," has just given out an account of the installation and starting up of its central station. The idea of the company is to regulate the flow of the rivers El Valle and Saliencia by means of dams and to obtain two waterfalls of 582 and 245 meters head respectively, giving approximately 20,000 hp. and driving six Pelton wheels of 3300 hp. each. Two of these generators are now in operation. The Asturian mountains give rapid falls, and rains are abundant. The water turbines are the Pelton wheel type and were constructed and supplied by Escher Wyss of Zurich. The electrical material in the station was supplied by the Spanish branch of the Brown-Boveri company. A minimum efficiency of 81 per cent was guaranteed for the waterwheel at full load, while the efficiency of the unity power factor generator for full load was guaranteed to be 95.5 per cent and for the transformers at full load 98.4 per cent power factor—London *Electrical Review*, Nov. 29, 1918

Calculation of the Propagation of Alternating Currents Over Long Lines.—P. BOUCHEROF.—The usual methods of calculating the distribution of current and voltage along transmission lines involve the use of partial differential equations of the second order or imaginary quantities. The object of the present article is to demonstrate a method of avoiding the imaginary quantities and of simplifying the mathematics so that only an ordinary differential equation of the first order has to be solved with one variable, the distance. This is effected by using the principle of the conservation of the real and imaginary power.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Comptes Rendus*, July, 1918.)

Controlling Efficiency of Combustion.—E. A. UEHLING.—The author states that as combustion is a chemical process it can be diagnosed and controlled properly only by means of chemical apparatus. Various forms of such apparatus are mentioned and their uses explained. —*Power*, Dec. 24, 1918.

Power Possibilities in California.—F. H. FOWLER.—A comprehensive survey of power possibilities on the streams of California, indicating plainly where the maximum development has already been reached, the drawbacks of certain localities and the advantages of others.—*Journal of Electricity*, Nov. 1, 1918.

Saving the Waste in Penstock Pipe Design.—B. F. JAKOBSEN.—Economic proportioning of penstock pipes and of transmission lines is a matter of prime importance in these days of saving the waste. Under the present conditions of national stress the problem passes beyond that of successful engineering attainment and becomes one of real service in the saving of essential materials.—*Journal of Electricity*, Nov. 1, 1918.

Ideal Barometric Condenser Conditions.—G. T. KEECH, JR.—The four important factors which determine ideal conditions for barometric condensers are stated by the author as follows: Topography of ground, water level, kind of water, installation and operating costs. These four items are then elaborated.—*Power*, Dec. 17, 1918.

Traction

Railway Electrification to Save Fuel.—W. J. DAVIS.—Some new figures on railway electrification which bring out the loss of fuel which results from the present method of making each engine a power plant in itself. Even with the most modern of steam equipment, the engine is very inefficient as compared with centralized power generation.—*Journal of Electricity*, Nov. 1, 1918.

Electrification of Railways in Germany, Sweden and Norway.—P. POSCHENRIEDER.—Gives a brief survey, without details but with the leading features, of the present state of the electrification schemes in the countries mentioned.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, March, 1918.)

Efficient Operation with the Skip-Stop Service.—This article was prepared by the United States Fuel Administration and calls attention to the fact that by reducing the actual number of stops which a car makes, by accelerating and braking at higher rates, and by shortening the duration of stops, it is usually possible greatly to increase the schedule speed of cars. This increase in many cases might be sufficient to allow as good service to be given with five cars as was formerly possible with six. Curves are presented showing the relation of speed, energy consumption and stops per mile at two rates of acceleration and braking.—*Electric Railway Journal*, Dec. 14, 1918.

Semi-Automatic Portable Substation.—A short time ago the United Railways of St. Louis placed in service a 500-kw. rotary-converter substation housed in a steel car for use at various parts of the system to carry local overloads. The substation is described as semi-automatic in operation and illustrated by a wiring diagram. —*Electric Railway Journal*, Dec. 14, 1918.

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Installations, Systems and Appliances

A New Coke-Oven Installation.—Waste gases are used in this installation to generate steam in Lancashire boilers at a working pressure of 150 lb. per square inch (10,500 g. per sq.cm.). The boilers are equipped with fronts lined with 9-in. (22-cm.) firebrick, wherein the surplus gas is burned in Terbeck burners. Each boiler is furnished with a series-flow superheater of the "unit" type and the waste gases are passed through a Green's economizer designed to reduce the temperature to 200 deg. C. and the feed water to 265 deg. Fahr. (130 deg. C.). The electrical plant consists of a 500-kw. high-pressure steam turbo-alternator made by the British Thomson-Houston Company, and the electrical energy, which is three-phase, 50-cycle, is generated at a pressure of 3300 volts stepped down to 550 volts for use in driving the electric pumps, rams, compressors and various motors in connection with the new washery and by-product plant. Arrangements have also been made so that the generator can be synchronized with other generators at the firm's other colliery and by-product plant, about three miles away, feeding into a ring main for the supply of power to several adjacent collieries and pumping stations.—London *Engineer*, Nov. 22, 1918.

Effect of Power Factor on Output of Rotary Converters with Reactance Control.—R. G. JAKEMAN.—When installing rotary converters with reactance control a leading current is often required to relieve the generators and cables. In this article it is shown, however, that if a large leading current is specified the converter becomes unduly expensive.—London *Electrician*, Nov. 22, 1918.

Electrophysics and Magnetism

Electromagnetic Vectors.—H. BATEMAN.—An electromagnetic field is studied geometrically in relation to a moving observer and various vectors are located with the aid of the two cones which at each point limit the direction of the forces acting on the electric and magnetic charges moving with velocities less than that of light. A critical discussion is given on the nature of the energy in an electromagnetic field and the nature of its flow. A theory is developed which indicates that there is a colossal amount of concealed energy in the field of a moving electron.—*Physical Review*, December, 1918.

Specific Heat of Platinum at High Temperatures.—WALTER P. WHITE.—The specific heat of platinum has been redetermined from 100 deg. to 1300 deg. with a precision estimated to be better than 0.3 per mille and with very satisfactory agreement with the results of Gaede at 100 deg. and with those of Plato, Corbino, Magnus and Fabaro at higher temperatures. Most published results below 100 deg. appear to be 1 per cent or more too high. The atomic heat of platinum at constant volume is, from 100 deg. up, above the value 5.96, as indicated by Dulong and Petit's law and by the accepted kinetic theories of the solid state, and also increases regularly to 1300 deg. and probably beyond that.—*Physical Review*, December, 1918.

Arrangement for Obtaining a Unidirectional High-Tension Current from Three-Phase Current.—O. M. CORBINO and G. C. TRABACCHI.—The object is to obtain an arrangement which will remove some of the limitations inevitable with the induction coil as at present employed. This it is proposed to do by a special grouping which enables a periodically interrupted three-phase current to be used and by arranging a "make" of the current at a suitable interval after each "break" so that the core is magnetized in the opposite sense to the preceding. The experiments described indicate that it is possible to make an apparatus of this type to suit the many different circumstances that are met with in practice. Various diagrams illustrating the grouping and connections are given.—*Science Abstracts, Section A*, October, 1918. (Abstracted from *Nuovo Cimento*, February, 1918.)

Units, Measurements and Instruments

Prepayment Meters.—G. W. STUBBINGS.—The necessity for rugged and reliable construction is pointed out by the author since the prepayment meter may at times contain considerable sums of money. It is also essential that the internal mechanism should be particularly reliable since it is difficult to obtain payment of prepayment meter deficits after the energy has once been obtained by the customer. The meters of modern design offer little scope for the ingenuity of unscrupulous persons in obtaining light without the insertion of the appropriate coin. While it is impossible for any prepayment meter to differentiate between metal disks of the correct size and weight and the required coin, the losses incurred by supply companies due to causes of this kind are quite negligible. Most troubles attending the use of prepayment meters are due to defects in prepayment mechanisms, the type of mechanism in most common use at the present time being one in which the switch is closed by gearing in which the coin forms a temporary link.—London *Electricity*, Oct. 4, 1918.

A Hot-Wire Vacuum Indicator with Multiplier.—W. TSCHUDY.—Description of an apparatus which can be used for measuring pressure in the bulbs of mercury converters, or as a resistance thermometer. The principle is that of the Kohlrausch bridge, one of the branches of the bridge being formed by an incandescent lamp of which the ohmic resistance of the filament varies when put in communication with the vacuum chamber. A battery of constant emf. and resistances of which the temperature coefficient is null and the most favorable value is 10 ohms or 100 ohms are employed. The sensitiveness of the apparatus is such that one division on the galvanometric scale corresponds to a vacuum of 0.0001 mm. of mercury. The proper construction of the lamp is described, with directions for its use.—*Revue Générale de l'Electricité*, Sept. 21, 1918. (Abstracted from *Elektrot. Zeits.*, June 13, 1918.)

Miscellaneous

Canada's Heritage in the St. Lawrence River.—ARTHUR V. WHITE.—It is pointed out that treaties safeguard the interests of both the United States and Canada where waters form the border line between the two countries. The author cites a case where an American company diverted water from the Niagara River without first getting permission of the international commission on the ground that the power was necessary for the prosecution of the war. The necessity of protecting Canadian interests in this matter is pointed out. The writer advocates the development of all water power under the control of the government.—Toronto *Electrical News*, Dec. 1, 1918.

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Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

CONDUCTIVITY, THERMAL, OF VARIOUS MATERIALS.

The thermal conductivity of various materials used in certain manufacturing processes was determined by measuring directly the amount of heat that passed through a thickness of material between two equi-temperature surfaces and the temperature drop through the sample. A soapstone electric heater was used for the source of heat, while the cool surface was furnished by a reservoir with circulating water. The temperature drop was measured by means of small copper-constantan couples. Among the materials tested were hard rubber, fiber, different kinds of wood, plate glass, soapstone, sheet steel, graphite (solid and powdered), lamp black, etc. One fact that was noticed in particular was the large increase in the transverse conductivity of a pack of iron sheets when the individual sheets are painted with asphalt.—*T. S. Taylor, Pittsburgh, Pa.*

CONDUITS, THERMAL CONDUCTIVITY OF.

It is a well-known fact that the insulation in high-voltage cables remains good only up to a certain temperature, after which the leakage through the insulation becomes such as still further to heat the insulation and cause its ultimate breakdown. It was therefore thought that if one kind of conduit radiated heat more rapidly than another it would be best to use the type which possessed the best heat-radiating qualities. At the writer's suggestion, W. S. Wilder has made some tests at the University of Wisconsin, and the results seem to indicate that vitrified clay dissipates heat at a rate of about 10 per cent faster than fiber. There may, therefore, be some real advantage in the use of vitrified-clay conduit instead of fiber conduit for transmission cables, because with a given size of cable a heavier load may be carried on it than would be possible if fiber ducts were used.—*G. G. Post, Milwaukee (Wis.) Electric Railway & Light Company.*

INSTRUMENTS, INDICATING—DETERMINATENESS OF HYSTERESIS.

Experiments have been performed to determine whether or not hysteresis determinations on non-integrating instruments are reproducible within themselves. The data obtained indicate that such determinations are reproducible to a high order of precision, and it becomes possible to extend the definite utilization of such determinations in testing and calibration, with a noteworthy improvement in the precision of results of actual use of instruments. Certain fundamental laws respecting instrumental hysteresis and the relation of that hysteresis to the use and testing of instruments have been derived and set down, and it has been shown that a remarkable improvement in the reliability of instrument observations is attainable by the simple expedient of operating the instrument only through definite cycles subsequent to suitable regularization. The results will be published by the Washington Academy of Sciences.—*Frederick J. Schlink, Bureau of Standards, Washington, D. C.*

LAMPS, MERCURY-VAPOR, QUARTZ TYPE; DECREASE IN RADIATION WITH USAGE.

The object of the investigation was (1) to devise methods of determining quantitatively the decrease in intensity of emission with usage and (2) to make preliminary measurements on radiant-power life tests of quartz mercury-vapor lamps. The measurements of the radiations from these lamps were made by means of a thermopile, in front of which was placed a 1-cm. cell of water to absorb the infra-red rays of long wave lengths emitted by the electrodes. The variation in intensity of the ultra-violet rays was determined by observing the variation in transmission of a yellow Noviol glass with usage of the lamp. It was found that the intensity of the total radiation as well as the ultra-violet component decreased to about one-half to one-third of its initial value in the course of 1000 to 1500 hours. During the first 500 hours of usage no marked difference was observed in the percentage of ultra-violet emitted by two commercial types of lamps. Data have been obtained (1) on the variation of the total radiation emitted by quartz mercury-vapor lamps with variation in energy input, (2) on the variation of the intensity of the irradiation parallel with the axis of the lamps, and (3) on the variation of the intensity of the total radiation with distance from the lamps. Comparative data have been brought together on the ultra-violet component in the radiations from the sun, from quartz mercury-vapor lamps, and also from a carbon-arc lamp which is used in dye-fading tests.—*W. W. Coblentz, M. B. Long, H. Kahler, Bureau of Standards, Washington, D. C.*

MATERIALS, SELF-LUMINOUS.

For war purposes a brief statement has been prepared of those properties of self-luminous materials and of those principles of vision which should be known by all concerned with the drawing of specifications for the illuminating of articles by means of self-luminous material. This information will later be published by the National Advisory Committee of Aëronautics. A limited mimeographed edition was issued Aug. 10, 1918, under the title "Notes and Recommendations Regarding Specifications for the Illuminating of Articles by Means of Self-Luminous Materials Containing Radioactive Excitants."—*N. E. Dorsey, Bureau of Standards, Washington, D. C.*

SAFETY CODES, INDUSTRIAL.

Extensive work is being done on the formulation of standard safety codes for various industries. For this purpose information is being collected and arranged, tests are performed where necessary, and the existing codes are studied with the view to their unification. The work includes safety of elevators, head and eye protection, power-transmission machinery and apparatus, explosives, etc. A number of conferences and public hearings will be held to which interested parties will be invited, such as representatives of the various industries concerned, federal bureaus, state industrial accident commissions, some public service commissions, state authorities which make rating laws for casualty insurance, municipal authorities, technical and engineering societies, manufacturers' associations, employees' representatives, casualty insurance companies, etc. The work is being conducted in connection with the Working Conditions Service of the Department of Labor. The work of this department comprises industrial health, labor administration and industrial safety.—*M. G. Lloyd, Bureau of Standards, Washington, D. C.*

X-RAY WORK, PROTECTIVE MATERIALS FOR.

Attention is called to the necessity for testing all material that is to be used for X-ray protection. Some of the lead substitutes that are offered to the public for such use are practically worthless. The values of the lead equivalent of typical commercial materials have been determined.—*N. E. Dorsey, Bureau of Standards, Washington, D. C.*

Suggestions for Research

ALTERNATOR, HIGH-FREQUENCY, HIGH-POWER.

A high-frequency, high-power induction-type electric furnace has been successfully developed and would become of extensive use in electrometallurgy if a suitable source of power were available. High frequency is desired in order to do away with the iron core between the existing coil and the heated metal, which serves as the secondary of a transformer. Moreover, power-factor correction, which is essential with this type of furnace, can be readily accomplished by means of condensers, provided that the frequency is high enough. An efficient alternator is needed of 500 kw. to 1000 kw. rating at 12,000 cycles to 20,000 cycles per second, one of reasonable weight and price.—*Editorial Suggestion.*

FIELD DISTRIBUTION, ELECTROSTATIC OR MAGNETIC, WITH TWO MEDIA.

The following problem has recently arisen in connection with the discussion of some A. I. E. E. papers on electrostatic fields and insulators. Let a field of force be established between two electrodes of some arbitrary given shape in a homogeneous dielectric. Consider the space occupied by a tube of force of finite transverse dimensions, limited by a lateral surface and by parts of the electrodes; fill this space with a dielectric of different, say higher, permittivity. The question to determine is whether or not the field distribution is thereby affected, so that some outside lines of force will enter the new dielectric on a part of their length and then emerge again. If such be the case, then the former lateral surface is no more an envelope for lines of force, and the field distribution must be determined anew. In the design of some recent insulators the assumption seems to have been made that the substitution of porcelain for the air in part of the field would not affect the dielectric flux distribution in the remaining air, provided that the porcelain surfaces are shaped along former lines of force. If this be so, then local stresses and ionization can be reduced and the flash-over point considerably raised. While the practical improvement achieved seems to be quite notable, the theoretical basis for it is still in doubt and requires a proof as to its validity, exact or approximate.

LIGHTNING ARRESTERS—THE USE OF CONDENSERS TO ELIMINATE SURGES.

It has been the practice in certain sections of Europe, especially in Switzerland, to use comparatively large electrostatic condensers connected between the line wires of a high-tension transmission line and ground to carry high-frequency, high-potential surges and electric discharges to earth. A condenser will carry current in proportion to the frequency of the impressed potential, and line surges are in general of the nature of high-frequency discharges to earth. It should therefore appear that the use of condensers would be of material value and would afford considerable protection.—*V. L. Hollister, University of Nebraska, Lincoln.* [While such condensers may be too expensive in the present state of the art for universal use, experiments on a small scale are recommended to determine their effectiveness for the purpose. The recently developed oxide-film arrester (A. I. E. E., 1918) may also contribute to the solution of the problem, although the practical experience with it at the present writing has been only limited. The great advantage of a condenser is that it has no spark gap in series with it and is therefore instantly active with high-frequency oscillations.—*Editor.*]

SEPARATOR, MAGNETIC.

There is need for powerful magnets or groups of magnets and corresponding auxiliary apparatus adapted to extract magnetic bodies from broken stone or metallic ores which are being mechanically transported for feeding large crushers. Small bodies of iron, such as drills, hammer heads, railway spikes, large bolts and nuts, etc., are liable to cause a serious break in almost any type of crusher, and large numbers of such iron bolts get mixed with stone dug by steam shovels and carried on belt conveyors. The separation of such objects on a large scale has proved a very difficult problem, but one very important. Magnetic separators now on the market are intended for a different type of work and cannot satisfactorily perform this duty.—*Percy H. Thomas, New York City.*

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

PLANS FOR AFTER-THE-WAR ACTIVITIES OF THE N. E. L. A.

Announcement of Membership of Committees to Be Made Soon—Arrangements Under Consideration for Annual Convention in June

Plans for a renewal of the activities of the National Electric Light Association through committees and sections, as in the times before the war, are well under way. It is expected that announcement will be made soon of the membership of committees. The titles of the committees will be the same as in other years. Arrangements of a general character are also under consideration by the association general officers for an annual convention to be held in June. It will be like the conventions before the war.

CONSIDER WAR RULING ON EXTENSIONS IN ILLINOIS

Hearing by Illinois Commission on Rescinding of Temporary Order—Companies Express Willingness to Meet Views of the Commission

The Illinois Public Utilities Commission held a hearing in Chicago on Jan. 14, when the electric and gas utilities of the state were called upon to show cause why the commission should not rescind its temporary war ruling which required customers to finance extensions. The utility representatives asked the commission to bear in mind that the signing of the armistice had not made it any easier for them to get money nor had it affected appreciably the high war-time costs of material and labor. Notwithstanding those conditions, however, the utilities were almost unanimous in expressing their willingness to coöperate with the commission and go back to the pre-war free extension rules if the commission thought best to do so.

The companies explained unofficially that their willingness to do this was based mainly on optimism. On a basis of the costs entering into service extensions the utilities believe they are as justly entitled to ask their customers to finance extensions now as they were when the service rules were rescinded. The war is over now, however, and the Illinois utilities showed willingness to "take a chance" on the future.

One company said that prospective customers requiring extensions in its territory had been holding off on account of the cost. If free extensions were reintroduced, the company would have to ask the commission to allow it time to connect up all that apply for service. If prices drop, all will be well, but if not the commission will be appealed to for relief.

One of the utilities' representatives pointed out that the rates in the state are based on 1916 cost of construction and that the rules governing extensions were also promulgated under conditions as they existed at that time. He asked the commission, therefore, to determine the average cost of free extensions in 1916 and to limit the value of each free extension made now to an amount equal to that required by an extension made in 1916. He also suggested that the commission put free extensions on a dollars and cents basis instead of a basis of so many poles or feet of wire. Then as long as the base rates for service remain the same customers should pay all expense of an extension in excess of the 1916 cost.

The commission will take up the matter later.

SAFETY CODE CONFERENCE AT BUREAU OF STANDARDS

Plans to Co-ordinate Safety Codes with a View to National Uniformity Discussed at Meeting in Washington This Week

At a meeting of representatives of public service commissions and others at the Bureau of Standards, Washington, on Wednesday of this week, the question of industrial safety was considered. Dr. S. W. Stratton, Director of the Bureau of Standards, presided. Plans to coördinate safety codes were discussed with a view to bringing about national uniformity.

There were present representatives of the state commissions, engineering societies, utilities associations, federal bureaus, insurance organizations, both fire and casualty, and others. Among those who spoke were W. H. Cameron of the National Safety Council; Prof. C. A. Adams, president American Institute of Electrical Engineers; Albert W. Whitman of the Whitman Compensation Bureau, and John R. Brownell of the California Industrial Accident Commission. The result of the conference will be made public later.

Outlook for New England Coal Supply

James J. Storrow of Boston, Mass., federal fuel administrator for New England, has recently announced that both the hard-coal and soft-coal situations are now satisfactory and that he has requested Dr. Harry A. Garfield, United States Fuel Administrator, to relieve him of his duties. The soft-coal situation has been satisfactory as regards supply for several weeks.

From April 1, 1918, to Dec. 1, 1918, New England received 20,187,670 tons of soft coal as compared with 16,469,866 tons during the corresponding period of 1917. Mr. Storrow stated that the conservation policy in effect in New England has saved at least 1,000,000 tons of coal this year, and in addition a large increase has been brought about in the steam sizes of anthracite.

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Electric Power Club Talks on Reconstruction

Price Reactions Not Expected, as Cost Depends Largely on Wages and Living Expense Is Still High—Contact with Government and Foreign Trade Opportunities—An Era of Expansion Before the Industry

THE Electric Power Club, made up of manufacturers of motors, generators, transformers and electrical apparatus, met in Cleveland, Ohio, on Monday, Tuesday and Wednesday of this week to consider the problems of reconstruction facing the electrical manufacturing industry. Three facts affecting the present situation of the industry were prominently brought out in the various sessions.

First, electrical machinery has not advanced in price level during the war in the same ratio as costs of labor or cost of living. The electrical industry has not profiteered so that any price reactions from war levels will not be acute or rapid.

Second, there are few lines of industry in which the cost of labor forms relatively so large a part of total costs. The price reactions must therefore turn largely on what happens in the field of labor readjustment. It was the consensus of opinion that no immediate sharp changes in labor costs are likely to occur, but that, on the contrary, wage reductions may not be expected until actual reductions in the present cost of living become effective.

Third, that it would be a serious mistake for the electrical industry to lower the price level of its product by lowering the standard of design and performance.

Emphasis was placed on the international fame of American electrical equipment for reliability and efficient performance, and manufacturers were urged not to jeopardize this reputation by impairment of design and quality even though pressure for price reduction at this time might create a temptation to do so.

Rapid Return to Normal Conditions Probable

From what could be gathered at the meeting there is every probability of the electrical industry being one of the first to return rapidly to a peace footing of normal activity since the absence of radical price inflation during the war has been such as to breed confidence on the part of the public and lead to the immediate resumption of peace-time buying on a considerable scale.

The features of the general meeting on Tuesday were the presidential address by C. L. Collens, 2d, and the addresses of Walter Robbins on the industries' new contact with government and Gilbert H. Montague on coöperation with the government. These addresses were followed by a general discussion on readjustment problems.

In the afternoon the possibilities of foreign trade were outlined in two papers, one by Gilbert H. Montague on combinations under the Webb-Pomerene bill, and the other by Philip S. Smith of the Bureau of Foreign and Domestic Commerce on the opportunities for the export of motors to foreign lands. W. M. Strachen of the Bureau of Foreign and Domestic Commerce also spoke of the work which that bureau had under contemplation in Spain, Italy and Africa. The question of tariff legislation and the necessity for its consideration by electrical manufacturers was touched on by S. L. Nicholson of the Westinghouse Electric & Manufacturing Company.

At the session of the club held Tuesday evening L. W. Lyons of the Westinghouse Electric & Manufacturing Company read a paper on terms of payment, and Hugh A. Brown of the Burke Electric Company presented a paper on simplified contract forms.

Wednesday's sessions were devoted very largely to questions of standardization. The committee report and general discussions on this subject were preceded by a very excellent and idealistic paper on uniform motor design by James Burke of the Burke Electric Company. Dr. Agnew of the Bureau of Standards voiced the appreciation of the government for the work of the war service committees of the electrical industry in bringing in conformity with good commercial practice the work of the War Department.

The Industries and the Government

In speaking of industries' new contact with the government, Walter Robbins contrasted the isolation of the Department of Commerce from industry compared with the close coöperation enjoyed by the War Industries Board. It developed from this work that there were possibilities of coöperation between industry and the government and that this point of contact is now centralized in the Department of Commerce. This work is in a formative stage, but the possibilities which such an arrangement with the government present for continued conservation and standardization of equipment and for uniformity in cost systems and selling methods are admittedly of great advantage to electrical manufacturers. It was pointed out that commercial rather than technical standardization is needed at the present time.

The very excellent work of the Electric Power Club, particularly in connection with the war, was summarized by C. L. Collens, 2d, in his presidential address, and since most of this work fell to the lot of Mr. Collens a vote of appreciation was extended to him for the personal and business sacrifices which he made for the club as well as for the electrical industry in that connection.

Mr. Collens spoke of the changes confronting the industry since the signing of the armistice and pleaded for the elimination of wasteful practices. Unrestricted competition, he said, tends to develop uneconomical conditions as to the character and multiplicity of the products manufactured, and the electrical industry should promptly eliminate all such sizes, types, finishes, styles, attachments, etc., as do not render an actual needed additional service or which are unnecessarily wasteful of capital, labor and material. The practicability and desirability of coöperation between business and government, he said, was conclusively demonstrated under emergency conditions in the relations which existed between organized industry and the War Indus-

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tries Board, and while restrictive regulation of the character enforced during the war is no longer necessary, organized industry should foster and develop normal coöperative relations between itself and the government, thus exercising a constructive attitude toward legislation and approaching such problems as wasteful destructive competition, uneconomical standards and commercial abuses. The point of contact which the electrical industry has through Walter Robbins and the Department of Commerce and through that agency with the Federal Trade Commission offers many practical possibilities.

Possibilities of Export Situation

Mr. Collens directed attention to the heavy inventories of materials purchased at war prices for the purpose of placing each manufacturer in a position to render greater service to the government in winning the war and to the necessity of gradually liquidating these inventories without loss to the manufacturer. He also drew attention to the great possibilities in the export situation and said that American manufacturers should coöperatively as well as individually create a demand for high-grade American-made electrical apparatus in the markets of the world. In order to win these markets, however, he said, there must be increased efficiency and closer coöperation on the part of labor, elimination of wasteful methods, a higher degree of standardization and conservation and greater specialization of product.

Gilbert H. Montague told of the work of the Federal Trade Commission and outlined various phases of unfair competition which have developed. It was brought out that most of the complaints made to the Federal Trade Commission come from individuals and disgruntled competitors rather than from trade associations and that the Federal Trade Commission has been more successful in bringing about correction of abuses and its decisions have been more uniformly accepted than have been the decisions of United States courts.

In considering the problems of readjustment, the questions of inventory, labor, inflation and quality of goods were discussed at some length. There was a very evident inclination on the part of all manufacturers to deal very fairly with labor and to hold up wages until the cost of living goes down. It was pointed out that coupled with the demand of labor for adequate compensation is the opportunity for self-expression, and it was recommended that all trade associations give serious consideration to the labor problem and evolve a plan whereby self-expression will be guaranteed to the laborer. Most manufacturers have a conviction that an era of expansion never before equaled confronts the electrical industry. It was said that people are beginning to realize and appreciate the dominant power of electricity and that there is a general recognition of the fact that the industry as a whole was not guilty of profiteering during the war. The manufacturers were a unit on the proposition that there must be no labor troubles in the electrical industry and that there is room for a higher quality of salesmanship.

Foreign Trade Combinations

All the various combinations for foreign trade possible under the Webb-Pomerene bill were explained at length by Gilbert H. Montague of New York. He showed how various individual concerns might form an export association, which association might act as broker or agent or purchase outright from the individual concerns. Such an association might also sell through commission houses which in turn possess branch offices or selling facilities in foreign countries. Individual concerns might also form subsidiaries to look after foreign trade or have an informal agreement between themselves as to prices, territory and distribution of product in foreign markets.

Philip S. Smith told of the differences in frequency and voltages employed in various countries, the character and extent of German, English and Japanese competition, the tariff preferences in force in some countries and the classes of industries existing in various countries which use electricity.

On the recommendation of S. L. Nicholson, who heads the committee of the Electric Power Club making a study of tariff, the club will secure the services of an expert adviser on tariffs and canvass its membership on the labor, material and load content represented in apparatus manufactured.

The advantages of uniform motor design were very strikingly set forth by James Burke of Erie, Pa., who presented all the points of difference found in motor design, wire bolts, feet, etc., and how this lack of uniformity and interchangeability affects large users of motors and particularly how differences in design militate against rapid and reasonable repairs. Mr. Burke enumerated all the advantages which various engineers claim for the individual designs and outlined the immense possibilities of gain to the manufacturer and user inherent in a standard motor. That the scheme outlined by him was not entirely visionary was evidenced from the discussion of numerous designers of motors, who showed that standardization along very many lines was already under way and near the point of completion.

Standardization of Raw Materials

A. H. Moore of the General Electric Company spoke on the standardization of raw materials and the advantages which accrue to a company using standard materials in design.

The committee on fractional-horsepower direct-current motors recommended the adoption of a 32-volt fractional-horsepower direct-current motor in connection with low-voltage farm-lighting work. It also recommended the elimination of the ⅓-hp. size of direct-current and alternating-current motors of all voltages, speeds and frequencies. An effort was also made to standardize on compound-wound motors from ⅛-hp. to ¾-hp. inclusive, and on shunt-wound motors below ⅛-hp. The committee has also under consideration the standardization of motor terminals and pulleys and the question of 50-deg. ratings.

Other reports were made by the large power motor committee for direct-current, polyphase and single-phase motors. These indicated a move to restrict the list of ratings to the number really needed by the industry in the interest of economy to the manufacturer and showed a purpose to standardize shaft extensions and pulley dimensions. Certain changes in the standard test for three-phase distribution transformers were recommended by the transformer committee.

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MASSACHUSETTS COMMISSION FIGHTS NEW TELEPHONE RATES

Public Service Commission Finds that Order of Federal Authorities Provides for a Substantial Increase Instead of a Decrease

A battle royal was staged at Boston, Mass., for Jan. 17 between the Massachusetts Public Service Commission and the federal government over the telephone toll-rate schedule issued in accordance with Postmaster-General Burleson's Telephone and Telegraph Bulletin No. 22, Order No. 2945, effective Jan. 21, 1919. On Dec. 21, 1918, the New England Telephone & Telegraph Company filed with the commission a basic toll-rate schedule issued in accordance with the above bulletin. The impression has gone abroad through the country that the schedule represented a rate revision downward, but upon analyzing its application in Massachusetts as exemplified in the New England company's tariff the commission finds that in reality it provides for a substantial advance in charges, and cannot permit the new rates unchallenged to go into effect. In a letter to Postmaster-General Burleson dated Jan. 9 Chairman F. J. Macleod said in part:

This schedule provides for so large and so general an increase in charges within Massachusetts that the commission has felt that it ought not to permit the new rates to go into effect, with its approval, until cause has been shown. For this reason it has set the matter down for public hearing on Friday, Jan. 17, 1919, at 10:30 a.m., the hearing to be held at the office of the commission at No. 1 Beacon Street, Boston, in order that an opportunity may be given to representatives of the company or to your own representatives to explain the reasons for the change. We have been reluctant to take this step, for the commission has been desirous of helping you in the successful administration of the telephone properties in every way that it could. The increases proposed, however, are very substantial, and it has not seemed to the commission that it could, in good faith with the people of Massachusetts, give its sanction to the new schedule until it has been shown just and reasonable.

The new rates were scheduled to go into effect Jan. 21 and although they were advertised throughout the nation as a "slashing of toll rates" and it was averred that they represented a tremendous decrease in such rates throughout the country, it now appears that, so far as Massachusetts and the other New England States are concerned, they represent a sweeping increase over existing charges. Present night rates are abolished, station-to-station charges are imposed which increase the burden of toll business and add to the expense of the patrons, the cost of bringing parties to pay stations is increased, and a complexity in traffic charges is introduced which threatens the quality of the service. William H. O'Brien, chief of the telephone and telegraph bureau of the commission, informed a representative of the ELECTRICAL WORLD a few days ago that the issue involved is the most important which has arisen since the Massachusetts commission was established. He characterized the new schedule as "frightfully complicated as compared with the present single-track system."

Public sentiment is greatly aroused, and to the hearing of Jan. 17 representatives of the governments of all the principal municipalities of the state were specially invited. The commission is prepared to carry the issue to the highest court if necessary.

GOVERNOR OF MASSACHUSETTS ON CENTRAL POWER STATIONS

In His Inaugural Address Governor Coolidge Indorses Central Stations at Tidewater and Inland Water-Power Development

In his inaugural address at Boston on Jan. 2, Gov. Calvin Coolidge of Massachusetts emphasized the production of mobile mechanical power as one of the chief means of lessening the burdens of man and increasing his material blessings.

"There can be no doubt," said the Governor, "of the great benefits derived from the development of electric power from coal and water. Central power stations at tidewater and inland water-power development should be stimulated and encouraged. On the increase of such power will depend the place we shall hold in future civilization."

GEN. GUY E. TRIPP IS GOING TO PAY VISIT TO ENGLAND

Chairman of Board and Other Officials of Westinghouse Company Plan Enlargement of Export Business—Condition of the Company

© Gen. Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, will sail for England on Jan. 29. He will be accompanied by several officials of the company. The object of the trip is to further plans for enlarging the export business of the company. It is expected that the party will be away about six weeks. The company now has as one of its subsidiaries the Westinghouse Electric Export Company, formed several years ago to take over the direction of the export business of the Westinghouse concern.

Unfilled orders of the Westinghouse Electric & Manufacturing Company as of Jan. 1, 1919, amounted to over $95,000,000 exclusive of approximately $3,500,000 munitions orders. This fact was stated by General Tripp in a letter to Kuhn, Loeb & Company in connection with the issue of $15,000,000 one-year 6 per cent notes to retire a like number of notes due on Feb. 1. The new notes are being offered to holders in exchange for the maturing issue. Chairman Tripp says of the company's business:

At the close of business Nov. 30, 1918, its current assets as they will be defined in the indenture amounted to over $110,000,000, while its current liabilities as so defined amounted to less than $41,000,000, which the present issue of notes will not increase, as the proceeds thereof will be applied to the payment of outstanding notes. The funded debt of the company, consisting almost entirely of the Westinghouse Machine Company first and refunding mortgage bonds, due 1940, amounts to about $6,570,000, and its capital stock, now paying 7 per cent dividend per annum, amounts to $74,812,650 par value.

The net income of the company for the period of eight months ended Nov. 30, 1918, of the current fiscal year after the payment of capital stock taxes and all state and municipal taxes, and applicable to the payment of interest, was $19,018,030.64, and the interest charges for the same period amounted to only $1,567,679.59, leaving a balance of earnings for the period of $17,450,351.05 applicable to federal income and excess-profits taxes and dividends. Reserves of $8,000,000 have been made out of these earnings to provide for such federal taxes for said eight months' period.

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CENTRAL STATION AND THE CONTRACTOR IN MASSACHUSETTS

Merchandising Policies Discussed at Massachusetts Contractors' Meeting—E. R. Davenport Points Out Value of Joint Electrical Conventions

Merchandising policies with special reference to relations between central stations, manufacturers and contractors formed the chief topic of discussion at the annual meeting of the Electrical Contractors' Association of Massachusetts at Worcester Jan. 9. A. B. Hixon of Boston presided, and the speakers included E. R. Davenport, sales manager of the Narragansett Electric Lighting Company, Providence, R. I.; W. L. Goodwin, author of the "Goodwin plan," New York; J. M. Wakeman, general manager of the Society for Electrical Development, New York, and Samuel A. Chase, Westinghouse Electric & Manufacturing Company, New York. Representatives of central stations from Boston, Worcester, Fitchburg and other New England points, together with representatives of electrical manufacturers and jobbers, brought the registration to nearly 100, and the convention marked a distinct advance in the attendance and interest shown by the various branches of the industry represented.

ADVOCATES READJUSTMENTS IN TRADE RELATIONS

In opening his address, Mr. Davenport expressed his pleasure at the diversified attendance and touched upon the value of joint electrical conventions in which the various branches of the industry can meet under a single roof and by parallel and general sessions work out many problems of a perplexing character. Turning to these problems, the speaker said that the present method of purchasing motors is open to criticism. Operations are being attempted to-day under a form of motor agency agreement designed some twenty years ago. Conditions have changed materially during that time and still the motor agency agreement has not been brought up to date. Under this form of agreement customers having a connected horsepower equal to or exceeding 200 are entitled to a flat discount of 10 per cent. A firm with such an installation was once considered a large customer, but to-day it is safe to say that nothing less than 1000 hp. is considered large. No modification has been made in the agreement to cover this changed condition, and the result is that a discount is now being made to the small customer who is not entitled to it. The manufacturer is not so much concerned in raising the limit from 200 hp. to 1000 hp. because there is no lost profit to him; but there is an unfairly lost profit to the dealer.

A motor agency agreement for a dealer is at present of little advantage in meeting the motor manufacturer's competition for the business of the dealer's customers. In certain fairly large-sized installations the motor manufacturers get into competition with one another, with the result that the customer purchases a much smaller quantity of motors than the dealer, and he secures them for less money than the dealer can buy them for. An agency agreement, of course, has the advantage to the motor manufacturer that it gives the latter a certain staple year-around business. It is unfair to the dealer to treat him in the way outlined above, and his business should be cultivated and expanded rather than discouraged and curtailed. In spite of the fact that dealers hold agency agreements they receive no protection whatever on motor orders placed with the manufacturers' local representatives from factories within the dealers' territory. In other words, the dealers are always in a sense competing with the manufacturers on the goods which the dealers themselves buy from them through the same office. Only by giving better service, more prompt shipment of motors from stock or more cordial relations with the trade can the dealer hope to do business under the conditions just described.

Mr. Davenport said that for some time he has believed that the margin of profit for dealers on the sale of motors has been absolutely insufficient, and that the dealers' gross profit on this class of business should be 33 per cent at the lowest margin. He challenged comparison with other lines of business conducted between manufacturers and dealers on any such low margin as the present profit. Complications and unfair competition also arise in many cases where the motor manufacturer does engineering work for prospective customers. The speaker said he knew of cases where this engineering had been literally forced on the customer, the technical work being done from an absolutely selfish standpoint, requiring such apparatus as only the manufacturer could furnish whose representative did the engineering work. Then again, said the speaker, there is a sort of camouflage by the manufacturer which goes by the name of "end shields," "extended shafts," "special equipment," etc., thereby preventing the purchase of this material through a local dealers' agency agreement. Once a manufacturer puts a factory engineer on a layout of applying motors to certain machines the engineer rarely remembers that standard motors can be adapted quite as well to certain machines. The policy of the manufacturer's continuing to do business under the old basis direct to consumer is wrong and will stunt the development of the industry.

DISCUSSION OF THE LAMP SITUATION

Turning to the lamp situation, Mr. Davenport said that the central stations are not alone to blame for it. Most of it, he said, is due to the lamp manufacturers. The central stations had no choice of a lamp policy, and free renewals were practically forced on them by inducement after inducement on the part of the manufacturer. It is only within two years that the manufacturers have changed this policy. At Providence when the Narragansett company adopted its lamp sales policy some of the lamp manufacturers went so far as to bring their attorneys to the city in the endeavor to prevent the company's merchandising lamps, but unsuccessfully.

In Providence to-day only the 25, 50, 75 and 100-watt sizes of tungsten lamps are carried by the central station, and the speaker urged the elimination of the present odd sizes throughout the industry. Regarding lamp sales, Mr. Davenport said that he has yet to meet the central station that can justify distributing lamps in its territory below list prices. He said: "The central stations that sell lamps at less than list prices are losing money that rightly belongs to them and, further, are stunting the development of the business of their territories, so that it is a losing proposition to them from two angles."

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For years there have been efforts through the National Electric Light Association to standardize accounting methods. It is only a question of time when rates must all be based upon fundamentally the same principles in all cities. There must be a more unified conduct of central-station business in every direction. If the government should take over the business, one of the first things would be the standardization of it, and the industry is nearer government control to-day than ever before. Statistics show that 75 per cent of the central stations in this country to-day merchandise lamps, and undoubtedly that policy would be accepted by the government as a basis for standardization, and the rest ordered upon the same basis.

Proper Credit Policies for Jobbers

Touching upon jobbing policies, the speaker said that the jobber should be careful about extending credit on new accounts. It is surprising to find that a contractor's workman can set himself up in business in competition with his former employer by the lack of a jobbers' credit system, going from one jobber to another and securing a limited credit from each. Cut prices by dealers hurt the trade as a whole, and where the contractor cuts on motors, especially in face of the present insufficient profit, his action is ridiculous. In the Providence territory contractors were found to be cutting prices on tungsten lamps and covering by making a flat price for wiring, including lamps. To stop the practice the Narragansett company threatened to give free renewals.

In closing, Mr. Davenport advocated the running of the central-station appliance department like a John Wanamaker store, with a separate set of books and true merchandising methods entirely divorced from central-station ways of doing things. He commended the work of the Society for Electrical Development and urged the coöperation of the entire trade in this field. Central-station dignity sometimes prevents the maximum success in merchandising. The merchandising methods at Providence have built up a business from $150 twelve years ago to a third of a million in 1918. The profits are more than sufficient to pay the entire expenses of the sales department and declare a further dividend to the company in 1918 of $15,000. The speaker highly praised the Goodwin plan in the course of his remarks.

In the discussion Mr. Davenport said that he saw no tendency toward the abandonment of appliance sales by central stations. He felt that the development of the industry proceeds faster where central stations sell appliances. Mr. Wakeman said that syndicates operating 400 central stations were interviewed recently by representatives of the Society for Electrical Development, and in every case merchandising appliances on a "make-it-pay" basis is the approved policy. Mr. Goodwin said that it would be most disastrous for the central stations to go out of the appliance business at this time. He contended that great opportunities for electrical development lie ahead with business enough for all coöperating interests. A thoroughly practical dishwashing machine is needed for sale by the million, and electric ice making also offers a wonderful opportunity for development. Mr. Goodwin thought that the central station should devote its energies to exploiting the newer devices and less stabilized equipments rather than featuring old-established appliances, while the contractor-dealer on his part should be a creator of business and not a mere sidewalk service station of the curbstone gasoline-pump order. The contractor-dealer can create a demand without cutting prices. Not more than 20 per cent of the buildings and houses of New England are as yet wired. The speaker said it is better for the dealer to be in competition with the central station under a healthy merchandising policy than to be pitted against price cutters of the drug and department store order. The plan of allowing dealers to pool appliances for exhibit and sale in the central-station showroom, with 10 per cent credit to the latter on the turnover, is not generally applicable to energetic sales development. The speaker concurred with Mr. Davenport's plea for a revision of motor agency contracts and urged the value of a "chamber of commerce of the electrical industry," embracing all branches and capable of taking up every problem causing difficulties in public relations, merchandising, engineering and devices development.

Work of Electrical Development Society

Mr. Wakeman said that the Society for Electrical Development has secured free publicity for the industry easily worth $2,000,000 by actual measurement of space in the press on file at its headquarters. The various national campaigns were described briefly, and now a campaign is under way through a coöperative agency to stimulate the brightening up of the country for the boys coming home from war. Welcome signs, floodlighted flags and a standard of lighting in excess of pre-war standards are sought. For years the society has advocated merchandising at a profit.

Mr. Chase urged the establishment of a serious policy of merchandising throughout the industry and emphasized the value of each branch in electrical development. He strongly advocated the abandonment by central stations of the policy of selling appliances below a fair profit and suggested that each branch of the industry prepare its own ideal sales plan with a regard to the joint interests of all, hoping that by such a course a general plan could be worked out of maximum benefit. The speaker emphasized the vital importance of providing many more electric service outlets in wiring installations.

Mr. Goodwin then took the floor and vigorously defended his plan for electrical coöperative development. He said that he was given insufficient time in which to answer certain criticisms at the recent Cleveland convention of the Electrical Supply Jobbers' Association, but he emphatically disclaimed infallibility while he challenged the combined branches of the industry to bring forward a better program. The speaker said that he is working for the good of the entire industry and will not take a partisan viewpoint on behalf of any branch. A proper accounting system is only one phase of the plan.

Officers for Ensuing Year

The following officers were elected: State chairman, A. H. Gove, Norwood; secretary, J. E. Wilson, Boston; state committeeman, A. J. Hixon, Boston; executive committee, Wesley S. Snow of Brockton, Henry W. Jones of Lenox, Frank L. Ham of Worcester, A. O. Alexander of Lawrence and George B. Quimby of Boston.

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SUBSTANTIAL RATE INCREASE AUTHORIZED IN CALIFORNIA

Order of Railroad Commission in Southern California Edison Company Case Points to Estimated Gross Increase of $1,000,000

The Railroad Commission of the State of California handed down a decision on Dec. 21 authorizing the Southern California Edison Company to increase its rates for electric service. Based upon the estimated earnings for 1919, the commission's order will represent an increase in gross revenues in excess of $1,000,000 over what they would have been at the rates prevailing in 1918. In addition, the order also provides for the elimination of free lamp renewals in parts of the company's system where this practice has continued up to the present, and this provision will represent a considerable saving in operating expenses. The increases are in the form of surcharges, which range from 10 to 14 per cent, depending upon the class of service supplied. They became effective after Jan. 2, 1919.

Application was made to the commission by the Southern California Edison Company last July and hearings were held in Los Angeles in August and September. At these hearings practically every municipality affected was represented, as were also several of the company's largest power consumers. No contention was made by any of the interested parties that the company should not be allowed an increase upon the showing made—the only doubt seemed to be as to how little or how much increase the company was justly entitled to. The case was heard and the order and opinion were written by President Edgerton, who said:

I am satisfied from the showing made that applicant, because of the increase in the price of material and labor, is entitled to an increase of revenue and that therefore rates to consumers must be increased, and I am also convinced that we will be acting with entire fairness to applicant as well as to consumers if we fix rates so as to put applicant approximately in as good condition as it was before these abnormal increases in cost. If the rates set out in the attached order result, as expected, in restoring applicant to its pre-war financial condition, it seems reasonable to anticipate that applicant will not be handicapped because of insufficient revenue in financing appropriate extensions and betterments. This will be true unless, as a result of the extraordinary war conditions, a violent change in the relations of available money to investment in public utility property has occurred, and of this we have no evidence.

The Southern California Edison Company was one of the last utilities in the state to apply for relief from the burden of increased operating costs. The company at one time hoped to pull through without asking the commission for assistance, but the conditions were uncontrollable, and increases in rates became necessary. That the commission recognizes the necessity for reimbursing the company for the loss of earnings sustained in its effort to meet the extraordinary conditions of the year just closed is made apparent by the following extract from the commission's opinion in the case:

The year 1918 has practically passed, and the utility has suffered a marked reduction in net return below pre-war conditions which cannot be recouped during the year. Some consideration should be given to this fact in determining what increase should be allowed in the future. It is not fair to speculate as to the future conditions under the present conditions and the demands on the company.

For the purpose of properly distributing the increases allowed, the company's consumers have been segregated into six classifications, and the following surcharges were found to be just and reasonable to apply to the company's electric rates:

For energy sold for lighting service, including domestic, commercial and municipal metered service other than street lighting, per kw.-hr.	1 cent
For energy sold for heating and cooking, per kw.-hr.	5 mills
For energy sold for commercial and industrial power, per kw.-hr.	2 mills
For energy sold for municipal street lighting	10 per cent on monthly bills
For energy sold for electric railway service, per kw.-hr.	1 mill
For energy sold to other corporations, including municipalities buying electric energy for resale, other than Southern Sierras Power Company, San Joaquin Light & Power Company and Mount Whitney Power & Electric Company and city of Los Angeles, per kw.-hr.	1.2 mills

The exceptions made regarding the three power companies and one municipality in the foregoing paragraph are because there exist agreements between these companies, including the city of Los Angeles and the Southern California Edison Company, providing through interconnections of lines for an interchange of service and the utilization of overflow hydroelectric energy along the lines of practical conservation.

The increase in revenue to be obtained by the application of the surcharges provided, based upon 1918 estimates, amounts to $952,416. The heaviest increase in any classification is for energy sold for railway power—this being equal to $275,000 for twelve months.

The Railroad Commission has also authorized certain increases in monthly minimum charges for lighting service. These minimum charges have varied in different localities from 50 cents per month to $1 per month. The commission found that a minimum charge of 75 cents to $1 is reasonable and that consumers paying a minmum of 50 cents for lighting service are being served at a loss. Accordingly all minimum bills for service at less than 75 cents per month are to be increased to 75 cents per month.

All consumers being supplied with service under so-called deviation rates are to be placed upon the regular rate schedules applying to their class of service. The elimination of these deviations will wipe out what the commission terms a serious form of discrimination. The increases allowed on minimum charges for service and the gain on account of the elimination of deviations added to amount represented by the surcharges on rates justify an estimated total gain in revenues for 1919 of between $1,000,000 and $1,100,000.

The commission's order stipulated that the Edison company should file all effective schedules by Jan. 2, 1919. This was to provide for the equalization and standardization of schedules over the entire system, including the territories formerly supplied by the Pacific Light & Power Corporation and the Ventura County Power Company, which territories are now served by the Southern California Edison Company. The Pacific Light & Power Corporation and the Ventura County Power Company were merged with the Edison company in June, 1917, and advantage has been taken of this opportunity to clean up duplication of schedules and unequal rates.

It is confidently expected that the increase in revenues authorized by the Railroad Commission will enable the company to carry out its plans for the completion of certain hydroelectric plants already well under way and to accomplish other extensions and developments.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. & S. E. E., Cleveland Section.—At the next meeting of the Cleveland district section of the Association of Iron and Steel Electrical Engineers, to be held in the Hotel Statler on Jan. 25, the subject will be "'Telautograph' Applications, Including Steel Mills."

A. I. E. E., Midwinter Convention.—The seventh annual midwinter convention of the American Institute of Electrical Engineers will be held in the Engineering Societies Building, New York City, on Feb. 19, 20 and 21. The complete program will be announced later.

Electric Club of Cleveland.—"A Romance of Light and Power," motion pictures dealing with the electrification of steam railroads, and another film showing the Norfolk & Western Railroad's electrified road were the entertainment at the Jan. 9 meeting of the Electrical League of Cleveland.

Electric Club of Chicago.—Lieut.-Col. H. M. Byllesby and Lieut.-Col. Bion J. Arnold spoke at the Jan. 2 meeting held by the Electric Club of Chicago. Harry A. Wheeler, president of the Chamber of Commerce of the United States, addressed the Electric Club at the meeting which was held on Jan. 9.

Annual Dinner of Western Society of Engineers.—On Jan. 22 the Western Society of Engineers of Chicago will celebrate its fiftieth anniversary at an annual dinner. Brigadier-General Taylor, who was in charge of the activities of the construction division, Quartermaster's Corps, in France, will be the speaker of the evening.

Association of Iron and Steel Electrical Engineers.—Following a dinner in the Chatham Hotel, Pittsburgh, Pa., on the evening of Jan. 18 W. Pace and Conrad Hibbeler of the Mercury Manufacturing Company, Chicago, are to present a paper on "Electric Tractors in Iron, Steel and Manufacturing Industries." Discussion is to follow this paper, which is to be illustrated by motion pictures.

A. I. E. E., Madison Section.—Prof. Edward Bennett gave a brief summary of the losses in low-radio antennas and their effect compared with losses in high-radio antennas at the Jan. 10 meeting of the Madison Section of the American Institute of Electrical Engineers. Prof. E. M. Terry discussed this paper and spoke of the present use of low antennas for receiving, and H. M. Crothers gave some calculation results for tuning coils.

A. I. E. E., Ithaca Section.—Dr. Carl Hering addressed a recent meeting of the Ithaca Section of the American Institute of Electrical Engineers on "Departures from the Beaten Track."

New York Jovian League.—Louis D. Gibbs, judge of the Bronx County Court, was the guest of honor at the annual meeting and luncheon of the New York Jovian League on Jan. 7. Judge Gibbs spoke optimistically of America's future, laying particular emphasis on the reconstruction period in business fields. James M. Wakeman of the Society for Electrical Development was reëlected president for the ensuing year, and J. Wynne Jones of the New York Telephone Company was elected secretary.

A. I. E. E., Chicago Section.—The Chicago Section of the American Institute of Electrical Engineers will hold an industrial power meeting on Jan. 27 in conjunction with the American Society of Mechanical Engineers, the Mechanical Section of the Western Society of Engineers and the American Chemical Society. The speaker will be Martin J. Kermer, general manager and chief engineer of the Cannon-Swenson Company, whose subject will be "The American Sugar-Beet Industry."

Engineers' Club of Philadelphia.—The Engineers' Club of Philadelphia announces the following schedule of speakers and subjects for its Tuesday noon lunches: Jan. 21, Lieut.-Col. E. B. Norden, U. S. A., Philadelphia, "The Construction Division of the Army"; Jan. 28, P. H. W. Ross, president of the National Marine League, on "Public Participation in Maritime Development"; Feb. 4, William S. Twining, director Philadelphia Department of City Transit, "Financing City Departments"; Feb. 11, William D. Lewis, principal William Penn High School, "What the War Has Taught Us About the Educational Needs of Democracy"; Feb. 18, Joseph A. Steinmetz, "News from the Peace Zone."

Indiana Engineering Society.—The thirty-ninth annual meeting of the Indiana Engineering Society will be held on Jan. 23, 24 and 25 in the Claypool Hotel, Indianapolis. An interesting program, dealing chiefly with the engineer's part in reconstruction problems, has been arranged. It includes a report by Prof. D. D. Ewing, Purdue University, on "The Year's Progress in Electrical Engineering in the Allied Fields," and papers by J. E. Hannum, efficiency engineer of the Diamond Chain Works, on "Efficiency Engineering in Industrial Plants"; Prof. A. V. Achatz, Purdue University, on "Some Recent Technical Developments in Telephone Systems"; Prof. D. D. Ewing on "Electrical Pumps in Municipal Water Works," and Prof. F. C. Wagner, Rose Polytechnic Institute, United States fuel engineer for Indiana, on "Steam Plants in Indiana in Relation to Fuel Conservation."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Two Rates Ordered.—The Ohio Public Utilities Commission has issued an order declaring the ordinance rate of 6 cents fixed by the Defiance City Council as confiscatory and in its place fixing two other rates. The first is for 12½ cents per kilowatt-hour and covers a period of two years and one-half. The other is 8½ cents for eight and one-half years. The higher rate is charged at present. The commission refused to fix a rate for street lighting, as the ordinance was not definite. The Alliance Gas & Power Company operates in Defiance.

Approval of Pasadena Agreement.—The California Railroad Commission has approved the agreement entered into between the city of Pasadena and the Southern California Edison Company by which the company will lease and sell to the city the utility's electrical distributing system in Pasadena. The object of the agreement is to remove competition and unnecessary duplication of service, and it is expected that by reason of the elimination the city will profit to the extent of $40,000 per annum. This figure was given at the hearing on the application for approval of the agreement filed jointly by the company and the city. The commission takes exception to that part of the agreement governing the fixing of rates, but otherwise finds it favorable. Under the terms of the agreement, the city is to pay the company an 8 per cent return during the life of the lease upon an agreed property valuation of $515,425.97. The city further agrees to accumulate during the terms of the lease a depreciation fund at the rate of 3.36 per cent per annum upon a property valuation of $446,775.34, plus cost of extensions and betterments subsequent to Dec. 1, 1917. The company will lease from the city, under the terms of the agreement, all of its lines outside of its territory, with certain exceptions, paying therefor an 8 per cent rental. A joint operating policy, with a rate of 8.75 mills a kilowatt-hour, is also provided. Referring to the rate section of the agreement, the commission says: "While this may not be a deliberate attempt to limit the jurisdiction of the commission, such will be the effect if the commission approves this agreement. With this eliminated and also that clause by which the company agrees not to sell or furnish electrical energy to any firm or individual outside the city for the purpose of transmission by such firm or corporation to a point within the city, the agreement will be approved."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Brooklyn Edison Company, Inc.—Pursuant to a resolution adopted at a special meeting of the stockholders of the Kings County Electric Light & Power Company held Dec. 18, 1918, the name of the company was changed on Jan. 10 to Brooklyn Edison Company, Inc.

Cities Service Buys Boulder (Col.) Property.—The Cities Service Company has bought from Westinghouse, Church, Kerr & Company the control of the Western Light & Power Company, Boulder, Col. Eventually the property will probably be connected with the Denver Gas & Electric Light Company. The Western company has outstanding $3,000,000 stock and $2,300,000 bonds.

Army Post at Massachusetts Institute of Technology.—A post of the United States Army was established at the Massachusetts Institute of Technology Jan. 6, and it is expected that for at least a year a provost guard of from 500 to 700 infantry will occupy the barracks constructed at the institute for the Students' Army Training Corps. The group of buildings includes a kitchen and mess hall capable of providing for 1000 men, a quartermaster's department and administration building. Occupation is under government lease.

H. I. Harriman Discusses Reconstruction Matters.—Before the Holyoke (Mass.) Chamber of Commerce, on Jan. 6, Henry I. Harriman, president of the Boston Chamber of Commerce and of the New England Power Company, discussed reconstruction issues, favoring a league of nations having common ideals, with the British Empire, France, Italy and the United States and also some of the minor states as a nucleus. The speaker said that the world faces a stupendous problem of reorganization and that it will never be the same socially and industrially as before the war. There is no sacrifice on the part of business too great, the speaker held, to insure that our returning soldiers have good paying positions, and he urged that business men keep their factories running in spite of present conditions, with confidence and courage for the future. He emphasized the importance of river navigation and pointed out the value of a dam in the Connecticut River at Windsor Locks (a projected large power site) as a means of securing water transportation to and from Holyoke. A five-year control of the railroads by government is undesirable, in Mr. Harriman's opinion.

Prices Authorized on Securities.—In a supplemental order issued by the Railroad Commission the Pacific Gas & Electric Company is authorized to sell on or before June 30, 1919, for not less than $87.50 a share in cash, its first preferred stock, the authority to issue which was granted in January, 1916. The company is also given permission to issue on or before June 30, 1919, $1,500,000 of its 6 per cent first preferred stock at not less than $87.50 in cash, or $1,500,000 of its 5 per cent general and refunding mortgage bonds, payable Jan. 1, 1942, at not less than 85 per cent of their face value, plus accrued interest, or such portions of either stock or bonds as the company may elect to issue to aggregate par value of $1,500,000.

Proposed Development of Finland's Water Power.—United States Consul Thornwell Haynes, writing from Helsingfors, says that the utilization of the water power of Imatra Falls, immediately north of Viborg, has been discussed in Finland for many years. Recently the question has been again taken into serious consideration by the government and plans have been drawn for a hydraulic plant, with a fall of about 68 ft., yielding 118,000 hp. The total estimated expense for such an electric installation before the war was $6,000,000; at present the estimate is $18,000,000 to $24,000,000. An additional cost of $4,000,000 is estimated for the control of an even flow of water from Saimaa Lake. This would permit the utilization also of the Vuoksen rapids and would furnish an additional 500,000 hp. The plans, as now discussed by the Finnish authorities, embrace a unification of the electrical hydraulic stations along the Vuoksen Falls, operating in tandem so that the total force would be available at once.

Lectures on the War by Dr. Kennelly.—A course of free public lectures is being given in the Lowell Institute, Boston, on "Engineering in the War," by Dr. A. E. Kennelly, professor of electrical engineering in Harvard University and director of electrical engineering research in the Massachusetts Institute of Technology. The lectures, including those already delivered, are: "War-Construction Engineering, Buildings, Camps, Factories," Jan. 7; "Ship and Marine Engineering—Submarines and Their Detection—Camouflage at Sea," Jan. 10; "Military Roads and Road Vehicles—Autos, Locomotives, Tanks, Etc," Jan. 14; "Aëronautic Engineering—Zeppelins, Dirigibles, Captive Balloons, Airplanes—Aërial Camouflage," Jan. 17; "Airplane Engineering—Liaison, Bombing and Aërial Photography—Anti-Aircraft Engineering," Jan. 21; "Radio-Engineering—Signals and Communication," Jan. 24; "Ordnance Engineering—Guns and Gun Detection, Reglage—Searchlights and Illuminating Engineering," Jan. 28; "Sanitary and Medical Engineering—Water, Ice, Gas and Gas Defense—Protection Against Disease," Jan. 31.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Trespass on Land to Trim Trees.—A license given telephone company to maintain a telephone system upon city streets gives the company no right to enter upon land within the street and commit acts injurious thereto without preme Court of Wisconsin (169 N. W. owner's consent, according to the Su- 308). A telephone company which trimmed the trees on a parkway between the sidewalk and street without owner's consent is liable to owner in a sum equal to three times the actual damages sustained by the owner of the trees in question.

Terminating Street-Lighting Contract.—Where a city council adopted an ordinance terminating a contract for street lighting, pursuant to expressed power given by contract, and thereafter refused to pay bills for lighting, its allegation that the contract is still in force, in suit to compel defendant utility company to perform contract, must be held as ineffectual, since a municipality in matters of this kind can speak only by its records, the Court of Appeals of Kentucky held in City of Winchester versus Kentucky Utilities Company (206 S. W. 296). In a suit brought in order to compel the defendant utility to perform the contract for lighting streets, etc., defendant could, although it pursued the practice prescribed by the code in filing an affidavit as proof where it might have filed an answer, reply upon city's attempted cancellation of contract, the city still having burden of making out its case. Where a city council adopted an ordinance declaring a contract for street lighting, etc., terminated and refused to pay for lighting for the following three months, it was not entitled to mandatory injunction requiring defendant utility to perform contract regardless of whether ordinance was void. A lighting company may be enjoined from discontinuing its services on a failure of the customer to pay a bill which he in good faith and upon reasonable grounds disputes, provided that the customer offers to pay the charges which he considers to be justly due. In suit by city to compel defendant utility to supply light and power for street lighting, etc., it would be no answer to the application of the principle that before one can obtain injunctive relief in such case there must be an offer to pay charges considered to be justly due to say that the company owes the city money for overcharges which are not only disputed but are also of an indefinite and unliquidated nature.

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Arthur Moss, chief engineer of the Hydraulic Service of Quebec and member of the Quebec Streams Commission, has become a member of the Dominion Power Board as a representative of the water-power interests of the Province of Quebec.

Ross B. Mateer, formerly commercial agent of the Southern Sierras Power Company, Riverside, Cal., who was commissioned a captain in the Engineer Reserve Corps but was not called to service overseas, has become associated with the Philadelphia Electric Company.

H. D. Townsend, formerly chief electrical superintendent of the United States Steel Company at Lorain, Ohio, has been appointed electrical superintendent of the Dominion Iron & Steel Company's works at Sydney, N. S., succeeding Mr. Collins, who has gone to the United States.

G. R. Rinke, formerly chief engineer of the West Virginia Traction & Electric Company at Morgantown and Wheeling, has severed his connection with that organization and is now chief engineer of the Utilities Mutual Insurance Company. This company is identified with the public utility interests in the State of New York in connection with their compensation insurance. Mr. Rinke was graduated from Cornell University in 1913, with the degree of mechanical engineer. During the next two years he was engineer for the Claremont (N. H.) Power Company, Claremont Railway & Lighting Company and Colonial Power & Light Company. From August, 1915, to July, 1916, he was associated with the United Electric Light & Water Company at Waterbury as power engineer, and since then he has been connected with the West Virginia Traction & Electric Company.

G. E. Pingree has been appointed vice-president and general manager of the International Western Electric Company, Inc., and vice-president and managing director of the Western Electric Company, Ltd., of Canada, succeeding Gerard Swope, resigned. Mr. Pingree joined the Western Electric Company in 1903, after graduation from Dartmouth College, and his early work was in the clerical and financial department of the Clinton Street office in Chicago, then the executive headquarters of the company. He occupied successively positions in the Cincinnati and Chicago offices, becoming assistant treasurer at New York and general telephone sales manager, with headquarters at New York. In 1908 Mr. Pingree went to China as the company's special representative in the Far East and upon his return was appointed to the position of managing director of the company's London house. This position Mr. Pingree has since occupied. During the past six months he has been in New York, which will be his headquarters after May 1. Mr. Pingree is spending the intervening time on a short trip to England, France, Belgium and Italy.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

A. Edward Newton, president of the Cutter Electrical & Manufacturing Company, Philadelphia, is the author of "The Amenities of Book Collecting and Kindred Affections," just issued by the Atlantic Monthly Press of Boston. This is a handsomely printed volume containing 355 pages and profusely illustrated with portraits of bookmen of former times and to-day and with reproductions of old prints and noteworthy manuscripts and title pages. It bears testimony both to Mr. Newton's success and skill as a collector of literary treasures and to his mastery of a racy English style, full of enthusiasm and human interest. Some of the chapters in the book have previously appeared as essays in the *Atlantic Monthly*, a fact which is sufficient testimony to their excellence and to the entertaining manner in which the author treats his hobby.

Major Carroll H. Shaw, Engineers, U. S. A., who was the officer in charge of the New England district of the power section of the War Industries Board, is now engaged in the preparation of a report on the power requirements and resources of New England as a unit, which is to be submitted to the War Department to furnish a basis for any future conservation that may be required. He was born at Abington, Mass., and was graduated in 1910 in the electrical engineering course from the Massachusetts Institute of Technology. His professional experience began in the engineering department of the National Electric Lamp Association at Cleveland, Ohio, where he was employed for about four years. In this organization he was occupied largely with engineering associated with the commercial phases of industrial illumination and street lighting, with extensive field work in the Middle West and the East. In October, 1914, he was appointed electrical engineer of the Sheboygan (Wis.) Railway & Electric Company, now the Eastern Wisconsin Electric Company. This post also covered operating service as superintendent of light and power, in charge of overhead distribution and station electrical engineering. In April, 1917, he became engineer and soon after manager of the Minnesota Utilities Company, Eveleth, Minn., operating in the Mesaba Iron Range district. Major Shaw in June, 1917, received a commission as captain in the Engineer Reserve Corps, later being ordered to report for instruction at Camp Lee, Petersburg, Va. In February, 1918, he was ordered to Washington and was detailed by the Chief of Engineers to duty with the power section of the War Industries Board, with headquarters at Washington. Since then Major Shaw has traveled more than 25,000 miles in the Central, North Central and New England States in power-conservation service, performing special work in power utilization at Cleveland, Ohio, Harrisburg, York, York Haven and Erie, Pa., and Utica, N. Y. On Aug. 20, 1918, he was ordered to Boston as officer in charge of this work in the New England district. He was commissioned major of engineers in October, 1918.

Obituary

John E. Williams, federal fuel administrator for the State of Illinois from the inception of the federal fuel control to July, 1918, and also widely known as an arbitrator in industrial disputes, died on Jan. 2 at his home in Streator, Ill., at the age of sixty-five years.

Capt. George K. Sabine, radio officer at the Air Service School at Columbia University, died on Jan. 7 at his home in New York City from pneumonia, following influenza, at the age of twenty-nine years. He served through the Mexican campaign, after which he was ordered to Plattsburg for training. Later he was ordered to France to join the Sixth field artillery. He was sent to Columbia University in the month of October last.

Prof. Wallace Clement Sabine of the Harvard Engineering School, widely known as a physicist and formerly dean of the Lawrence Scientific School and of the Harvard Graduate School of Engineering, died at his home in Boston on Jan. 10. Dr. Sabine was born at Richwood, Ohio, in 1868. He was educated at the Ohio State University, being graduated in 1886, and in 1888 he received the degree of M. A. from the graduate department at Harvard University. From 1889 to 1890 he was assistant in physics, from 1890 to 1895 instructor, from 1895 to 1905 assistant professor, and since that date Hollis professor of mathematics and natural philosophy. Of late years he had been acting director of the Jefferson Physical Laboratory. In 1907 he received the honorary degree of D. S. from Brown University and in 1914 the degree of D. S. from Harvard. He succeeded the late Dean N. S. Shaler as dean of the Lawrence Scientific School in 1906. Professor Sabine was an inspiring teacher and able administrator. He was an authority on acoustics. In the early part of the war he was exchange professor at the Sorbonne, in Paris, and had unusual opportunities to become familiar with aircraft problems in England, France and Italy. Upon his return to America some months ago he became engaged in important confidential work of an advisory character for the Bureau of Aircraft Production and was placed in charge of its division of scientific intelligence.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

CURRENT MARKET CONDITIONS ARE SHOWING UP WELL

While Sales Have Fallen Off from War Peak, They Are Not Poor for a January Market Compared with Other Years

Conditions in the electrical field are by no means so bad as some would have people believe. In fact, now that the excitement of the closing down of war activities is virtually over and people are again settling down, men prominent in the sale of electrical goods are becoming a lot more cheerful.

Business, in electrical lines at least, is not bad. In fact, in many places it is rather good for this time of the year. Generally speaking, the months of December, January and February are not particularly active. Sales of building material and socket devices begin to open up as a rule in March. These conditions, therefore, must be taken into consideration when speaking of current business.

To be sure, sales have dropped off from what they were prior to the signing of the armistice. Furthermore, it is probably true that sales would have been much larger had war continued. This, however, was a forced demand and did not represent normal purchases.

With the war over the market again returns to normal purchases and therefore must follow, more or less closely, normal buying customs. Therefore it is reasonable to expect that the current demand for electrical goods will be less than October sales. If the sales, however, were away below those for the same period last year or before the war, there might be some occasion for feeling pessimistic. As a matter of fact, it will probably be found that the January and February sales, particularly those by jobbers. will surpass those for the first two months of 1918 and will be greatly in excess of the sales during pre-war Januarys and Februarys.

Incoming orders to manufacturers are, of course, smaller than they have been, but it is doubtful if they have fallen below what would be good business for this season. Certain it is that the total volume of current sales billed of electrical goods surpassed that of the first two weeks of January, 1914.

Individual incoming orders, it is true, are not large, but this is by comparison with the size of the orders during the war. In the light of normal winter business these orders will probably be seen differently.

Optimism is growing, and along this line are quoted the following paragraphs written by a prominent Northwestern electrical jobber:

"Reports from many sources in the territory we serve show that while new buildings, and in fact most construction, have been curtailed, still business has held up very well. There has been a great deal of necessary repair work. Many of the electrical goods merchants who formerly depended principally on wiring for business have come through the past year in very good condition. Many, owing to their new problems, have learned the value of studying merchandising harder than ever and no doubt will continue to do so from now on. The war has made them resourceful, uncovering new openings for business undreamed of before. Shortage of labor, for one thing, has caused a demand for a great many labor-saving electrical devices, and though with peace conditions will gradually become normal, these appliances will not be laid aside but will continue to be used, and the demand for them will be greater this year than ever before.

"It is easy to see the new opportunities. There certainly is a great deal of wiring work which was left undone in the last year or two which will be done in 1919. It will undoubtedly pay dealers to keep up their stocks of labor-saving electrical devices and push their sale. Each appliance well sold will sell another. We owe credit for this to the many manufacturers who have advertised nationally and who have created the demand. Display such goods, and the sale of them is already partly made. Success depends upon the merchant's familiarity with these appliances. He should be able to explain their use, to repair them and give such service that they will prove themselves to be all that is claimed for them. It is also true that the distribution of fittings, attachments, motors, etc., is as necessary as the wiring of a building. The wise electrical dealer will take advantage of this fact and become the natural outlet for such material."

HOW THE LABOR FACTOR AFFECTS PRICE REVISION

Lines in Which Labor Is a Large Percentage of Cost Are Not Expected to Follow Drop in Raw Materials Directly

The downward trend of prices is receiving considerable attention at the present time. It seems to be pretty generally felt by producers that prices in the immediate future will depend largely on the labor factor. Thus if labor represents a very large percentage of the cost of the finished product, the chances for prices coming down are not good. If, on the other hand, raw materials represent the predominant cost, prices will drop as raw materials drop. Dependent again upon the labor cost will be the extent to which the latter class of commodities follow the raw material downward.

Thus wire has followed copper down. The drop has not been the same percentage as the drop in copper. Rather has the same differential been kept between refined copper and copper wire base. Even here some of the wire producers were reluctant to lower prices.

On materials where labor plays a much larger part in the cost, such as motors, generators, transformers, etc., producers have not lowered prices, nor do they seem inclined to do so at the present time.

SEPTEMBER ELECTRICAL EXPORTS AMOUNT TO $5,146,077

Figures for the First Nine Months of 1918 Totaled $43,756,901, Which Is at the Rate of Almost $60,000,000 for the Entire Year

During the month of September last the exports of electrical merchandise amounted to $5,146,077, compared with $3,942,219 for September, 1917. The volume of insulated wire and cable exported in September last, while up to the general average, was over $200,000 less than in September, 1917. A large part of this, however, can be accounted for by price reductions. A nice volume of motors and transformers was shipped in September.

Exports for the first nine months of last year totaled $43,756,901, which is about $4,000,000 in excess of those shipped during the first nine months of the previous year.

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On the basis of these figures 1918 electrical exports probably ran up almost to $60,000,000.

Figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce:

	September		Nine Months Ended September	
	1917	1918	1917	1918
Batteries	$187,665	$250,037	$2,568,049	$2,318,224
Carbons	96,297	125,956	336,180*	1,135,391
Dynamos or generators	106,784	269,276	,858,005	2,464,929
Fans	52,808	26,396	474,238	707,663
Heating and cooking apparatus	39,927	48,552	85,396*	470,784
Insulated wire and cable	774,326	548,640	5,492,283	4,214,439
Interior wiring supplies, including fixtures	64,713	88,139	929,800	1,091,379
Arc lamps	1,193	4,141	13,415	13,464
Carbon lamps	6,948	6,369	134,364	68,460
Metal-filament lamps	205,793	282,518	2,016,889	2,524,412
Magnetos, spark plugs, etc.	239,724	206,160	712,345*	1,948,805
Meters and measuring instruments	111,906	100,301	812,181	1,462,320
Motors	468,867	589,905	4,599,037	5,489,651
Rheostats and controllers	4,882	12,993	37,845*	167,578
Switches and accessories	166,299	162,049	501,897*	,711,966
Telegraph apparatus, including wireless	17,707	42,289	470,351	239,260
Telephones	106,758	228,961	1,495,245	2,228,807
Transformers	88,660	392,026	1,038,650	2,572,802
All other	1,200,962	1,761,369	16,401,472	12,926,567
Total	$3,942,219	$5,146,077	$39,977,642	$43,756,901

* Covers period beginning with July 1.

METAL MARKET SITUATION

Copper Is Gradually Getting Down to 20 Cents for Immediate Shipment

Some purchasing in small lots, probably to take care of current needs, went on last week. Prices show a tendency to go a little lower. Copper is gradually getting down to 20 cents for immediate shipment. Occasional shadings of this price on resale are reported. Producers are curtailing output, and it has been estimated that only 80 per cent of capacity is now in operation. Efforts are being made to interest European buyers in spot American copper. A committee of prominent American producers leave for Europe within a few days.

Tin prices strengthened slightly last week in London. There is still a wide difference between that market, however, and the price of 72.50 cents for United States government tin.

Other metals virtually show no change. Old metals are still weak with no buying.

NEW YORK METAL MARKET PRICES

	Jan. 7	Jan. 13
Copper:	£ s d	£ s d
London, standard spot	96 0 0	94 0 0
	Cents per Pound	Cents per Pound
Prime Lake	23.00	23.00*
Electrolytic	20.62½	20.50
Casting	19.00	18.75
Wire base	29.75	22.75*
Lead, trust price	6.00	6.00
Antimony	7.75	7.75
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	13.00	13.00
Spelter, spot	7.90	7.65
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.50	16.00 to 16.50
Brass, heavy	9.00 to 9.50	9.00 to 9.50
Brass, light	7.50 to 8.00	7.50 to 8.00
Lead, heavy	4.50 to 4.75	4.50 to 4.75
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

* Nominal

THE WEEK
IN TRADE

A FAIR volume of business for January is being done in supplies. In many sections of the country January sales by jobbers will equal or surpass those of January, 1918. Of course, the volume of business is not large when compared with preceding months, but the January business never is large. Jobbers generally see no reason to be discouraged with current demand.

The feeling of optimism is becoming stronger and no setback is expected. The number of new projects reported is increasing, and as soon as the winter is past a good volume of building is expected.

Current orders are generally smaller in volume than they have been and tend to show the natural hesitancy of buyers at this time. Great caution is being exercised everywhere.

Collections generally are fair. Where government contracts were taken by word of mouth there may be some slowness in settling indebtednss.

NEW YORK

While immediate business is still rather quiet, the trade is very optimistic. Sales are expected to pick up from now on. One prominent jobbing house reports that January sales so far are ahead of those of the first two months of January, 1918, and that the indications are that the first two months of this year will lead the corresponding period of last year. It will be remembered that the first two months of 1918, with the extremely cold weather, snow and heatless Mondays, did not make so large a showing as succeeding months.

Prices remain very steady. Wire is slightly lower and cotton tapes have dropped somewhat.

WIRE.—Further reductions in rubber-covered wire have been made since last week. There are now three manufacturers quoting on 27-cent base, one of them having been on 28-cent last week. Five manufacturers are on 28-cent base, one on 29-cent, one on 30-cent and two on 34-cent. The market is still quiet. The sixty days in the government contract clause, it is understood, will be up some time next week.

LAMPS.—Sales in this territory were larger in 1918 than in 1917. Agents' sales were much larger owing to the new lamp policy of the New York Edison and the United companies. Except for miniature lamps, stocks are in pretty good shape. No appreciable increase in sales of sign lamps has been noticed since the repeal of Fuel Administration restrictions. The new rigid-filament tungsten lamp is selling very well. In fact, production is not yet able to keep pace with sales.

USED APPARATUS.—Just at present the market is rather slow, but a fair volume of business, considering conditions, is being handled. There is a stock of machines on hand and the disposition seems to be to reduce this as rapidly as possible.

CONDUIT.—One of the most prominent producers said this week that there was no reason to believe that iron conduit would be lower immediately.

INSULATING TAPE.—Prices fell off slightly on cotton tapes this week. One jobber reports a drop of from 3 to 5 per cent.

LAMP CORDS.—Following the price of wire, cords are dropping. Already they are off some 10 per cent.

PORCELAIN.— Although there has been a drop in other building porcelain, the electrical line so far as could be learned showed no reduction.

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CHICAGO

Tangible evidence that residential building is being resumed in the Chicago territory came to light this week, when it was announced that a million-dollar apartment building will be erected immediately on the south side in Chicago. In the industrial building field it has been announced that the Conlon Electric Washer Company, which manufactures Western Electric washing machines, will erect a three-hundred-and-fifty-thousand-dollar factory building on the west side in Chicago. The expenditure of $24,000,000 for track elevation and other public improvements in Chicago is still being held in abeyance by the City Council awaiting decision upon a definite plan of action.

Evidence that public utilities will be in the market as buyers is to be found in the announcement that a syndicate is being formed to sell $65,000,000 of American Telephone & Telegraph Company notes and debentures and $40,000,000 of notes of the subsidiary companies. The Cleveland Electric Illuminating Company is also offering an additional $2,500,000 worth of first-mortgage 5 per cent bonds to yield about 5¼.

An interesting sidelight on the war contract business held by many electrical concerns is the formation of an association by 200 manufacturers who have been engaged in war work. This organization was formed in Cleveland for the purpose of bringing about an early settlement of the claims of these contractors against the government.

The general outlook on business has undergone considerable change since the first of the year. Extreme views have passed. Predictions of calamity and of tremendously enhanced prosperity alike have yielded to saner expectations for the future. A middle ground, that of good and satisfactory business to follow a brief period of readjustment, appears to be generally taken at present.

Jobbers report that during the last two weeks business has been quiet and that inquiries have been almost entirely for material to fill immediate needs. During this period sales conferences have been held to determine what channels shall be utilized for the distribution of goods in 1919. To most jobbers it appears that the dealer field and the central-station field will be likely to produce the most volume. The dealers, it is felt, have an opportunity to capitalize upon the favorable electric appliance situation, and it is believed that central stations will open up on construction work. In the meantime there appears to be very little tendency for prices to soften.

COPPER WIRE.—One exception to the general price situation appears to be in the copper trade. Bare copper has been offered at 23, with 19 bid. Rubber-covered wire is being offered in Chicago at from 27 cents to 32 cents per pound. While the copper situation has continued to weaken during the last week, the belief is that it has very nearly reached its level.

CONDUIT.—The expected price reduction has not yet taken effect.

FANS.—The prices of all fans have been advanced by manufacturers in the neighborhood of 20 per cent. Increased prices of labor and of materials bought early for this class of goods is given as the cause for the advance.

STREET-LIGHTING EQUIPMENT.—The electrical department of the city of Chicago has been busy during the past week preparing estimates that may be used in connection with a bond issue to secure money for additional street lighting. This work will be made a part of the program for pushing public improvements in order to give returning soldiers work.

AUTOMOBILE ACCESSORIES.—There has been no tendency toward a reduction in prices in these goods. Jobbers who are making up catalogs and have applied to manufacturers to know what is about to happen have been told to go ahead and make up catalogs on the basis of last year's list prices. This is taken to indicate that the prices will be comparatively steady, although it does not necessarily follow that no change will be made in the discount.

MOTORS.—While motor buyers are apparently waiting for a drop in motor prices, the motor manufacturers state that no price decrease is contemplated and that furthermore, some increases may go into effect. Practically complete stocks are available.

BOSTON

Business is still rather quiet, but inquiries are coming in satisfactorily and a good deal of project work is being done. Engineers are investigating power development and applications for clients who talk of improving their plants this spring. Contractors are handling many odd jobs and are getting their organizations into shape for the expected revival in building. Better relations between all branches of the industry were forecast at last week's convention of electrical contractors at Worcester, and it would seem that most of the old sources of friction between contractors and central stations are gradually being removed.

Labor conditions are steadier with the virtual end of the strike at the Pittsfield works of the General Electric Company. Jobbers are still resting on accumulated stocks, and few shortages of material are now reported. Rumors persist that the prices of some of the smaller appliances are booked for further advance soon. Deliveries are getting better. The Worcester Electric Light Company has voted to issue 4000 shares of additional capital stock at $185 to meet the cost of improvements now under way or recently completed. Central stations continue to report record holiday sales of appliances. Collections are still a bit slow, but there appears nothing to worry about in this department after the way in which the shock and burden of war were met and carried. Optimism is general as to the outlook despite the time required in readjustments.

WASHING MACHINES.—Stocks have more nearly caught up with the demand than for many months. Prices are steady and solicitation is on the increase. One jobber reports double the orders in 1918 which he filled in 1917, but production curtailment hit the local market hard.

VACUUM CLEANERS.—Business is excellent and there is little complaint as to deliveries. Prices are firm and seem likely to stay so.

ELECTRIC SIGNS.—The demand is picking up fast, the last fortnight showing a big increase in orders. While deliveries are still slow on sign lamps, better stocks will soon be available. Material is plentiful, but labor is short. Just before the armistice it was hard to obtain any quotations, but now the outlook is excellent.

WIRE.—All sizes are now plentiful. The demand is light. Prices are rather soft, quotations 7 cents below the recent 32-cent mark being heard of last week. "Watchful waiting" appears to be the policy of buyers.

MOTORS.—Inquiries hold up well, though sales are considerably below recent war levels. Factory stocks are increasing. Immediate shipments on sizes up to and including 50 hp. are generally to be had. Stocks are a bit spotty above this rating. Jobbers are not buying many motors at present. A vigorous attack on the present form of motor-agency contract by E. R. Davenport, sales manager of the Naragansett Electric Lighting Company, Providence, R. I., was a feature of last week's electrical contractors' convention at Worcester. Motor prices are firm, and the entrance of boxes of used motors into the market from war plants does not appear to have much effect on schedules. Many inquiries are being received in connection with future power development engineering.

ELECTRICAL RADIATORS.—Deliveries are improving and jobbers' stocks are in better shape. Some cutting in prices by retailers is in progress. These outfits are fast getting into the staple class.

SCHEDULE MATERIAL.—The demand is light and stocks are large. The factories are disposed to take things easily and are very hard pressed at present.

CONTROLLING APPARATUS.—Orders favor the smaller equipments. Deliveries are better and prices are firm.

CONDUIT.—Stocks are gradually increasing, without much change in price. The demand is off.

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ATLANTA

The total volume of business shows an apparent slump as compared with last week. Stocks, however, are being kept up and the assortments fairly well maintained, more particularly in staples and necessities than in luxuries, odds and ends and slow-selling articles. The feeling is general that goods will be more plentiful and easier to get in the coming months than they have been for some time. This naturally leads to declines in prices, some of which are already in evidence. Nothing so far has developed in the way of a tendency to force sales at the expense of prices, as there seems to be a realization that such a course will merely precipitate trouble and defeat its own purpose. Manufacturing continues very good throughout the Southeast. Although this section will be affected less than any other during the reconstruction period, owing to the fact that industrial life is not so highly organized as in other sections, the cancellation of government work and contracts will be keenly felt. Building and construction are comparatively still this week, but there is a general hope for an early opening up of activity. Probably the most significant facts that have developed are the universal optimistic attitude toward the future and the constant and steady endeavor to sustain and enlarge the demand for all classes of material. There is great activity in the Kentucky coal fields.

POLES.—Business seems to be increasing and the call is more insistent than for the same period in December. Prices are steady and shipments excellent.

HARDWARE.—The demand appears to be holding up well. Deliveries are improving and prices are unchanged.

CROSS-ARMS.—The volume of sales remains about the same on arms and pins. Orders for small lots are increasing, while on the other hand carload lots show a decided decrease. Prices are steady.

INSULATORS.—Although there was considerable activity during December, business this week is comparatively slow.

ELECTRIC RANGES.—Dealers report that the range sales have slowed down during the past six weeks. This is accounted for by the fact that central-station interest is lacking at this period of the year. Factory facilities have reached the point where shipments can be made promptly.

WIRE.—In the face of a weakening in price the demand for both rubber-covered and weatherproof continues active. While there was a shortage in a few sizes in December, there is no difficulty now in securing any reasonable requirements. The call for heavy cable is away off and very little business is being transacted. This condition is thought to be only temporary, however.

SEATTLE—PORTLAND

From present indications business transacted by electrical jobbers and dealers in Seattle during January will be as good and in as large a volume as last year. Buying to date this month has been comparatively brisk when certain factors such as closing down of lumber mills and camps are taken into consideration. Deliveries are being made in steady volume, and shipyard and industrial orders are coming through well. During the week the second drop in copper and rubber-covered wire was noted. Rural business since the signing of the armistice has been gradually dropping off. It is expected that when out-of-town buyers are convinced that prices will not drop back to pre-war standards new construction long pending will proceed. At present sales made are for maintenance work strictly, and every one seems waiting for a decrease in prices, which the jobbers as a whole believe will not materialize for a long time. Portland territory reports conditions about the same. Electrical contractors are having little to do, contrary to expectations. The utilities have lost an appreciable power load owing to the closing down of the lumber mills and the wooden shipbuilding plants.

MOTORS.—Demand for smaller sizes is keeping up well. Orders for larger sizes show a slight decrease.

LAMPS.—All sizes, particularly 100, 150 and 200-watt size for industrial purposes, are moving finely. Residential demand, particularly for new construction, during the past two weeks showed a material decrease. Demand from all sources is expected to decrease rapidly with the coming of longer and lighter days.

COLLECTIONS.—Since cessation of hostilities collections have not been nearly so brisk. This condition was noticeable to a greater extent during the past month. Collections from wooden shipbuilding concerns especially are slow. This is said to be due to the government's attitude on payment for wooden ship contracts. The government's attitude regarding private interests accepting foreign contracts is also hindering proposed constructional activities in both wooden and steel yards. Collections from steel shipyards are satisfactory and industrial collections are as good as ever. New credits are few, and not many will be placed until the country generally has settled back more or less to normal. Rural collections are satisfactory, although recently they have shown perceptible slowing up. Rural credits are negligible.

SAN FRANCISCO

Although architects are again busy and daily construction notes record many new projects, orders are still rather small and reflect the tendency toward an attitude of watchful waiting. Electrical contractors report that they have signed up on a number of jobs. A great deal of new construction work was announced during the past week, and although there were no exceptionally large jobs included, the number of new clubhouses, large dwellings, auditoriums and hotels is significant. San Francisco building permits for December, 1918, total 222, amounting to $467,000. Los Angeles permits for the same period total 527, amounting to $603,000. New canneries and packing plants at Turlock, Chino and San Diego are reported, and the importance of cereal crops for the coming year is forecast by the establishment of a new tractor plant in Fresno.

TOOLS.—The government is requisitioning a number of small electrical tools, such as pliers, clamps and the like, and it has disclosed the fact that the Pacific Coast is very short on this material owing to the inability of Eastern factories to make delivery.

WIRE.—The situation is a little better on inside and outside telephone wire, with the exception of No. 17, which is scarce in the copper-steel style.

INSULATING MATERIAL.—Some styles of insulating varnishes have increased in price 10 per cent, but in general the line remains steady with a big demand and fairly good local stocks. It is a question whether this business will run as well as it did last year, when the extreme dearth of motors made it imperative to patch up every available style.

CONDUIT.—The cost of flexible non-metallic conduit has been decreased about 20 per cent, and it is again being sold in less than coil quantities in small sizes. Rigid-iron conduit has decreased 10 per cent in all sizes. The conduit situation is better, a number of outstanding orders have been completed and jobbers' stocks have improved.

PORCELAIN MATERIAL.—Five-sixteenths-inch tubes and No. 5½ knobs have decreased about 10 per cent, the rest of the line remaining firm. The demand has fallen off considerably since many municipalities were compelled to resort to knobs and tubes in special cases, on account of the former conduit shortage.

ELECTRIC RANGES.—There is practically no electric range business at this time, principally on account of the lack of any special solicitation. This again is affected by several factors, of which the principal is the inability of the central stations to handle or create a range load at this time. Several factories have announced educational campaigns and missionary work which will no doubt result during the latter part of the year in increased activity.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20% List
Coil to 1000 ft	
No. 12 Solid	
Less than coil	+20% List
Coil to 1000 ft	

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+30% to +20% List
Coil to 1000 ft	

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20% List
1/5 to std. pkg	
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.44 to $0.45	$0.44 to $0.45
12 to 50	.38 to .39	.38 to .39
50 to barrel	.35 to .362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
½-in. single trip.	$75.00	$63.75— 69.75
¾-in. double strip	75.00— 82.50	72.00— 75.00
¾-in. single strip	100.00	85.00— 93.00
¾-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.25 to $63.75
¾-in. double strip	78.25 to $78.75	71.25
¾-in. single strip	100.00	75.00 to 85.00
¾-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¾	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
¾	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00–50.70	$24.60–35.20	$23.00–30.25
¾-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.	$60.00	$30.00	$26.00
¾-in.—	65.00	32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40.

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb	7% to 7.1%	9% to 9.1%
2500 to 5000 lb	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb	+5.5% to +3.5%	+3.5% to +1.5%
2500 to 5000 lb	+2.5% to +0.5%	+5% to +1.5%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$7.00 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List, each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted:		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

otton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.66— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$38.00
Coil to 1000 ft	28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$30.00 to $3[illegible].00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%	10%
$10.00 to $50.00 list	30%	20%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	20.00– 21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$32.00
1/5 to std. pkg.	13.60	27.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5 to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.44– $0.66
No. 18, full spools	.42– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.72
No. 18, full spools	.435 to .605

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00–$25.00	$12.50–$17.00	$12.50–$15.00
12	23.40– 27.09	21.06– 23.22	17.55– 23.22
10	32.14– 32.40	28.92– 32.40	23.14– 27.45
8	40.32– 45.72	36.96– 45.72	32.26– 38.10
6	58.52– 72.36	53.20– 60.30	51.07– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$24.00–$25.00	$17.50–$18.00	$15.00–$15.50
12	30.48– 31.44	30.48– 31.44	26.67– 31.44
10	42.32– 43.84	42.32– 43.84	37.03– 38.36
8	59.36– 61.76	59.36– 61.76	51.94– 54.04
6	97.68–101.28	85.47– 88.62	85.47– 88.62

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$34.75
25 to 50 lb	34.75
50 to 100 lb	33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$35.76 to $39.75
25 to 50 lb	34.76 to 38.75
50 to 100 lb	33.76 to 37.75

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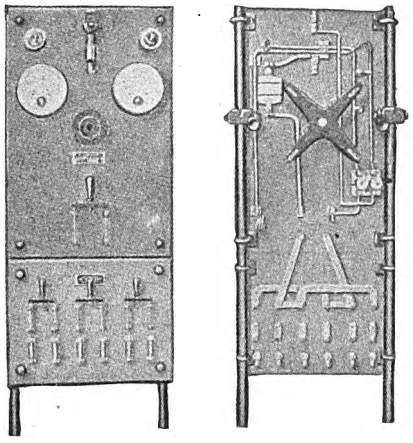
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Switchboards for Small Installations

Switchboards suitable for small installations such as the control of a direct-current generator and three lighting circuits are being made by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and are called the "ready-to-wear" kind. One feature of these switchboards is that they can be placed in operation by simply connecting the leads from the generator and feeder circuits to the terminals for that purpose. Contrast with this simplicity,

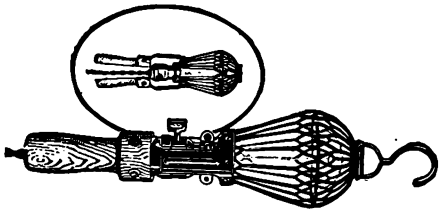


FRONT AND BACK VIEWS OF SWITCHBOARD

says the manufacturer, the complexity of purchasing meters, switches, circuit breakers, framework and so forth and the work of designing and assembling these separate devices into the complete panel on the job. Detail work, time, expense for tools and the possibility of faulty assembly and operation are obviated by using these panels, which are suitable for 125-volt and 250-volt installations up to 600-amp. rating and permit a choice in the number and capacity of feeder circuits.

Split Handles for Portable Lamp Guards

What is said to be a new departure in portable lamp-guard handles has been placed on the market by the Flexible Steel Lacing Company of Chicago for attachment to the "Flexco" expanded-steel lamp guards manufactured by this company. The new handle as well as these lamp guards opens in halves from a hinge at the bottom of the guard, thus permitting the quick insertion of the lamp. After this has been done the halves of the handle and guard are closed and locked, the cord running through grooves in the handle, which is made of wood. A distinct

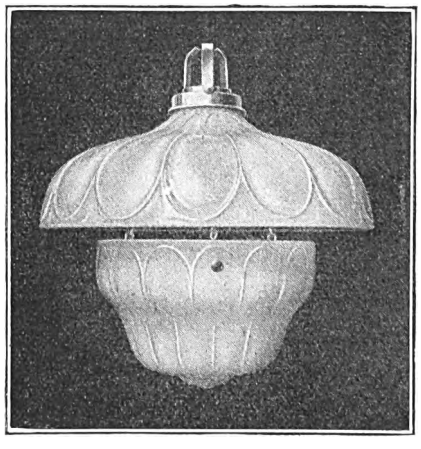


QUICKLY SNAPS OVER LAMP BULB AND CORD

advantage of this portable lamp extension is claimed, since most handle lamp guards must be "wired up" while the new handle and lamp guard snap right over the bulb and cord, making a safe light for use in garages, factories, warehouses and other places where dark corners and fire danger exist.

Semi-Indirect Lighting Unit with Safety Holder

A new design of semi-indirect lighting unit for hanging on a drop cord or chain has been placed on the market by the American Fixture Dealers' Syndicate of 235 Fifth Avenue, New York City, and features a double-grip safety holder. It consists of a lower bowl and an upper reflector, both being of a

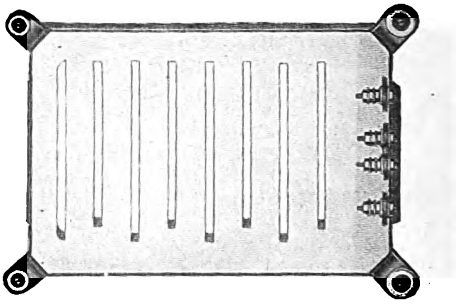


SUPPORTED FROM SOCKET AT TWO POINTS

pearly white glass, and has a holder which supports the fixture from the socket at two points. Three screws not only grip the lamp socket in the same manner as an ordinary 2¼-in. shade holder supports a shade, but there are also three straps extending up from the inner collar and these screws. The straps clamp over the top of the socket, making it impossible for the unit to become loose and drop. Because of a safety ring in the holder it is also said that the glassware will not fall even though broken. The new unit measures 11 in. by 7½ in. (28 cm. by 19 cm.).

Heaters for Crane Cabs or Similar Service

A heater for use in crane cabs, street cars and similar places is being marketed by the Simplex Electric Heating Company of Cambridge, Mass. It consists of a protective iron casing, within which a coil spring heater is mount-



GRID-TYPE UNIT CAN BE ARRANGED FOR THREE-HEAT CONTROL

ed, and a reflector arrangement for keeping the heat out of the walls upon which the unit is mounted. A maximum of 1000 watts may be obtained from these units, which are of the one-heat type.

Where a more inexpensive construction is desired the grid-type heating units also made by this company may be used. They are of enamel cast iron, have a maximum voltage of 1200, may be arranged for three-heat control and may be mounted almost anywhere.

Decorated Lighting Fixture

A decorated-type lighting fixture has been added by the Luminous Unit Company of St. Louis to its line of "Brascolites." The new style uses one of the regular commercial types of these units as the basis of its construction, but it has a silk shade and is suspended from the ceiling by a silk rope, forming a highly decorative and efficient fixture for residence, tea room, candy shop and other artistic application. It is pointed out that the silk shade is not only decorative but also eliminates ceiling shadows by reflecting the light from the white interior.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

La Sociedad Espanola de Lampasas Electricas "Z," Barcelona, Spain, lamp manufacturer, wishes information regarding the most up-to-date American machinery for manufacturing incandescent lamps, with a view to purchasing such apparatus.

An engineer in France (No. 27,984) wishes an agency for the sale of all kinds of electrical equipment and supplies. Cash will be paid and correspondence may be in English.

New District Managers for the Roller-Smith Company

The Roller-Smith Company, manufacturer of electrical instruments and circuit breakers, New York City, announces the opening of a Detroit office in the New Telegraph Building in charge of C. H. Nicholson, formerly connected with the Chicago office of the company, who has just returned from service with the Signal Corps. Mr. Nicholson is a graduate of the University of Wisconsin and has been with the Roller-Smith Company since his graduation with the exception of a short period when he was with the General Roofing Company of St. Louis. The activities of the Roller-Smith Company's Detroit office cover the entire State of Michigan, and Mr. Nicholson will give special attention to the automobile instrument business in that territory.

The company also announces the appointment of James E. Wood as manager of its Cleveland office at 711 Williamson Building, succeeding C. S. Ripley. After leaving the Hawley Electrical School of Boston Mr. Wood spent two years in the electrical contracting business in the East, giving up this line to enter the employ of the Screw Machine Products Corporation of Providence. Here he was first engaged in automatic telephone development work and later was associated with the Chicago office of the same concern. He then left to enter the engineering department of the Western Electric Company at Chicago, remaining in Chicago until the latter part of 1918, at which time he left to engage in government radio work. The Cleveland office covers the State of Ohio and part of the State of Kentucky.

THE CROCKER-WHEELER COMPANY on Jan. 8 declared regular dividends of 1¾ per cent on the preferred and 2 per cent on the common stock for the quarter ended Dec. 31, 1918.

FANS TO BE TAXED 5 PER CENT UNDER NEW WAR REVENUE BILL.—The Senate and House conferees on the war revenue bill have agreed on the following taxes on electrical goods, based upon sale prices: Portable electric fans, 5 per cent. On portable lighting fixtures, including lamps of all kinds and lamp shades in excess of $25 each, the Senate semi-luxury taxes were adopted.

SHIPMENTS TO FRANCE AND ITALY.—Supplementing W. T. B. R. 412, issued Dec. 13, 1918, and W. T. B. R. 453, issued Dec. 21, 1918, the War Trade Board announces that individual applications for export licenses for France will no longer be referred to the French High Commission and that individual applications for export licenses for Italy will no longer be referred to the Italian High Commission.

PRESENTATION TO GEORGE E. CULLINAN.—On the evening of Jan. 4 about sixty of his St. Louis friends tendered George E. Cullinan a farewell banquet at the St. Louis Club. This was on the occasion of his leaving to take up the management of the Chicago office of the Western Electric Company. The affair was arranged by C. E. Michel, W. A. Layman and W. N. Matthews. H. J. Pettengill, president of the Southwestern Bell Telephone System, officiated as toastmaster. Among the speakers was Mayor Kiel of St. Louis. On behalf of those present Col. Isaac Hedges, manager of the Cupples station, presented Mr. Cullinan with a complete silver coffee service. E. H. Waddington, acting for the Western Electric Company employees in St. Louis, presented their old "chief" with a book containing his photograph followed by personal messages written by each employee.

"MOVIES" FOR WESTERN ELECTRIC EMPLOYEES.—Last week the Western Electric Company entertained 700 of its Philadelphia employees and guests at Horticultural Hall at motion pictures showing many of the activities of the company. Next Monday and Tuesday the company will entertain its New York forces in a similar manner at the Lexington Theater, which has been rented for the purpose. All of the company's films that have been officially released are being shown. Later these films will be shown at high schools and colleges as a part of the company's program for recruiting employees. The company is watching with considerable interest this plan of educating its employees by motion pictures in its manufacturing activities. By picture trips are taken through the factory, equipment is put together, and the value of the company's products to the user is portrayed. At these entertainments the best orchestral music is provided.

Trade Publications

CONCRETE POSTS.—"Star" concrete posts are the subject of a sixty-eight page booklet issued by the Chicago Concrete Post Company, 608 South Dearborn Street, Chicago.

THERAPEUTIC LAMP.—The Magic Pair Relieving Lamp Company, 546 Garfield Avenue, Chicago, has issued a thirty-two page booklet about its lamp for therapeutic use.

VARIABLE-SPEED MOTORS.—Its line of "Kazoo" variable-speed motors is the subject of a folder being distributed by the R. P. Warner Electric Company of Kalamazoo, Mich.

POWER AND LIGHT SYSTEMS.—The Swartz Electric Company, Indianapolis, Ind., has issued a new booklet about the electric light and power systems marketed by this concern.

DECORATIVE LIGHTING UNIT.—A leaflet illustrating the new decorated "Brascolite" fixture made by the Luminous Unit Company of St. Louis has been issued by that company.

TRANSFORMERS.—The different styles of transformers sold by the Betts & Betts Corporation, 510 West Forty-second Street, New York City, are taken up in its transformer bulletin No. 126.

LIGHTING UNIT.—A folder for dealers' use has been prepared by the Beardslee Chandelier Company, 216 South Jefferson Street, Chicago, about its "Denzar" fixture for lighting stores, offices and factories.

EQUIPMENT FOR DENTISTS AND DOCTORS.—Electric devices for use by physicians and dental practitioners are the subject of a general catalog No. 4 issued by H. G. Fischer & Company, 2341 Wabansia Avenue, Chicago.

LIGHTING FIXTURE.—The "Ny-El-Co Star," which is a semi-indirect lighting unit having a new safety holder, is shown in a leaflet being distributed by the American Fixture Dealers' Syndicate of 253 Fifth Avenue, New York City.

HEAVY-DUTY RANGES.—In a two-page bulletin No. 10 the Simplex Electric Heating Company of Cambridge, Mass., describes the construction, operation and application of its heavy-duty sectional electric ranges for users in hotels, hospitals, on shipboard and in other places doing quantity cooking.

AUTOMOBILE AND INCLOSED FUSES.—Various types of the "Service Brand" inclosed and automobile fuses are listed in an illustrated booklet prepared by the Elliott Electric Company, Shreveport, La., in which are tables of the proper size fuse for the different makes of electric and gasoline cars

LEATHER BELTING.—"Ladew Leathering Belting" is the title of a new 100-page catalog just issued by the Edward R. Ladew Company, Inc., Glen Cove, N. Y. In addition to describing this company's products and how they are made, a number of pages are devoted to information of interest to belt users. A discussion of belt enginering and belting economics is also contained in this interesting catalog, which is well printed and illustrated.

CLAMSHELL BUCKETS.—The Blaw-Knox Company, Pittsburgh, Pa., has issued a third and revised edition of its booklet describing the Blaw single-line clamshell buckets. The new publication is twenty pages in length, is illustrated and will be sent to those interested upon request.

POWER-PLANT INSTRUMENTS.—"Foxboro Power Plant Instruments," bulletin No. 115 of the Foxboro Company, Foxboro, Mass., contains condensed descriptions of the company's instruments and is intended for those not having time to look through the larger and more complete catalogs issued by the company.

PORTABLE GRINDERS.—The Saphil Manufacturing Corporation, 147 West Austin Avenue, Chicago, has issued an envelope stuffer which describes, illustrates and points out applications for its "Saphil" portable electric tool cutter and surface grinder. This can be attached to any lathe, shaper or milling machine and is also serviceable as a portable tool.

SWITCHES AND WIRING MATERIAL.—Catalog P has just been issued by the Hart & Hegeman Manufacturing Company of Hartford, Conn., having for its subject "Hart & Hegeman" switches and accessories and "Paiste" wiring material. In this 183-page book the many items in these two comprehensive lines of electrical supplies are shown and described, prices and carton weights being likewise given.

SWITCHES, LIGHTNING ARRESTERS AND SUBSTATIONS.—In a mailing folder being distributed by the Railway and Industrial Engineering Company of Pittsburgh, Pa., illustrations and general descriptions of the Burke horn-gap switch, the Burke vertical-break switch and the Burke horn-gap lightning arresters are given, together with pictures of outdoor transformer substation installations made by this company.

New Incorporations

THE UNIVERSAL ELECTRIC COMPANY of Spokane, Wash., has been incorporated with a capital stock of $10,000 by C. F. Uhden, G. W. Crowder and A. E. Russell.

THE ADVANCE ELECTRIC COMPANY of St. Louis, Mo., has been incorporated by A. L. Canavan, Edward Bretch and D. J. Keefe. The company is capitalized at $50,000 and proposes to manufacture electrical apparatus.

THE WILKERSON ELECTRIC & MACHINE COMPANY of Youngstown, Ohio, has been incorporated with a capital stock of $5,000 by Richard W. Wilkerson, Anthony C. Montani, Roscoe A. Montani and Carmel Wilkerson.

THE FULLER ELECTRIC COACH COMPANY of New York, N. Y., has been chartered by W. A. Walling, C. L. Thompson and E. L. Dolder, 315 East Seventeenth Street, New York City. The company is capitalized at $10,000 and proposes to deal in stocks and bonds, cars, autos and farm machinery.

THE STERLING FIXTURE COMPANY of Milwaukee, Wis., has been incorporated with a capital stock of $25,000 to manufacture electric lighting and power fixtures and to do a general electrical contracting and engineering business. The promoters are represented by Henry H. Otjen of Otjen & Otjen, attorneys, 97 Wisconsin Street, Milwaukee, Wis.

THE RAWSON ELECTRICAL INSTRUMENT COMPANY of Cambridge, Mass., has been chartered with a capital stock of $50,000 by Homer E. Rawson of Cambridge, Ralph C. Watrous of Providence, R. I.; Melville Eastham of Cambridge and Ernol H. Locke of Lexington, Mass. The company proposes to manufacture high-grade electrical instruments and supplies.

THE DALYTE ELECTRIC COMPANY, Ltd., of Guelph, Ont., has been incorporated by Leo. W. Goetz, John Sunderland, Jr., Helen McTague and others. The company is capitalized at $1,000,000 and proposes to take over the business of the Dalyte Lamp Company and the Flexible Conduit Company, and will manufacture conduits, cables, tungsten lamps, electrical equipment, etc.

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New England States

BELLOWS FALLS, VT.—Plans are under consideration by the Bellows Falls Power Company for the construction of a hydroelectric power plant at Rockingham, N. H.

BRATTLEBORO, VT.—Plans are being prepared by the Twin State Gas & Electric Company for a water-power development on the Passumpsic River at St. Johnsbury, Vt. H. L. Olds is vice-president.

BURLINGTON, VT.—The Board of Aldermen has adopted a resolution favoring the signing of a contract with the Public Electric Company of St. Albans for furnishing energy to operate the municipal lighting system for a period of ten years. If the contract is approved by Mayor Jackson steps will be taken at once by the company for the installation of additional equipment at its plant in St. Albans and the erection of a transmission line to Burlington. The service is to be ready within six months after permission is granted by the Public Service Commission.

WESTFIELD, MASS.—A new switchboard is being installed in the power house of the municipal electric light system. Energy supplied by the Turners Falls Power Company will be received through the new board.

HARTFORD, CONN.—Rights-of-way are being secured by the Hartford Electric Light Company for extension of its lines for power service in the southern part of the town of East Hartford.

HARTFORD, CONN.—Plans are being prepared by J. O. Rogers, architect, 470 Fourth Avenue, New York City, for the erection of a building for the Connecticut General Life Insurance Company on Elm Street, to cost about $500,000.

NEW LONDON, CONN.—Notice has been filed that the Connecticut Light & Power Company has petitioned the incoming Legislature for extensive grants of authority to its charter. The petition asks for permission to divert surplus water from the Housatonic River to increase its generating capacity, the privilege of damming the Housatonic River at Southville near New Milford, and the diversion of water of the Housatonic River and the Ten Mile River near Bull's Bridge.

Middle Atlantic States

BALDWINSVILLE, N. Y.—The capital stock of the Seneca River Power Company is reported to have been increased by $50,000, the proceeds to provide for extensions and improvements to its plant.

BINGHAMTON, N. Y.—The purchase of rock-bottom dam and power site and construction of municipal lighting plant, to cost about $100,000, is under consideration by the City Council.

LIMA, N. Y.—The plant of the Locke Insulator Manufacturing Company was destroyed by fire on Jan. 8, causing a loss of about $125,000.

LITTLE FALLS, N. Y.—Improvements and alterations are contemplated to the power house, heating and ventilating systems at the plant of the H. P. Snyder Manufacturing Company, to cost about $10,000.

LONG ISLAND CITY, N. Y.—Preliminary plans are being prepared by the Watson Engineering Company, Hippodrome Building, Cleveland, Ohio, for the erection of a 200-ft. by 600-ft., 1½-story factory building at Thompson, Nott, Mount and School Streets, Long Island City, for the White Company, Park Avenue and Fifty-seventh Street, New York City. The cost is estimated at $500,000.

NEW YORK, N. Y.—Plans have been prepared for the construction of a new boiler plant in connection with another building at the Bronx Hospital, Fulton Avenue and 169th Street, to cost about $30,000.

NEW YORK, N. Y.—The contract for electrical work in connection with the construction of the new shop building of the Welin Marine Equipment Company, Long Island City, has been awarded to Louis Mantel, 788 Amsterdam Avenue, New York City.

NEW YORK, N. Y.—Plans are being prepared by the New York Telephone Company, 15 Dey Street, for the erection of a new telephone exchange building at 227-43 East Thirtieth Street. The building will be about 75 ft. by 100 ft., five stories, and will cost about $500,000. McKenzie, Voorhees & Gmelin, 1123 Broadway, New York City, are architects.

PHOENIX, N. Y.—The Sweet Paper Company is planning to rebuild its machine shop, recently destroyed by fire. The cost is estimated between $75,000 and $85,000.

SYRACUSE, N. Y.—Plans are under consideration by the city officials for the installation of a new electric lighting system in the Hiawatha Lake section of Onondaga Park.

BOONTON, N. J.—Plans are under consideration by the Board of Aldermen for the installation of a new fire-alarm system throughout the borough.

JERSEY CITY, N. J.—Plans, it is reported, are being prepared by the Continental Can Company of Syracuse, N. Y., for its proposed plant to be erected in the vicinity of Fifteenth Street, Jersey City, to cost about $200,000.

KENVIL, N. J.—Plans are under consideration by the Roxbury Township Committee for the installation of a new electric street-lighting system from the main entrance of the Hercules Powder Works to Jardin's Corner, a distance of about a quarter of a mile.

PATTON, PA.—The Northern Cambria Railway Company has placed a contract with the General Electric Company of Schenectady, N. Y., for one 300-kw. motor-generator set. Energy will be purchased from the Pennsylvania Central Light, Heat & Power Company.

PHILADELPHIA, PA.—A large quantity of electrical equipment will be required in connection with the erection of the factory addition, 52 ft. by 108 ft., at the plant of William Sellers & Company, at Sixteenth and Hamilton Streets.

PHILADELPHIA, PA.—Arrangements have been completed by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the installation of new boiler equipment at the Naval Home, Grays Ferry Road. Four new units will be installed.

PITTSBURGH, PA.—The contract for the installation of a complete lighting system in the new commissary building for the Bureau of Mines, Department of the Interior, at the Experimental Mine, Experiment, has been awarded to the Babbitt Electric Company, 631 Penn Avenue, Pittsburgh, Pa. C. E. Babbitt is manager.

READING, PA.—Final contracts for the erection of its proposed power plant to be located at River Road and Exeter Street have been awarded by the Carpenter Steel Company. The cost is estimated at $110,000. The Beard Construction Company, 658 Penn Street, Reading, is in charge of construction work.

BALTIMORE, MD.—The construction of an electrically operated pumping plant at Dickeysville, to cost about $15,000, is reported to be under consideration by the Baltimore County Water & Electric Company.

BALTIMORE, MD.—Plans are being prepared for doubling the capacity of the Evergreen Junior United States General Hospital No. 7. Five new buildings are to be erected at cost of about $500,000.

BALTIMORE, MD.—Plans have been filed in Baltimore County by the United Railways & Electric Company for its proposed double-track extension to the yards of the Bethlehem Shipbuilding Corporation at Sparrows Point. The cost is estimated at $145,472.

WESTMINSTER, MD.—The J. F. Roystone Engineering Company of Westminster has been engaged by the B. F. Shriver Company to prepare plans for the erection of power houses in New Windsor and Westminster.

HAMPTON, VA.—The Newport News & Hampton Railway, Gas & Electric Company contemplates the purchase of 2900 ft. of 500,000-circ. mil feeder cable, 5400 ft. of 300,000-circ. mil feeder cable and 32,000 ft. of 4/0 feeder cable during 1919.

NORFOLK, VA.—Contract, it is reported, has been awarded by the Norfolk-Hampton Roads Dry Dock & Ship Repair Corporation to James Stewart & Company, 30 Church Street, New York, for construction of its proposed plant, to cost about $7,000,000. J. B. Morgan is president.

RICHMOND, VA.—Contract for lighting the plaza of the new Broad Street railway station has been signed by the Administrative Board.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

DETROIT, MICH.—Options have been secured on nearly all the power dam locations on Rouge River from Dearborn to Northville by the Henry Ford interests. Northville is at the headwaters of the Rouge's west tributary, and there are three power dams, one at the mouth, one at Newburg and one at Nankin. Utilization of the power of nine or ten dams, it is understood, is contemplated. The erection of a series of small factories at these power stations is reported to be under consideration.

HOWELL, MICH.—The city of Howell has decided to sell its municipal electric lighting plant to the Edison Illuminating Company for $50,000. The purchasing company, it is understood, contemplates improvements to the system, involving an expenditure of about $100,000.

KALKASKA, MICH. — The Kalkaska Light & Power Company is reported to be contemplating the installation of additional equipment at its plant in Rugg. G. W. Goddard is superintendent.

ASHTABULA, OHIO.—Plans are under consideration to practically double the output of the municipal electric light plant. The proposed improvements include the installation of an additional 1000-hp. boiler and other equipment. No extensions to the power house will be necessary.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Jan. 23 for rubber-insulated flame-proof cable and also for hard-drawn copper busbar. Specifications may be obtained on application to the office of the division of light and heat, Room 204, City Hall.

VINCENNES, IND.—Contracts have been awarded by the Indiana Power & Water Company for improvements to its plant and system, to cost about $150,000. The work will include the erection of three 33,000-volt transmission lines across the Wabash River, spanning the river from one of the main streets in Vincennes, to supply the Illinois oil fields with electricity for lamps and motors. Energy will be sold to the Central Illinois Public Service Company, which is to supply territory near Lawrenceville, Bridgeport and Story, and also to residents along the proposed line.

CHICAGO, ILL.—Preparations are being made by the Wisconsin Steel Company, 606 Michigan Avenue, for the construction of a by-products plant, to cost more than $2,000,000. The plans provide for an eighty-eight-oven coke plant, one 500,000-gal. and two 1,000 000-gal. storage tanks, and five small buildings. Contract for foundations has been awarded.

PEORIA, ILL.—The plant of the American Milling Company was badly damaged by fire, on Jan. 1, causing a loss of about $600,000. The mill, dairy barns, power plant and an addition recently erected to the plant were destroyed.

SPRINGFIELD, ILL.—The installation of an ornamental lighting system in the downtown district is under consideration by the Board of Local Improvements.

ASHLAND, WIS.—The Ashland Light, Power & Railway Company, it is reported, is planning to begin work on a hydroelectric project on the Flambeau River, 14 miles north of Ladysmith, early in the spring, to cost about $1,750,000. L. E. Myers & Company, 53 West Jackson Boulevard, Chicago, Ill., engineers, have charge of the work.

EAU CLAIRE, WIS.—The International Toy Company of Eau Claire, recently organized, is considering the construction of a plant, 60 ft. by 300 ft., with a separate transformer station and office building. L. D. Pangborn is president and manager.

OCONTO FALLS, WIS.—Frank F. Becker and C. H. Hartley, it is reported, contemplate the construction of a hydroelectric power plant and dam between Oconto Falls and Gillette, to develop from 2500 hp. to 3000 hp. Mead & Seastone of Madison are engineers.

WAUSAU, WIS.—Plans have been completed for the construction of a power dam for the Wisconsin Valley Electric Company. M. C. Ewing is manager.

WEST ALLIS, WIS.—The City Council is considering the question of establishing a municipal electric lighting plant. The present contract for street lighting expires next fall.

ALDRICH, MINN.—The Little Falls (Minn.) Power Company is contemplating extending its transmission lines into Aldrich to supply this village with electricity for lamps and motors.

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HIBBING, MINN.—The Hibbing Electric Light Company, it is reported, contemplates the construction of a new plant south of the Great Northern Railroad tracks, to cost about $400,000. C. Foster is manager.

LITTLEFORK, MINN.—The Littlefork Light & Power Company, recently incorporated with a capital stock of $10,000, is contemplating establishing an electric light and power plant in Littlefork. E. Polkinghorne is interested in the company.

MINNEAPOLIS, MINN.—Plans are under consideration by the Electric Machinery Company, Fourteenth Street, N. E., for the erection of an additon, 60 ft. by 80 ft., four stories, to its plant.

ORTONVILLE, MINN.—The installation of a new municipal electric light plant, to cost about $75,000, is under consideration by the city officials.

PIPESTONE, MINN.—Improvements are contemplated to the municipal waterworks system, involving an expenditure of about $100,000. It is proposed to replace the present steam equipment at the pumping station with electrically operated pumps. Energy will be supplied by the Southwestern division of the Northern States Power Company.

TYLER, MINN.—The proposal to issue $20,000 in bonds to rebuild the electric light plant and water system, destroyed by fire last summer, will be submitted to the voters.

AURORA, MO.—Local business men are considering the installation of a new lighting system.

ST. LOUIS, MO.—Bids, it is reported, will soon be received by the Deaconess Hospital Association, 4125 West Belle Place, for the construction of hospital buildings on Oakland and Berthold Avenues, to cost between $750,000 and $1,000,000. W. Wedemeyer, Wainwright Building, is architect.

BISMARCK, N. D.—Plans are under consideration by the Budget Board of the state administration for the installation of electric lighting plants in the various state institutions.

EAGLE, NEB.—Bids will be received by H. K. Frantz, director, Eagle, until Jan. 30, for construction of new school building, including electric wiring, steam heating, etc. The cost of the building is estimated at $85,000. Ellery Davis, Security Mutual Life Building, Lincoln, is architect.

LAKESIDE, NEB.—The Omaha Potash & Refining Company, it is reported contemplates the erection of a plant 20 miles south of Lakeside, to cost about $500,000.

WYMORE, NEB.—The city of Wymore has entered into a contract with the Nebraska Gas & Electric Company of Norfolk to supply electricity to operate the municipal electric system for a period of five years.

DOWNS, KAN.—Bonds to the amount of $40,000 have been voted for the installation of a municipal electric light plant. W. B. Rollins & Company, Railway Exchange Building, Kansas City, engineers, have been engaged to prepare plans.

HILLSBORO, KAN.—Bids will be received by P. C. Hiebert, vice-president, Hillsboro, until Jan. 27, for construction of college building for Tabor College, to cost about $100,000. Separate bids for electrical work, heating and plumbing will be called for at a later date. William Mampe, Sheidley Building, Kansas City, Mo., is architect.

PRATT, KAN.—General contract has been awarded by the Board of Education for construction of a high school building to William Foley, Dodge City, Kan., at $153,212. Separate contracts will be awarded later for heating, electric wiring and plumbing.

Southern States

ASHEVILLE, N. C.—The Southern Aluminum Manufacturing Company of Asheville is considering the construction of a new plant near Asheville.

ORANGESBURG, S. C.—Plans are under consideration for the installation of an additional generating unit in the municipal electric light plant.

EAU GALLIE, FLA.—The Eau Gallie Utilities Company, recently incorporated with a capital stock of $30,000, has merged with the Eau Gallie Light & Ice Company and with the Rose Fish Company. No new work, it is understood, is contemplated at present. G. C. Rose is manager.

ORLANDO, FLA.—The Orlando Water & Light Company is installing a new 1000-kw. General Electric turbo-generator. This unit was ordered nearly two years ago, but owing to war conditions it was impossible for the manufacturers to deliver it.

SARASOTA, FLA.—Bonds to the amount of $80,000 have been voted, the proceeds to be used for the purchase of the electric plant of the Sarasota Ice & Electric Company and for improvements and extensions to same.

FLORENCE, ALA.—The Muscle Shoals Traction Company has completed a second survey of its proposed traction line between Huntersville and Florence via Athens. The government has made arrangements with the company to use its terminal in Florence and is desirous of having the company construct branch lines to Dams Nos. 2 and 3. Thurston Allen of Florence is secretary.

DUNCAN, OKLA.—Bids will be received by the Board of Commissioners until Jan. 20 for furnishing material and equipment for waterworks and electric light plant, including two 160-hp. engines directly connected to a 100-kva., three-phase, 60-cycle, 2300-volt generator with exciter and rheostats. Alternate bids will be received for furnishing and installing oil and natural gas engines directly connected to 100-kw. generators; one five-panel switchboard and power wiring; one 350-gal.-per-minute, two-stage centrifugal pump directly connected to a 40-hp. motor; two 40-hp. motors, belt drive, and one 60-hp. motor, to be directly connected to present pump, and construction of power house complete. The Benham Engineering Company, Colcord Building, Oklahoma City, has charge of the engineering work.

HOWE, OKLA.—Plans have been completed for improvements to the municipal electric light plant. Bonds to the amount of $5,000 have been voted for the work.

MUSKOGEE, OKLA.—Improvements are contemplated to the municipal waterworks system, including the installation of new pumping station equipment. The cost of the proposed work is estimated at about $200,000.

YALE, OKLA.—Arrangements are being made for extensions to the water and light systems, including power house, smokestacks, boilers, engines and generators, electric wiring, electric lines and power lines to wells, switchboard, construction of reservoir, distribution system for water supply, etc. Bids, it is understood, have been received for the work. George B. Gelder is city clerk.

OMAHA, TEX.—The local electric light plant, owned by H. B. Stevens, was recently destroyed by fire.

RANGER, TEX.—The Ranger Light & Power Company, recently incorporated with a capital stock of $20,000, is planning to install an electric light and power plant here. S. C. Green and others are interested.

Pacific and Mountain States

CHEHALIS, WASH.—The Idaho, Oregon & Washington Light & Power Company has applied to the City Commission for a franchise to do a general lighting and power business in Chehalis. Some months ago the voters rejected a proposal to grant a second franchise to supply electricity in the city.

HUNTERS, WASH.—The local electric light plant, owned by A. Waterbury, was recently destroyed by fire. The loss is placed at $3,500.

OAKVILLE, WASH.—The Town Council has engaged Rodney Maxwell, engineer, to make investigations in connection with the installation of an electric light plant and submit a report.

SEATTLE, WASH.—The Skinner & Eddy Corporation is planning to erect a blacksmith and power house, 100 ft. by 220 ft. in Seattle, to cost about $4,500, and a fitting-out shop, to cost $7,000.

WENATCHEE, WASH.—Plans have been completed by the Wenatchee Woodworking Mill Company for the installation of a box-making plant with a capacity of 200,000 boxes. The development of additional power is included in the proposed plans.

FOSSIL, ORE.—The Fossil Milling Company, recently organized, has purchased the property of the Fossil Flour Mill Company, including machinery and electric lighting equipment. The company proposes to supply electricity for lamps and motors and operate a flour mill in Fossil.

ALTURAS, CAL.—Plans are under way for the installation of pumping stations along the Pitt River for the purpose of furnishing water for irrigation purposes. Arrangements, it is understood, have been made with the Alturas Electric Light & Power Company for the erection of 5 miles of transmission line and the installation of at least 65 hp. in motors. W. Gibbins is manager of the Alturas company.

ATASCADERO, CAL.—The State Railroad Commission has issued an order directing the Midland Counties Public Service Corporation of San Luis Obispo to extend its service to Atascadero Colony, to furnish electricity to the residents here.

LOS ANGELES, CAL.—A bond issue of $4,500,000 has been approved by the City Council for improvements at the city habor, San Pedro, and vicinity, which will include the installation of cranes and other machinery for hoisting, loading and unloading materials, grain elevators, etc. The work will be in charge of the Harbor Department.

MODESTO, CAL.—The construction of an electrically operated pumping plant in the vicinity of Toulumne River, near Waterford, is under consideration by the Waterford Irrigation District of Modesto. The cost together with proposed irrigation system is estimated at $50,000.

NEWPORT BEACH, CAL.—The Board of Trustees is considering the installation of an electrically operated pumping plant in connection with the new municipal sewerage system. The cost of the entire work is estimated at $173,000.

SAN FRANCISCO, CAL.—The Motor Transportation Corps, which has charge of the wheeled vehicles in the army, is considering the construction of a repair shop in San Francisco similar to those in the East and the South, to cost from $750,000 to $1,000,000.

SAN PEDRO, CAL.—Plans have been prepared by the Southwestern Shipbuilding Company for the construction of a new transformer station at its works in East San Pedro.

VISTA, CAL.—Plans are under consideration by the Vista water committee for an irrigation system in the vicinity of Vista. It is proposed to take over the present irrigation system of the Vista Land & Water Company and also to utilize the water of the San Luis Rey River, from which it will be diverted at the Warner Reservoir and taken down the south side of the river across Valley Center county to a point near Vista, via head of Twin Oaks Valley, thence on to the coast. The water company will reserve the right to develop water power as a by-product at the power drops on the main supply canal to generate electricity.

Canada

PRINCE RUPERT, B. C.—The Mullen Construction Company of Pittsburgh, Pa., which is taking over the local drydock and shipyards to carry out a steel shipbuilding contract for the Dominion government contemplates improvements involving an expenditure of about $500,000, including extra equipment and the erection of plate, angle and assembling shops.

VANCOUVER, B. C.—The Pacific Great Eastern Railway Company, Vancouver, is considering the development of electrical energy along its railway lines in British Columbia.

PORTAGE LA PRAIRIE, MAN.—The large elevator of Woodward & Company of Portage la Prairie was recently destroyed by fire, causing a loss of between $400,000 and $450,000.

CANNINGTON, ONT.—A by-law will soon be submitted to the ratepayers appropriating $3,000 to complete the system for the distribution of hydroelectric power in Cannington.

ST. THOMAS, ONT.—The City Council is contemplating extensions to the street-railway system.

CHICOUTIMI, QUE.—Price Brothers & Company, 36 St. Peter Street, Quebec, it is reported, are contemplating the construction of pulp mills, to cost about $1,000,000.

LACHINE, QUE.—The City Council is considering improvements to the municipal electric light plant.

SHERBROOKE, QUE.—The Council is considering an issue of $90,000 in debentures for the construction of electric distributing stations.

THREE RIVERS, QUE.—Plans are reported to be under consideration by the St. Maurice Lumber Company for the construction of pulp and paper mills in Three Rivers, to cost about $500,000. R. F. Grant is manager.

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Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 10, 1918)

1,286,889. INSULATING MASS ESPECIALLY FOR ELECTRIC USE; Johannes Andersen, Lillehammer, Norway. App. filed June 1, 1916. Comprises powdered steatite (talc) and a mixture of resin and linseed oil.

1,286,966. TELEPHONE METER-SERVICE SYSTEM; John Erickson, Chicago, Ill. App. filed Feb. 21, 1916. Particularly related to systems in which the operation of a subscriber's metering device depends upon the actual length of conversations rather than upon the number of separate conversations.

1,286,981. IMPULSE TRANSMITTER; William H. D. Ford, New York, N. Y. App. filed June 10, 1916. For use in connection with party-line or like systems.

1,286,982. CALLING DEVICE; Oscar F. Forsberg, Yonkers, N. Y. App. filed Dec. 29, 1916. Relates to impulse senders for automatic and semi-automatic telephone systems.

1,286,996. SELECTING SWITCH; Charles L. Goodrum, Brooklyn, N. Y., and John A. Kropp, Oak Park, Ill. App. filed Oct. 13, 1916. Utilizes a single motor for actuating the switch in its several movements to place the active contacts of the switch into engagement with the desired passive contacts.

1,287,009. TELEPHONE-EXCHANGE SYSTEM; William H. Harrison, Brooklyn, N. Y. App. filed May 9, 1918. To provide improved signaling means for systems employing trunk circuits over which connections between the telephone lines terminating at different switchboards may be made.

1,287,012. MAIL BOX; James F. Hayes, Chicago, Ill. App. filed Nov. 16, 1916. The owner may ascertain whether mail has been deposited without leaving his house to inspect the mail box.

1,287,013. SYSTEM OF CONTROL FOR SINGLE-PHASE MOTORS; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 23, 1915. Relates to alternating-current dynamo-electric machines of the commutator type.

1,287,014. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 29, 1915. To provide good starting torque and smooth acceleration for alternating-current motors of the commutating type.

1,287,015. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 29, 1915. Sparking at the commutator in alternating-current dynamo-electric machines of the commutating type may be substantially eliminated under all conditions of speed and load.

1,287,016. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 29, 1915. To provide means for the definite adjustment of the field of the alternating-current dynamo-electric machines of the commutating type under control when action is either that of generator or motor.

1,287,017. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 29, 1915. The load power factor and speed characteristics of dynamo-electric machines of the alternating-current commutating type may be adjusted and modified as desired, and substantially sparkless commutation may be obtained.

1,287,022. LOCOMOTIVE; George H. F. Holy, Pittsburgh, Pa. App. filed May 2, 1917. Relates particularly to electric locomotives that are provided with jackshafts and side rods for transmitting the driving effort of the propelling motors to the associated driving wheels.

1,287,039. CARTRIDGE FUSE; Oscar H. Jung, Milwaukee, Wis. App. filed Feb. 12, 1918. When the fusible link is blown the retaining casing is prevented from shattering or rupturing.

1,287,058. LOCKING DEVICE AND ALARM FOR MOTOR VEHICLES; Simeon G. McDaniel, Laurens, S. C. App. filed May 2, 1918. To provide means for preventing the cranking of the motor of the vehicle.

1,287,064. TELEPHONE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed April 13, 1917. Relates to systems employing machine switches.

1,287,079. AUTOMATIC TELEPHONE SYSTEM; Frank Newforth, Chicago, Ill. App. filed Dec. 31, 1915. Relates to automatic systems comprising two or more exchanges between which connections may be established automatically.

1,287,082. ATTACHMENT PLUG; George W. Norgate, Chicago, Ill. App. filed Dec. 28, 1914. An insertible member is provided with a spring coil surrounding it which may be forced into engagement with the threads of the shell contact of the lamp socket.

1,287,100. TERMINAL STRIP; John N. Reynolds, Greenwich, Conn. App. filed Nov. 9, 1916. Relates to multiple-contact members for electric switches of the movable-contact type.

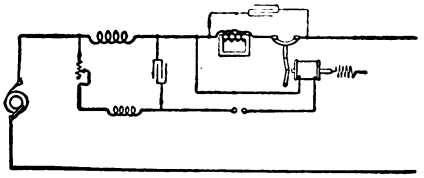
1,287,101. METHOD OF MANUFACTURING MULTIPLE-CONTACT STRIPS; John N. Reynolds, Greenwich, Conn. App. filed Aug. 1, 1917. To provide for manufacture in an efficient and economical manner.

1,287,108. METAL MOLDING; William C. Robinson, Sewickley, and Homer G. Knoderer, Edgeworth, Pa. App. filed May 12, 1917. Cannot be fully or completely assembled until adequate electrical connection has been established between the conduits and fittings.

1,287,138. COMBINATION DISCONNECTING SWITCH, FUSE, CHOKE COIL AND LIGHTNING ARRESTER; Lucian A. Thomas, New York, N. Y. App. filed Oct. 8, 1917. Self-contained and may be readily mounted upon cross-arms, walls of buildings or other suitable supporting structures.

1,287,156. ELECTROLYTIC APPARATUS; Robert L. Whitehead, Perth Amboy, N. J. App. filed June 22, 1915. Primarily for use in the electrolytic refining of tin and the production of fluosilicate electrolytic solutions from impure tin anodes.

1,287,161. VACUUM-TUBE VOLTMETER; Richard H. Wilson, East Orange, N. J. App. filed Aug. 30, 1916. For measuring the peak voltage between two points of an electrical network without introducing any complications in the network.



1,287,232—Circuit-Interrupting System

1,287,171. CONTROLLING MECHANISM FOR AUTOMOBILES; Thorsten von Zweigbergk, Lancaster, and Gillis von Zweigbergk, Fulwood, Preston, England. App. filed Nov. 1, 1915. To provide simple and effective controlling mechanism for the speed-changing gear.

1,287,180. METHOD OF TELEPHONIC TRANSMISSION WITHOUT RETURN WIRE; Cesare Bardeloni, Rome, Italy. App. filed May 28, 1915. Utilizes the variations of electrostatic and electromagnetic conditions.

1,287,186. FLASHLIGHT; Percy M. Beard, Hardinsburg, Ky. App. filed Feb. 27, 1917. Any number of batteries may be arranged in the casing.

1,287,188. THERMOSTAT; Heinrich Beck, Schenectady, N. Y. App. filed March 29, 1917. To neutralize the tendency to respond effectively to variations of temperature of the surrounding medium.

1,287,190. DYNAMO-ELECTRIC MACHINE; Sven R. Bergman, Nahant, Mass. App. filed Nov. 1, 1916. Provides an improved arrangement of the compensating winding in a direct-current dynamo-electric machine.

1,287,192. ELECTRIC HEATING DEVICE; Arthur F. Berry, London, England. App. filed July 9, 1918. Heating element suitable for cooking and similar apparatus.

1,287,217. MOTOR CONTROL; Eugene R. Carichoff, Schenectady, N. Y. App. filed Oct. 24, 1916. Retains the electromagnetically actuated switches having shunt windings and eliminates the troublesome interlocks.

1,287,226. SYSTEM OF DISTRIBUTION; Herbert W. Cheney, Milwaukee, Wis. App. filed July 26, 1915. Means for regulating the output of a generator.

1,287,231. CIRCUIT-INTERRUPTING SYSTEM; Lewis W. Chubb, Pittsburgh, Pa. App. filed May 3, 1916. Adapted to open at the instant the value of the current traversing the circuit is substantially zero.

1,287,232. CIRCUIT-INTERRUPTING SYSTEM; Lewis W. Chubb, Edgewood Park, Pa. App. filed Jan. 6, 1917. Relates particularly to interrupters adapted to open at the zero value of the current wave traversing the same; also flattens current wave to insure a longer period of practically zero current.

1,287,233. CIRCUIT-INTERRUPTING SYSTEM; Lewis W. Chubb, Pittsburgh, Pa. App. filed July 5, 1917. Pertains particularly to circuit interrupters that are adapted to open at the zero value only of the current wave traversing the same. By making potential wave peaked a current wave more susceptible to control is obtained.

1,287,236. TEMPERATURE-CONTROL APPARATUS; Edgar F. Collins, Schenectady, N. Y. App. filed May 6, 1918. To enable a furnace to operate in accordance with desired thermal and electrical conditions.

1,287,244. ELECTRIC PROTECTIVE DEVICE; Elmer E. F. Creighton, Schenectady, N. Y. App. filed Nov. 10, 1914. To prevent injurious effects of abnormal conditions on transmission lines and in generator armature circuit.

1,287,250. FLASHLIGHT; James O'D. Dalley, Tillamook, Ore. App. filed Jan. 31, 1918. Permits the light to be removed from the casing without breaking the battery connection and to be placed at a point removed from the battery.

1,287,251. METHOD FOR LOCATING CONCEALED CONDUCTORS; William S. Darley, Chicago, Ill. App. filed Aug. 11, 1915. Consists in passing an intermittent electric current through the conductor and then locating it by means of an exploring coil.

1,287,259. SYSTEM FOR CHARGING STORAGE BATTERIES; Robert M. Dixon, East Orange, N. J. App. filed Aug. 10, 1912. Has special reference to charging the so-called "straight-storage-battery" system of lighting railroad cars.

1,287,262. PORTABLE ELECTRIC LIGHT; John T. Druva, Longmeadow, Mass. App. filed April 4, 1918. One contact spring operable either by the exterior slide or thumb piece or by the push-button completes circuit between the light and battery.

1,287,265. ELECTRIC DISCHARGE DEVICE; Saul Dushman, Scotia, N. Y. App. filed Feb. 20, 1915. To prevent injury to or distortion of the cathode when subjected to static strains.

1,287,283. ELECTRIC SWITCH; Robert A. Gally, Cincinnati, Ohio. App. filed Sept. 10, 1917. Has three positions, two to close the circuit and one to open it.

1,287,286. VEHICLE SIGNAL; Henry M. Fuller and George A. Sewell, Salt Lake City, Utah. App. filed June 10, 1918. Visible at night as well as in the daytime.

1,287,309. COMMUTATOR; William T. Hensley, Indianapolis, Ind. App. filed Oct. 15, 1914. Arrangement to hold commutator bars of dynamo-electric machines in place.

1,287,323. ELECTRIC HEATER; Alfred R. Huntington, Riverside, Cal. App. filed March 21, 1918. Is of the reflector type and radiates heat in substantially parallel lines.

1,287,331. ELECTRICAL SYSTEM OF DISTRIBUTION; John W. Jepson, Buffalo, N. Y. App. filed Aug. 24, 1915. Relates to current control in systems in which the generator is driven at variable speed such as in car-axle lighting sets.

1,287,337. WELDING TOOL; Otis A. Kenyon, New York, N. Y. App. filed July 26, 1918. Eliminates overheating and destruction due to arcs.

1,287,348. FIRE-ALARM SYSTEM; Peter J. Kutulan, San Francisco, Cal. App. filed March 7, 1918. Automatically notifies the fire department of the location of the building and sounds an alarm to the occupants of the building.

1,287,356. PEDAL; Alfred W. Lawson, Green Bay, Wis. App. filed Jan. 5, 1918. Electrically heated for use with the rudder bar of an aeroplane.

1,287,376. METHOD OF AND APPARATUS FOR SPOT WELDING; Charles H. S. MacLennan, San Francisco, Cal. App. filed April 19, 1918. A cooling agent acts upon the surface of the metal immediately surrounding the spots being welded.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Fuel Conservation Still Necessary

THE ELECTRICAL WORLD deems it of highest importance to the nation that fuel resources be conserved without delay. These resources are definitely limited. They are irreplaceable. They are of great and increasing value. They are being wasted. While they are being depleted steadily we have no national program, no public concern over the situation. Scientists, economists, publicists warn the nation from time to time. Nothing is ever done. Congress, lost in a maze of politics, fails to grasp the problem. No more important duty confronts the engineer than to awaken the public mind to our shiftless lack of national policy. Potential water power should be put to productive use promptly.

Shifting gears from a war to a peace basis may jar our industrial mechanism a bit, but this is no time to lose one's head, condemn the 1919 model and jump out of the car into the quicksand of pessimism. Plan, order, contract as opportunity permits, and watch the bus accelerate into undeniable stable prosperity.

Government and Industry

THE electrical industry gave its whole-hearted support to the government in the war. It knew how difficult and how vast the war work was and instinctively sympathized with those on whom the responsibility fell. Something important had to be done and it was of no consequence who did it or who got the credit. Men volunteered from all branches. Manufacturers turned over their entire plants and research departments, public utilities refused service to others so that the government should not want, and there was neither semblance nor suspicion of profiteering in the work of any branch. All served patriotically and willingly, spurred on by the greatness of purpose which animated the nation. We mention this lest there should be a tendency to overlook or forget it. Those in authority in Washington happily appreciate the part played by industry and indicate a willingness to meet the problems brought on by the sudden termination of the war without unduly disturbing the supply markets or productive labor. There is even a disposition to help keep up production by offering shipping and other advantages for export trade. Thus the war has not been altogether without recompense to peaceful industries like ours. The government and the people have seen a light and are inclined to deal fairly with the manufacturing and supply industry, more so now than ever. There is therefore no reason for pessimism or doubt. The same spirit of coöperation which won the war can be relied on to solve present problems.

Public necessity is a wonderful shock absorber in times of business transition. Electrical service is a peace essential as well as a war requirement, and the supply of that service can no more be stopped in civilized countries than waterfalls can be reversed by human hands.

Hydro Development in California

A SURVEY of the economic and financial conditions surrounding power development in the State of California discloses four important facts—one, the desirability of conserving fuel oil through hydroelectric developments; two, the necessity of additional power in the central and northern part of the state for meeting the requirements for irrigation projects, industrial growth and the normal increase in power demands; three, a fear in some sections of the restrictions which are supposed now to obtain under the regulations of the Departments of Agriculture and the Interior, and, four, the control of these hydroelectric power companies by the above-mentioned departments and the Railroad Commission of the State of California.

It is obvious that more than a million barrels of oil per annum can be saved by additional efficient hydroelectric developments. The oil usage in 1918 has increased by 700,000 barrels over the consumption of 1917 for three of the companies serving the industrial district in San Francisco and its environs. A similar situation obtains in the southern part of the state and in the San Joaquin valley. If the power companies can secure the necessary funds with which to make developments, such economies should result that a considerable increase in return can be made on present and prospective investments. It is hoped therefore that early steps can be taken to start the developments outlined in Major Sever's report so that the electricity will be available within the time program mentioned. The indications are that industrial development in that part of the Pacific Coast is going to be greatly accelerated, and that will call for additional and large amounts of electric power. The Railroad Commission has brought about some slight relief by ordering the interconnection of some of the existing systems and the installation of additional steam generating equipment, but this has helped to deplete an already too scant oil supply and unless further hydroelectric developments are made the

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situation threatens to become worse. Most of the water power on the Pacific Coast being on the public domain, the speedy enactment of pending water-power legislation is very desirable.

Discrimination against the individual customer by reduced lighting rates to municipal buildings should be discarded in progressive communities where the square deal exemplifies the relationship between public utilities and all classes of energy consumers from the cigar stand up.

Industrial Lighting as an Engineering Problem

ARTIFICIAL illumination bears a vital relation to quantity and quality of output so that its economic aspect is a very important one. From a practical standpoint the question is continually one between cost and result, but if the researches of the last two years have shown anything, they have proved that up to some indeterminate point, beyond present practice in lighting, improved illumination pays. The fundamental object of the lighting codes adopted by various states is to secure good working conditions for the employee, but incidentally they benefit the employer in at least equal measure. From an engineering standpoint there is no royal road to good lighting. Under given conditions to be maintained indefinitely a comparatively simple prescription is sometimes effective, and attempts have been made to systematize methods of lighting so that a few simple rules will lead to thoroughly good results. As a matter of practice, the case stands quite otherwise; for only in the minority of cases is a working space used continually for the purpose for which it was originally designed. Some of the worst cases of bad lighting to be found anywhere are those in which the original scheme was good but has been rendered useless or inadequate by changes in the character of work done or subdivision of the space illuminated. It is the task of the illuminating engineer to treat industrial lighting not by cut and dried formulas but by acute judgment as to what is the best thing to be done under circumstances, not as they were some years back, but as they are now with the space applied to its actual purposes. Panaceas in illumination are about as ineffective as they are in medicine.

With the war behind us, let us take a firmer hold upon the steering wheel of progress and throw our efforts into high gear, lest our competitors show us their tail-lights and we lose our way in the dust of the more courageous!

A Tale and a Moral

WITHIN a year thousands of persons have learned for the first time the joy and the power of coöperative effort. Personal and business considerations have been subordinated to national policy. Duty, far-reaching in its scope and yet intimate in its appeal, has been realistically presented to each of us, and we have been made to feel that we are a part of a great nation and that that nation's welfare is in our keeping. James Burke tried to inject a somewhat kindred spirit into the meeting of the Electric Power Club in Cleveland last week. He seeks to remove motor manufacture from the field of drudgery to that of pleasure and profitableness through uniformity of design. The personal jealousies and petty ambitions of manufacturers and designers have no place in his program. He deals with the problem of motor design in the light of great ideals and seeks to perpetuate the lessons learned in war time to the mutual profit of maker and user both. A dream he calls it, and yet it needs only coöperative effort within the electrical industry and the subordination of a very few things to that industry's welfare to make the dream come true. Mr. Burke's address is printed in full, and the story is so well told that its reading will give both pleasure and profit.

Worry over the future course of prices, hesitation to undertake intrinsically meritorious projects and resultant stagnation in fear of an abnormal overhead have little place in a nation like this. One hundred million people are not going to commit industrial harikari because prices recede so slowly. Deliveries and service as well as current quotations will control sales in the business of the great era which we have entered.

Apparatus for Arc Welding

THE paper by Otis Allen Kenyon on recent welding systems gives an admirable summary of present conditions. Arc welding as a method of metal working has become so important in the past few years that it has really grown to be an important branch of engineering. As generally happens in electrical practice, no universal solvent of the difficulties of the situation appears, and the choice of apparatus becomes to a large extent a matter of suitability to the task in hand. To make a very general classification of the requirements of arc welding, they fall broadly into two groups, one of them involving work varying widely in kind, in thickness, shape and material to be dealt with, the character and location of the welds required. This, so to speak, is the engineering side of the art. The second is the use of arc welding in a manufacturing process where it becomes one of the tools of quantity production and has to meet the requirement of performing similar operations over and over again with the maximum speed and certainty, as close to automatic action as conditions permit.

Now, as a study of Mr. Kenyon's admirable paper shows, this division of the work must lead to different requirements in the apparatus, and does do so in fact. For the former uses accurate control of the welding process in the hands of a skilled workman is sometimes all-important, and if it can be attained, even at the cost of somewhat heavy and expensive apparatus and inefficient use of the energy, it is still exceedingly worth while. In other cases it is profitable to plan for a higher degree of automatism in the operation, even at considerable trouble, in order to avoid depending too much on the judgment of the workman in cases which require not so much extreme precision as a good and uniform job; hence the variety of lines on which the problem of designing welding apparatus has been approached and the considerable differences in detail that present themselves. The plans of operation range all

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the way from a multiple system, with great flexibility in the control of individual welders, to, for the case of quantity production work, a constant-current series system which with proper attention almost runs itself in the repetition of a series of like operations.

The various classes of apparatus leading to these results Mr. Kenyon admirably describes, together with some of their special working properties. Several of the systems in use, and successful use at that, demand a separate generating equipment for each individual arc, and for certain classes of work this is not an objectionable feature if thereby energy can be saved and work facilitated. The alternating-current arc-welding system, with its relatively light transformers and covered electrodes, represents an ingenious attempt to escape the limitations just mentioned. It is interesting to note that the various types of apparatus employed involve properties of regulation closely similar to those which much earlier appeared in arc-lighting practice. Indeed, at the bottom of each case lies a similar requirement, that a stable and uniform arc should be produced with the minimum cost and complication of apparatus. As in lighting, so in welding, both constant-potential and constant-current systems are in use to the same end, and, as in lighting also, it is altogether likely that each system will find its own particular field of application to which its properties are especially suited. Certain it is that the art of arc welding has come to stay and to bring increasing usefulness in the working of metals, and we are glad to present to our readers so good an account of the present situation as it has been developed in recent years and at the hands of engineers with different viewpoints and lines of attack.

Place that order to-day if your stock shows signs of running low and do not wait in timid uncertainty for the drop in prices which you have been expecting daily since Foch booted Hindenburg nach Berlin. Mayhap you could turn over your new investment two or three times before you lose a dollar and make enough en route to show healthy net.

Government by Law or by Man?

BY A VERY easy process the administration has taken and held complete operation of several of the great groups of utilities. There was a war, Congress passed laws to give the administration what it asked to prosecute the war, the war was ended, but the administration clings to its firm grasp of the railroads and communication systems. What does the man in the street think about it all? His mental methods are ordinarily simple and direct. He is beginning to get some light on the question of what is being done at Washington. The latest developments are illuminating to his clear reasoning. There was a flare of trumpets and the announcement of a new schedule of telephone rates. People were given or got—it doesn't really matter which or how—the impression that rates were to be reduced. What were the facts? Representatives of nineteen state public utility commissions met in Chicago last week and passed a resolution declaring that the Postmaster-General had exceeded his legal powers. They apparently objected strenuously to the proposed change in intrastate rates, which was increase instead of decrease. A number of states have already acted to investigate or nullify the higher rates which the Washington authorities sought to levy. The Illinois commission has ordered suspension of the new schedule for 150 days. In Massachusetts the commission announced that it would not put the new rates into effect until the conclusion of hearings begun on Jan. 19. The Michigan commission declined to give immediate approval to the rates, holding that the companies have neither advertised them sufficiently nor published their application for hearing as required by the Michigan law. The Ohio commission rejected the rates on the ground that they were excessive and had been made without due investigation. The Florida commission asked a court restraining order against the rates, though the Washington telephone authorities say that it was denied. Nebraska, New Jersey, Missouri, West Virginia, Nevada, Arizona, Connecticut object to the scheme. This is an effective voice of protest. It is an expression from Mr. Common Citizen.

The states created their public service commissions to regulate the charges for public utility service. Do they surrender this power to the federal government in time of war? The answer is, yes, they did so. When they are asked to abandon the exercise of their power after the war is over in the interest of a public ownership policy ardently exploited by a Cabinet officer they see that a new question is involved. Entirely outside of the issue of government operation the question of states' rights is raised. Suppose that the states, loyal to the government in war, feel that they are better fitted to determine what is in the interest of their communities than an autocratic official in Washington. Assume that their point of view is that they are satisfied that they can get what physical development of utility service they need so long as they have power to regulate, but that they are very doubtful of getting such development if they have to deal with an arbitrary power at the national capital. No, the states are not yet ready to throw aside the system of regulation under which they are watching utility services and rates within their borders.

This is a government of law, not of men. It is a government of principles, of ideals if you like, but not one in which arbitrary individual power rules. The function of the individual is the administration of the law, obedience to its letter and spirit. The present telephone policy rests, so far as it has any sanction of law, upon an act of Congress passed to centralize authority in Washington for the purpose of waging war. Neither in law nor in the declared policy of the people is there justification for government operation of the telephones after the final settlement of the war. Technically speaking, peace has not been signed. But there is not room for much difference between a peace that is not signed and a war that, in the President's words, has come "to an end." If government operation without state regulation is to be substituted for private operation with regulation, the states have shown plainly through their commissions that they don't like it. If the system of regulation by law is to be supplanted by a system of arbitrary determination by men clothed with brief authority, the state commissions have shown that they cannot approve of the change.

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Standard Testing Code for Hydraulic Turbines

To Avoid Disputes Over Hydraulic Turbine Performance a Simple Testing Code Recognized by Manufacturers and Operating Companies Should Be Agreed Upon—Engineering Societies Are Urged to Adopt Code of the Machinery Builders' Society

BY F. H. ROGERS
Hydroelectric Engineer I. P. Morris Department of William Cramp & Sons Ship & Engine Building Company

THE need of a standard testing code for hydraulic turbines has long been recognized by the engineers of operating companies and manufacturers. Until recently no such standard or generally accepted code was in existence, so that often disputes arose as to the performance of the turbines or the actual hydraulic conditions existing in the plant. In order to avoid the possibility of such disputes, it is important that both purchaser and manufacturer have a clear understanding and agreement on all the conditions entering into the contract. Such a result is best accomplished by the previous acceptance by both parties interested of a standard testing code which not only protects the purchaser in that he knows ahead just what he is buying but also protects the manufacturer in that he knows definitely the exact conditions for which he is to design the machinery.

In order that such a code may become standard and universal, it is necessary that it be of so broad a character that it covers the conditions entering into all contracts for hydraulic turbines. In preparing such a code it is realized that the turbine is but a part of the entire hydroelectric installation, and therefore the particular conditions applying to it must be separated from the general conditions applying to the whole installation. Thus, for example, the efficiency of the plant may be considered to be the electrical output from the transformers divided by the total potential water horsepower as calculated from the total flow of water through the turbines and other auxiliary machinery together with any leakage and spillway discharge, and the total head as measured from the still-water levels in the headrace and tailrace. The efficiency of the hydraulic turbine, on the other hand, is the horsepower output at the turbine shaft divided by the water horsepower supplied to the turbine, as calculated from the actual quantity of water flowing through the turbine and the effective head measured at the unit.

WHAT THE CODE SHOULD CONTAIN

It is evident therefore that the code should contain exact definitions of the mechanical and hydraulic elements entering into all contracts, such as horsepower output, quantity of water, effective head, water horsepower and turbine efficiency.

It is equally important that the code should clearly state the methods of tests or the exact means of determining in actual performance whether the turbine has met its contract guarantees.

The preparation of such a code requires a very careful investigation of the methods used in current practice and should be based on the opinions and experience of the leading engineers and manufacturers in the hydroelectric field. The impossibility of the agreement of all engineers on all points covered is admitted, but where disputed points may exist standardization of method is more important than absolute accuracy, as it results in a definite basis for turbine contracts and avoids disputes.

THE A. S. M. E. CODE

Some time ago the power test committee of the American Society of Mechanical Engineers prepared a report on "Rules for Conducting Performance Tests of Power-Plant Apparatus" which was published in the *Transactions* of the society for 1915. This report contained a section on testing waterwheels which was so incomplete and inadequate that it did not in any way cover the subject as called for by modern conditions in this field of engineering, and hence has never been referred to in actual practice. To substantiate the above statement consider the following examples taken from the code:

Power Output.—It is stated that where the turbine drives an electric generator the power output is measured by calculation from the electrical output. No definition is given, however, of the generator efficiency or the method of obtaining it on large machines in the field. This point is of great importance as the output of the turbine is the output of the generator plus all losses supplied by the turbine, and hence methods should be stated for determining the efficiency of the generator, considered as a dynamometer, under the conditions existing in the turbine test. References are made in the code to correcting for excitation losses which are not at all clear. This point is easily settled when a definition of generator efficiency is given which specifies the losses to be considered.

Water Measurement.—The method given the greatest prominence is by means of floats in the headrace or tailrace. This means of measurement can be applied only to a very limited number of cases where a canal of the necessary length is available, but even in such cases it is very inaccurate and should only be used where approximate results are sufficient. Mention is also made in the code of current meters, weirs and pitometers, but very little detail is given as to these methods, which are far more accurate than floats.

In the appendix to the code it is stated that for measuring the flow a current meter of the cup type is quite satisfactory and may be calibrated by moving the meter through still water. It is well known, however, that the particular meter mentioned is not the most accurate type and that results based on its still-water rating are under usual conditions seriously in error.

Under the heading of "Weirs," it is recommended that the Francis formula be used. As stated in the code, however, this formula is correct only when applied to a weir built to the dimensions used by Francis and for the ranges in head used in his experiments. The use

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of a weir, therefore, according to this code is limited to small units. No mention is made in the code as to methods of measuring the flow through turbines supplied with metal penstocks or concrete intakes, which type is by far the most common in modern plants.

Head.—The head is stated as the difference between the levels in the flume and discharge pit as measured by graduated scales. Such a definition applies only to turbines set in open flumes, which type comprises a very limited class not considered modern practice. Under a footnote in the code a method is given for measuring the head on wheels supplied through penstocks. This method should be given the prime consideration due to its general application in modern practice. No correction is made in the code for the outflow loss at the discharge of the draft tube, so that apparently this loss is charged against the turbine. As it is necessary to get rid of the water used by the turbine, a certain velocity must exist at the discharge of the draft tube, which should be considered as a tailrace loss and hence credited to the turbine.

Instructions.—There is no mention made in this code as to the actual methods of testing the turbines, and no instructions are given as to the variations which should be allowed in the hydraulic conditions during the test or the means of correcting for such variations. In short, the code does not cover any of the difficulties which usually arise in tests of hydraulic turbines and therefore cannot possibly settle any disputes which are likely to arise between the manufacturer and the purchaser.

CODE OF THE MACHINERY BUILDERS' SOCIETY

About a year ago the question of drawing up a suitable testing code was taken up by the leading manufacturers of hydraulic turbines. This work was done, under the auspices of the Machinery Builders' Society, by a committee composed of representatives of the turbine manufacturers of which H. Birchard Taylor was chairman. Many meetings were held by this committee during a period of nine or ten months, with the result that a testing code was drawn up which had the approval and acceptance of all the manufacturers. Preliminary copies of this code were sent to the most prominent engineers in the hydroelectric field in this country and in Canada in order to obtain their advice as to possible revisions and their approval of the code as a whole. Many valuable suggestions were obtained from these engineers which were incorporated in the final form of the code.

To review this code briefly, it may be stated that its primary feature is to define clearly all of the elements entering into the performance of hydraulic turbines and to specify definitely the means of determining this performance by tests in place, in order that no disputes can arise between the manufacturer and the purchaser as to the carrying out of the terms of the contract. For example, consider the same elements discussed in the A. S. M. E. code.

Power Output.—The code carefully defines the generator efficiency and the method of determining this efficiency under the test conditions, so that the power output of the turbine can be accurately obtained. The code also takes care of the question of excitation load by omitting this loss in the determination of the generator efficiency. Therefore, for separate excitation, this loss is omitted in computing the turbine output, and in cases where the exciter is mounted on the unit shaft it is considered as a separate generator driven by the turbine, and its kilowatt output divided by its efficiency is added to the turbine output as calculated from the main generator.

Water Measurement.—Under this heading the principal methods are described in some detail, as it is realized that this is the most difficult of all the measurements to be made. Measurement by weir is given considerable space and a formula presented derived from the averages of values computed by the most reliable formulas and data obtainable at the present time. The code is definite as to the dimensions of the weir and channels, the head on the crest and the velocity of approach.

Under the current-meter method of measuring discharge, the code explains how the errors in the readings may be determined by the simultaneous use of two different types of meters which have been previously calibrated so as to obtain data for correcting the readings during the tests.

The Pitot-tube method, which is generally used in the case of turbines fed through steel penstocks, is described very fully, and details are given as to the number and location of tubes and peizometers required. The method of plotting the results is described, and the correction coefficient by means of which the mean velocity is obtained is given.

Other methods, applicable under special conditions, for measuring the flow, such as the screen or diaphragm method, the titration or chemical method, the color velocity method, the brine velocity method, etc., are briefly described and their limitations given.

Head.—An exact definition of the effective head and the means of measuring it are given both for incased turbines and those in open-flume settings. The velocity corrections to be made to the head both at the intake to the casing and at the discharge of the draft tube are fully explained.

Instructions.—This code also goes into the matter of varying conditions which usually occur in tests on hydraulic turbines and definitely limits the allowable variations of load, head and speed. It explains how to make corrections in the results obtained where the head is not the same as that mentioned in the contract, in order that the actual performance of the turbine may be properly compared to the guarantees of performance in the contract.

This code was approved by the Machinery Builders' Society on Oct. 11, 1917, and is now being used in connection with all turbine contracts by the following manufacturers: The William Cramp & Sons Ship & Engine Building Company, I. P. Morris department; the Wellman-Seaver-Morgan Company, the Allis-Chalmers Manufacturing Company, the S. Morgan Smith Company, James Leffel & Company, the Pelton Water Wheel Company, and the Platt Iron Works Company.

At a special meeting which was held in December, 1917, in New York City by the American Society of Mechanical Engineers to consider the question of revising the power test codes, the machinery builders' code was presented to the society with the recommendation that it be adopted as the best available code for the testing of hydraulic turbines. While no action was

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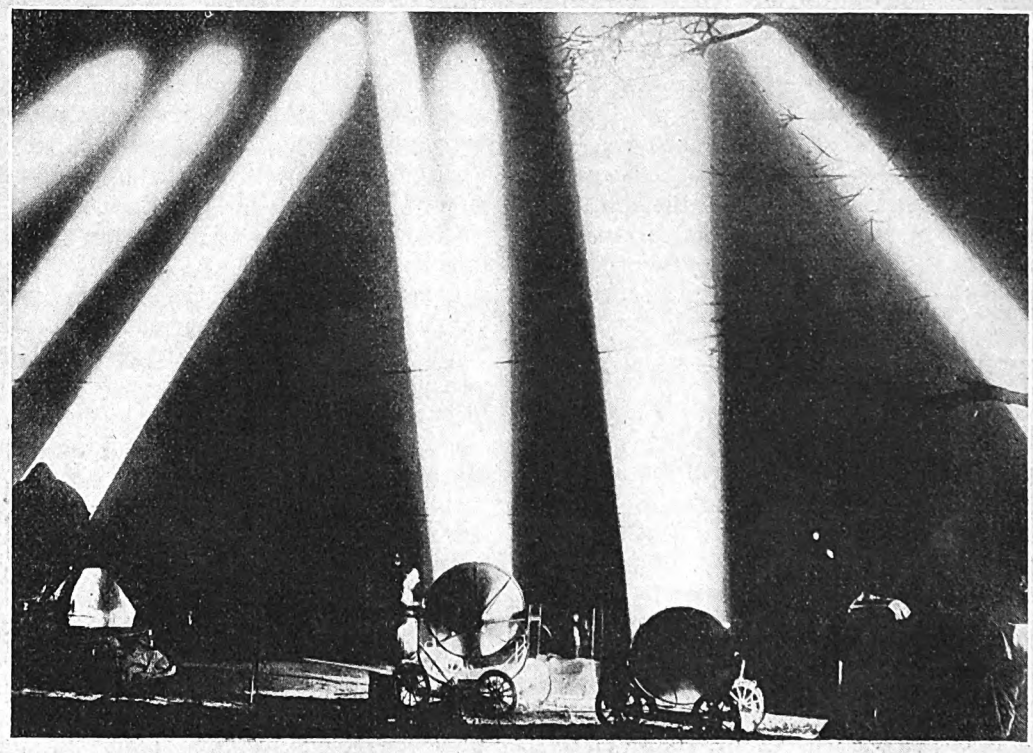
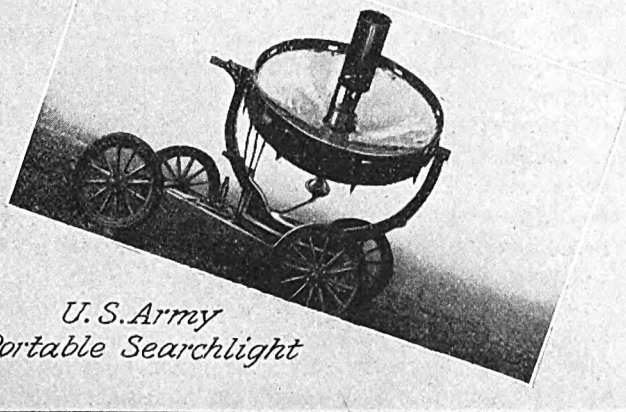
taken on this recommendation, a sub-committee of the power test committee was appointed by the American Society of Mechanical Engineers to meet with committees from the American Society of Civil Engineers, the National Electric Light Association and the American Institute of Electrical Engineers to draw up a revised code for the testing of hydraulic turbines. No code has as yet been submitted by these committees and in the meantime the machinery builders' code is now in general use in connection with all important contracts for hydraulic turbines.

NEED OF CODE WILL CONTINUE TO INCREASE

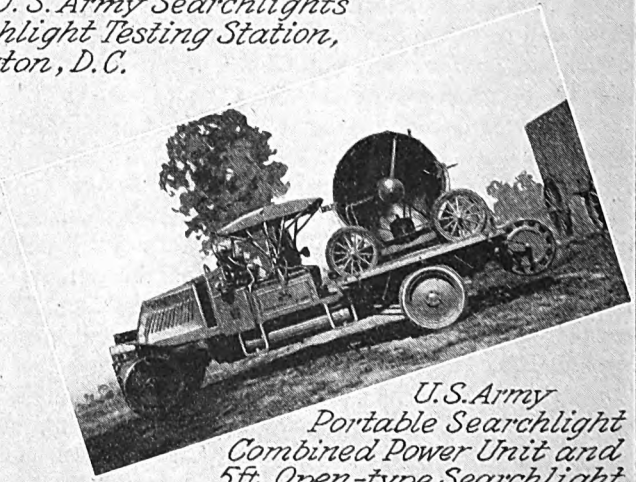
The point which the writer wishes to make is that water-power development and extension of plants is almost certain to increase now that attention can be given to expansion, and especially since Congress has had it forcibly brought to mind that national interest demands utilization of water power. As a result the need of a standard testing code will be felt more than ever before by purchasers of hydraulic turbines, as their acceptance of the machines depends on tests made at site. A complete and suitable working code which has the approval of both the manufacturers and the most prominent engineers in the hydroelectric field exists in the form of the "Machinery Builders' Testing Code," so that it only remains for the national engineering associations which are interested in water turbines formally to adopt this code, embellishing or revising it where necessary. In order to expedite this work, the coöperation of turbine users or engineers having to do with the purchase of waterwheels should be given without stint, for the need of a national code of this character will be greatly felt in the readjustment period ahead.



Latest 5ft. Open-type U. S. Army Searchlights in Operation at Searchlight Testing Station, Washington, D.C.



U. S. Army Portable Searchlight



U. S. Army Portable Searchlight Combined Power Unit and 5ft. Open-type Searchlight

Searchlight Equipment in Use by the United States Army

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Arc-Welding Systems

Rapid Advancement of Arc-Welding Practice Makes a Thorough Understanding of the Fundamental Principles Essential—Welding Systems Are Discussed in a Broad Way, Showing Advantages and Special Usefulness of Each Method

BY OTIS ALLEN KENYON
Chief Engineer Arc Welding Machine Company

IN THE last five years arc welding has made greater advances toward the practical realization of its potential value than were made in the previous twenty-five years, and we are on the threshold of even greater things in the near future.

In the present article the fundamental principles of arc welding are broadly treated, giving due consideration to the physical laws underlying welding practice. It is assumed that the reader is familiar with Bernardos, Slavianoff and Kjellberg and that he thus knows the basic principles of arc welding. In a later article commercial applications of arc welding will be discussed and certain data will be given on welding practice.

In order to visualize present progress, the fundamental types of arcs in use to-day will be taken up, and the types of apparatus used to supply the electric energy will be discussed briefly in an endeavor to bring out the practical bearing of the various characteristics of welding operations.

CHARACTERISTICS OF ARC TYPES

There are four fundamental types of arcs in use, namely:

1. Constant potential applied to the arc and the fixed resistance in series therewith.
2. Variable potential applied to the arc, rising with falling current and falling with rising current.
3. Constant current.
4. Alternating current with reactive control.

Constant Potential.—This system is the oldest and is the only direct-current system which permits the connection of more than one arc in multiple on the same circuit. The voltage of the line ranges from 60 to 80, while the voltage of the metallic arc varies from 18 to 22 under average conditions of proper use; therefore from 40 volts to 60 volts must be absorbed in resistance. The ballast resistance limits the rise in current at the start and steadies the arc by varying the voltage across it so as to counteract changes in current.

In Fig. 1 is shown the volt-ampere characteristic of such a system, assuming values in wide practical use, namely, 150 amp. at 20 volts and $\frac{5}{32}$-in. (4-mm.) mild steel electrode. In practice the arc may vary, depending upon the operator, from 15 volts to 45 volts while welding, and when the arc is broken it will rise to a value that depends upon the voltage and inductance of the circuit. The temperature curve shown in Fig. 1 is obtained by dividing the power dissipated in the arc by the rate at which the metal is melted at the current value in question. This latter value is taken from observed data and is expressed in pounds per hour. Therefore the unit is kilowatts per pound per hour.

The current regulation of this system is excellent when operated by a skilled welder. By this is meant that the arc is steady and the current free from violent momentary fluctuations due to rapid variation in the counter-emf. of the arc. Furthermore, with this system the operator can learn to vary the heat over a considerable range by holding a longer or shorter arc; that is one of the principal reasons why the constant-potential system gives such erratic results in practice. A skilled operator uses the heat-varying feature to adapt the arc to the exact requirements of the weld from one instant to the next, while a less skilled operator may cause considerable variations in the heat without reference to the requirements of the work.

Variable Potential.—The variable-potential system is more difficult to generalize, because the characteristic depends entirely upon the design of the generator. In Fig. 2 is given the characteristic of one of the best known variable-voltage machines on the market. The variable-voltage generator has a drooping characteristic, and its normal operating current can be varied over a limited range. A reactor or stabilizer is usually employed to prevent constant surging of the current and emf. of the arc. Some machines possess enough internal reactance to stabilize the arc without the use of any external device.

The characteristics shown in Fig. 2 do not hold for the heat rise when the arc is broken, as in that event the current persists with increasing emf. until the energy stored in the inductance of the circuit, whether it be in the machine itself or in an external reactance, has been dissipated in the arc.

In this arc it is seen that the greatest stability of heat is obtained with a relatively long arc, and though the current varies more with the length of the arc than in the constant-potential system, the heat varies less, provided always the arc is not too short. There are some who do not advocate long arcs on account of the fact that the metal is unnecessarily exposed to the air, which is supposed to cause oxidization. The variable-potential arc with reactance in series is easier to hold than the constant-potential arc because of the relative constancy of the heating effect with a comparatively long arc. Unless the operator exercises due care to maintain a short arc at all times, however, there is a tendency to porous metal.

Constant Current.—This system is applicable to single arcs and to arcs in series. The characteristics are shown in Fig. 3. Comparison with Figs. 1 and 2 reveals the fact that the constant-current arc suffers a greater change in temperature of the metal with increase in length than either of the others. As far as decrease in length is concerned, the energy per pound of metal is practically the same in all systems. However, the increase in current and the corresponding increase in flow of metal in the variable-potential and constant-potential arcs make it harder to hold a short arc than with the constant--current system.

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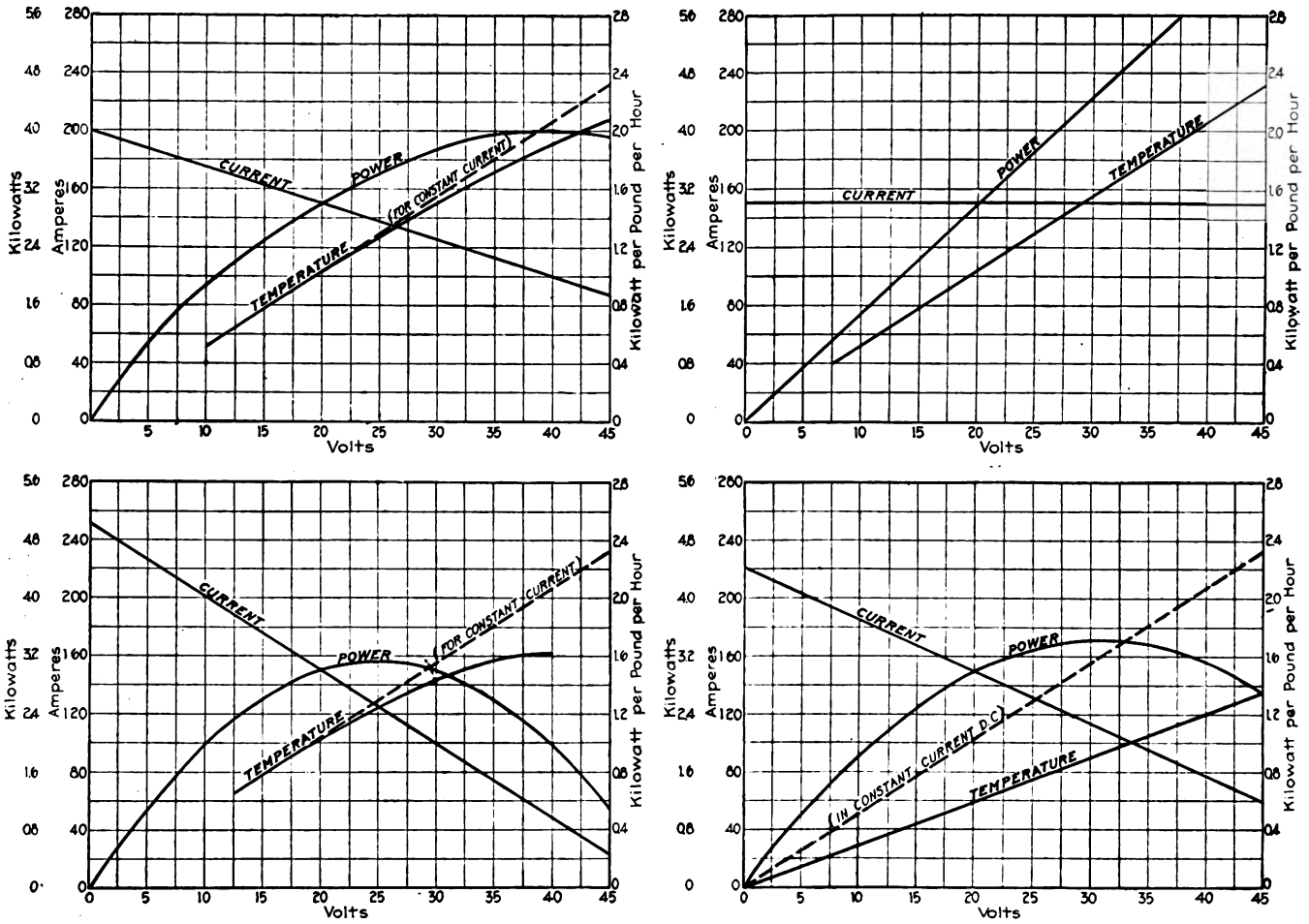
The distinctive characteristic of the constant-current system is the uniform flow of metal, which in itself greatly reduces the skill required to hold a short arc, and since the constant-current system, to be successful, requires a short arc this may be said to be a fortunate coincidence.

The author has devised a shunting control which permits the volt-ampere characteristic of the constant-current arc to be changed at will. By means of a shunt, the current line can be rotated in a clockwise direction about the normal point as a center, and by the use of a resistance in series with the arc and included by the shunt, a line of given slope can be raised or lowered to any desired point below the normal line current. In other words, the slope of the current characteristic is determined by the resistance of the shunt, while the percentage shunted from the main line is determined by the resistance in series with the arc. If we assume a 200-amp. constant line current and shunt the arc with 0.4 ohm resistance, we obtain exactly the same volt-ampere characteristic as in Fig. 1, and by varying the value of this shunt we can obtain any characteristic between the constant potential of Fig. 1 and the constant current of Fig. 3.

It so happens that the maximum percentage that can be shunted without seriously affecting the stability of the arc is that which corresponds to the volt-ampere characteristic of an arc fed from an 80-volt constant-potential circuit. However, as was mentioned before, the percentage of shunting can be increased to any desired degree by using the series-parallel shunt, as shown in Fig. 5. The series portion acts in a way which stabilizes the arc.

Alternating Current. — The alternating-current arc volt-ampere characteristic is shown in Fig. 4. On account of the alternations of the current it is impossible to draw a long arc, so that a short arc in necessary, and since a short arc with this characteristic is more sensitive to slight variations than a long one, the alternating-current arc is harder to hold than the same type of direct-current arc. The use of coated electrodes greatly assists in holding an alternating-current arc by retaining the hot vapors more readily than bare electrode does. Therefore, where the alternating-current arc is used the coated electrode should be employed if best results are to be expected.

The characteristics in Fig. 4 cannot be compared directly with those of the direct-current arcs because the melting rate of the alternating-current arc operated with coated electrode is much higher than the direct-current arc with bare electrode. First of all, the energy released on the electrode side of the arc is more, and then, on account of the insulating quality of the coating, it takes less energy to produce the temperature. From the curve it is seen that the characteristic of this arc lies between the variable-potential arc which is shown in Fig. 2 and the constant-potential arc which is shown in Fig. 1.



FIGS. 1, 2, 3 AND 4—CHARACTERISTIC CURVES OF ARC-WELDING SYSTEMS

Arc current and power are plotted against voltage at the arc. The arc temperature being proportional to the kilowatts per pound of electrode melted per hour is expressed in this unit. The top set of curves refer to constant-potential and constant-current systems respectively, while the bottom apply to variable-voltage and alternating-current systems.

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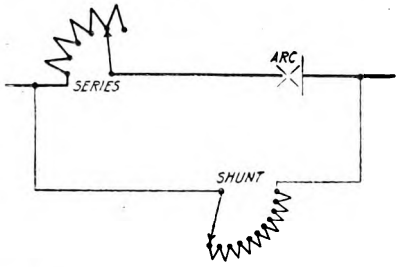
There are seven fundamental types of supply systems in use for arc welding, namely:

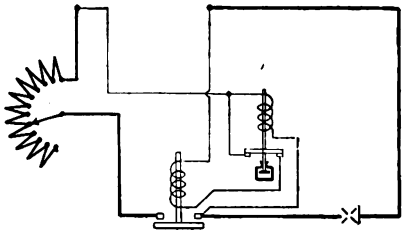
1. Constant-potential generator, 60 volts to 80 volts, for use with fixed ballast resistance.
2. Constant-potential generator, 35 volts to 45 volts, flat compound, for use with automatically regulated ballast resistance.
3. Constant-potential two-voltage generator for use on three-wire system with fixed ballast resistances.
4. Differentially wound, separately excited generator, designed with drooping characteristic to limit current on short circuit and limit emf. on open circuit.
5. Differentially wound, separately excited generator operated with its motor as a balancer from 125-volt circuit.
6. Constant-current generator.
7. Alternating-current transformer designed with large leakage reactance to produce a drooping characteristic similar to that of the differential wound, separately excited generator.

Constant-Potential Generator, 60 to 80 Volts.—This type of welding supply is so well known that little need be said concerning it. Sixty volts is the practical low limit at which regulation can be obtained. Eighty volts is used more often than 60 volts, however, because the regulating characteristics are so much better.

Special control apparatus is used with this type of generator by some manufacturers to limit the duration of the initial rush of current when starting and also when the electrode sticks to the work. The wiring diagram of a typical system of this kind is shown in Fig. 6. Still another system uses a higher resistance in series with the arc at the start and then cuts out part of it automatically as soon as the arc is started. One of the oldest systems employs a contactor operated by the current through the arc to insert a resistor in place of the arc each time the arc goes out of circuit, thus maintaining a constant load on the generator. This, of course, is extremely wasteful of energy and requires a generator of higher rating than otherwise need be used.

The chief objection to the constant-potential high-voltage system is the loss in ballast resistance of from two to three times as much energy as is actually required for welding. On the other hand, it is a simple rough-and-ready plant that requires considerable welding skill but no electrical knowledge to operate.





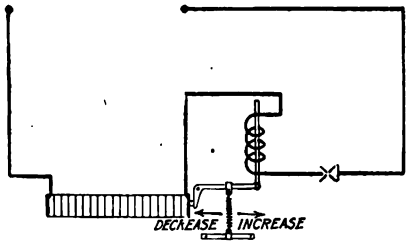
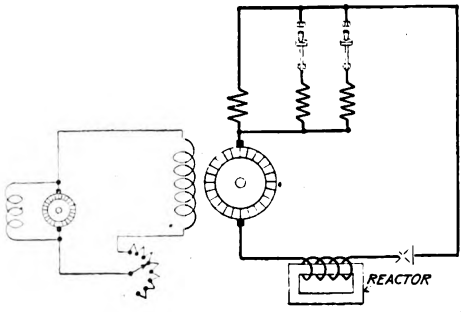


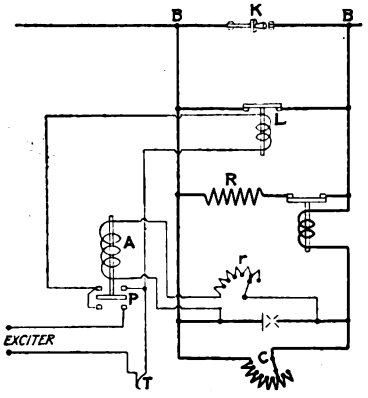
FIG. 5—SERIES-PARALLEL CONTROL CIRCUIT. FIG. 6—CONTROL WIRING WITH CONSTANT-VOLTAGE GENERATOR. FIG. 7—SCHEME FOR GETTING CONSTANT CURRENT WITH CONSTANT-VOLTAGE GENERATOR

Constant-Potential Generator, 35 to 45 Volts.—This system employs a standard flat compound generator to feed a special constant-current controller. The wiring diagram is shown in Fig. 7. The carbon pile and the solenoid that operates it are in series with the arc, so that the current through the arc is controlled by the automatic variation of the resistance of the carbon pile, in response to the pull of the solenoid. The pull of the solenoid is balanced in turn by a spring acting from a leverage, and the current adjustment is made by changing this leverage. A pilot motor that may be controlled by a switch from the welding tool handle regulates the leverage, so that the operator can change his current adjustment at will while welding,

In this system the power lost in the line and in the automatic resistor is reduced to from three-quarters to one and a quarter times the energy actually required for welding, which is a great saving over the constant-potential generator of higher voltage. This system also has the advantage of constant current through the arc, and when the generator is wound for 35 volts it limits the length of the arc sufficiently to give a very favorable break. But when the generator voltage is greater than 35 this advantage does not exist.

The range of current adjustment on a given control





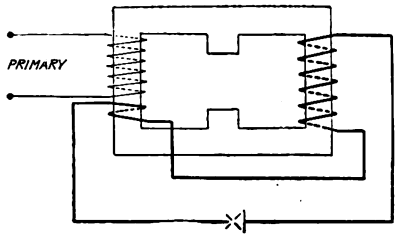


FIG. 8—DIFFERENTIALLY WOUND GENERATOR WITH REACTOR. FIG. 9—TYPICAL ARC CONTROLLER FOR CONSTANT-CURRENT SYSTEM. FIG. 10—HIGH-REACTANCE CONSTANT-CURRENT TRANSFORMER

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panel, by means of leverage, is from approximately 50 per cent up to the maximum normal rating of the carbon pile. However, control panels designed for any current value within the range of the supply circuit can be used simultaneously on the same line. In order to operate the automatic resistor, a drop of at least 5 volts must be available, therefore the line drop must be kept down to less than 5 volts when the supply is 35 volts. This means that the work must be carried on near the generator, because of the cost of copper.

The low-voltage, constant-potential system with the automatic constant-current regulating control panels, involving considerable special apparatus, requires intelligent care by an electrician if the advantages of the system are to be realized. When the remote-control feature is eliminated, however, and the adjustments put in the hands of a competent man, more uniform results can be obtained with comparatively inexperienced operators than with other constant-potential systems.

The author does not approve of the feature that permits the operator to vary the current at will except where expert operators are concerned. It is this very feature that should be avoided in improving upon the constant-potential arc. On the other hand, this feature is valuable in repair work that is handled by highly skilled operators, as it enables the operator to adjust the current to meet the exact needs of the work without stopping the arc.

Constant-Potential Two-Voltage System.—One manufacturer has put on the market a three-wire system that furnishes a high emf. through a comparatively high ballast resistor to start the arc, and once the arc is started and the current reduced to a predetermined value, the arc is automatically transferred to a lower voltage line with a comparatively low ballast resistor. The regulation of the arc on the low-potential system is naturally much more sensitive than on the high emf. system. The only object of changing from high to low is to accomplish a saving in energy once the arc has been established, the regulation being left to the steadiness of the welder's hand. Incidentally, this system limits the length of the arc, on account of its instability and also on account of the low voltage.

Differentially Wound Generator.—This type of machine is marketed under various names, such as "variable voltage," "constant current" and "constant energy." "Variable voltage" is correct. "Constant current" is absolutely a misnomer, as a glance at Fig. 2 will reveal. Constant energy is approximately true over a very limited range. Every system is a constant-current and also a constant-energy system when the operator holds a perfectly steady arc, otherwise there is no constant-energy system on the market. Constant current can be obtained by a properly designed generator, but constant emf. at the arc can be obtained only by a steady hand, although a constant current through the arc assists the operator in holding a constant voltage.

In Fig. 8 is shown a typical wiring diagram of the variable potential system, using a reactor or stabilizer in series with the arc. The generator is differentially wound and taps are brought out from the series winding which carry the arc current, or the series winding may be shunted as indicated in Fig. 8. This field is opposed by that produced by a separately excited field. The normal welding current can be adjusted from about 40 per cent to its maximum value by varying the differential turns and the separate excitation. The machine is limited to use with one arc. Its characteristics were described in connection with Fig. 2. It is easily portable and simple to operate, therefore well adapted to many classes of work that do not require the finest degree of control. The energy loss in the welding circuit is extremely small, as no ballast resistance other than the reactor coil is required.

The chief disadvantages of this machine are the very considerable change in the flow of metal that takes place with change in the length of the arc and also the very large energy discharge that occurs each time the arc is broken when changing welding electrodes. In some kinds of work these characteristics are not objectionable. There are cases, however, where they cannot be tolerated.

Balancer.—This system, as far as welding characteristics are concerned, is practically the same as the variable-potential generator just described, and the description need not be repeated. The machines that have been put on the market are more sensitive as far as regulation is concerned than the straight single-arc machines and therefore require more skill to hold the arc unless the open-circuit voltage is set at 65 or higher. It has the advantage of saving enough material, as compared with the straight single-arc machine, where a sufficiently large installation is involved, to pay for the 125-volt generator required to operate the balancer.

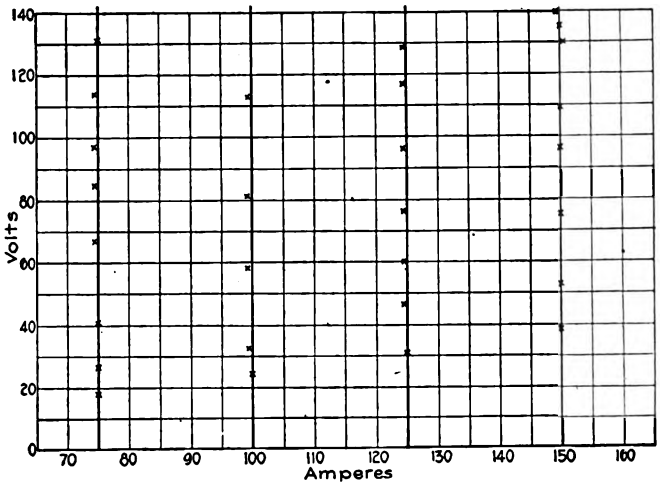

FIG. 11—TEST CURVES FOR CONSTANT-CURRENT GENERATOR WITH AUTOMATIC EXCITER

Constant-Current Generator.—There are two types of constant-current generators that have been used for welding purposes, namely, (1) Rosenberg generator, (2) separately excited shunt generator with automatically regulated field current.

The Rosenberg generator has been used almost exclusively in Europe. It is a very heavy and expensive machine for its output and therefore has not been taken up extensively in this country. There are two types of regulated field machines in use, namely, (1) field current regulated by automatic resistor, (2) field current regulated by automatic exciter. Both these machines are employed in systems covered by patents issued to the writer. The first is used for one-arc installations, and the second for from one to ten arcs in series. The first provides approximately constant-current regulation over a limited range of current adjust-

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ment (40 per cent to maximum), while the latter furnishes a practically perfect regulation over the entire range of the machine for all currents and voltages. Fig. 11 shows the results of an actual test of the latter system.

Connection of arcs in series requires that each arc on the same circuit be used on a separate piece of work and that the main circuit be kept closed at all times. This excludes the series system from ship welding and much of railroad shop welding. The natural field for the series or closed-circuit system is in manufacturing or production welding, where large numbers of the same type of welds are to be made.

A wiring diagram of a typical arc controller for insertion into a constant-current line is shown in Fig. 9. The controller is connected in series in the line at *BB*, and the knife switch *K* cuts out the controller by short-circuiting it. With *K* open and no welding going on, the contactors *S* and *L* are closed and pilot relay *P* is open. The path of the current is through the short circuit closed by contactor *L*. Preparatory to welding, the operator presses the trigger *T* in his welding handle. This excites coil *L* and opens the short circuit, leaving the resistor *R* across the terminals of the controller. The drop through *R* establishes a starting emf. across the terminals of the arc, and by varying *R* this starting voltage can be adjusted to any desired value. The arc is struck in the usual way and the current through *S* opens the contactor, dropping the resistor *R* out of circuit. The operator can then proceed with the arc until the voltage of the arc is drawn out to such a value that the current through coil *A* lifts *P*, cutting off coil *L* and short-circuiting the arc. The limited arc voltage that will automatically trip out the arc is set by adjusting rheostat *r*. It will be noted that the arc can be tripped out at any time without lengthening it simply by releasing the trigger *T*. If less than full line current is required, the excess is shunted around the arc through the rheostat *C*.

This type of control is expressly adapted to production work with ordinary labor, because it enables the foreman or expert to determine or adjust the current, length of arc and the regulation characteristic of a given panel, and the welder cannot operate it in any way except as set. There are a number of special types of controllers used on this closed-circuit system, but the diagram in Fig. 9 gives the basic principles involved in all.

Welding Transformer

Alternating current with ballast resistance has been used in arc welding for a number of years. With bare electrodes there are some obstacles, because it is difficult to start an arc on cold metal, although once the metal is heated up the arc works fairly well. With the covered electrode the arc is easily started and held from such circuits.

Recently special welding transformers designed with large leakage reactance have been placed on the market. The general scheme of the reactive method of control is contained in the diagram of Fig. 10. The primary winding is connected to the distribution line. The major portion of the secondary winding or welding circuit is wound on a separate leg of the magnetic circuit, and a smaller portion on the same leg with the primary, to give a fixed maximum voltage on short-circuit. Excessive current is prevented by leakage across the magnetic shunt between the primary and the secondary. As current in the welding circuit increases, part of the magnetism is forced across the air gap, and thus the voltage decreases until the balance is struck.

The welding transformer uses no ballast resistance; therefore its energy efficiency is high, but on account of its high leakage reactance its power factor is low. The system is chiefly important on account of its low first cost, and since its low power factor means excessive primary capacity (line copper, transformers, generators, etc.) its field of commercial application is naturally limited to small installations where the excess primary capacity already exists. If this excess capacity has to be provided, the alternating-current system becomes the most expensive of all.

As far as welding results are concerned, it does not differ materially from the various standard direct-current systems on the market. However, on account of greater sensitivity of the arc, and also on account of the fact that covered electrodes are practically necessary, it is more expensive when operated at all continuously than some of the other systems.

DISPOSING OF GOVERNMENT CONSTRUCTION MATERIAL

Large Supplies on Hand Demand a Method for Their Disposition Which Will Not Interfere with Markets in This Country

The Western Society of Engineers, Chicago, has been asked to approve and adopt a plan for the use of the enormous quantities of construction supplies on hand to aid in the physical restoration of France. The chief points of the plan are:

1. That the United States shall propose to France to collect all construction material now in warehouses and yards in this country and in France to be turned over to France, and that the delivery of this material be expedited by every possible means.

2. That the value of this material shall be considered a part of the cost of the war and shall be charged to Germany.

3. That a part of the construction division, Quartermaster's Corps of the United States Army shall be sent to France to work with French engineers in planning the erection of this material into the needed buildings in the devastated area.

In submitting this plan, John V. Shaffer pointed out that one-sixth of the area of France has been entirely devastated, that 350,000 homes and one-sixth of the pig-iron industry of France have been entirely ruined, and that one-fifteenth of the French people are gone at this time when speedy rehabilitation is most desirable. Aside from the humanitarian reasons why the United States should carry out this program, Mr. Shaffer stated there are many economic reasons why the plan is desirable. The principal among these are that such disposal of the material would tend to stabilize American markets, would assist in developing our foreign trade, and would create a demand for additional material since that on hand is insufficient for carrying on the complete physical restoration of France.

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The Advantages of Uniform Motor Design*

Opportunities That Are Afforded for Enlarged and More Profitable Business Through the Improvement of Efficiency and Economy of Electric Motor Drive from the Standpoint of Operation, Maintenance and Repairs

BY JAMES BURKE
President Burke Electric Company, Erie, Pa.

THE purpose of this paper is to start a constructive discussion on the advantages of a uniform motor design. It is a privilege to be able to tell you about some work accomplished in this direction in another land, some of which may be applicable to conditions existing in this country.

The movement was started by the efficiency committee of a large manufacturing company which had wisely adopted electric motor drive throughout its various plants and was constantly buying new motors in connection with the rapid growth of its plant. Naturally all the manufacturers of electric motors were endeavoring to get their share of this desirable business, and each motor manufacturer presented the good points of his motors by calling attention to how they differed from the equivalent in motors of their competitors. One told about his practice in using more commutator bars than the other. Another told about using larger shafts than the others. Another told about furnishing larger pulleys than his competitors. One brought out strongly the relatively long distance between bolt holes on the feet in the direction parallel to the shaft. Another called attention to a similar dimension but at right angles to the shaft. All of the motor manufacturers were unanimous in claiming that each one was entitled to the entire business or to at least a fair share of it. The efficiency committee of the purchaser studied over the matter, which had been well presented to them by the motor manufacturers, and also carefully considered the practical experience which the purchaser had undergone with the motors already installed, and then wrote the following letter to all of the manufacturers of electric motors:

Gentlemen: As large purchasers of motors we feel that you ought to know our opinion of your product and the considerations which influence our decision in purchasing.

Your representative was under the impression that your prices should be the determining factor, and we want you to know that this is really of secondary importance. We are willing to pay much higher prices if the increased investment is justified by the economies in the operation of our plant as a whole.

You all manufacture good motors, and each one of you has certain good points, but your motors are all so different from each other and your good points differ so much that if in any one of our plants we use motors of several different makes we have as much confusion as if our foremen were of a variety of nationalities each speaking his own language and all having very limited vocabulary in common. We think that individually your motors are fine fellows, but collectively you are very poor for team work.

In the operation of all of our machinery we necessarily have repairs to make, and we feel that a reasonable amount of repairs on electric motors is to be expected. We maintain an efficient repair department and carry spare parts and also spare motors. If a motor breaks down, we replace it with one of our spare motors, and repairs are made on the defective motor in our repair shop, where we try to practice some of the economies employed in regular manufacture.

It is naturally embarrassing and expensive to find that if the spare motor happens to be of another make we have to change the foundation on which the motor is placed or spend some money on temporary structure, all because the dimensions and location of the feet and holding-down bolts are arbitrarily determined and the different motor manufacturers are so arbitrary that they intentionally make them different. We have been told that there are inherent differences in electrical design which necessitate these differences in location of feet, etc., but we submit for your consideration that it would be possible for us to standardize certain plates on which we could attach motors as we purchased them, and these plates, which would become sub-bases, would make the motors interchangeable from that standpoint. You can doubtless save the expense of such plates or sub-bases by making them integral with the motor, which of course means simply adopting some standard dimension of feet and bolt-hole location and bolts. We would rather pay you what the uniform sub-bases would cost us than to have the trouble of making these ourselves, and as your only expense would be in making some changes in patterns and jigs we submit that this investment would be warranted by your increased receipts.

SHAFTS AND PULLEYS

After taking care of our foundation problem and getting the spare motor into operation, it is very embarrassing to find that the driven machine is operating at a different speed due to the pulley on the spare motor being of different diameter from the one previously operating at that location. Our first thought is to take the pulley off the defective motor and put it on the spare motor, but we find that between these two motors of the same horsepower and speed there is a difference in the diameter of shaft of $\frac{1}{16}$-in., and therefore we have either to bush or bore out the pulley. We have been told by some motor manufacturers that their shafts are calculated by the best kind of mathematics that money can buy and that they cannot make any changes. Of course, one remedy would be for us to buy our motors without pulleys and adopt our own standard of shaft diameters for each horsepower rating of motor and buy our own pulleys accordingly. We know that no manufacturer of motors is supplying motors with shafts so small that they will break in practice, and therefore we could adopt as our standard the diameter of shaft of that motor which has the smallest diameter and turn down all shafts of other makes of motors of this horsepower and speed to this same dimension. However, we would rather pay the motor manufacturer to do this for us and save us the trouble.

BOLTS, NUTS AND SCREWS

A complaint was recently made that our repair department spoiled the appearance of bolt heads and nuts by using monkeywrenches on them, and the obvious remedy was to use standard wrenches. However, it was found that there was no uniformity in the dimensions of nuts and bolt heads and that a large variety of wrenches would be required for each size of bolt or nut. Even when it was attempted to follow the national standard, we found that some manufacturers used machine-finished nuts, while others used hot-finished nuts and bolt heads, and still others entirely rough, and that there was enough variation between them to make the standardization of wrenches impracticable.

Of course, sometimes a cup screw gets damaged or

*Address before Electric Power Club at Cleveland, Ohio, Jan. 15, 1919.

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broken, and it is our practice to carry a variety of cap screws, bolts, nuts, etc., in stock for repair purposes. One of our recent experiences was that a ½-in. cap screw was broken in taking it out of a motor, and although we had some of this size in our spare-part collection which we carry in stock, we found that it was of no avail because the broken one had twelve threads to the inch and our spare stock had thirteen threads to the inch. This led to an investigation of why we had purchased a ½-in. cap screw with thirteen threads to the inch, and we found this was selected from a certain motor which was under repair at the time the selection was made. Further investigation showed that some motor manufacturers use twelve threads per inch and others thirteen. We called this to the attention of a salesman from one motor manufacturer, but he thought that a difference of one thread was not worth talking about. He may be right, but we feel that it is at least worth paying for, and we will pay a little more for motors that are practically standardized in this respect as well as theoretically. We are aware of the fact that for the ½-in. screw both twelve and thirteen threads to the inch are national standards, but why don't the motor manufacturers adopt one of them and forget the other?

WIRE

Some years ago motor manufacturers used special sizes of wire, and when we had a breakdown requiring rewinding we experienced a long delay in getting this special wire from that particular motor manufacturer. Of course, our requirement was too small in quantity to get any of the wire manufacturers to make it for us. In a good many emergencies we could not wait, and so we used the nearest standard size of wire that would fit, and although at first we did this with fear and trembling, as we had heard so much of the exact calculations made by motor manufacturers in determining the size of wires, nevertheless we did not encounter any serious results. We are happy to find that practically all of the motor manufacturers now pretty generally use the standard wire gages.

Occasionally we find square wire used in armatures, and while we realize that this is done to obtain a greater output from the same size of machine, we would rather pay more for a machine wound with round wire. We would thereby avoid carrying in stock square wire for repair purposes, and in addition to this our repair department tells us that it is more difficult to repair a machine with square wire than with round as the sharp corners result in damage to the insulation. In several cases we have substituted round wire for the square in repair work. We do not claim that our repair men are engineers or that they know anything about the mathematics of electricity, but we think that if your engineers knew some of the things that our practical repair men do motors would be better from our standpoint of operation and maintenance. Sometimes we run across motors with armatures wound with rectangular copper of some odd dimension which cannot be purchased in the open market, and quite often the manufacturer of that motor is out of the stock of that special size of copper when we need it for repairs. We may continue to buy motors from that manufacturer, but we discontinue that particular size from him.

COMMUTATORS AND BEARINGS

We carry some spare commutators in stock for repair purposes, but we naturally cannot carry all sizes of all motor manufacturers. If commutators could be standardized, we would be in much better shape for making our repairs, and the records of some makes of motors as to the number of days that they are out of service when repairs are necessary would be very much improved. We fully appreciate that commutators are expected to wear out in time, and the fact of a necessary replacement of commutator only becomes conspicuous with us on account of the delay incidental thereto.

Sometimes we have to put in new bearings due to the natural wear in use or occasionally to neglect in oiling. This means that we have to carry in stock reserve bearings for every size of motor multiplied by every make of motor. We have no criticisms of the bearings in any of the makes of motors which we are using, and would be satisfied to have any one of them adopted as the standard, and our repair problem would be much simplified thereby.

The variety of sizes of brushes is a serious complication and necessitates the carrying in our repair stock of about thirty-five different sizes of brushes. As we have to buy these in fair quantities, you will realize the large amount of money which we have to keep tied up in this item alone and also the care necessary to be sure that we do not run out of any one of these sizes. We do not understand why, for a motor of any specified horsepower and speed, the same size of brushes could not be used by the various motor manufacturers.

Recently we were in the market for a motor and wanted to place the order with a motor manufacturer who we had heard was furnishing very good motors, and wished to give that concern an opportunity, but it was pointed out that we had in use fifteen motors of this horsepower and speed of another make, and also had two spare armatures, and that we would be safer to get another motor of the make in use on account of the advantage of the spare armatures. Of course, this condition could be met by buying an extra armature with the new motor of the make which we did not have in use, but we felt the expense of this armature was not warranted. The thought occurred to us that possibly the armatures might be interchangeable between the motors which we had in use and the one which we desired to purchase, and so we asked for information on certain dimensions of the armature and compared same with the spare armatures on hand. We found that one had an armature core of 18¼-in. diameter, with 8 in of punching assembly, and the other had 18½-in. diameter with 7¾ in. punching assembly. One had sixty armature slots and the other had sixty-four. One had 120 commutator bars and the other had 128. The length of the commutator on one was ½ in. longer than on the other. Of course, we appreciate that there must be good scientific reasons for these slight differences, but we felt that the differences were so slight, although sufficient to make interchangeability impossible, that the adoption of some compromise between these two might not have resulted in a very bad motor.

In conclusion, we wish to say that, although you may find our ideas theoretically and scientifically wrong, we feel that from a practical standpoint they are right, and are willing to back them up by paying more for motors which embody these features of interchangeability. Our idea of the magnitude of this problem is best expressed by what we would be willing to pay for these advantages. We feel that, for any given size and speed of motor, if five motor manufacturers are using a uniform and interchangeable design, we would be willing to pay to each of these companies 10 per cent more a motor than to the companies that are not following the uniform design. Further, if any five companies adopted some plan of uniformity and interchangeability in their complete line of motors, we would feel strongly inclined to place our entire business with those companies provided they could supply our requirements.

Yours for progress, EFFICIENCY COMMITTEE.

The motor manufacturers were righteously indignant at the presumption of this purchaser in trying to tell them how to build motors. Some of them replied, and a few samples of these letters are given. One of them is as follows:

If we all manufactured motors of the same dimensions and practically the same design, the initiative of our designing engineers would be killed and salesmanship would cease because our salesmen would have no talking points on the features of our motors compared with those of our competitors.

To this the sender received the following reply:

All of the steel mills furnish channel, angle and other shapes of uniform design and dimensions and weights, and notwithstanding this the demand for steel engineers is greater than the supply. Steel manufacturers probably make nearly as large percentage profit as motor manufacturers, and their salesmen usually have something to talk about.

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Another motor manufacturer wrote as follows:

Even if uniform design was adopted, the motors and parts would not be interchangeable on account of variations in manufacture.

To this the following reply was sent:

There are some companies which furnish new commutators to fit any of the standard makes of motors, and we know from experience that they do fit. Cannot each motor manufacturer do equally accurate work compared with these concerns that make spare commutators? We know that five manufacturers of ball bearings make the ball bearings interchangeable, so that if we have a motor with one style of ball bearings in it, any of the other four makes will fit. Why cannot motor manufacturers who manufacture plain sleeve bearings, which are much simpler than ball bearings, maintain a quality of workmanship which will keep them interchangeable? The problem is much simplified by adopting some standard make of gages. We know of one large motor manufacturer operating three manufacturing plants on the same kind of motors of uniform design, which they claim are interchangeable. If these three plants were owned by separate interests instead of one interest, the problem should not be changed. All you need is coöperation.

Another manufacturer wrote as follows:

I have the honor to be president and financial backer of our company. I started my electrical career by investing a small amount in a new company which was going to manufacture motors and put all the other motor manufacturers out of business. I am permitted to make an additional contribution every year, and after doing so our books just balance without any profit or loss to worry over. Your kind words look good to me, and I am going to invite the president and financial backers of a number of the motor manufacturers to a conference on this subject. I feel better already.

The convention of the motor-manufacturing presidents was more in the nature of a court of inquiry, and the designing engineers of various companies were called before them for opinions and explanations. Their opinion varied to some extent, but in general the conclusions were that from an engineering standpoint a uniform motor design was morally wrong, with a minority opinion that it was morally rotten; that the consumer and purchaser of motors would be getting more than he was entitled to; that the manufacturer of electric motors would be degraded into an ordinary money-making business without a soul and without artistic temperament.

Opportunities for Standardization

Finally one of the presidents advanced the idea that all the talent in the designing of electric motors was progressive and energetic but was misdirected, and that the mistake had been made of expecting engineers to organize the business instead of conducting engineering work along lines laid down by the organization. The ultimate outcome was the formation of an organization known as "The Electrical Manufacturers' Institute." This institute has undertaken not only the problem of uniform motor design but many other problems that will make the manufacture of electric motors a more profitable and happier business.

The institute has laid down the fundamental principles that the best way to sell more motors is to create a bigger demand for them and that everything which will improve the efficiency and economy of electric motor drive from the standpoint of operation, maintenance and repairs is going to create a correspondingly greater demand; that the real competition which motor manufacturers have to meet is not with other makes of motors but other forms of power transmission; that many of the best engineers are wasting their energies in designing different kinds of motors for each motor manufacturer, whereas a small group could do the designing for all of the manufacturers and the rest of them would be available for the broad and better field of application engineering.

Some of the work already accomplished by the Electrical Manufacturers' Institute may be worthy of notice, all committees being under salary:

It has formed a "central bureau of design" employing at substantial salaries designing engineers selected from the various manufacturing companies.

It has formed a "central testing bureau." All new designs of motors are tested in this bureau, and the characteristic information, such as on efficiencies, power factor and all other features of performance, is obtained and all experimental testing conducted in this bureau. This not only saves expense to manufacturers but is considered more authoritative as it is non-competitive.

It has formed a "committee on awards for improvements." This committee considers all suggestions and submits and discusses them with the central bureau of design and other committees, and if the suggestions are adopted, makes appropriate award. This takes the form sometimes of a recommendation of increase in salary, sometimes of a percentage of the saving made and sometimes of an award in cash. As an example of this committee's work, a suggestion was received from a young engineer that the terminal cables on motors were unnecessarily long and would be more convenient if made shorter. Incidentally he pointed out that an average of 3 in. of cable could be saved on each lead. The total saving to the motor industry amounted to an enormous amount, and this young engineer not only received a substantial increase in salary but a cash award amounting to about $5,000 in our money.

A committee on the purchase of material was formed which prepared specifications and gave advice to the purchasing agents of the various companies. Methods of making patterns were settled by this committee in coöperation with the various foundries. In many cases large quantities of castings were made at a few central points and distributed to the various manufacturers. The requirements for commutator bars and other special material were combined so that greater quantities could be made at a time with the resulting economy in cost.

A committee on preparation of bids was formed. This committee takes care of the preparation of all engineering information, which is submitted to a prospective purchaser in answer to his specifications and inquiries as the engineering information of all manufacturers using the uniform motor design, each manufacturer, of course, making his commercial bid separately. This committee plan was found necessary because engineering information or calculated and predicted test information varied so much between the different manufacturers, although they were all figuring on exactly the same design of motor.

One of the most interesting developments which have already taken place is the discovery that a great many of the formulas and constants which had been sacredly adhered to by designing engineering were entirely wrong. They were undoubtedly the best possible at

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the time they were developed, but have been handed down from one author to another and copied from one book into another without taking advantage of new evidence which necessarily modified these conclusions.

A new committee has recently been formed to cover the work of making every electric motor manufacturer a repair station for all of the manufacturers who are using the uniform motor design. This will permit of great saving in time in repairing motors for those concerns which are not large enough to have their own repair departments in various cities.

Incidentally it is thought that with every motor manufacturer who is following the uniform motor design, concentrating on the quality of his interpretation of this design, the life of motors will be very much improved and that the word "guarantee" will go into the discard.

Another committee which the Electrical Manufacturers' Institute has formed is the "export committee." It rightfully claims to have advantages over the manufacturers of all other countries for foreign trade on account of the uniform motor design and interchangeability.

The member companies are extremely enthusiastic and believe that their business will be lifted from the field of drudgery, long hours and worry to that of the pleasure of living with enough work to keep one healthy.

Now, gentlemen, what can we do in the United States along these lines? The United States of America has played a most important part in terminating a world war that had no parallel in history. We have manufactured shells and guns and other munitions all over the country and all in accordance with uniform design and interchangeability. The precision on shell manufacture has been greater than is necessary in motor manufacture, and many of the electric motor manufacturers have manufactured shells of uniform design and dimensions and have made good. Can we not do likewise in this business of our choice?

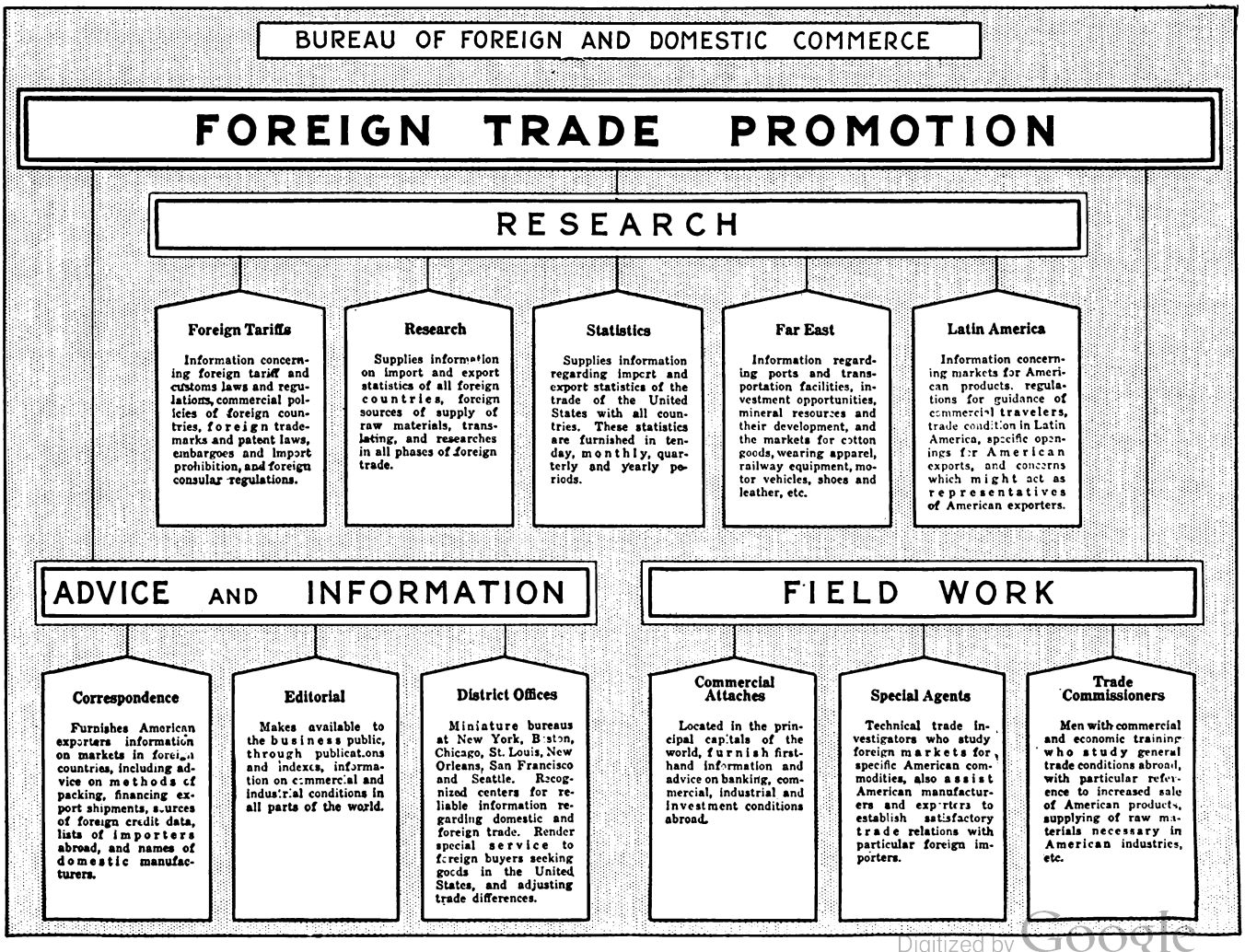
I hear some one asking in what land all these things happened, and I find that I overlooked mentioning this in the beginning of this paper. It was in the Land of Dreams, but sometimes dreams come true.

GOVERNMENT DIRECTION IN FOREIGN EXPORT TRADE

Bureau of Foreign and Domestic Commerce Organized to Assist Those Seeking International Markets—Trade Commissioners Now in This Country

The possibilities of the application to industry of the organization created by Secretary William C. Redfield of the Department of Commerce is shown in the accompanying diagram. From reports of the various trade commissioners now returning to this country many feel that the work of the Department of Commerce should be of infinite value to American manufacturers who are seeking foreign markets.

Aside from the information shown on this chart there is being issued a monthly index on statistics pertaining to specific articles of import and export, as well as general information on markets for given products.



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WHAT SHOULD AMERICA DO TO AID RECONSTRUCTION?

Calmness, Patience and a Steady Look Ahead Will Carry Business Safely Through the Period of Uncertainty

BY ROBERT K. SHEPPARD
Sales Manager, Simplex Wire & Cable Company

CALMNESS, patience and a steady look ahead into the not-too-near future will carry American business safely through the complexities of these post-war days. True, the world cataclysm has brought forth a new Europe and Siberia, a rearranged Africa, a firmly welded British Empire, an awakened China, a thoroughly energized America. But the force and ultimate grip on human affairs of the law of supply and demand have not been weakened by our efforts to suspend for a brief period that law's penalties and compulsions.

For generations to come the peoples of Central Europe must pay, directly to some extent, indirectly to a far greater degree, the stupendous taxes inherited from the war and the war's aftermath of "restoration, restitution and reparation." In those lands the daily wage, the weekly salary and the selling prices of all commodities will rise until the people can pay those taxes and also can obtain all of life's necessaries and some luxuries. The industrial effectives of the Central Empires have been decimated on the fighting fronts, by disease and by starvation. Just now chaos reigns. Perhaps never again, certainly not until political stability obtains, can the potential economic strength of Germany's surviving toilers be concentrated and flung against us in the mass formation which was as characteristic of Germany's foreign trade before as of her military strategy during the war.

Let these factors in the commercial struggle give pause to those who croak their warnings about impending destructive competion from those lands. Let sound economics prove to us that the sooner the Huns are busied industrially the faster will their inevitably high production costs become apparent from the prices they will demand for their goods, now that the reservoirs of imperial subsidies have gone dry forever.

France must restore her industries in the north, and elsewhere reëquip her factories for peaceful pursuits, before she will be ready for her full commercial endeavor. Even then her historic export policy, specializing on those commodities which her people can make best, many of them the world's luxuries, is not likely to change. For those goods France can and will obtain good prices. She is not a commercial lizard that she should discard tried garments of quality and high value for the tawdry of the cut-throat and the pirate.

Italy still is poor. Her manufactures are not comprehensively diversified. We need fear her rivalry in only a few directions.

Great Britain remains. She is a stern competitor because she is aggressive and never wearies. Her products generally are good. Her costs will not now be much lower, if any, than our own. Moreover, she is now embarked on imperfectly charted political seas. Her labor unions may yet sway those "right little, tight little" isles whose policies affect so large a part of this earth. Do American business men suffer sleepless nights for fear that labor rule in Great Britain will reduce her already high production costs?

France, Italy, Great Britain, all are saddled with the legacies of war in so big a ratio to their national wealth that the slow processes and inevitable incompleteness of German reparation will leave them burdened with heavy taxes for many a decade.

WHAT OF THE UNITED STATES?

Now what of our land?

Millions of young Americans, the youth in performing their military and naval duties, the women in their manifold services to the nation and her fighting sons, have learned that hard work pays. Let our people now understand that truly a nation prospers only as its material, mental and spiritual productivity increases.

When men produce more per worker, obtaining for that increased production proper increase in pay, then the workers will truly prosper. The products to be bought are more abundant, never more but often less costly per unit. Moreover, the worker has more money with which to buy.

Conversely, when men get more pay per worker for the same old volume of production per worker, the cost of living is universally raised so that the recipients of the extra pay are not profited. The products to be bought are not more abundant but they are more costly per unit. Each worker divides his increase between other workers and has none left for himself.

With their eyes so widely opened surely those young Americans will perceive, so let them teach, that as an individual's hands and brain produce per day or per year more and still more of the tangibles or intangibles which others require, so his life becomes richer, influential and finally successful.

When such men rule our country, their guidance is bound to be beneficent. Conceiving that their day of power now is at hand, we may answer the question, "What then should America do?"

1. Swing back swiftly to private control of every business activity which has not been fostered by, or has not acquired, public grants of land, natural resources, franchises, subsidies or other special privileges.

2. Repeal federal and state inhibitions against private coöperation and combination by individuals, natural or corporate, and impose healthily restraining federal supervision of the acts of every such combination of individuals or coöperative organization.

3. Under rational governmental supervision, retain or reinstate private control of quasi-public activities, especially those in the pursuit of which productive labor has to be employed.

4. Retain completely under government management only those activities which are essential to the maintenance of local, national and international law, order and justice.

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Water-Power Development on the Pacific Coast

Study of Economic and Financial Conditions Leads to Outline of Developments Approximating $50,000,000 Cost, and All of the Power Furnished Can Be Absorbed Easily Within Two Years After Development

BY MAJOR GEORGE F. SEVER, U. S. A. ENGINEERS

These extracts from a paper presented by Major Sever last month before the San Francisco Association of Members of the American Society of Civil Engineers follow his study and report for the War Industries Board. Upon the basis of the information that oil is likely to remain high, Major Sever pointed out that there has entered into the problem of electric power supply a new and serious factor which warrants an early and large development of hydroelectric power.

IN LAYING out a program for meeting the power deficiency it was necessary to consider what could be secured during one, two and three years. It was felt that the war might last at least until 1920, and consequently it was necessary to lay out a program which would provide for power to meet the present deficiency, the natural increase plus the power needed for additional war contracts and that amount which was deemed necessary to conserve fuel oil as used by the public utility steam plants. It is on the basis of this program that the developments which I will outline have been made.

In the first place it was desirable to secure developments which could be made inside of a year, then those that could be made available inside of two years, and further, those that might be brought in within three years, thus meeting the above-arranged program.

Six Great Power Companies

There are within the industrial districts of the central and northern part of the state six important power companies, known as the California-Oregon Power Company, the Northern California Power Company, the Pacific Gas & Electric Company, the Great Western Power Company, the Western States Gas & Electric Company and the Sierra & San Francisco Power Company.

There is no shortage of electric power, nor has there been any, on the system of the California-Oregon Power Company, and my investigations show that there was no shortage on the system of the Northern California Power Company. There has been a shortage of power on the systems of the Pacific Gas & Electric Company, the Great Western Power Company and the Sierra & San Francisco Power Company, and in my investigations I have paid particular attention to these three companies, as each of them has developments which can be easily and quickly made to meet the program that I have indicated should be followed. Each one of these companies has a fundamental development which is in use now for power supply purposes, and each one has a steam standby service which enables it to carry a portion of its load when there is trouble on the transmission lines from the hydroelectric supply. The steam stations also act as a means of regulating the voltage and for taking the short-time peaks on the systems.

After a careful inspection of the various developments, the author's recommendations as to the work that should be done on the Pacific Gas & Electric system are the raising of the dam at Fordyce Lake 21 ft. (6.4 m.) so as to add 11,800 acre-ft. (14,500,000 cu.m.) of storage, this water being spilled into Lake Spaulding and then put through the Spaulding, Drum, Halsey and Wise power stations, and later, in time, through a No. 2 station which is recommended to be built. The Fordyce dam is of the rock-filled type, with a wooden facing, and the 21-ft., (6.4-m.) increase in height is the most economical construction that can be secured. If it should be raised to a greater height, there would be required a largely increased expenditure which is not now warranted.

The second item is the raising of the Lake Spaulding dam 10 ft. (3 m.) so as to add 6423 acre-ft. (7,900,000 cu.m.) to the storage in this important reservoir. The additional water is intended to be passed through the Drum and other stations mentioned above, and also the No. 2 station, the construction of which is in contemplation. Besides these two increases in storage capacities, there is what is known as the "Bowman-Spaulding project," which will add a large storage capacity to the system, and the water would be spilled into Lake Spaulding. The building of a No. 2 station on the Bear River, with a capacity of 25,000 kw., will, together with the present stations and the additional storage, provide 233,000,000 additional kw.-hr. to the Pacific Gas & Electric Company's system. The cost of these improvements is approximately $7,200,000.

In addition to these hydro developments on the Pacific Gas & Electric Company's system, there will be installed in Station "A" in San Francisco and Station "C" in Oakland the full complement of boilers to make the electric generating apparatus fully available. The cost for these steam additions will be approximately $525,000. Heretofore the practice on the Pacific Coast has been to equip a steam station with only a sufficient number of boilers to operate generating machinery to give good regulation, to take a portion of the load in case of trouble on the transmission line and to handle the peaks during the so-called rush hours or periods. It is also used to build up load which can later be transferred *en bloc* to a hydro plant which has been under construction for some time.

Proposed Feather River Development

The next important addition to the power capacity is that of the Great Western Power Company in its proposed development of a 40,000-kw. station on the Feather River at Butte Valley. It is proposed to run a tunnel 11,800 ft. (3.6 km.) long from Lake Almanor into Butte Valley, and thence by another tunnel 10,400 ft. (3.2 km.) long to the point of drop into the Feather

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River, dropping this water 1155 ft. (320 m.) into the power station in the bed of the canyon. This project will cost in the vicinity of $6,000,000 and will take about two to two and one-half years to construct.

The Sierra & San Francisco Power Company has its power station and reservoirs in and about the Stanislaus National Forest Reserve and on the Stanislaus River. This company is in a position to supply power at the earliest date. It has two reservoirs in operation, namely, the "Relief," 14,965 acre-ft. (18,400,000 cu.m.) and "Strawberry," 17,900 acre-ft. (22,000,000 cu.m.). It has in prospect another reservoir known as "Big Dam," 16,654 acre-ft. (20,400,000 cu.m.), which would spill its water into "Strawberry." At the present time water from the South Fork of the Stanislaus and "Strawberry" is running in what is known as the "Philadelphia Ditch," at the rate of 50 sec.-ft. (1.41 cu.m. per sec.), which spills from a height of 1860 ft. (567 m.) at Spring Gap into the Middle Fork of the Stanislaus River and is diverted at the Sand Bar dam into the present flume to the Stanislaus power station. It is proposed to put a power station at the foot of this present spillway near Baker's Crossing containing a 9000-kw. generator, and later, when the size of the ditch has been increased to accommodate 100 sec.-ft. (2.82 cu.m. per sec.), to add another 9000-kw. unit at this point, thus giving 18,000 kw. additional development. At the same time an increase in the size of the penstock at the Stanislaus power station will gain 7000 kw. which is now lost in friction head. This will make available the total capacity of 40,000 kw. at Stanislaus.

There is also contemplated in connection with the North Beach steam station of this company an increase in the boiler capacity so as to make the three 9000-kw. units available for full operation. The cost of these additions will approximate $2,000,000.

Besides the previous developments which I have definitely recommended on the basis of a war-time program, there are many other available power developments, some of which have been carefully considered by me, but I have not thought them worthy of recommendation on the basis of war-time service. Among these might be mentioned the projects on the Big Bend of the Pitt River of the Pacific Gas & Electric Company and the Northern California Power Company; the Fall River development, between Fall River and Pitt River, and also the various smaller projects on the Pitt River and its tributaries; the additional developments on the North Fork of the Feather River, owned by the Great Western Power Company; the first project in connection with the Hetch Hetchy water supply, which will take approximately three years to develop, and other smaller developments which can be secured on the Pacific Gas & Electric Company's system, and also the Western States Gas & Electric system in the central part of the state. There are developments contemplated by the Southern California Edison Company and the Southern Sierra Power Company, as well as by the San Joaquin Light & Power Corporation, and the city of Los Angeles contemplates the development of approximately 21,000 kw. in connection with its aqueduct.

Without considering the latter project, the total additions to the systems I have mentioned approximate a cost of $50,000,000, and so far as my investigations go I am convinced that all of this power can be easily absorbed within two years after development.

An entirely new project which was brought to my attention and which I have carefully investigated is now known as the Pitt River Power Company and is intended to develop power at two locations on the Lower Pitt River by the construction of two dams, each giving a first possible development of about 32,000 kw. Favorable recommendation was given to this project.

At the present time there exist between the companies in and about the bay district interconnections so that the companies can exchange power between their systems. An additional interconnection was found desirable between the Sierra & San Francisco Power Company and the Pacific Gas & Electric Company.

It is also extremely desirable for the companies to arrange for complete interconnection of the steam stations, both in San Francisco and Oakland.

The author has made a careful study of the regulations and rules and laws of the Forest Service and the Department of the Interior in so far as they relate to hydroelectric development and control. The opinions in regard to the effect of the present rules and regulations and stipulations differ so widely that it is almost impossible to determine what changes in the present laws or what recommendations as to alterations in pending legislation will make for the more rapid development of hydroelectric power. Certainly the main ideas that are debatable are the revocable permit, the definite franchise stipulation, the matter of just compensation, and the power to be exercised over the complete operations of the company as to conduct and rates. These appear to be the crucial points in all the present legislation and proposed legislation in regard to the power companies. If these can be adjusted, the author believes that the financing of the companies and the development of water power can be readily secured.

The deficiency in power during the last year approximated 25,000 kw. for safe operating, and as the normal growth is between 20,000 kw. and 25,000 kw., there is great need for increased generating capacity. Besides this need there is the further need for the replacement of the use of fuel oil by hydroelectric development, and this should be carried out at the rate of about 50,000 kw. per annum until the oil-generated power is reduced to a safe and economical value.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

WHAT A WATER BALANCE OF THE PLANT MAY SHOW

Inefficiencies That Might Escape Notice for a Considerable Period Are Brought to Light and Definitely Located by This Method

BY EDWARD MARSHALL

An important power-plant problem is the checking up of steam after it has been generated. Occasionally a water balance of a plant should be taken. It may show that operators permit blowing off of many steam siphons for hours at a time, or that the steam ejector is being used on a LeBlanc air pump because the vacuum cannot be held up without it, or that the distributer is choked with sticks and stones, or that some of the nozzles and blading of the small turbines are so worn that they take twice the correct amount of steam, or that feed-water heaters have not the proper baffling and the air vents to utilize and absorb the minimum amount of exhaust steam to give maximum water temperature, or that valve settings on stoker, engines, air compressors, dry-vacuum pumps, etc., are so far off that an excessive amount of steam is being used. It may be possible that such a test will show a difference of 33⅓ per cent between the steam fed to the main units and the water fed to the boiler. If that is the case, it is time to look for the leaks.

HIGH RATINGS FOR BOILERS IN EASTERN POWER PLANT

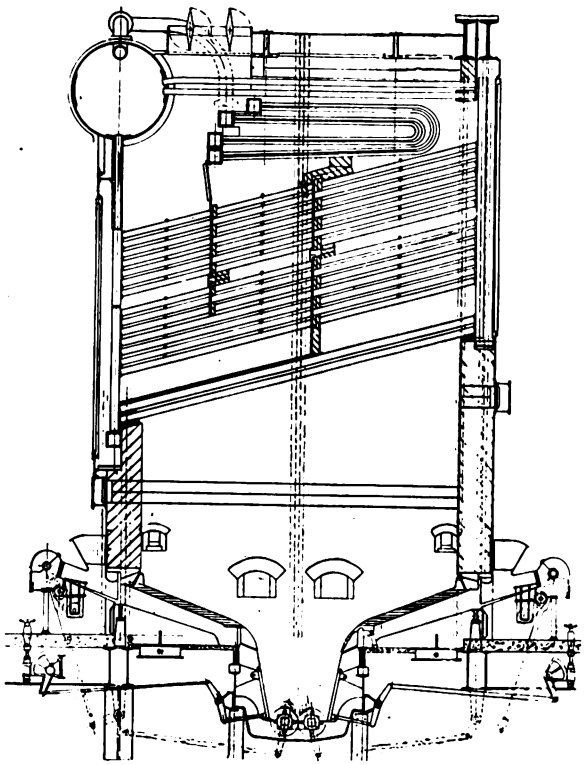
Boilers Rated at 1529 Hp. and Equipped with Double Fourteen-Retort Underfeed Stokers Expected to Deliver Up to 400 per Cent of Rating

The new plant of the West Penn Power Company, to be built on the Allegheny River near Freeport, Pa., contemplates some decidedly novel featues in the boiler and stoker equipment. The initial installation is designed for six boilers of the cross-drum vertical-header type, forty-two sections wide, sixteen tubes high, 20 ft. (6 m.) long, set with the front header 16 ft. (4.9 m.) above the floor.

Each boiler in the plant is rated at 1529 hp. and is equipped with superheaters designed to give 200 deg. Fahr. (93 deg. C.) superheat. Underfeed stokers are to be installed at the front and rear with fourteen retorts under the mud drum and fourteen retorts under the front of the boiler. The maximum operating conditions are to be 300 lb. (21 kg.) gage pressure and 200 deg. Fahr. (93 deg. C.) superheat.

The boilers will be set in two rows with aisles about 15 ft. (4.6 m.) betwen the boilers, thus giving plenty of room around each boiler for proper operating facilities. The stoker drives are so divided that either seven or fourteen retorts can be driven by one prime mover. The wind-box dampers are arranged to control the air separately for units of three or four retorts. The stokers are to be equipped with clinker grinders for continuously removing the ash and clinker. Pittsburgh coal will be used with approximate analysis ranging from 11,500 B.t.u. to 13,500 B.t.u. and 7 per cent to 14 per cent ash.

The boiler equipment is so designed that the flue-gas temperatures will range from 500 deg. Fahr. (260 deg. C.) at 150 per cent of rating to 700 deg. Fahr. (370 deg. C.) at 300 per cent of rating, the combined efficiency ranging from 75 per cent at 150 per cent of rating to 65 per cent at 350 per cent of rating. Each stoker, when burning the fuel for which it is designed, is expected to develop 350 per cent of boiler rating continuously with the clinker grinder in operation and 400 per cent of boiler rating for peaks of short duration. Under these operating conditions the combustible in ash is not to exceed 14 per cent. The ash is to be discharged into water-sealed ash pits.



WITH THIS EQUIPMENT STOKERS FEED COAL FROM BOTH FRONT AND REAR

The facts contained in the preceding paragraphs concerning the installation of the West Penn Power Company were given to the station and operating committee of the Ohio Electric Light Association at the meeting held recently at Cincinnati, Ohio.

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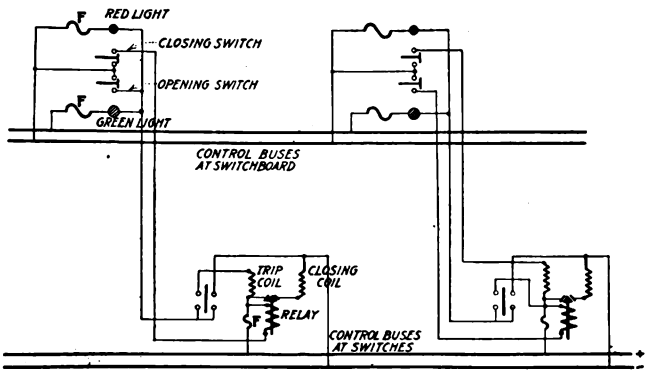
REMOTE-CONTROL WIRING PLAN FOR SWITCHBOARDS

Two-Wire Connection Between Control Switches and Oil Switches Can Profitably Be Changed to Three-Wire Circuit

BY K. B. AYRES

Switchboard equipment for central stations should be made as free as possible from trouble that can in any way cause an interruption of service. One point that is often overlooked is illustrated in the accompanying



TWO-WIRE AND THREE-WIRE CONNECTIONS BETWEEN CONTROL SWITCHES AND BREAKERS

figure. While it may not cause trouble for long periods of time, it has been known on several occasions to cause service interruptions of considerable importance.

It will be seen on the left of the figure, which shows two control wires running between the control switches at the switchboard and the operating coils at the oil switch, that these two wires not only carry the operating energy at the time of operating the switch but also serve to complete the circuit for the pilot lamps. This being the case, it is necessary that the trip coil be in circuit with the red lamp which is lighted when the switch is closed.

As a rule the lamps used for this purpose are the small style "E" with the candelabra base, and the energy for the operation of the switches and the lighting of the pilot lamps is taken from the exciter buses. At times the voltage may rise to rather a high point so that there is danger of the red lamp short-circuiting in the base when it burns out, in which case it throws the trip coil across the line, having the same effect that operating the opening switch would have. Of course, this light has a fuse in circuit with it, but almost invariably the damage is done before the fuse can open the circuit.

On the right-hand side of the figure a third wire is shown between the switchboard and the oil switch so that the control circuit and the signal circuit are kept separate, thereby eliminating the possibility of trouble on the signal circuit throwing out an important feeder or generator.

Doubtless there are a large number of stations operating with the two-wire plan of control and signal wiring, inasmuch as some of the largest manufacturers of switchboards in the country have furnished to their customers wiring diagrams showing the two-wire system of connection between the control switches and the oil switches.

The cost of changing from the two-wire to the three-wire system is in no way prohibitive as the two-conductor control cable removed can always be used for other purposes. The labor of making the change is not great as the three-wire control cable can be tied to the two-wire cable before it is pulled out, so that as the two-wire cable is removed the three-wire is at the same time pulled into the conduit.

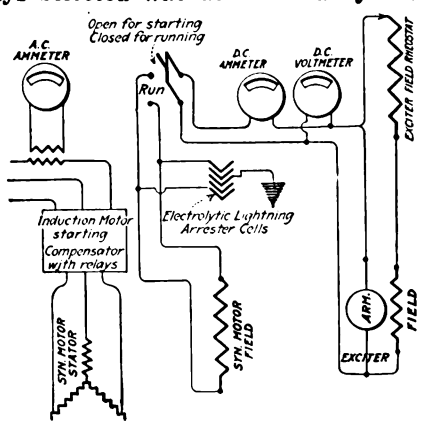
ELIMINATING TROUBLE IN SYNCHRONOUS MOTOR FIELD

In Case of Dangerous Voltage Rise a Section of Electrolytic Arrester Is Placed Across Motor Field Circuit

BY J. A. OBERMAIER

In a plant where several 100-hp. synchronous motors were started frequently trouble arose due to the field winding insulation breaking down during the starting period. After trying the usual methods for limiting or reducing the voltage rise during the starting period without success, the following method was recommended and employed. An electrolytic lightning arrester, consisting of the proper number of trays mounted and filled in the usual manner, was connected directly across the slip rings of the field. The accompanying sketch shows the general arrangement of the complete motor circuits. The motor stator winding was energized at starting through the starting compensator. During the starting period the field was not energized. When the machine reached approximately normal speed the field switch was closed and the field was energized with direct current in the usual manner. This method of starting has given very good service and is considered reliable. However, for severe starting duty the cells must be inspected at least once every six months.

The sketch shows five electrolytic trays connected solidly to the field winding, the middle tray being tapped to ground to divide the stress on the winding equally. The function of this apparatus was as follows: The number of trays selected was determined by the allowable



ELECTROLYTIC LIGHTNING ARRESTER SHUNTED ACROSS FIELD TO AVOID VOLTAGE TROUBLE

voltage rise across the field. In this case it was assumed that the insulation would stand 1500 volts. The breakdown point of an electrolytic cell is approximately 300 volts. Thus with five cells when the voltage exceeds 1500 volts during the starting period the electrolytic arrester breaks down, causing a considerable discharge of current through the field winding, thereby limiting the induced voltage. When the voltage returns to normal value the arrester is restored to normal.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

SOCKET APPLIANCES ARE SOLD ON A CASH BASIS

Partial-Payment Plan Discontinued on Large Devices in Order Not to Tie Up in This Manner More Money than Necessary

Although the policy of selling appliances on the partial-payment plan had been well established, the Little Rock (Ark.) Railway & Electric Company some time ago discontinued the practice of the sale of vacuum cleaners, washing machines and other large household socket devices on easy terms. This was done in order not to tie up any more money than was necessary in appliances. However, with increased efforts the company in the month of December last, for instance, disposed of nine vacuum cleaners and one washing machine. This shows that sales can be made on a cash basis.

CLEVELAND COMPANY CHANGES POLICY OF MAKING EXTENSIONS

Customers Are No Longer Asked to Finance Public Utility Construction on Installations Larger than 5 Kw. of Rating

On Jan. 1 the Cleveland Electric Illuminating Company withdrew its schedule, which was on file with the Public Utilities Commission of Ohio, covering line extensions and increases for service in excess of 5 kw. of rating. For fourteen months prior to that time the Cleveland company asked consumers in this class to advance the entire cost of making extensions and increases, and under this schedule the so-called normal cost of the work, which was the estimated cost on the basis of July 1, 1914, was refunded to them over a period of years, the rate of refund depending on the use of the service.

The company's policy now for large extensions and increases is the same as it was for years prior to the war. Under this policy the company will make extensions and increases of its lines and service wherever there is business which in its judgment justifies the investment of money necessary to make the increase.

In commenting on the change in policy G. E. Miller, sales manager of the company, said: "The schedule under which consumers were asked to pay for new service or additional service was of course a war measure, and since it is now possible for us to finance our reasonable requirements, we feel that it is only good business policy to follow the practice which the company had pursued in years past.

"Incidentally the company's load continues to hold up in a rather surprising way, as up to date there has been no decrease whatever in its maximum load and the prospects for additional new business are very good."

THE FREE LAMP RENEWAL POLICY RE-ESTABLISHED

Management of Hartford Company Believes that Public Is Better Served Thereby and that a Closer Touch Is Kept with Customers

Two weeks after the signing of the armistice the Fuel Administration of Connecticut relaxed the restrictions which had been placed upon lamp renewals and the use of energy for lighting, and the Hartford Electric Light Company reëstablished the policy of free renewals on the larger sizes of type B and type C lamps. Inquiry by a representative of the ELECTRICAL WORLD as to the reasons for restoring free renewals at Hartford brought out two main points which determine the company's policy: First, the management believes that the convenience of the public is better served by free renewals on the larger sizes of lamps; second, the company is enabled by this policy to keep in closer touch with its customers' installations and present and prospective wants.

The general desire of the company's customers, as repeatedly expressed to the management, is to have the cost of lamp renewals covered in the monthly bills for service. Should the public desire to pay for lamps separately, the company would put such a policy into effect, but the evidence is overwhelmingly the other way at Hartford. Widespread satisfaction was expressed by the company's customers when the improved fuel conditions following the end of hostilities abroad permitted the reëstablishment of the free renewal plan. Neither the company nor the public in Hartford overlooks the fact that the cost of free renewals must be covered in the price of service.

The supply of lamps below list price in the renewal of the smaller sizes, 15-watt and 25-watt type B's and 100, 150 and 200-watt type C's, also, combined with free renewal of the larger sizes, whether clear or frosted, brings the customer into much closer touch with the company than if these lamps were purchased in the open market. The customer's sockets are better filled; there is less borrowing of lamps to take the place of those which have outlived their usefulness, and the percentage of dead sockets is lower. Moreover, the company's knowledge of the individual connected load and the service conditions tends to protect both the customer and itself from poor service and complaints due to the under-illumination of many premises. The company is selling illumination in the last analysis, and neither lamp nor energy cost can properly be overlooked in the price of service. Incidentally, the public objected strenuously to the cutting down of the free renewals forced by the war.

The relation of the contractor-dealer to the Hartford policy is interesting. For the first installation a charge

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at list is made on all lamps, so that the contractor-dealer has the opportunity to furnish lamps on a profitable basis to himself, just as he enjoys a profit on the rest of the material installed. The Hartford company does not maintain its free renewal policy on the ground that the quality of lamps sold by contractor-dealers is inferior to that supplied by the central station, but the management feels that the contractor-dealer's connection with the lamp installation policy terminates with the completion of the wiring job, and that thereafter the central-station interest predominates. In order to prevent the use of lamps in improper locations where the mechanical breakage would be excessive, as in gar-

The Hartford Electric Light Company MAZDA LAMP PRICES—NOV. 25, 1913

SIZE IN WATTS	NUMBER IN STD. PACKAGE	STYLE OF SCREW BASE	DIAMETER IN INCHES	LENGTH IN INCHES	LIGHT CENTER LENGTH IN INCHES	SALES PRICE Clear or Frosted	RENEWAL PRICE Clear or Frosted
REGULAR LAMPS							
15	100	Regular	2⅛	4⅝		.38	.25
25	100	"	2⅜	5¼		.38	.25
40	100	"	2⅝	5¼		.38	Free
60	100	"	2⅝	5½		.45	"
100	24	"	3¼	7⅜		.92	"
CONCENTRATED FILAMENT LAMPS Enclosing Globes or Indirect Fixtures are Recommended for Use With These Lamps							
100	24	Regular	3⅛	7⅛	5⅛	1.10	1.00
150	24	"	3⅛	7⅛	5⅛	1.65	1.50
200	24	"	3⅝	8⅜	6	2.20	2.00
300	24	"	4⅜	10¼	7½	3.25	Free
400	—	Mogul	5	10	7	3.25	"
500	—	"	5	10	7	3.25	"
750	—	"	6½	13¾	9½	5.00	"
1000	—	"	6½	13¾	9½	5.00	"

10% Discount for Standard Package Quantities.

Note: In order to prevent the use of lamps in improper locations where the mechanical breakage would be excessive, the Company restricts the Free Renewals to one lamp per socket per year.

HARTFORD SCALE OF LAMP PRICES

ages, shops, etc., the company restricts the free renewals to one lamp per socket yer year. A 10 per cent discount is given when lamps are purchased in standard-package quantities.

With the exception of lamps, the Hartford company stands ready at all times to supply contractor-dealers with appliances selling below list in special campaigns or otherwise at prices which enable the contractor-dealer to realize a profit in merchandising such articles at the central-station prices.

UTILITY STARTS BUREAU TO STUDY PROFIT SHARING

New Operating Research Bureau of Milwaukee Company Created to Carry on Certain Functions of Management

A new organization known as the Operating Research Bureau was started by the Milwaukee Electric Railway & Light Company on the first of this year. It was created for the purpose of carrying on certain of the functions of management in dealing with the research work required by the company and its subsidiary.

At first the work of this bureau will be confined largely to investigating and standardizing existing profit-sharing plans with a view of taking advantage of past experience. Extensive and comprehensive study will also be required to place all plans on a basis which will as far as possible recognize individual effort to a greater extent. The bureau will coöperate with the various departments in devising new plans for profit sharing where practicable in divisions not now participating. It will prepare monthly a summary of results achieved by the profit-sharing plans in each department and comment thereon in a monthly report. Data necessary for these reports will be obtained from the representatives appointed in each department to coöperate.

The bureau will likewise assume charge of all valuation work required from time to time. In connection with this work and the profit-sharing plans unit costs will be developed. Such cost information is to be kept in a manner suited to use of the departments for estimating purposes. The bureau will also be called upon to make time studies and will develop the facilities.

The operating research bureau is under the direction of William Baum, research engineer, and Ralph Moody, assistant research engineer.

WAR-LINE CONSTRUCTION COSTS FINANCED BY CUSTOMERS

Knoxville Plan Provides for 60 per Cent Refund, Payable Semi-Annually, on Basis of 25 per Cent of Net Bills in Twenty-four Months

A special agreement for service extension whereby the excess cost of line construction over normal cost is borne by the consumer has been put into force by the Knoxville (Tenn.) Railway & Light Company.

According to this agreement the consumer pays the company the estimated cost of the construction. If this construction cost does not amount to the estimate, the balance is refunded to the consumer immediately, while if the estimated amount is not sufficient to pay the construction cost, the consumer agrees to pay the balance. The refund clause of the contract makes the following provisions: The company agrees to refund to the customer 60 per cent of the amount paid by the customer for the construction of the line, such refund to be 25 per cent of the amount of the customer's net payment to the company for electric service during the first twenty-four consecutive months after connection is made to the customer's premises, provided, however, that no refund shall be in excess of 60 per cent of the construction cost, nor shall any refunds be made from payments for service after the first twenty-four consecutive months so named. The amount of refund is to be calculated and paid on Jan. 1 and July 1.

"Therefore," says W. R. Sammons, commercial manager of the company, "where a line extension is estimated to cost $50, the consumer pays this amount before the work is started, but in event that the work costs actually $40, $10 is immediately returned. Assuming that the monthly net bill averages $3, or $18 for six months, the amount of $4.50, or 25 per cent of the net bill, is refunded to the consumer by voucher at the end of six months and charged against the construction account. The consumer will be entitled to a full refund of 60 per cent of $40, provided that 25 per cent of the total net bills for twenty-four months amount to this sum. The average net bills, however, of $3 a month make a refund of $4.50 for each six-month period, or $18 in twenty-four months, which constitutes the total refund. If the average net bills amount to $6, the six-month refund will be $9 and the consumer will have earned a refund of the entire 60 per cent at the end of sixteen months."

The agreement also contains a clause whereby the consumer agrees to pay a certain minimum amount, which apparently is based upon extension conditions. This system, it is reported, is working out very well.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Formulas and Charts Relating to the Performance of Industrial Transformers.—L. DUBAR.—Constructors have continually need of determining rapidly the output and voltage drop of transformers under varying conditions. In this article the author gives charts designed to obviate long processes of calculation by a simple alignment of points.—*Revue Générale de l'Electricité*, Nov. 30, 1918.

New Graphic Method for Winding Schemes.—L. FLEISCHMANN.—There are two ordinary methods of graphic representation of winding schemes. In one the conductors are arranged in the drawing exactly as they lie on the armature, but in the Arnold plan the scheme has to be prepared from the winding formula. There is a change from the actual number of poles to the number which corresponds to that of the circuits, and questions of drum winding and ring windings are involved. The new method proposed by the author is similar to Arnold's but avoids the change in the number of poles and the passage from drum to ring.—London *Electrician*, Dec. 13, 1918.

Special Transformer Connections.—M. VIDMAR.—The usual forms of three-phase transformers are not quite symmetrical. The differences between the three magnetic paths cause the magnetizing currents to be unequal, and the situation of the center core between the outer ones gives rise to a greater temperature rise in the center core. These differences may be removed to some extent by winding the cores with unequal numbers of turns. This affords a means of shifting the star point of the transformer to any desired extent along the median line of the three-phase vector triangle. The angle between either of the outer phase voltages and the line voltage between the outer phases has the value 30 deg. in the balanced transformer. If unbalanced windings are used to balance the magnetizing currents, it is possible to obtain a true neutral point by the addition of an auxiliary boosting winding on the middle phase to counteract the shift of the neutral point by the change in the voltage angle. The true neutral may also be obtained in an unsymmetrically wound transformer by zigzag connections between the halved three-phase windings. It is shown that a decrease in the voltage angle involves an increase in the amount of copper and a decrease in the amount of iron, and *vice versa*. The unequal heating of the limbs is reduced by an increase of the voltage angle beyond 30 deg., which throws part of the winding of the central core onto the outer core, and by adjustment of the sections of the three cores equal magnetizing currents may be obtained in the three phases.—*Science Abstracts, Section B*, October 1918. (Abstracted from *Electrot. Zeits.*, July, 1918.)

Generation, Transmission and Distribution

Modern Boilers.—L. CONGE.—A discussion of the boilers used in central stations with steam-driven generators. The makes of boilers illustrated and discussed include the Garbe, Stirling, Woodeson, Buttner-Leflaive, Babcock-Wilcox, Babcock with high evaporative feature, marine-type Babcock, Robert, Belleville, Niclausse and Romanet.—*Revue Générale de l'Electricité*, Nov. 9, 1918.

Saving the Waste in the Chimney.—ROBERT SIBLEY and CHARLES H. DELANY.—To understand properly how to save the waste occasioned by the chimney and its accessories in the modern oil-fired power plant a knowledge of the fundamental laws of chimney design is necessary. This article is the first of a series on this subject aiming at increased power-plant fuel economy.—*Journal of Electricity*, Nov. 15, 1918.

A Plan for Power Development.—C. EDWARD MAGNUSSON.—A basic plan for natural water-power development which applies the principle of the Reclamation Service to the electrical field; a new idea which permits of government aid without doing away with private enterprise.—*Journal of Electricity*, Nov. 15, 1918.

Some Experiments with Long Electrical Conductors.—JOHN H. MORECROFT.—Working at frequencies from 12 to 152 cycles per second, an artificial antenna made up of numerous sections, each having lump capacity and inductance and closely simulating an actual antenna, is carefully studied. The effective capacity, inductance and resistance are measured and found to agree with theory, and the theoretical effects of capacity and inductance loading are similarly experimentally verified.—London *Electrician*, Dec. 6, 1918.

Floating Electric Power Station.—Among the many war problems calling for solution has been the question of electric power supply to meet variable conditions overseas. A description is here given of a plan giving the necessary mobility and convenience for harbor duty, which was designed under the direction and for the service of the Directorate of Inland Waterways and Docks, War Office. It takes the form of a floating electric power station, and the nature of the duty calls for a wide range of supply. Direct-current supply can be given between 100 volts and 75 volts and alternating current from 200 volts to 7600 volts. The plant is installed on a large steel barge, and the accommodation consists of two dynamo rooms and a boiler room.—London *Engineering*, Dec. 6, 1918.

Present Status of Hetch Hetchy.—RUDOLPH W. VAN NORDEN.—The Hetch Hetchy water and power project undertaken by the city of San Francisco is one of the most stupendous pieces of work of its kind. In this

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article is presented a most comprehensive survey of the project, its scope and the progress to date, as well as difficulties encountered and possibilities for the future.—*Journal of Electricity*, Nov. 15, 1918.

Traction

Electrification of the Melbourne Suburban System.—E. P. GROVE.—The first article of this series described the Newport power station. The present article deals particularly with the overhead equipment of the permanent right-of-way, which constitutes a very extensive system. A system of 1500 volts direct current is used on the trolley supported by a simple catenary suspension. The messenger wires in turn are supported from bridge structures along the right-of-way.—*Commonwealth Engineer*, Nov. 1, 1918.

Vibration of Electric Locomotives.—P. LEBOUCHER.—The author, premising that the problem of rapid transit is still far from satisfactory solution from either the mechanical or the electrical point of view, argues in favor of the entire suppression of driving rods in electrical locomotives. The vibrations of the frame caused by them are obviated by those systems of gear in which the motor acts directly upon the axle. The future of rapid electrical transit lies along these lines.—*Revue Générale de l'Electricité*, Dec. 14, 1918.

System of Braking with Recovery of Energy.—Dr. BEHN-ESCHEBERG.—After a brief notice of the different modes of electrical braking employed hitherto, the author describes the method used at the Oerlikon construction plant for the single-phase locomotives of the St. Gothard railway and explains the theory of regeneration on which the system is based. It permits of the extension of braking with regeneration to all loads and all speeds down to the lowest. A reactance coil is the only addition to the normal motor installation.—*Revue Générale de l'Electricité*, Dec. 7, 1918.

Installations, Systems and Appliances

Oil Disconnecting Switches.—W. A. COALES and W. H. WADMORE.—The authors specify nine conditions that a circuit breaker ought to satisfy. They discuss the use of these appliances in combination with relays and their performance with single and double busbars and with ring connection. It is not always the case that circuit breakers are the ideal system for great installations at low tension, because of the very great care necessary in regulating the relays. The use of reactors in the generator circuits and in the sections of the busbars is for this reason becoming more and more common in spite of their high price and their great bulk. While limiting the power that can pass from one side of the system to the other, they have the advantage of never opening the circuit.—*Revue Générale de l'Electricité*, Dec. 7, 1918.

Employment of Synchronous Motor to Improve Power Factor.—PAUL RIEUNIER.—A long article on this subject in which the author analyzes the methods of improving power factor by the use of the ordinary apparatus of electric power houses.—*Revue Générale de l'Electricité*, Nov. 23, 1918.

Supply of Single-Phase Power from Three-Phase Systems.—MILES WALKER.—The various methods of supplying single-phase power are considered. The correct method of balancing the phases in the case of an electric furnace working at 0.7 power factor is developed for both choke-coil balancer and the condenser balancer. Rotating balancers are classified under five sub-headings, and the merits and drawbacks of these balances are discussed. A new type of balancing transformer is described, and a calculation of a balancing transformer for feeding a 400-kw. electric furnace is worked out.—London *Electrician*, Dec. 13, 1918.

Contactor Control Gear in Industrial Work.—Automatic control, besides acting as a measure of safety, may considerably reduce the costs of maintenance. An instance is described giving the experience of the British Westinghouse Company in a certain steel mill with two motors. With hand-operated control the armatures had to be replaced in about two weeks, frequently requiring new coils and commutators. After the installation of an automatic controller the motors ran for two years without requiring any repairs to the armatures. In many cases automatic control brings other benefits; for example, it may facilitate simpler driving, smaller consumption of energy and speedier operation. A detailed discussion of crane controllers follows with wiring diagrams.—London *Electrician*, Nov. 29, 1918.

Electric Welding in Shipbuilding.—COMFORT A. ADAMS.—In this article Professor Adams enumerates all of the facts of importance that bear on the subject of electric welding and briefly discusses each. Among these factors are the question of when to use arc or spot welding, electrodes for arc welding, training of arc welders, the use of direct or alternating current, size of electrodes and strength of current, automatic arc-welding machines, strength of welds, relative cost of welding over riveting, etc.—*General Electric Review*, December, 1918.

Arc Welding in Shipyards.—W. L. ROBERTS.—Both resistance and arc welding are employed in shipbuilding. In this article Mr. Roberts describes some of the applications of arc welding. He first shows how the angle-smith's work is facilitated by the use of arc welding in the production of staples, and then predicts that the use of staples will soon be abandoned in favor of directly arc-welding together the parts to be joined. Other sections of his article are devoted to descriptions of the application of the electric arc to the construction of water, oil and air tanks, stacks, condensers, ballast tanks, etc.—*General Electric Review*, December, 1918.

New Method of Cleaning Condenser Tubes.—T. G. OTLEY.—By means of an air pistol water with sand in suspension was blown through the tubes. A modification of this method was proposed by G. Hall in which sand was introduced into the condenser tubes by means of the circulating water. About 1½ cu.yd. (0.4 cu.m.) of sand was added to the water daily, and after three weeks of this treatment the condition of the condenser became satisfactory.—*Proceedings* South African Institution of Engineers, October, 1918.

The Lifting Magnet a Valuable Piece of Laboratory Apparatus.—L. A. DOGGETT and C. A. STYER.—Experiments are described with lifting magnets to bring out the following points: (1) Magnetization curve and saturation, (2) hysteresis effects, (3) law for the pull exerted by an electromagnet, and (4) effects of inductance in an electromagnet. It is thus pointed out that the

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lifting magnet forms a valuable piece of laboratory apparatus.—*Proceedings* Society for the Promotion of Engineering Education, November, 1918.

Note on Effect of Temperature on Resistance of Spark-Plug Insulation.—J. D. MORGAN.—The question here discussed is how the conductances of plug insulations at temperatures found in engine cylinders are sufficient to short-circuit the high-tension system of a magneto or induction coil and thereby extinguish sparking of plugs. Curves are plotted between resistance and temperature showing the critical temperature above which the resistance is very low. Other curves are plotted between resistance and the rapidity with which sparks occur for various combinations of spark plugs and engines.—London *Engineering*, Nov. 8, 1918.

Power from the Tides.—In this article J. O. Boving, who has been studying the problem for some years, puts forth proposals with special designs of turbines which may possibly help toward rendering the utilization of tidal power economically feasible.—London *Times Engineering Supplement*, November, 1918.

Electrochemistry and Batteries

Electric Furnaces in Metallurgy.—The war has brought the electric furnace into prominence very much more quickly than would have been the case under normal conditions in this country. One reason is that these furnaces are particularly suited for the production of special alloys, and such alloys have been in very great demand. Another reason is the large amount of steel scrap that has been available during the war. It has therefore come about that, whereas the electric furnace was used somewhat experimentally before the war, it is now being used commercially in increasingly large numbers. The Héroult furnace considered particularly in this article has increased in its business in a manner strikingly shown by curves presented by the author. He states that since the outbreak of the war the number of Héroult furnaces in Great Britain has increased from five to fifty-four, and the transformer capacity from 3500 kva. to 50,000 kva. The present output is at the rate of about 150,000 tons per annum, and this amount should be almost doubled before the end of the year.—London *Electrician*, Nov. 15, 1918.

Ionization of Mercury, Sodium and Potassium Vapors and the Production of Low-Voltage Arcs in These Vapors.—T. C. HEBB.—It has been shown that: (1) Potassium vapor can be ionized at 1.6 volts, its resonance voltage. (2) Sodium vapor can be ionized at 2.5 volts, which is very close to the resonance voltage. This result agrees with that found by Wood and Okano. (3) The *D* lines of sodium can be excited at less than 1 volt; also in agreement with Wood and Okano. (4) The sodium and potassium arcs in mercury vapor can operate below their resonance potentials and as low as 1.4 volts for sodium and 0.5 volt for potassium. (5) The mercury spectrum can be produced as low as 0.5 volt in an atmosphere of mercury and potassium.—*Physical Review*, December, 1918.

Telegraphy, Telephony and Signals

Fundamental Formula in Radio Transmission.—L. BOUTHILLON.—For radio transmission with damped oscillations over flat and perfectly conducting ground, with the air regarded as a loss-free dielectric, the following formula giving the current at the base of the receiving antenna may be deduced theoretically:

$$I_r = 377 \frac{I_s}{R} \frac{h_1 h_2}{\lambda d} \div \sqrt{1 + \delta_1/\delta_2}$$

I_s is the current at the base of the transmitting antenna, R is the total resistance of the receiving antenna, d the distance apart in centimeters, $h_1 h_2$ and $\delta_1 \delta_2$ are the respective effective heights and decrements of the two antenna. In the present paper some early experiments by Tissot are used to calculate the value of the constant of the formula, neglecting the transmission absorption term. The value deduced from the experiments is 390, which is in good agreement with the theoretical value. In the discussion, O. C. Roos pointed out that it is possible that Bouthillon has not deduced the proper form-factor, which would involve a change in the decrement of the receiving antenna. Allowing for this, the value of the constant might be considerably nearer the theoretical value.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Proceedings* Inst. Radio Eng., August, 1918).

Radio Communication with Moving Trains.—F. H. MILLENER.—The radio-telegraphic researches carried on under the auspices of the Union Pacific Railroad are described. A radio "danger" signaling system was first worked, but, while operable, it did not give the extreme reliability required by such systems. A radio-controlled car is described, and a series of experiments with arc radiophone equipment are considered. Their applications to inter-car wire telephone communication and train-to-station radiophone communication are given in detail. The necessary fixed stations are also described. The experimental radio-telegraphic car laboratory is then taken up, together with the antennas, ground, engine and transmitter thereof. Finally, receiving sets and a telephone-relay amplifier (intended to facilitate telegraphone or dictaphone recording of signals) are considered.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Proceedings* Inst. Radio Eng., August, 1918.)

Miscellaneous

Some Field Experiments on Evaporation from Snow Surfaces.—F. S. BAKER.—The experiments could not be carried out on windy days when the snows was drifting or during periods of snowfall, but they fully cover the calm, clear days of winter. The total loss during the winter 1915-16 was found to be equivalent to 3 in. (7.6 cm.) of water or 14 per cent of the total snowfall. A graph exhibits the relation between evaporation and temperature, showing a rapid rise at the higher temperatures.—*Science Abstracts, Section A*, October, 1918. (Abstracted from *Monthly Weather Review*, July, 1917.)

Economics of Works Costs.—J. R. DICK.—The author indicates the use of some elementary mathematics and curves on cross-section paper to aid in the discussion of the cost of manufactured products as affected by labor and investment.—London *Electrician*, Nov. 29, 1918.

Fusibility of Coal Ash from West Virginia Coals.—WALTER A. SELVIG.—The method of preparing ash for fusion tests and determining initial softening temperature and the interval of fusion are described in this article. Tables are presented giving a summary of tests of West Virginia coal—*Chemical and Metallurgical Engineering*, Dec. 15, 1918.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

ARMY ENGINEERS TO REPORT ON POWER IN NEW ENGLAND

Report Will Give Comprehensive View of Power Needs with Map of More Important Systems and Study of Interconnection

Based on the work of the army officers detailed to investigate the power requirements of New England industries and under the direction of Major Carroll H. Shaw, Engineers, U. S. A., who was in charge of the New England district for the power section of the War Industries Board, a report is now in preparation covering the power requirements and resources of the New England States. It is expected that about three months will be required to complete the report, which will give a comprehensive view of the power needs of the section covered, with a map of the more important transmission systems of electrical energy and study of possible interconnection developments. It is expected that the report will provide many data which will be of service in connection with federal franchise legislation, if such is discussed in the near future.

NATIONAL SERVICE COMMITTEE OF ENGINEERING COUNCIL

M. O. Leighton Made Chairman of a New Committee to Have Headquarters in Washington to Render Service to the Nation and the Profession

In order to provide better for united action upon matters of common concern to engineers, the Engineering Council has recently organized a national service committee and has established an office in the national capital. This action was based upon a tentative plan for representation of engineers at Washington submitted to the council at a special meeting on Nov. 21, 1918, by Philip N. Moore of the American Institute of Mining Engineers.

The Engineering Council, through this national service committee and its Washington office, intends to accomplish the following general purposes, this committee acting always under the direction of the council and within limitations fixed for it:

1. To discover public services which may best be performed by engineering societies, and, when desired, to offer the proper men for such services.
2. To speak authoritatively for the Engineering Council before committees of Congress and departments of the government on all public questions of common interest to engineers, within such limitations as the council may set from time to time.
3. To give promptly wide circulation among engineers to authentic information regarding pending legislation and executive actions which may affect the interests of engineers in any way.
4. To gather opinions of engineers on these matters.

The Engineering Council's aim is disinterested usefulness to the nation and the profession—not advocacy of any selfish ends—by giving unbiased information and counsel on technical matters, chiefly when asked. A modest start is being made. The work will be enlarged only as a real demand for services develops.

The members of the national service committee have been chosen so as to represent different parts of the country. They are: Chairman, M. O. Leighton, Washington; C. B. Burdick, Chicago; George F. Swain, Boston; Philip N. Moore, St. Louis; L. D. Ricketts, Warren, Ariz.; Andrew M. Hunt, San Francisco and New York; Andrew M. Lockett, New Orleans; W. C. L. Eglin, Philadelphia; Bancroft Gherardi, New York.

The Washington office is at 502 McLachlen Building, Tenth and G Streets.

STORM OF PROTESTS AGAINST NEW TELEPHONE RATES

Many State Commissions Take Action Against Schedules Promulgated by the Postmaster-General—Proceedings Before the Massachusetts Commission

A storm of protests and prompt official action by many of the state public service commissions has followed analysis of the new telephone rates promulgated by the Postmaster-General. Investigation showed many increases in rates, although the impression had prevailed that the new schedules meant decreases. Representatives of nineteen states met in Chicago and passed resolutions declaring that the Postmaster-General had exceeded his legal powers. Some of the state commissions have asked for injunctions against the establishment of the new rates; others have confined their action to refusal to approve the schedules. It is announced in Washington that the Post Office Department will enforce the rates except where courts have granted restraining orders.

Among the states which have taken action against the rates are Illinois, Massachusetts, Michigan, Ohio, Florida, Nebraska, New Jersey, Missouri, West Virginia, Nevada, Arizona, Connecticut and New York (Second District).

Proceedings before the Massachusetts Public Service Commission, which made public an analysis of the rates, are reported to the ELECTRICAL WORLD as follows:

Following an all-day hearing at Boston Jan. 17, at which it was clearly demonstrated that the telephone toll rates recently ordered by the Postmaster-General represent a substantial advance over the previous schedule, the Massachusetts Public Service Commission suspended the proposed rates, prepared to carry the issue to the courts if necessary to enforce the finding of the board.

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Postmaster-General Burleson was represented at the Massachusetts hearing by Matt B. Jones, vice-president of the New England Telephone & Telegraph Company. Mr. Jones read a letter from W. H. Lamar, solicitor for the Post Office Department, in which it was announced that the purpose of the new toll rates is to effect a standardization of charges for such service on a nation-wide basis, and that the question of revenue to be derived therefrom was merely incidental. It was pointed out that there are many serious irregularities and inconsistencies in the existing rates, and that in removing these some rates would run higher and some lower, in different sections of the country. No discrimination was intended against the people of Massachusetts, the letter stated, and the coöperation of the commission was urged in giving the new rates a trial and in preparing to equalize exchange telephone rates in the future. Representatives of municipal governments and of chambers of commerce in many of the principal cities and towns of the state were present at the commission's invitation, and widespread opposition was recorded against the proposed establishment of toll rates along the lines fixed by the government (Bulletin 22 and Order 2495).

Chairman Macleod questioned the materiality of a nation-wide rate equalization of rates as a basis for increasing the charges for Massachusetts service. During the hearing exhaustive tabulated data were presented by William H. O'Brien, chief of the telephone and telegraph department of the commission, showing the increases which the new rates signify. A station-to-station rate forms the basis of the new charges, with a report charge on all person-to-person business. The rates will in general be increased by the schedule on both long-haul and short-haul service. A few instances of the increases which will result on interstate calls are given below:

PRESENT RATES AND RATES OF POSTMASTER-GENERAL

Boston to	Present Person-to-Person Charge	New Person-to Person Charge	Proposed Station-to-Station Charge	Report Charge
Portland, Me.	$0.65	$0.85	$0.70	$0.20
Augusta, Me.	.90	1.30	1.05	.30
Bangor, Me.	1.35	1.65	1.35	.35
Manchester, N. H.	.35	.50	.40	.10
Burlington, Vt.	1.15	1.50	1.20	.30
Providence, R. I.	.30	.40	.35	.10
New Haven, Conn.	.90	1.00	.80	.20
Hartford, Conn.	.75	.80	.65	.20
New York City	1.25	1.55	1.25	.35

Mr. O'Brien also presented data sheets analyzing about 200 intrastate toll rates and showed that in the great majority of cases the new charges will be higher than the former tariff, although for some unexplained reason, he said, the administration has exempted the Boston metropolitan district in this so-called "standardization" of rates. Mr. Jones made no claim that the rates are established on account of the financial needs of the New England company, but said that if the government had not taken over the telephone systems during the period of hostilities, it would have been necessary for rates to have been revised upward and the toll business would have been the first to be taken in hand.

During the hearing Mr. Jones presented extended figures to show that the estimated normal increase in revenue on the New England system for 1919 will be $777,800, and that the new toll rates may yield $500,000 more, making a total increase of $1,277,800 against an estimated increase in expenses of $900,000. Mr. O'Brien pointed out that the complexity of the new rates would interfere with the quality of the service, commending the simplicity of the present toll rates.

Mr. Jones pointed out that unless Congress takes further action the government will be obliged to return the telephone system to its owners at the formal conclusion of the war. He informed the commission that in the light of the recent decision of Justice Learned Hand in the case of the Commercial Cable Company versus Postmaster-General it would appear that the President of the United States or his delegated representative has power to modify the rates and practices of the telephone systems as he sees fit, even though there is no claim by the Post Office Department that the proposed rate schedule is a direct war measure.

Chairman Macleod stated that the commission is of the opinion that it has jurisdiction over intrastate toll rates, notwithstanding the federal operation of the telephone properties, and said that as insufficient evidence had been presented to warrant the commission's approval of the new rates, admittedly representing a very substantial increase over present charges, the board ruled that the rates must be suspended. The hearing was adjourned to Jan. 30 to enable the company to present further evidence.

ACTION TAKEN IN OHIO

The Public Utilities Commission of Ohio, in a decision rendered on Jan. 16, rejected by unanimous vote the rate schedules filed by telephone companies operating in that state for long-distance service, as ordered by Postmaster-General A. S. Burleson. According to estimates made by the commission, the new schedules would result in an increase of approximately 25 per cent over the present long-distance charges. Under this decision the new rates cannot go into effect and the authority of the Postmaster-General to issue orders contrary to state laws and regulations will probably be tested in this case. Among the findings of the commission in rejecting the schedules are:

That said proffered schedules contain an entirely new classification of the service which ought not, in the interest of the public, to be instituted without careful consideration supported by evidence of the justness and reasonableness of the same.

That the rates, tolls and charges carried in said proffered schedules are so greatly in excess of the rates, tolls and charges which are now being charged and collected for similar service as to be injurious to the business or interest of the public and ought not to be established and imposed without a satisfactory showing that said enormous increases are necessary and proper.

That the rates, tolls, charges and classifications carried in said proffered schedules do not appear to be based upon any investigation, figures or data showing that such increases are necessary to yield a proper return upon the investment of said companies in their properties used and useful in serving the public in the State of Ohio, but to be arbitrary and imposed for the purpose of creating a uniform standard of rates and charges throughout the United States without giving proper consideration to density of business and the varying conditions and circumstances peculiar to each locality, rather than for the purpose of yielding a just and reasonable return upon the investment.

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NEW INTERCONNECTION IS COMPLETED IN CALIFORNIA

California-Oregon Power Company Now Tied in with the Northern California Power System, Effecting Substantial Saving of Oil

The California-Oregon Power Company has just completed the 10,000-kw. link which connects its transmission lines with the Northern California Power Company system. This link involved the reconstruction of 60 miles (96 km.) of line and the construction of 30 miles (48 km.) of new line. It makes possible the transmission of energy from the Copco plant of the former company to the lines of the Northern California Power Company at Kennett. The latter company in turn delivers the energy to the Pacific Gas & Electric Company at Colusa Corners, 200 miles (321 km.) south of the point of generation.

This interconnection ties together on a large-capacity basis all of the important systems in northern California so that there is now interconnected service reaching from the southern part of Oregon to San Francisco. The energy interchanged over the new link is expected to effect a saving of 20,000 barrels of oil annually in San Francisco.

CALIFORNIA COMMISSION SAYS REGULATION STOOD WAR TEST

Necessary Rate Increases—Adjustment of Surcharges with Return to Normal Conditions—Water-Power Development—Federal-Controlled Properties

"The year 1917-18," covered by the report of the California Railroad Commission forwarded by the commission to Governor William D. Stephens, "was one of intense activity and interest due to war conditions," says the letter of transmittal accompanying the report. "Civic, industrial and economic disturbances were all reflected in the activities of utilities, and these disturbances were necessarily in a large measure passed along to and required solution by the commission."

Continuing, the letter says:

> It may properly be said that the severest test was put upon public regulation in the period covered by the report, and if, as we believe, such regulation has withstood this test and measured up to the responsibilities and unprecedented needs created by the emergency, the wisdom of the policy of public regulation has been justified.

Many utilities made applications for increases of rates, basing their applications mainly upon increased cost of material, oil and labor—the labor costs making great forward strides on account of increased cost of living and acute competitive labor demands—and increased demand for steam-generated electricity by reason of water shortage. Commenting on these, the commission says:

> The commission had no hesitancy in allowing such increases as it deemed proper and reasonable. The commission in its actions believes it fully discharged its duty, not only to the public but to the utilities and national government, by allowing such increases as were necessary to enable the utilities to function efficiently and to prevent financial disaster. This policy is not only just and equitable and consistent with the true spirit of fair public regulations but also responsive to the direct needs of the federal government as expressed in official requests and communications.

Quoting from the statistics of the United States Labor Bureau showing the decrease in the purchasing value of a dollar from 1913 to May, 1918, the figures showing that in May of this year it took $1.91 to equal the purchasing power of the dollar in 1913, the commission points out:

> The government, after taking over the railroads, found it necessary to order sweeping increases in all freight and passenger rates on all roads under federal control, which increases were much greater than those made by the commission on other utilities. The average increase of prices for industrial, commercial and domestic products exceeded 50 per cent up to June, 1918. The increase of utility rates did not exceed 15 per cent, on the average. It is a fact, therefore, that the consumer of public utility products in this state was compelled to pay but a very small increase for the commodity and service furnished, as compared with what he was required to pay for all other services and commodities.

The commission speaks in favor of the "surcharges" allowed on existing rates, holding that "increases in cost came so rapidly that it would have been impossible for the commission to give the necessary prompt relief if attempt had been made to have detailed valuations under normal conditions. The factor of time forbade the remedy which a less comprehensive study would show was needed. Adjustment of the surcharges may easily and readily keep pace with the return to normal conditions."

The abnormally low rainfall during the season of 1918, following two unusually dry winters, intensified the problems of the utilities, the close and important relationship of water to most public utility activities brought out by the work of the commission being revealed. In this connection the commission says:

> The amount of stored water is immediately related to the amount of electric power that can be generated. A reduction of water available for hydroelectric power immediately demands additional steam-generated electricity to meet demands; steam-generated power connects up immediately with increase in price of oil—the increase ranging from 80 cents a barrel in 1916 to $1.63 at present—and the price of oil to a large degree determines the cost of gas. Water shortage required curtailment of use of water for irrigation purposes. Reduction of delivery brought reduction of income to irrigation utilities, necessitating such increases in rates as would enable the water utility to continue its functions. Increased cost of power in time was visited upon electric street and interurban railroads. Here is a clear instance of how the disturbance of one important operating utility factor immediately affects all other factors with a result that might well be disastrous to consumers in the absence of effective regulation.
>
> That the effect of public regulation was of the greatest possible benefit to the utilities themselves during this period (a period that might well be considered the acid test of the efficiency of regulation) is evidenced by the fact that during that period not a public utility in the State of California went into bankruptcy or receivership. The securities of the California utilities were as well able to withstand the strain of war conditions as were those of any utilities in the nation, and better than many similar utilities and other industries in sister states.

In addition to proposing the legislation which resulted in furnishing water to many thousands of acres, thus accelerating food production, the commission "put into effect a plan under which the electric energy of all companies operating in northern and central California was pooled and directed from one administrative control." The extremely serious power situation early in the year 1918 threatened a breakdown of hydro-

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electric activities. The commission called a meeting of the thirty power companies, and the situation was frankly discussed. The representatives of the companies manifested a fine spirit, with the result that, with the concurrence of the utilities, H. G. Butler, assistant chief engineer of the commission, was appointed power administrator, with authority to direct the distribution of power in the best interests of the war emergency. Of the results of this action the commission says:

A survey showed a total load of 5,000,000 kw.-hr. a day, with resources equal to but 4,000,000 kw.-hr. To stimulate production to meet this 20 per cent shortage all steam plants were required to operate twenty-four hours a day, irrigation was lessened wherever possible, and faulty interconnections were corrected. Connections established between the Northern California Power Company and the California-Oregon Power Company, by which electricity generated by the latter company was made available for the pooled companies, were speeded up to be serviceable in October, instead of January of next year.

By the prompt and efficient measures taken by the power administrator the war industries were assured abundant power and the agrarian producers abundant water. The willingness of the utilities to engage in the plan was, we think, an evidence of confidence of the utilities in the Railroad Commission and its staff, because these companies had been business rivals for many years and were, naturally, jealous of their load capacities, connections and strategic positions.

Federal Control of Public Utilities

Referring to federal control of railroads and telegraph and telephone companies, the commissioners say in part:

It must be remembered that irrespective of whether or not complete control will finally lodge in the federal government, the state will be vitally interested in a great many steam-railroad transportation and rate problems, and the only body through which representation can properly be had is this commission. The commission is still charged by the state constitution and by the public utilities act with jurisdiction over rates, securities, service and practices, grade crossings, interlockers, safety of roadbed and structures, safety of train operation and operating methods, clearances, spur track and interyard connections, valuations and informal complaints.

The question of the jurisdiction of this commission in most of these matters has been formally challenged in proceedings now pending before this as well as other state commissions. No decision was rendered on this question during the progress of the war, but now that the armistice has been signed, the question in so far as it affects this commission in common with other state commissions will of necessity be determined.

If, in the absence of positive legislation by Congress, the Director-General's second alternative (early return of the roads to their owners) should come about, then the commission would within a short time again have to assume complete and unquestioned jurisdiction over state and interstate roads in California. If this happens, not only will there come back again all of the old problems but there will also arise a number of new ones, born during the war, which will be more important and larger than any the commission has had to deal with in this field in the past.

The commission is positive, therefore, that the question to-day is, not to what extent the commission's railroad activities should be further curtailed, but rather how far it should go at this time to prepare and be ready for these new issues which are bound to come before us in one form or another.

Analogous to the railroad situation is the situation with reference to the telephone and telegraph utilities. When the question of the continued jurisdiction of the commission under the new régime came up, the commission entered into direct communication with the Postmaster-General and inquired whether it was his understanding and desire that the commission should continue with its normal functions in relation to these utilities. The Postmaster-General answered that this was his wish and gave it as his interpretation of the federal control law that the commission should exercise all of its functions as heretofore, but that in cases where the commission might see fit to order rate changes they should not be put into effect without his approval.

Under the circumstances the commission has not felt at liberty to discontinue its regulatory work with this class of utilities, and the numerous telegraph cases now before the commission, including the cases involving all of the rates of the Pacific Telephone & Telegraph Company in this state, are being prosecuted as heretofore.

As in the case of the railroads, even if the Postmaster-General's recommendations to Congress for complete federal ownership and operation of wire utilities should be made into law, it would probably still be necessary and desirable for this state to be represented at least during the period of reorganization and adjustment that would as a matter of course precede complete federal ownership. It would be logical that to this commission should fall the task of representing the state's interest in that event.

CAPITAL OF $20,000,000 FOR NEW GENERAL ELECTRIC SUBSIDIARY

International Company Organized with $10,000,000 Preferred and $10,000,000 Common Stock to Take Over Foreign Interests and Export Business

Organization of the International General Electric Company, Inc., has been effected under New York laws with a capitalization of $20,000,000. This is divided between $10,000,000 of 7 per cent cumulative preferred and a like amount of common stock. The stock is paid in and is all held by General Electric interests. All of the foreign interests and export business of the General Electric Company will be under the charge of this company.

The directors are C. A. Coffin, A. W. Burchard, E. W. Rice, Jr., Owen D. Young, J. R. Lovejoy, G. F. Morrison, Gordon Abbott, Sidney Z. Mitchell, George P. Gardner, Charles Neave and Gerard Swope.

As stated recently in the ELECTRICAL WORLD, Gerard Swope is president of the new company and Charles Neave chairman of the board. M. A. Oudin is vice-president of the company.

ADD MEMBERS TO COMMITTEE ON INTERNATIONAL TRADE

Enlargement of Committee of the Associated Manufacturers of Electrical Supplies—Division of Subjects to Facilitate Work

Four additional members were added to the International Trade Committee of the Associated Manufacturers of Electrical Supplies at a meeting of the committee at the association headquarters, New York, on Jan. 15. They are: J. H. Trumbull, Trumbull Electric Manufacturing Company; C. E. Corrigan, National Metal Molding Company; A. F. Hills, Crouse-Hinds Company, and Joseph McElroy III, Pass & Seymour, Inc.

The committee decided to divide its work into two general subjects—the tariff and imports and exports. Members of the committee will be assigned work dealing with different phases of these subjects.

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EXPECTS CENTRAL-STATION DEVELOPMENT TO BE RAPID

Fred H. Smith of Worcester, Mass., Looks for Speedy Resumption of Commercial Growth That Was Temporarily Halted by the War

Fred H. Smith, assistant general manager of the Worcester (Mass.) Electric Light Company, looks for an early return of central-station development along commercial lines interrupted by the war.

"At Worcester," said Mr. Smith to a representative of the ELECTRICAL WORLD, "we are fortunate in having plant capacity which can quickly be utilized to meet the increasing requirements of a diversified patronage. As soon as money becomes easier we expect a healthy development in the way of new building work, in the production of commodities needed in civilian life, and in the further popularization of electrical conveniences. The fuel situation with us is now in better shape than for some time. We are busy investigating prospective power customers' conditions and are taking on new business right along.

"Our men in the service will be welcomed to their old posts on their return to civil life. We shall probably continue to use women in our office work in place of male clerks, as this has worked out exceedingly well; but in other departments the need for men will be met by employing men, especially where we can restore those now in the service to our organization. I look to see a gradual reduction in the government's control of industry and feel that good ground exists for optimism in glancing ahead in the central-station field."

WAR LABOR BOARD DECISION IN GENERAL ELECTRIC CASE

Finding Is that Recent Strikes at Schenectady and Pittsfield Were in Violation of Board's Award—Settlement at Pittsfield

C. E. Michael and William H. Johnston, a committee of the National War Labor Board, have rendered a decision in the General Electric Company strike case. It has been approved by the War Labor Board and is as follows:

The undersigned committee, to which has been referred the General Electric Company situation for consideration and report, now makes the following recommendation:

First—With regard to the troubles at Schenectady and Pittsfield, your committee believes that, since this board has made an award at these plants and has provided a means for adjustment of any controversy arising therein, the recent strikes at these plants were in violation of this board's award.

However, since, owing to changed conditions following the cessation of hostilities, the company's production at these plants has been necessarily curtailed with a consequent necessary curtailment of employees, and the company having expressed its willingness to continue operating under the conditions of the award of this board, we recommend that all questions concerning any alleged discrimination either in the curtailment of forces or the restoration of employees who went on strike be referred for consideration and decision to Examiner Stoddard, who is now engaged in the application of this board's award at Lynn, and whose services in this capacity at Schenectady and Pittsfield shall continue for the period of the war or until it may be determined that his presence is no longer necessary; that, at Erie, Pa., where the company has declined to submit to the jurisdiction of the board, as a conciliatory measure your board also will assign an examiner, selected by the undersigned, whose duty it shall be to pass upon any alleged discrimination either in the laying off or restoration of employees, and who shall continue at Erie in such mediatory capacity until withdrawn by the undersigned as a section of this board; that at Fort Wayne, Ind., any controversy that may exist there be referred to the Secretary of Labor for such action as contemplated by an existing agreement between the company and its employees which does not expire until Feb. 1, 1919.

That the examiners at Pittsfield, Schenectady and Erie shall receive instructions from and report to the undersigned as a section of the board, and that any appeal from their decision be referred to this section for consideration and action. That a copy of this recommendation, if adopted, be sent to the company and the representatives of employees at all of the plants of the General Electric Company interested.

STRIKE ENDS AT PITTSFIELD WORKS

The strike which has been in force among employees of the General Electric Company's works at Pittsfield, Mass., since Dec. 20, ended Jan. 19, when the fourteen labor unions affiliated with the Metal Trades Council voted unanimously to accept an agreement reached during the day with General Manager C. C. Chesney and about 1000 strikers who had not been taken back. The employees' committee on appeals, appointed last year under decree of the War Labor Board, reached an understanding with Mr. Chesney and reported back to the unions. It was planned to take back about 350 workers Monday under a preferential list established a fortnight ago by the company. The agreement provides that the company will endeavor to find work for all the remaining employees who went out by Jan. 27. About 4000 employees were involved in the strike, and the estimated cost of the walkout is about $1,000,000, of which $750,000 represents the burden borne by the company.

NEW HAMPSHIRE COMMISSION URGES USE OF WATER POWER

Declares It Is of Great Importance that a Broad Scheme for Conservation of Power Be Undertaken and Encouraged

Water-power development demands increased attention at the hands of the legislators, especially now at the dawn of a new normal era, says the biennial report of the New Hampshire Public Service Commission to the Governor and Legislature of 1919.

Storage reservoirs may readily be established on the headwaters of many, if not all, of the principal rivers, so that the minimum flow may be largely increased and the use of coal to produce electricity in the state may be practically eliminated—a matter of increasing importance to all the inhabitants of the state. The commission says that such a scheme effectively carried out would largely reduce all the higher prices of electricity, resulting in diminished cost of production and a much more nearly universal use.

An extended report on the water-power resources of New Hampshire will be made public. It is written by George B. Leighton, who has been investigating the problem of conservation with the coöperation of C. H. Pierce, district engineer of the United States Geological Survey.

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"WELCOME HOME" FOR THE BOYS FROM "OVER THERE"

Society for Electrical Development Stimulating Movement for Bright Electrical Displays to Greet the Homecoming Forces with Cheer

The Society for Electrical Development is calling attention to the "welcome home" movement to cheer the returning soldiers and sailors.

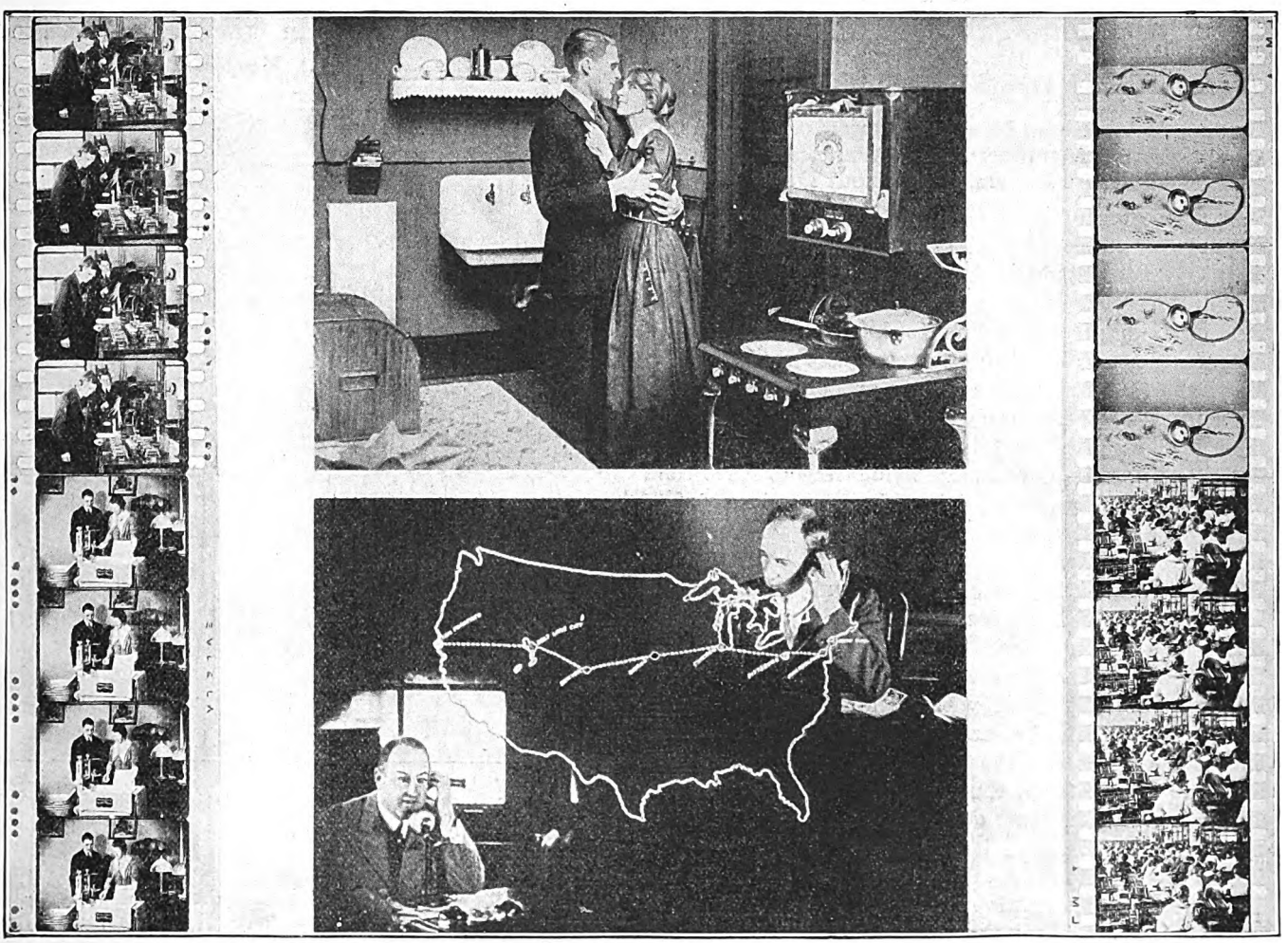
Some idea of the magnitude to which the plan of welcoming the boys home electrically is being carried can be had from these facts regarding the equipment that is being installed for the New York Times Building, which consists of more than 5000 10-watt lamps distributed as follows: The entire building will be outlined with 300 two-foot stars, each star containing eleven lamps, alternating red, white and blue, on a flasher. On the Forty-third Street side, facing Times Square, will be a cluster of Allied flags, surmounted by a spread eagle holding the American shield. This display utilizes 1000 lamps and will measure 40 ft. wide by 24 ft. high. The flags will have a waving effect, and over this will be an electric sign reading "Victory" in 6-ft. letters. At each of the four entrances of the building will be a pair of crossed American flags waving. These will contain 250 lights each. On the roof will be four flashlamps illuminating the American flag flying from the flagstaff.

However, expression of the "welcome home" spirit is not restricted to those only who can go in for large and elaborate displays. Individual dealers, many of whom have neither the facilities nor the means to make a big display, have utilized their windows as the basis for their share in the generally expressed welcome.

In Chicago the Commonwealth Edison Company has taken an active part in the movement to arouse and direct the enthusiasm of business interests, as well as to secure the coöperation of clubs, churches, civic and other bodies. Recommendations to cheer up, paint up, brighten up and light up were scattered broadcast. A series of newspaper advertisements was run in Chicago papers.

The Society for Electrical Development called a meeting of a special committee recently to formulate ways and means to enable the electrical industry to do its share toward making the boys realize that America honors them for their patriotism and is not forgetful of their many sacrifices.

Educational Motion Pictures for Employees of Western Electric Company



The Western Electric Company presented for its employees at the Lexington Theater, New York, on Monday and Tuesday of this week motion pictures dealing with its activities. The films shown were: "Telephone Inventions of To-day," "Forging the Links of Fellowship," "Inside the Big Fence" and "A Square Deal for His Wife."

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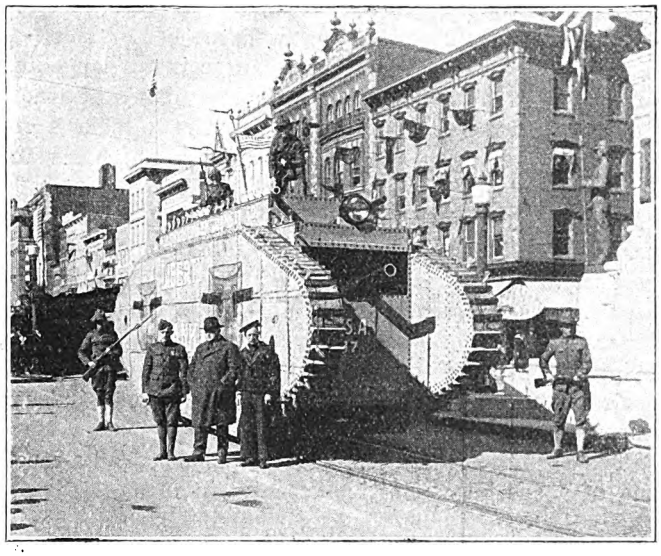
A Reminiscence of the Last War Loan and a Hint for the Coming Victory Loan



The greatest single factor in the successful prosecution of the campaign for the fourth Liberty loan in Lehigh County, Pa., was the coöperation of the Lehigh Valley Transit Company, according to Reuben J. Butz, of Allentown, chairman of the executive committee. This coöperation assumed the form of supplying a "Liberty tank" and the services of a crew to operate it.

MANUFACTURERS ASK PROMPT ACTION ON THEIR WAR ORDERS

Meeting in Cleveland Results in Organization of Association of Manufacturers of War Materials to Secure Legislation Without Delay

At a meeting of more than 200 manufacturers from all parts of the country at the Hotel Cleveland, Cleveland, Ohio, recently the Association of Manufacturers of War Materials was organized for the primary purpose of taking some action to hasten legislation to validate the so-called informal contracts made by the War Department and the ordnance authorities at a time when materials were needed without delay. These include orders placed by telephone, telegraph and letter. Obligations of the government amounting to more than $1,500,000,000 are included in this list, and manufacturers insist that delay in payment will soon result in industrial disaster.

W. S. Symington, Jr., of the Symington-Chicago Corporation, acted as temporary chairman and was afterward made president of the association.

It was decided, after discussion, to support the Dent bill, now before Congress, with such amendments as will remedy the defects the manufacturers feel it contains. This bill will enable the department that placed the orders to adjust them, thus meeting the desires of the contractors, but in some other respects they will insist upon amendments.

It is intended to align all war contractors in the country with this organization and have their influence for the campaign that is to be made for the legislation desired. Mr. Symington will appoint a board of directors and an executive committee. A paid secretary will also be employed, and a representative of the organization will be maintained at Washington to follow every move that is made. For the present Henry H. Dinneen, Maryland Trust Building, Baltimore, will look after the secretary's duties. He is the secretary of the American Fuse Association.

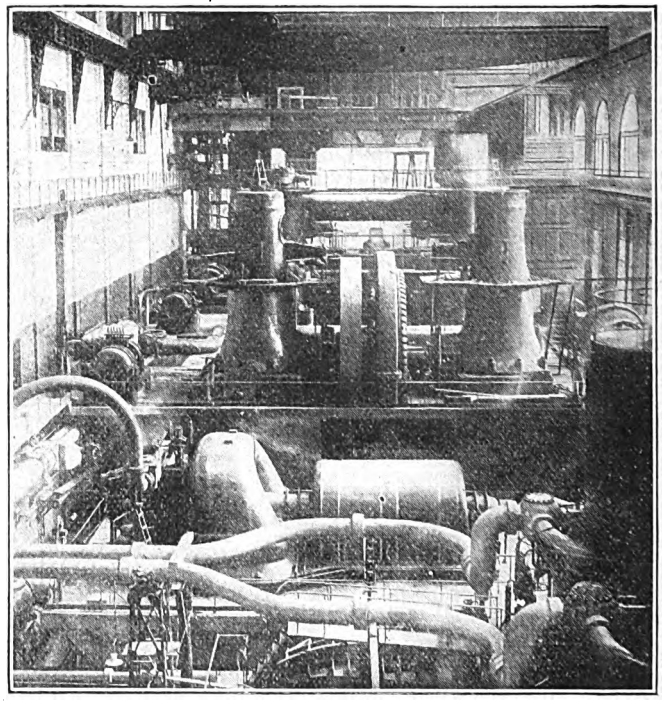
SEEK LARGE MEMBERSHIP FOR RECONSTRUCTED JOVIAN ORDER

Jupiter's Cabinet Considers Proposition to Expand Order Into the National Electrical Board of Trade with Business as Main Activity

An unofficial committee composed of members of the St. Louis Jovian League proposed to Jupiter's Cabinet on Jan. 17 that the Jovian Order be expanded into the National Electrical Board of Trade. It is also proposed to have the activities of the organization primarily business instead of pleasure.

A membership of at least 100,000 is expected, and no change has been suggested in the present optional dues of $2, $5, $10 or $20 per year. The important electrical interests would be asked to guarantee sufficient individual memberships to finance the board during the period in which the plans are being put into effect. When the project gets to be self-supporting all such underwriting payments would be refunded.

Installing 116,000 Kw. in Station Designed for 12,000 Kw.



The Ashley Street plant of the Union Electric Light & Power Company, St. Louis, Mo., was originally laid out to house only three 3000-kw. and two 1500-kw. cross-compound vertical Corliss units, aggregating 12,000 kw. Upon completion of work now in progress there will be installed between the same four walls three 20,000-kw. horizontal, four 12,000-kw. vertical and two 4000-kw. horizontal turbines, or a total capacity of 116,000 kw. The illustration shows the first of the 20,000-kw. turbines in the foreground.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Boston Section.—Dr. Ellwood B. Spear recently gave an illustrated address on "Problems of Gas Warfare" before the Boston Section of the American Institute of Electrical Engineers.

The Synchronous Club.—A feature of the meeting held by the Synchronous Club of Los Angeles, Cal., on Jan. 14 was a talk by G. G. Gillingham on "Submarine Cables and What the Germans Tried to Do with Them."

N. E. L. A., Philadelphia Electric Company Section.—A. H. Manwaring addressed the engineering branch meeting of Jan. 21 held by the Philadelphia Electric Company Section of the National Electric Light Association on the subject of "Transmission."

A. I. E. E., Fort Wayne Section.—Motion-picture films entitled "The Browning Gun," "The Rifle Grenade," "Submarines" and "Fire and Flame" were features of the Jan. 23 meeting of the Fort Wayne Section, American Institute of Electrical Engineers.

Illinois Contractors to Meet in Chicago.—On Feb. 14 and 15 the Illinois State Association of Electrical Contractors and Dealers will hold its semi-annual convention in Chicago. G. A. Engelken, 55 West Harrison Street, Chicago, is secretary of the association.

A. I. E. E., Detroit-Ann Arbor Section.—A paper by John C. Parker on "Fundamental Principles and Calculations of Direct-Current Circuits" was given lately before a meeting of the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers.

Electrical League of Cleveland.—William McClellan, dean of the Wharton School of Finance and Commerce, University of Pennsylvania, addressed the Electrical League of Cleveland on the subject of "Public Utilities and Public Service" at its meeting on Jan. 16.

I. E. S. and A. I. E. E., Philadelphia Sections.—On the evening of Jan. 13 at the Engineers' Club the Philadelphia Sections of the Illuminating Engineering Society and the American Institute of Electrical Engineers held a joint meeting at which Preston R. Millar spoke on "Lighting in War Times."

Pennsylvania State Association of Electrical Contractors and Dealers.—The next meeting of the Pennsylvania State Association of Electrical Contractors and Dealers is scheduled for Jan. 28 at the Hotel Adelphia in Philadelphia. Following open and executive business sessions a dinner will be held in the evening.

A. I. E. E., Schenectady Section.—F. L. Hunt had for his subject "Features of Design and Operation of the Turners Falls Power & Electric Company" at the Jan. 17 meeting of the Schenectady Section of the American Institute of Electrical Engineers.

A. I. E. E., Washington Section.—N. W. Storer was the speaker at the meeting of the Washington Section of the American Institute of Electrical Engineers held on Jan. 14, having for his topic "Electrification of the Chicago, St. Paul & Milwaukee Railway."

Empire State Gas and Electric Association.—At a meeting of the electric distribution section of the Empire State Gas and Electric Association held in Schenectady on Jan. 17 the use of disabled men in distribution work was discussed. Other topics that came in for consideration were transformer loading, the banking of transformers, interconnection of feeders, and methods of marking poles.

A. I. & S. E. E., Philadelphia Section.—John H. Anderson, chief electrical engineer, and H. W. Osgood, electrical engineer of the American International Shipbuilding Corporation of the United States Emergency Fleet, Hog Island, will have for their subject "Electrical Features of Hog Island" at the Feb. 1 meeting of the Philadelphia Section of the Association of Iron and Steel Electrical Engineers, to be held at the Engineers' Club.

Jovian League of Kansas City.—Plans for its greater usefulness both in electrical circles and in civic affairs were announced by President William Hand at the Kansas City Jovian League's first meeting of the new year, held on Jan. 7. The league will this year hold two meetings a month, on the first and third Fridays. It was announced that the first "rejuvenation" since the United States entered the war will take place in February.

Western Association of Electrical Inspectors.—Conservation by standardization will be the chief topic at the annual convention of the Western Association of Electrical Inspectors to be held at the Hotel Sherman in Chicago on Jan. 28, 29 and 30. W. H. Merrill of the Underwriters' Laboratories, Inc., and F. S. Wilhoit of the Cutler-Hammer Manufacturing Company will speak on different phases of this subject. Other speakers at the meetings will be Dana Pierce of the electrical committee of the National Fire Protective Association, on "Making Electrical Rules"; C. W. Babcock, assistant city attorney for Milwaukee, on "The Validity of Ordinances Covering Electrical Matters"; M. G. Lloyd of the Bureau of Standards, on "The Proposed Combined Electrical Fire and Safety Code"; Mr. MacNeill of the Westinghouse Electric & Manufacturing Company, on "A Small-Capacity Circuit Breaker to Take the Place of Fuses," and F. A. Barron of the General Electric Company, on "Time Lag in Motor Protective Devices."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Minimum Charge Decision. — The New York Public Service Commission, First District, has approved an opinion by the chairman, Charles B. Hubbell, and has decided that the Bronx Gas & Electric Company is violating the law in exacting from its electric customers a minimum charge of $1 per month when the total consumption of any single consumer during a particular month multiplied by the rate at which that consumer buys energy does not equal the minimum charge. The maximum price which this company may charge is 12 cents per kilowatt-hour for electricity. Chairman Hubbell found that the imposition of a minimum charge would have the effect in some instances of raising this rate and hence would be illegal. The commission, on the chairman's recommendation, directed that the company remove the minimum charge from its schedules.

Minimum Charge Upheld. — The Pennsylvania Public Service Commission has handed down a decision holding that the public service law of the state allows a minimum charge for electric service as well as a "readiness-to-serve" gas charge. The case at issue was brought by the Borough Council at Lewiston against the Penn Central Light & Power Company protesting against a minimum charge of $1 per month for electric service and 75 cents a month for a readiness-to-serve gas charge. In its decision the commission says: "The reasonableness of minimum schedules has been firmly established and approved in the public service utility law. The use of a separate charge to cover stand-ready costs is very general in electric power schedules, and at the present time the trend is undoubtedly toward a wider use of this form of charge in gas, electric, water and other utilities. The public service utility law does not prohibit its use either directly or indirectly. There is no dintinction in principle between a system of minimum payments and a system of ready-to-serve charges; both are predicated upon the same analysis of total cost of service, and both recognize the element of 'stand ready to serve.' In a schedule with minimum payment requirements the ready-to-serve costs are concealed in the rate per unit, and in the minimum, while in a schedule with a pure ready-to-serve charge these costs are revealed. The commission has not adopted any fixed policy in the matter of a ready-to-serve charge, even though it has in several instances and under certain conditions approved its use."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

"The Synchronous Motor."—*The Synchronous Motor* is the new title of the paper published by the welfare association of the Cleveland Electric Illuminating Company.

Shortage of Coal in Europe Acute.—Coal is scarce in Europe this winter, and behind the scarcity lurks the menace of Bolshevism, a special commission sent abroad by the United States Fuel Administration told Fuel Administrator Harry A. Garfield in a report. No European country has enough coal.

Ohio Commission Overrules Motion for Rehearing in Alliance Rate.—The Public Utilities Commission has overruled a motion for a rehearing filed by the city of Alliance in the case in which the commission fixed the electric rates for the Alliance Gas & Power Company. The city is said to be preparing to appeal to the Supreme Court. The rates were fixed at 12 cents per kilowatt-hour to Jan. 1, 1919, and 10 cents for the following seven and one-half years. The City Council had passed an ordinance fixing the maximum rate at 6 cents.

Development of California Hydroelectric Resources.—Governor William D. Stephens of California says in his message to the Legislature: "Coincident with irrigation expansion will come the development of our wonderful hydroelectric resources. The development of this power will prove a great stimulus to industrial activity. California, by reason of its nearness to the high Sierras, should have the cheapest electrical power in America, and this, together with its unfailing supply of raw materials and its easy access by cheap water transportation to the great markets of the world, should render it in time one of the greatest manufacturing states in the Union."

Toledo Refuses to Allow Service Charge.—On Jan. 8 the City Council at Toledo, Ohio, passed an ordinance reëstablishing the present rate of 8 cents per kilowatt-hour, with a provision for a discount if paid before the tenth of the following month, and a minimum charge of 50 cents. The ordinance extends over the period of one year. In order to increase the income to meet the advanced costs of operation, the Toledo Railways & Light Company had asked that a service fee of 50 cents a month be established, but the Council refused to incorporate this in the contract. Should the company insist, it will now be compelled to go to the Public Utilities Commission and prove that the service charge is necessary.

Prizes on N. E. L. A. Section Papers.—In the Public Service Company of Northern Illinois section of the National Electric Light Association prizes have been awarded for the best papers prepared in competition. The first prize was taken by William Jaeger for a paper entitled "Utility Company Salesmen." The second prize went to George F. Dunn for a paper entitled "Sticking Up," and the third prize was awarded to E. P. Liston for a paper entitled "Looking Ahead."

Federal Order Forbids Waste of Natural Gas.—Wasteful usages of natural gas, such as burning it all day to save the trouble of turning it off, are to be reported hereafter to the United States Fuel Administration, under an order promulgated on Jan. 7. Existing shortages of natural gas may be alleviated in some measure, Fuel Administration officials said, by the order. The natural-gas situation has become steadily worse during the last few years. In many parts of the country at the present moment it is critical; in many communities the consequences during the winter threaten to be serious. The supply is beginning to run short, and only by the greatest vigilance and care can due service be obtained from the quantity available. The losses in connection with use of natural gas are greater relatively than those of any other commodity, and many of these losses can be speedily improved.

To Study Social Status of Engineers.—The Duluth (Minn.) Engineers' Club has appointed a committee to study the question "How can the engineer advance to a more respected and higher plane?" The committee believes a solution of the problem is for independent engineering societies to form a combined engineering society, keeping in mind the importance of not destroying the identity of the present societies but of taking their good points, adding what is new and desirable and getting rid of the undesirable features. The work of the combined organization should be to supplement the work of the separate organizations now existing, taking up questions that they are too busy to handle and centralizing others where combined efforts will bring better results. Technical work and advancement of the arts and sciences would be accomplished in each individual society as at present. The general society would deal with such subjects as the status of the engineer, general welfare, professional ethics, employment agencies, relation of the engineer to the general public, publicity and social benefit. The Duluth committee, which is to ascertain the sentiment of the profession throughout America on the subject, consists of O. H. Dickerson, American Society of Civil Engineers; W. H. Heald, American Institute of Electrical Engineers; O. A. Graves, American Chemical Society; F. H. Linley, American Society of Mechanical Engineers, and D. E. Woodbridge, American Institute of Mining Engineers.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Cannot Refuse Service at Store Because of Overdue Residential Bill.—A public service corporation may not refuse to supply a consumer with electric energy at his place of business merely because he refuses to pay for overdue service at his residence, the two services being distinct, the Supreme Judicial Court of Maine held in Merrill versus Livermore Falls Light & Power Company (105 A. 120).

Electric Light Company Taxable Only on Authorized Business.—Under an act of June 21, 1899, imposing a tax on gross receipts from business of electric light companies, a company is taxable only for receipts derived from the business which it is authorized to transact as an electric light company and not on its receipts from sale of steam and merchandise, the Supreme Court of Pennsylvania held in Commonwealth versus Harrisburg Light & Power Company (105 A. 80).

Assessment of Taxes.—The Chicago drainage canal, constructed primarily for drainage purposes, but used for the production of electric power, is subject to local assessment for taxation, though the canal is used for purposes of navigation under requirements and regulations of the United States government imposed as a condition to the grant of a permit to destroy the Illinois & Michigan Canal for navigation purposes, according to the Supreme Court of Illinois (120 N. E. 818). In assessing the value of the Chicago drainage canal for local taxation, the cost of the improvements, less discount for depreciation, is not the sole criterion of value; but the net earnings from power transmission may be considered.

Right of Legislature Regarding Rules for Electric Wiring.—The Kansas Legislature cannot delegate to private persons or associations the right to make obligatory rules concerning the management of property, nor can it provide that the breach of such rules is a penal offense. Such is the decision of the Supreme Court of Kansas in declaring invalid the section of the fire prevention act providing that theater owners shall be compelled to make electrical wiring conform to the provisions of the National Electrical Code. Complaints had been filed against L. M. Crawford of the Grand Theater, Topeka, because he did not conform to the code, and the lower court decided adversely. The Supreme Court justice expressed the opinion that if the Legislature wished the code to prevail it must pass it as a special law.

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Irving Martin has been appointed a member of the California Railroad Commission.

Harley W. Brundige has been appointed a member of the California Railroad Commission.

Walter Rossman, for several years assistant manager at Grand Ledge, Mich., for the Consumers' Power Company, has been promoted to manager, succeeding H. H. Drew.

H. H. Drew, for the last nine years local manager at Grand Ledge, Mich., for the Consumers' Power Company, has been transferred to the Kent (Ohio) Water & Light Company as manager.

C. G. Engstrom, formerly line foreman in the Hutchinson (Minn.) section of the Southwestern division of the Northern States Power Company, has been appointed superintendent to succeed Thomas Pitts.

N. I. Garrison, manager of the El Reno (Okla.) division of the Oklahoma Gas & Electric Company, has been appointed district chairman of the Public Utilities Association for the district around El Reno, embracing twelve counties.

W. Jocelyn E. Dale has resigned from his position as superintendent of power for the Matahambre Copper Mining Company at Santa Lucia, Pinar del Rio, Cuba, to become electrical engineer for the Elia Sugar Company and engineer with the Cuba Cane Sugar Corporation of Havana.

Mortimer Freund, who has been in charge of the trench warfare branch, loading section of the explosives and loading division, Ordnance Department, at Washington, D. C., has resigned from that service and has resumed his activities in the firm of Eadie, Freund & Campbell, consulting mechanical and electrical engineers, New York City.

F. E. Bourget, who for the past thirteen months has been handling the distribution of bituminous coal throughout Ohio, Michigan, Indiana and the West for the Fuel Administration, resigned on Jan. 1, to become identified with the Interstate Coal & Dock Company as special sales agent with headquarters at Cincinnati.

M. C. Gilman, formerly sales manager of the Toronto (Canada) Electric Light Company and for the last few months manager of Willis L. Adams' Montreal office, has joined the staff of the Montreal Light, Heat & Power Company as special agent and research engineer. For a time Mr. Gilman acted as secretary of the Canadian Electrical Association.

E. N. Hurley, chairman of the United States Shipping Board and well known as an electrical manufacturer, it is announced by press dispatch from Pekin, has been decorated by the Chinese government with the order of Chiaoho, second class. The order is confined to civilians and is conferred by the President of the republic for distinguished service.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

S. D. Sprong, electrical engineer for the Edison Electric Illuminating Company, of Brooklyn, N. Y., has been appointed chairman of the street-lighting Committee of the Association of Edison Illuminating Companies and also a member of the committee on electricity distribution and use. Mr. Sprong has been associated with the Brooklyn utility in his present capacity for the past seven years, having been prior to that chief electrical engineer of T. G. White & Company, Inc. Previous to that again he was electrical engineer for the United Electric Light & Power Company, New York City, and he had been formerly connected with the New York Edison Company and the Public Service Corporation of New Jersey.

S. D. SPRONG

Peter D. Vroom, who has been editor of the *Doherty Monthly* and *Doherty Daily News* since their inception, has resigned to resume newspaper work. He is succeeded by Thomas B. Pratt, formerly with the publicity department of the New York, New Haven & Hartford Railroad and prior to that with the *Wall Street Journal.*

Lewis Rowe has been appointed superintendent of the municipal light station at Columbus, Ohio. He has been acting superintendent since the resignation of H. E. Eichhorn more than a year ago. Mr. Rowe has been connected with the station since its establishment in 1904 and has installed all the equipment in the plant. For the last four years he has been chief electrician in addition to his other duties. He was connected with the old Columbus Edison Company before it was taken over by the Columbus Railway, Power & Light Company.

William A. Widersmann, manager of the Stanislaus district of the Pacific Gas & Electric Company, has resigned to take up other duties.

John H. Miller, who for the last year was a lieutenant in the Signal Corps at Washington, D. C., in the radio development department, has been released and is now associated with the Jewell Electrical Instrument Company, Chicago, in charge of the engineering department. After graduation from the University of Illinois Mr. Miller was employed by the Westinghouse Electric & Manufacturing Company and was in the detail and supply department of that company for several years before he entered the army.

Charles R. Underhill, until recently captain in the Air Service, Aëronautics, received his discharge from the army on Jan. 8 and has returned to New Haven in the capacity of chief electrical engineer for the Acme Wire Company. For some time Captain Underhill was in charge of tests in flight for the radio development section of the Signal Corps at Langley Field, and when this work started at Little Silver he was transferred to the school for aërial observers at Langley Field, where he organized the radio department and the simulative artillery system. Later Captain Underhill was transferred to the Division of Military Aëronautics, Washington, D. C., where he specified the radio equipment for Air Service operations.

Obituary

Abram T. Baldwin, president of the Precision Instrument Company, Detroit, Mich., died on Jan. 8.

Prof. Rolla C. Carpenter, who until less than two years ago was professor of experimental engineering at Sibley College, Cornell University, which position he had held since 1890, died at his home in Ithaca, N. Y., on Jan. 19 at the age of sixty-seven years. Prior to taking the chair of experimental engineering at Cornell he was professor of mathematics and engineering at the Michigan Agricultural College. At the same time he was consulting engineer for the Lansing Engine & Iron Works, when he designed a governor for the company's automatic engine and made a number of important tests to determine friction losses under various conditions. Professor Carpenter was widely known for his consulting work, particularly that of testing of power-plant units. He did considerable technical writing, and among his works are two well-known textbooks, "Experimental Engineering" and "Internal-Combustion Engines." He was judge in the department of machinery at the Chicago Exposition in 1893, the Buffalo Exposition in 1901 and the Jamestown Exposition in 1907. Professor Carpenter was a member of most of the national engineering societies and was a past-vice-president of the American Society of Mechanical Engineers.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

ELEMENTS OF 1919 FAN DISTRIBUTION PROGRAM

Generally Speaking, 16-In., 12-In. and 9-In. Sizes in Four Blades Are to Be Made Standard for Both Oscillating and Non-Oscillating Types

Arrangements have just about been completed for the 1919 distribution of electric fans. A number of changes are noted from the 1918 fans, although the tendencies that developed at that time are even more pronounced this year. Standardization of electric fans apparently is going ahead rapidly.

The tendency appears to be for the manufacturers to confine their output as nearly as possible to a smaller number of styles. Of course, the 16-in. and 12-in. four-blade fans have virtually been standardized throughout the industry both for oscillating and non-oscillating types. A very strong tendency is seen to replace the smaller sizes with a standard 9-in. four-blade fan in both oscillating and non-oscillating types. There will, however, be a number of 8-in. fans on the market as well as some smaller sizes which are sold on a price basis.

One concern, for instance, that replaced its 6-in. fan with an 8-in. fan two years ago, continued its production of 8-in. fans to the extent that it had parts left over in stock. As soon as the stock of parts of 8-in. fans has been closed out, however, this company will standardize on the 9-in. four-blade type for the smaller sizes. This shows a tendency toward which all manufacturers are drifting.

Ceiling-fan production will come down virtually to one model for alternating current and one for direct current in four blades, plain body, with a 56-in. sweep. The tendency is for anything different from this to be considered special and not carried as a stock article. There may, however, be some departure from this practice, owing largely, it is understood, to stocks on hand. There are, however, some new models in ceiling fans which have departed from the plain body. While more ornamental, they are keeping to the other standards of four blades and 56-in. sweep.

Steel guards will probably be universally used on the 1919 fan output for domestic trade. The tendency is to drift into the use of steel guards also for export trade. There are, however, certain locations which demand a brass guard, and for these the steel guards cannot be used.

The industry had as a result of the ruling of the conservation board prepared to use steel for blades, but this ruling has been withdrawn since the war closed and the chances are that brass blades will be very much in evidence in this market. It is probably true that steel blades would be used more by fan manufacturers were it not for the fact that they must be either brass-plated or japanned. If brass-plated, then there is little difference between the cost of these blades and that of brass blades. If japanned, the japan must be cooled in such a way as to prevent the formation of drops on one side. The formation of these drops, with the high speed of the fan blades, would cause the fans to jump while in operation. Such difficulties have caused the manufacturers to look upon steel blades with less favor.

While 8 ft. of cord attached had virtually become the standard for 1918, still a number of manufacturers last year felt that the trade would be better satisfied with 10 ft. The War Industries Board was of the opinion, however, that 8 ft. was sufficient, and it will probably be found that this year's fans will carry not more than 8 ft. of cord.

Prices have advanced this year around 15 to 20 per cent for the oscillating and non-oscillating types and from around 20 to 25 per cent on ceiling types. There is one concern, however, which has advanced 20 per cent on all fans except ceiling fans, which it has advanced 30 per cent. This concern did not advance its prices as much last year, and the higher advance this year simply brings its products more into line with those of other makes.

The manufacturers found it necessary to increase the price of fans this year for many reasons. All of their raw material had been contracted for and delivered during 1918 or before, and the prices were in excess of those in the previous year. Labor has also gone up and is still up. Also there are high taxes to pay. These were at first placed at 10 per cent, but have later been reduced to 5 per cent, on the selling price of the fan and, of course, have to be incorporated in what the manufacturer charges. It is well known that the manufacturers had decided to charge even higher prices than are now being charged. When the armistice was signed, however, it became apparent that the prices for 1919 must be no higher than absolutely necessary.

LARGE VOLUME OF MOTORS EXPORTED LAST OCTOBER

Official Total of Electrical Exports for Month Is $4,860,392—Exports for the Year 1918 Are Estimated at $60,000,000

Exports of electrical merchandise for the month of October last amount to $4,860,392, or almost $750,000 in excess of October, 1917. Generally speaking, the exports for October, 1918, ran about the same as those for October, 1917. Insulated wire and cable, however, ran somewhat more than $200,000 in excess, and motors went to the high level of $1,147,159.

For the ten months ended with October last the exports of electrical goods amounted to $48,617,293, or a little more than $4,000,000 greater than for the corresponding period for the previous year. At this rate, figures for the entire twelve months of 1918, when available, should be around $60,000,000.

Details of the exports are given in the accompanying table and were compiled by the Bureau of Foreign and Domestic Commerce:

	October		Ten Months Ended Oct.	
	1917	1918	1917	1918
Batteries	$275,721	$276,730	$2,843,770	$2,594,954
Carbons	127,271	114,991	463,451	1,250,382
Dynamos or generators	196,146	254,156	2,054,151	2,719,085
Fans	29,276	15,679	503,514	723,342
Heating and cooking apparatus	63,840	86,144	149,236	556,928
Insulated wire and cables	306,713	525,031	5,798,996	4,739,470
Interior wiring supplies, including fixtures	100,345	83,656	1,030,145	1,175,035
Arc lamps	737	273	14,152	13,737
Carbon-filament lamps	18,023	5,758	152,387	74,218
Metal-filament lamps	240,686	191,344	2,257,575	2,715,756
Magnetos, spark plugs, etc.	283,272	222,099	995,617	2,170,904
Meters and measuring instruments	80,689	83,674	892,870	1,545,994
Motors	546,255	1,147,159	5,145,292	6,636,810
Rheostats and controllers	23,343	30,281	61,188	197,859
Switches and accessories	82,782	124,720	584,679	1,836,686
Telegraph apparatus, including wireless	16,609	19,689	486,960	258,949
Telephones	210,276	148,312	1,705,521	2,377,119
Transformers	224,975	206,575	1,263,625	2,779,377
All other	1,326,014	1,324,121	17,727,486	14,250,688
Total	$4,152,973	$4,860,392	$44,130,615	$48,617,293

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LARGE MARKET NOW SEEN FOR INDUSTRIAL HEATING EQUIPMENT

The Impetus Which Was Given to These Devices by War Is Expected to Carry the Demand Forward to Greater Volume of Sales

Industrial electric heating devices bid fair to become a considerable element in the total market for electrical goods. During the war the sale of such equipment was greatly increased and its value as an economic and efficient group of industrial appliances was recognized. Manufacturing facilities were enlarged, many new devices were developed, and a number of new applications were discovered.

Now, however, that the war demand is past, the manufacturers are going into the commercial market with redoubled effort. Furthermore, manufacturers can expect to receive more coöperation from central stations. Already the utilities are making plans to increase greatly the industrial heating load.

There is another factor that must be appreciated, namely, that this market, like others, is cumulative. It is much harder to sell the first than the second installation. Therefore the increased demand that accompanied the war should make for a better and larger market.

METAL MARKET SITUATION

There Is Still No Buying to Be Recorded—Copper Goes a Little Lower

Another drop in copper has occurred since last week. Electrolytic is now reported at 20 cents spot and 19½ cents for first-quarter delivery. There is very little buying, however. The producers' committee was scheduled to leave for Europe this week to study conditions there. Production has fallen off considerably.

Lead is now quoted at 5½ cents by all producers. Spelter softened somewhat in price, as did antimony also. The tin market continues stagnant, waiting for the government to remove its price of 72½ cents.

There is virtually no buying now of any of the metals, either new or scrap. In some lines, such as lead, the bottom prices have been pretty nearly reached, while in others still further reductions are expected. It is this latter condition that is holding up purchases probably more than any other single cause. Manufacturers hesitate to stock raw materials in any large quantity at prevailing prices when there is a possibility that lower quotations are coming. The tendency rather is to reduce supplies on hand as rapidly as possible in order to keep the "loss taking" on a declining market as small as possible.

NEW YORK METAL MARKET PRICES

	Jan. 13	Jan. 21
Copper:	£ s d	£ s d
London, standard spot	94 0 0	91 0 0
	Cents per Pound	Cents per Pound
Prime Lake	23.00*	21.00*
Electrolytic	20.50	20.00
Casting	18.75	18.25
Wire base	22.75*	22.75*
Lead, trust price	6.00	5.50
Antimony	7.75	7.50
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	13.00	13.00
Spelter, spot	7.65	7.35
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	16.00 to 16.50	15.50 to 16.00
Brass, heavy	9.00 to 9.50	9.00 to 9.50
Brass, light	7.50 to 8.00	7.50 to 8.00
Lead, heavy	4.50 to 4.75	4.50 to 4.75
Zinc, old scrap	4.75 to 5.00	5.00 to 5.25

* Nominal

THE WEEK
IN TRADE

CURRENT sales are for the most part for immediate requirements. There is little tendency to stock. Jobbers are keeping their stocks down. Still, business for this time of the year is pretty good.

The electric light utilities are beginning to borrow money. A few small lines are being set up, and construction work from this direction appears to be opening up.

Prices are holding remarkably firm. There is a tendency to cut prices here and there in an effort to stimulate business, but it does not appear to be hurting other distributers.

Labor is becoming more plentiful, and a surplus is developing in fifteen or more states.

NEW YORK

Inquiries are a little better, and there appears to be a fair amount of business placed. For the most part it is small-order business for immediate requirements. The tendency to order ahead has disappeared.

Prices are holding pretty firm. Local distributers see no reason for covering them at present because it would hardly be possible to stimulate any building purchases during the months of January and February. Considerable significance is attached to the new conduit discounts which have been lowered on less-than-carload shipments. Wire producers are gradually getting down to a 27-cent to 28-cent rubber-covered wire base.

Surpluses are shown to be increasing, there now being indicated a surplus of about 26,000 in New York State, though a marked shortage of common labor is indicated by the reports. Supply and demand are about equal in New Jersey. Shortages are still marked in Pennsylvania, though decreasing in Philadelphia.

USED MATERIAL.—The War Department reports as of Dec. 1, 1918, the following material on hand at or in transit to docks, camps and ports but not in possession of troops: Electrical material, 772 tons; copper wire, 1030 tons.

PORCELAIN.—Falling prices have been reported in the local papers, but so far as can be learned the price is holding firm with the producers and more reputable jobbers. The reports apparently came from cut-price houses.

ARMORED CABLE.—That a cut is coming has been rumored for the past three weeks, but at this writing the price remains unchanged.

CONDUIT.—Card 41 went into effect Jan. 14. This provides for smaller discounts on less-than-carload shipments. Discounts dropped 1 per cent on 10,000 lb. to carload, 3 per cent on 5000 lb. to 9999 lb., 5 per cent on 2500 lb. to 4999 lb., and 7 per cent on less than 2500 lb.

WOOD POLES.—Northern cedar pole cutters are offering distributers a contract at present prices until June 30. Owing to cutting, freight and labor conditions there appears to be little prospect of any drop in price. There is a possibility, however, that the decision on Monday in the California lumbermen's freight-rate case on shipments east of Denver may be reflected in lower prices to the consumer.

INSULATOR PINS.—Prices on wood insulator pins are beginning to ease off. They were as high as $25 per 1000. but can now be had for $4 to $5 less. Normal price is around $11 to $12 per 1000.

CROSS-ARMS.—Yellow pine has advanced $4.50 per 1000 board feet, which means an increase of about 5 per cent on cross-arms. Fir, used more, has not changed.

WIRE.—Two producers dropped their rubber-covered base since last week. One went from 34 to 28 cents and the

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other dropped from 28 to 27 cents. Of thirteen prominent producers on Tuesday, one was on 34 cents, one on 29 cents, six on 28 cents, four on 27 cents and one on cost.

CHICAGO

In the Middle West much thought is being given to making proper prices for electrical goods. There is a feeling that the price finally announced for the next few months should have a wholesome effect on the trade. In high-tension apparatus one manufacturer has in effect guaranteed his present prices against decrease until March 1. He figures that his announcement of this policy will permit him to work up raw-material stocks purchased at high prices and will stiffen the backbones of competing manufacturers. In heating devices the future price situation is somewhat complicated by the fact that there is a difference in price now between what are considered two of the major competing concerns. One of the manufacturers refrained from raising its prices to the new level established by its competitors in 1918.

Actual building thus far started in Chicago is not up to the expectations and promises made earlier in the winter. The reason given is that buildings built in 1914 can rent profitably at $2 per square foot, but that buildings built now would have to rent at $3.90 per square foot to give the same profit.

Public utility financing is proceeding at a pace which gives promise of activity in that field. There are now eleven companies in the State of Illinois petitioning the Public Utilities Commission of Illinois for authority to issue securities. The names of the companies and the amounts are: The Rockford Electric Company, $164,000 bonds and $66,000 preferred stock; Jacksonville Railway & Light Company, $186,000 bonds; Northern Illinois Light & Traction Company, $90,000 bonds; Illinois Central Traction Company, $254,000 bonds; Chicago, Ottawa & Peoria Railway Company, $576,000 bonds; Commonwealth Edison Company, $4,000,000 bonds; Calumet & South Chicago Railway Company, $225,000 notes; Carroll County Independent Telephone Company, $5,457.91 bonds or notes; Chicago Railways Company, $1,995,414 bonds; Aurora, Plainfield & Joliet Railway Company, $200,000 bonds, and the Pontiac Farmers' Telephone Company, $1500 capital stock.

Some jobbers report that the last week has been entirely satisfactory as to volume of business. While it has not been so good as it was in October or November, it was a good week for January. The business came from contractors, industrials and even from central stations. The lamp business has also been brisk.

CONDUIT.—There has been a revision in the scheme of discounts, but no reduction in price was made.

COPPER WIRE.—Prices are spread all the way from 27 cents to 32 cents according to the manufacturer.

LIGHTING FIXTURES.—Bracsolites have been guaranteed against price decreases up to April 1.

APPLIANCES.—Sales are satisfactory in volume. The situation is fraught with some danger because certain distributers with very large stocks may want to sell them rapidly. On the other hand, these distributers may realize that appliances are the one thing that the trade can easily sell during the first six months of 1919.

FARM-LIGHTING PLANTS.—New developments are being made in this field which will be of particular interest to light and power companies.

WASHING MACHINES.—Factories are still crowded to the limit to produce enough machines.

BOSTON

A waiting attitude is still maintained in the trade. Materials of practically all kinds are more plentiful; stocks are not being depleted fast enough to cause any extended buying, and the supply of labor is rapidly increasing. In spite of present dullness, the opinion is practically unanimous that good business cannot long be postponed. It is remarkable to find so much optimism in a period of so little expansion. Prices are still high and predicted reductions are little in evidence. One Boston jobber expressed the wish Monday that prices might come down with a rush, believing that industry would be quickly stimulated thereby. Another large dealer, however, who is carrying about $200,000 in electric motors on his floors, most of which were secured at top prices, looks at the matter from the opposite side. Here and there signs of new building plans are materializing slowly, and vigorous efforts are being made to revive public works projects held up by the war. A large amount of war material is still being produced in New England, and the government has not entirely stopped buying electrical apparatus. The market for small and moderate-sized generators for waterwheel service is coming to life. Appliance sales are fair. Collections are reasonably good, and concerns with good credit continue to meet their obligations promptly. The General Electric strike at Pittsfield has now been settled. Returning service men are being generally taken back into electrical concerns from which they joined the colors. It is pleasing to note that central-station power loads, while somewhat below recent levels, are not falling off at an alarming rate.

MOTORS.—Prices are firm, despite the release of many motors from war plants. Factories are still working on back orders, and shipyards and navy yards are absorbing motors ordered some time since. Stocks are being built up slowly, and some dealers are overloaded. It is hoped that the demand will strengthen soon so that extended price-cutting can be avoided. Industrial inquiries are in small volume at present, and the jobbers are holding off on purchases.

GENERATORS.—Recent sales of machines for water-power plants indicate that a real market is opening up. Public interest in water-power conservation is rising rapidly. The present demand covers units of from 50 kw. to 200 kw., and ninety-day deliveries are being quoted. Northern New England is coming into line for water-power development along modest but highly efficient lines, and the present relatively high cost of generating equipment does not appear to hamper this business much, in view of the exalted prices of coal and labor now current.

CONDUIT.—Pipe is moving into New England in reasonable volume. The wiring market is dull at presnt, but the outlook is good for spring business. Prices are running a bit lower in the central Connecticut valley.

WASHING MACHINES.—Dealers are looking forward to a record-breaking year. Distributers are rapidly getting primed for the expected increase in demand. Sales are in fair volume, despite the usual January breathing spell.

SCHEDULE MATERIAL.—Porcelain and brass are easier as to supply. The factories are still filling back orders. Local business is mainly of the pick-up variety, to fill gaps in jobbers' stocks. Prices are steady without much prospect of early change. The outlook is good, and one representative factory distributer is stocking up on the current price basis in the firm belief that when the demand increases it will come with a rush. January business is showing some improvement over that of last month. On standard products deliveries are now very satisfactory.

WIRE.—The market is slow. Some sales are reported below cost, and prices are rather unsteady.

LAMPS.—Ordinary sizes and types are in good stock. Prices are firm. The miniature-lamp supply is gradually increasing, but time is needed to overcome the effect of war orders on the factory facilities. Buyers can count on better deliveries from now forward, and in two or three months the supply should be nearly normal. The enormous orders placed by the government were little realized by the outside trade during the war, and the manufacturers did well not to permit the market to become absolutely exhausted.

FUSES.—Stocks are heavy and immediate deliveries can be made in nearly all sizes. Fuse prices maintain the low levels illustrated during the war, when acute competition held down the advances which rising production costs would have justified. For this reason distributers state that whatever happens to other material, no declines in fuse prices are to be anticipated for a long period.

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ATLANTA

Manufacturers report that the volume of business continues very satisfactory. This week's trade is somewhat below the same period in December. Jobbers and dealers are buying carefully and only in comparatively small quantities for fill-in purposes. A feeling of uncertainty still exists, however, and buyers are waiting for a substantial decline in prices covering standard material. This feeling is further accentuated by the weakening in metal prices. It is thought that after small declines take place in staples the buying element will be able to calculate future reductions and go ahead with plans for larger stocks. It is not probable that Southeastern jobbers' and manufacturers' stocks will be kept up to the point attained in 1918. Copper-wire base has dropped off to about 26 cents.

The effect of holding cotton in the rural districts for a higher price is beginning to be felt in some sections. This is bound to reflect on collections, and while the banking element is to some extent fostering the plan, it is expected that liquidation will take place soon. The Terry Shipbuilding Company, Port Wentworth, Ga., has let contracts for the construction of 120 dwellings to house employees. The Foundation Company, Savannah, Ga., has about completed plans for the installation of an electric power plant.

STORAGE BATTERIES.—The big demand of 1917 for automobile starting and lighting batteries that remained unfilled owing to poor deliveries has carried over to this year. Shipments show a marked improvement. There seems to be no hesitancy in purchasing, and wholesalers state that the volume of sales being transacted at this time indicates a substantial increase over last year.

LAMPS.—Manufacturers report that the activity of last fall continues and the volume of business is about equal to the early part of 1918. The decrease in industrial requirements is offset by the constant orders on government account for cantonments. The insistent call for 40-watt and 60-watt lamps is being taken care of from well-distributed stocks throughout the Southeast. Some difficulty is experienced in securing 75-watt and 100-watt sizes.

SEWING MACHINES.—Dealers and retailers have enjoyed an excellent trade of late, and there is no apparent let-up. Stocks are being well maintained.

FLOODLIGHTING.—While there has been some cessation in the demand for these outfits, the requirement for shipbuilding centers has not been filled and this together with a healthy industrial market, sustains activity. Lamps of 1000 watts are moving freely. Sipments are very good.

CONDUIT.—All sources report a substantial movement of both the black and white product. The decline in certain metals, together with the fact that an Eastern concern is offering quantities three points below the prevailing market, makes for a feeling of hesitancy on the part of some buyers. The trade is looking for a material shade in prices very soon. Shipments are freer and current orders are being filled more promptly.

SEATTLE—PORTLAND

The paramount issue in Seattle to-day is the strike set for Jan. 21 called by the Seattle Metal Trades Council against both wooden and steel shipyards, sub-contract, machine, boiler and allied shops. The strike will affect twenty-one affiliated unions having a membership of approximately 30,000. The authorities state that there is virtually no possibility of heading off the strike. Apparently both sides are as far apart as ever, and no steps are being taken to effect a compromise. The closing down of the shipbuilding industry in Seattle will leave seventy-three uncompleted vessels on ways and in the water, thirty-three steel and forty wooden craft. Electrical workers, about 500, in the shipyards walked out early last week. Work on twenty-five vessels will be halted in Tacoma when approximately 10,000 shipyard workers walk out on Jan. 20 in protest against the Macy scale. Three wooden yards and one steel yard and nineteen allied industries will be tied up. It is believed that the strike will spread up and down the Puget Sound district and to Portland.

Local jobbers refuse to comment on the probable effect on electrical business in case the strike is prolonged. However, as the greater part of electrical jobbing business is carried on with shipyards and similar industrial concerns, results are more or less obvious. Jobbers report no decided increase or decrease. Retailers, however, report a trifling increase in buying over any week since the holidays. Stocks are coming through better, and both jobbers and dealers are taking opportunity to replenish lines which were depleted.

The Norway Pacific Construction & Dry Dock Company, Everett, Wash., has received contracts from the government for five Coast Guard cutters, to cost $3,435,000. Resolutions urging delay in the construction of the proposed million-dollar dry dock in Portland were adopted by the port of Portland commission. Construction of 2000 freight cars for the federal Railroad Administration will be started immediately by the Pacific Car & Foundry Company, Seattle. The contract involves between $6,000,000 and $7,000,000.

Portland territory reports that business in general is simply marking time, awaiting, apparently, the outcome of the peace conference and the action of Congress and various state legislatures before taking any definite steps.

The government spruce production plant at Vancouver, Wash., is collecting electrical and other equipment used by the spruce division in various parts of Oregon and Washington. Quotations are being made on electrical equipment. Just how these prices compare with prices for new machinery of the same type and size is unknown, but the belief is that eventually they are bound to affect the local market.

SAN FRANCISCO

Recent heavy rains are greatly encouraging, bringing up the average fall along the coast and in the central valley to about 20 per cent above normal and averaging about eight times the precipitation at the same time last year. On the other hand, very discouraging reports are received of the snowfall on the high Sierras, and from present indications the power companies will be faced with their 1918 problem of handling the irrigation load.

New buildings reported include a cereal warehouse at Anaheim, a hundred-thousand-dollar hotel at Santa Ana, a two-hundred-thousand-dollar post office at Ventura and new stations and section houses along the Southern Pacific lines in southern California. No big building is announced from northern California, only a number of large dwellings and miscellaneous buildings. The labor situation is quiet, but a big strike of the iron workers has been decreed for February on the basis of back pay under the Macy award.

TAPE.—Big Eastern shipments have arrived, and the stock situation is better although the demand is comparatively small. The prices remain the same, with friction tape running about 30 per cent over the rubber price, a reversal of pre-war conditions.

POLES AND CROSS-ARMS.—The United States government is selling by public auction its spruce-cutting equipment used in the Northwestern forests last year, and the discontinuance of this service will release needed labor for private use. The bane of the pole and cross-arm market last year was the uncertainty of delivery due to the uncertainty of obtaining labor and cars, and it is expected that good stocks will again be distributed along the coast, although at present writing there is little demand for them.

HEATING MATERIAL.—Factories have caught up with their demands and stocks are now moving to the coast, which has been practically cleaned out of such standard commodities as irons and toasters for forty days. There is a brisk demand for radiators in expectation of the last spell of cold weather, which falls in February.

LAMPS.—Stocks are good and demands fair, principally from dealers. Decreased industrial business has caused keen competition for agents' renewals. Flashlamps are overstocked, with a decreased demand. Automobile lamps are still scarce. As usual, all dealers were sold out of Christmas tree outfits during the holidays.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+30% to +20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.44 to $0.45	$0.44 to $0.45
12 to 50	.38 to .39	.38 to .39
50 to barrel	.35 to .362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
⅝	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.75— 69.75
½-in. double strip	75.00— 82.50	72.00— 75.00
⅝-in. single strip	100.00	85.00— 93.00
⅝-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.25 to $63.75
½-in. double strip	78.25 to $78.75	71.25
⅝-in. single strip	100.00	75.00 to 85.00
⅝-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
⅝	.06	1¼	.33
¾	.09	1½	.40
⅞	.12	1¾	.47
1	.15	2	.55
1¼	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
¾-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00
¾-in.—	65.00	32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb	7% to 7.1%	9% to 9.1%
2500 to 5000 lb	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb	+5.5% to +3.5%	+3.5% to +1.5%
2500 to 5000 lb	+2.5% to +0.5%	+5% to +1.5%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$7.00 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List, each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted:		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$38.00
Coil to 1000 ft	28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33 00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25 00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%	10%
$10.00 to $50.00 list	30%	20%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$20.00 to $21.00
1/5 to std. pkg	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00
Standard package, 2200. List per 1000,	20.00– 21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$16.00	$32.00
1/5 to std. pkg	13.60	27.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13 00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25% +15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5 to %5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list.	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list.	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.54– $0.66
No. 18, full spools	.52– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.72
No. 18, full spools	.435 to .605

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00–$25.00	$12.50–$17.00	$12.50–$15.00
12	23.40– 27.09	21.06– 23.22	17.55– 23.22
10	32.14– 32.40	28.92– 32.40	23.14– 27.45
8	40.32– 45.72	36.96– 45.72	32.26– 38.10
6	58.52– 72.36	53.20– 60.30	51.07– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$24.00–$25.00	$17.50–$18.00	$15.00–$15.50
12	30.48– 31.44	30.48– 31.44	26.67– 31.44
10	42.32– 43.84	42.32– 43.84	37.03– 38.36
8	59.36– 61.76	59.36– 61.76	51.94– 54.04
6	97.68–101.28	85.47– 88.62	85.47– 88.62

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$34.75
25 to 50 lb	34.75
50 to 100 lb	33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$34.76 to $39.75
25 to 50 lb	33.76 to 38.75
50 to 100 lb	32.76 to 37.75

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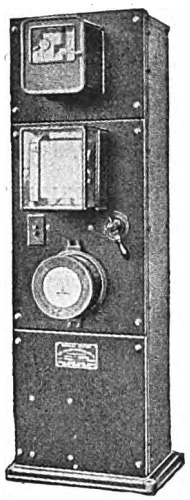
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Instrument Panel for Use with Thomas Meter

To make possible the installation of the recording instruments in a different location from that of the regulating apparatus the Cutler-Hammer Manufacturing Company of Milwaukee has



MAY BE PLACED AWAY FROM THE REGULATOR AND IS EASILY INSTALLED

got out a new instrument panel for use with the Thomas meter. Requiring but little floor space, the new panel may be installed in the superintendent's office so that the total and graphic records of the gas flow may be conveniently referred to while the regulator is at some other point in the plant accessible to inspection by the electrical department.

The new design follows the dead-front principle of switchboard construction and is therefore practically fool-proof and shock-proof. The top section of the panel contains a galvanometer in which the number of sensitive parts is said to have been reduced to a minimum. The necessary sensitive parts have been made easily replaceable, while all other parts are strong and durable. The mechanism and connections are not placed in a wooden but in an aluminum case and are stated to be arranged so that the sensitive parts are well protected and still accessible. The galvanometer is constructed jointly by the Leeds & Northrup company and the Cutler-Hammer company.

The middle section contains an Esterline graphic wattmeter, which records in standard units the flow of gas through the meter housing. Below the Esterline instrument is a Westinghouse single-phase wattmeter showing the total gas flow with a scale calibrated for thousands of cubic feet. Mounted on the back of the center section is a Square D quick knife switch, operated by a lever on the front of the section and serving as a main-line switch for the heater circuit and all control circuits. At the left of this switch a push-button control switch is mounted which operates a C-H single-pole remote-control switch. This switch is opened and closed magnetically and locked mechanically and is used to open the heater circuit in the meter housing, permitting the operator to balance the meter. The instrument panel also contains a current transformer, for all except the small sizes of meters, and fuses for the recording circuits and test connections used in electrically testing the two wattmeters. These wattmeters are standard 5 amp., 110-volt or 220-volt instruments, and therefore may be tested for accuracy in the same manner as other standard indicating or integrating electrical instruments; that is, by connecting them in series with similar meters of known accuracy. Test constants are stamped on each meter, and it is stated that there is no necessity of shutting off the gas or interrupting the gas measurement to test the recording and integrating instruments. All live parts are inclosed in the case upon which the sections of the panels are mounted, and the complete panel is furnished with a cast-iron sub-base, necessitating no other work in installation than the lagging of the base to the floor.

Heavy-Duty Sectional Range

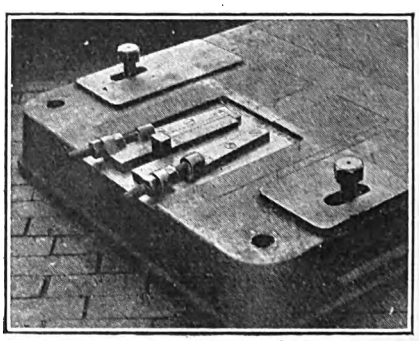
The heavy-duty electric ranges with total connected loads of 19.3 kw. being manufactured by the Simplex Electric Heating Company of Cambridge, Mass., are particularly designed for severe usage in hospitals, hotels, on board ship and in other places where quantity cooking is done. Being built in sections, these ranges may be installed separately or placed side by side according to individual requirements. Four cast-iron inclosed-type heaters are mounted flush with the range top, each being 14 in. (36 cm.) square and removable from the front without using tools. A scavenger pan, also removable, is provided under these top heaters, and the wiring, which is run in conduit, is protected against dripping so that, it is said, even if a kettle were upset on the range no harm would result. Heaters consuming 3.3 kw. on high heat are installed in both the top and bottom of the oven, which has a clear working space 27 in. (69 cm.) deep, 21½ in. (55 cm.) wide and 16 in. (41 cm.) high. The walls are said to be well insulated, and there is a ventilating flue with damper control in the back.

Nickel-chromium resistance wire is coiled in the form of a long spiral and suspended in the heater-plate grooves so that it touches nothing but small strips of mica which support it at short intervals. This heating-element construction is claimed to have two important advantages. The spiral coil makes it possible to get more wire within a limited area, and a larger and stronger wire can be used. Also, the air space between the element and the heater plate takes the place of layers of mica or other electrical insulation, the heat being radiated directly to the heating surface instead of being forced through insulation. Each heater is controlled by a double-pole, three-heat snap switch mounted on the front of the range beside the oven so that all fuses, cut-outs and connections are accessible from the front. Under each switch is a pilot light which remains lighted while the current is on.

An additional feature of this range is a receptacle for receiving an appliance such as a broiler, water urn or rim griddle. This company makes another range identical with the one described except for the top, which consists of smaller units and has no receptacle for portable devices.

Adjustable Anchorage for Motors

To support and align motors from 500 hp. up, and particularly for use



GIVES GREAT FLEXIBILITY IN ALIGNMENT OF MOTORS

with those equipped with magnetic clutches which require a very fine and accurate alignment, an adjustable an-

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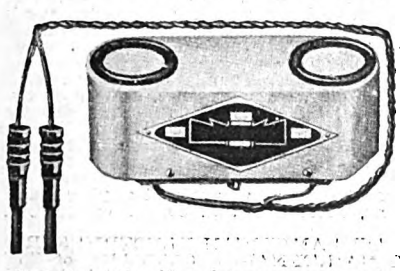
chorage is being manufactured by the Adjustable Anchorage Company, 1502 Ford Building, Detroit. By the use of this anchorage it is possible to move the motor to a limited extent in all directions so that the motor shaft may be accurately aligned with the machine to be driven and so insure proper operation. The device can also be used on motors driving belts. It is claimed that where changes in motor position are required they may be made on the new anchorage in a fraction of the time necessary where motors are dowel-pinned, since when the latter method is used the concrete foundation often has to be destroyed in making changes in position, but with the new device it is merely a matter of adjusting bolts.

The bed plate of the new anchorage is securely fixed in a concrete foundation. Four anchor bolts for engaging the motor base are held in slots so that the motor may be moved from side to side. At opposite ends of the bed plate there is a recess containing a key for holding and guiding the edge of the motor base. Each of these two keys is held between two wedges which, by a nut and stud arrangement, can be moved inward and outward from the edge of the plate. In this way the clamps, the motor and the sliding bolts may be shifted from side to side. The motor may also be rotated slightly by moving only one in each of the two pairs of wedges.

Device for Testing Electrical Circuits

In electrical work it is frequently doubtful whether the current at an outlet is alternating or direct and whether the voltage is 110 or 220. To indicate quickly and easily what kind of current is present the Majestic "determinator" has been developed by the Majestic Electric Development Company of San Francisco. By its use open fuses and circuits may be determined and broken wires or coils as well as bell and lighting circuits may be tested, according to the manufacturers.

To operate the instrument its two plugs, which are of the knife-blade type and constructed to render short circuits



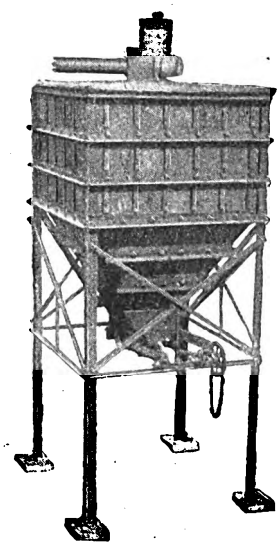
"A.C." OR "D C." SHOWS UP WITHIN THE TWO CIRCLES

or shocks impossible, are placed in contact with the wires or terminals and a button at the bottom of the determinator is pressed. Then, should the current be direct, the letters "D. C." appear within one of the circles at the top of the device, while if alternating current is present "A. C." shows up in the other circle. The brilliancy of the lights back of the letters indicates whether the voltage is 110 or 220.

The new device is conveniently light, weighing only 7 ounces (0.2 kg.), and measures 4 in. (10 cm.) long, 2 in. (5 cm.) high and 1½ in. (3.8 cm.) wide. The maker says it has no delicate or moving parts or fuses and is therefore not likely to get out of order. A wide field of usefulness is claimed for the determinator, it being valuable to wiremen, "trouble shooters," electrical engineers, building superintendents and all others using electricity.

Cast-Iron Storage Hoppers

Adapted to the storage and transfer of ash, sized coal and screenings a line of cast-iron hoppers with unit capacities of from 10 tons to 45 tons and which may be grouped together into manifold hoppers of any desired capacity has been placed on the market by the Green Engineering Company of East Chicago, Ind. In the power plant



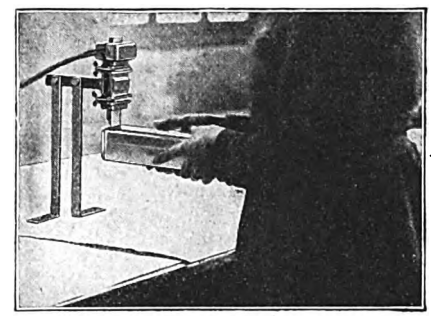
USEFUL IN THE STORAGE OF ASH OR COAL

these hoppers are said to be particularly useful in receiving ashes from steam-jet vacuum conveyors. It is claimed they possess advantages over hoppers constructed of wood, steel or reinforced concrete. The rusting of cast iron is negligible, and the thick metal plates resist the abrasive action of the material being stored. Ease and quickness of erection are said to be outstanding features of these hoppers. The body is composed of sectional cast-iron plates, and the supporting frame is made of standard steel sections which are cut and punched ready for bolting and erection. The cast-iron plate supports are hooked upon the angle struts of the frame, and the cast-iron side and corner plates are slipped into recesses in the sides of these supports. In this way no skilled labor is required in the assembly work, which may be accomplished in a short time.

At the bottom of the hopper is a substantial gate designed for quick discharge and large enough to offset any arcing tendency of the material handled. This hopper gate is mounted upon rollers and is actuated by racks and a chain-operated pinion gear. The chain can be arranged to come on any of the four sides.

Can-Soldering Iron

Ordinary soldering irons are not without disadvantage when used in soldering tin cans for containing foods and other materials. A large heating surface must necessarily be brought



DEVICE FOR SOLDERING CANS

into contact with the edges of the can if any measure of speed in soldering is desired, but the ordinary iron has only a small heated tip. To overcome this obstacle the Cutler-Hammer Manufacturing Company of Milwaukee has developed for special use in soldering cans a large heating surface iron with a rating of 200 watts to 225 watts which is claimed to equal in output the work done by a standard 400-watt iron.

The new iron consists of two type "H" heating units insulated with mica and then covered by a steel jacket placed in close contact with the mica by hydraulic pressure. These heating units are placed on either side of a copper bar and gripped between two iron plates forming a clamp for the bar copper, which is from 1 in. (2.5 cm.) to 1½ in. (3.8 cm.) wide and from ¼ in. (0.63 cm.) to ⅜ in. (0.96 cm.) thick. This flat bar is said to conduct the heat rapidly from the two heating units, a small percentage of heat being lost by radiation or convection. The heating units operate independently of each other and may be renewed separately in case of a burn-out The iron is supplied with a suitable bracket for bench mounting but may be obtained with a special handle adapting it for hand use if so desired.

Large-Size Vegetable Parer

An electrically operated vegetable-paring machine which is said to have a capacity large enough to meet almost any requirements is being marketed by Redmon, Edgar & Redmon of Cedar Rapids, Iowa. Occupying an approximate floor space of 2 ft. by 2 ft. (5 cm. by 5 cm.), this parer is of substantial construction and rapid operation, being fitted with an adequately sized motor of standard make.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Argentina (No. 28,048) wants an agency for the sale, among other things, of electrical goods.

An agency is desired by a man in France (No. 28,051) for the sale of small electric light plants for farms.

A man in France (No. 28,075) wants an agency for the sale of electrical equipment. Correspondence in French.

Robbins & Myers New District Managers

I. ELKAS, who has been made branch manager for the Robbins & Myers Company at Chicago, is a native of Mississippi. He received his education at the University of Illinois, being graduated with the class of 1898. After spending three years in the cotton-growing business, he opened a contracting and construction business in St. Louis, Mo. In the same city he was for more than eight years the St. Louis manager of the Sprague Electric Works of the General Electric Company. In December of 1914 he resigned to open a sales office for Robbins & Myers. He continued as branch manager at St. Louis until Jan. 1, when he removed to Chicago.

J. F. GALVIN, who was assistant to I. Elkas, St. Louis branch manager for the Robbins & Myers Company, for five years, has been made branch manager to succeed Mr. Elkas.

Edison Electric Appliance Company Appointments

WALTER FAGEN, who has been sales manager of the Hughes division of the Edison Electric Appliance Company, Chicago, has been made sales manager of the Hotpoint division of the same company. Mr. Fagen will also retain an active interest in the development of the goods marketed by the Hughes division.

C. M. LINDSAY, formerly sales manager, Hotpoint Division, Edison Electric Appliance Company, Inc., Chicago, has been appointed as manager of the company's new sales promotion and advertising department. This department has been inaugurated for the sole purpose of building up sales service with customers to the point of highest possible development.

EXPORTATION TO RUSSIA.—The War Trade Board announces that export licenses will be issued to approved consignees for the shipment of all non-conserved comodities to Siberia. It is no longer necessary to consign shipments to that country to the War Trade Board representative at Vladivostok.

WESTINGHOUSE AGENT-JOBBERS' COMMITTEES MEET.—An informal meeting of the active committees of the Westinghouse Agent-Jobbers' Association was held at the Pittsburgh Athletic Club, Dec. 12, 13 and 14. The executive committee received interesting reports from the service committee, also from the committee on channels of distribution. On Thursday evening, Dec. 12, H. D. Shute, vice-president of the Westinghouse Electric & Manufacturing Company, gave a dinner in honor of the visiting Westinghouse agent-jobbers. The dinner was attended by the officials and heads of the departments of the company. General Tripp spoke optimistically of the future and made an appeal for strong cooperation between the company and the agent-jobbers. General Tripp was followed by Dr. Holdsworth, who is the vice-president of the Bank of Pittsburgh and former dean of the School of Finance of the University of Pittsburgh. Dr. Holdsworth talked on "Readjustment of American Business." Walter Cary, vice-president of the Westinghouse Lamp Company, spoke on the lamp situation. The next annual meeting of the association will be held at the Hotel Del Monte, Del Monte, Cal., May 4-11 inclusive. A program for the delegates en route and while at Del Monte is being prepared.

NO LICENSE REQUIRED TO IMPORT WIRING SUPPLIES INTO BELGIUM.—Belgium has just given notice that a large number of items may be imported without license. Included in the list are the following: Electric heaters, arc lamps and parts, incandescent lamps, arc-lamp carbons, wire for electrical installation and insulating tubes, sockets, interrupters, connections and insulators therefor.

SHAFT MANUFACTURER VOICES OPTIMISM.—The Stow Manufacturing Company, Binghamton, N. Y., manufacturer of flexible shafts and tools, has sent to customers an optimistic letter from which the following is taken: "While a brief period of time must elapse before a natural economic and industrial readjustment can be effected, still, speaking for ourselves, we expect to go right along and maintain our large stocks just the same as in the past, believing that any one who shall stop and wait to ask questions impossible of proven answer at this time will forfeit opportunity and would do far better in the long run to just go to work. Our price sheets will keep you fully posted in all price changes in our lines, although we have not yet reached that point when prices are not largely controlled by required deliveries. Personally, we look for a long period of prosperity for the entire country, which we expect to share to a greater extent than ever before."

I. ELKAS

ORGANIZATION OF ITALIAN MACHINERY IMPORTERS.—There has been constituted at Milan, among the most important firms in Italy carrying on an import trade in industrial machinery and machine tools from the allied countries, the Italian Association of Importers and Merchants. The purpose of this organization, as outlined in the statute creating it, is the study, protection and promotion of all those interests appertaining to the importation of the articles mentioned.

GROWTH OF JAPANESE ELECTRICAL MANUFACTURING—Up to five years ago practically all the electrical apparatus used in Japan, according to J. R. Geary, writing in the *Journal of Electricity*, was imported either from America or Europe, 90 per cent coming from the United States. Since then the industry has grown rapidly until at the present time generating units as large as 7000 kw. to 8000 kw. can be turned out in one of the largest factories in from six to seven months. All of the electric lamps, it is stated, used in Japan are made in that country, while a considerable number of those made there are exported. Mr. Geary is of the opinion that in a few more years practically no electrical apparatus will be imported to Japan, because of the ability of Japanese plants not only to turn out all the requirements of the country, but also undoubtedly to be able to export to other countries.

A. H. KELEHER, direct factory representative for export, announces that after Feb. 1 his address will be 44 Whitehall Street, New York City.

THE McGLAUFLIN MANUFACTURING COMPANY, manufacturer of insulator pins, pole tops and the like, formerly at San Rafael, has moved its plant to Petaluma, Col.

GEORGE A. FRENCH, formerly with the Cutter & Wood Supply Company, Boston, acting specially as representative of the Shepard Electric Crane & Hoist Company, has joined the New York sales office of the latter company as sales engineer.

HOMER GREEN, traveling agent for the Mancha Storage Battery Locomotive Company of St. Louis making "the Mancha electric mule," has completed his trip through Missouri and finds the outlook for future business even better than on previous trips.

D. R. G. PALMER, who for the past year has been sales manager of the Habirshaw Electric Cable Company, has resigned to take charge of sales of the A. A. Wire Company, Inc., of Newark, N. J. Mr. Palmer is establishing offices at 50 East Forty-second Street, New York City.

THE BAILY ELECTRICAL SUPPLY COMPANY, 18 Warran Street, New York City, announces that Harry J. Hornung, formerly of E. B. Latham & Company and secretary of the Fullerton Electric Company, has associated himself with the company as general manager and assistant treasurer.

WILLIAM G. CAMPBELL, who has been identified with the conduit and conduit fittings business for a great many years, has severed his former business connections and has been appointed manager of conduit sales for the Central Tube Company, with headquarters at its general offices, First National Bank Building, Pittsburgh.

WALTER F. PFEIFER, who was assistant chief engineer for the Allen Bradley Company, Milwaukee, has been appointed district manager of the Boston territory with offices at 201 Devonshire Street, Room 308. H. B. Boswell, who represented the Allen Bradley Company in Boston, has been appointed district manager for the company's Philadelphia territory.

THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has just closed a contract with the Braeburn (Pa.) Steel Company, for a large continuous recuperative annealing furnace for annealing alloy steel bars and wire. This furnace will have a capacity for annealing 75 tons of metal per day and an electrical rating of 600 kw. One of the special features of the furnace is that the material is heated and cooled slowly This type of furnace is said to be meeting with favor among the steel mills.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., reports that contracts for 1919 are being concluded practically with all the wholesalers throughout the country handling its fans. As a result stocks of these fans will be available at a great majority of the important jobbing centers. The company says that arrangements have been completed with the Southern Electric Supply Company of Atlanta, Ga., whereby a stock of Emerson and Northwing fans will be maintained by this company in Atlanta during 1919.

THE PACIFIC STATES ELECTRIC COMPANY has been made exclusive Pacific Coast sales agent for the wire products of the Anaconda Copper Mining Company, rolling mills department, of Great Falls, Mont. These products consist of bare copper wire of all kinds, including solid and stranded wire and cables, as well as trolley wire and feeders. This new representation gives the Pacific States Electric Company a high-tension transmission department able to supply complete equipment for transmission-line construction, including poles, cross-arms, hardware and guying material, pins, insulators and copper conductors.

THE AMERICAN ELECTRIC SERVICE & MAINTENANCE COMPANY of Springfield, Mass., rebuilder of electrical machinery, has reorganized its entire business and added much new equipment to its plant a 51 Taylor Street. A. M. Sofield continues as the chief electrical engineer and manager of the company and has associated with him in the work I. P. Sprague as general sales manager, formerly of the Westinghouse Electric & Manufacturing Company; N. S. Monroe, electrical engineer in charge of motor work, and E. S. Allen, in charge of transformer work, both of whom were formerly with the General Electric Company.

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THE ELECTRIC MACHINERY COMPANY of Minneapolis, Minn., it is understood, is planning for the erection of a four-story addition, 60 ft. by 80 ft.

R. S. WAKEFIELD, 1312 Great Southern Life Building, Dallas, Tex., has been appointed Texas representative of the Steel City Electric Company, Pittsburgh, Pa.

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Finance Building, Philadelphia, is reported to have increased its capital from $100,000 to $300,000.

F. A. CLEGG & COMPANY, Louisville, Ky., heating and electrical engineers, announce that Frank E. Good is again associated with them as manager of the electrical department.

IRVING BURROWS has been released from the United States Navy, where he served as an ensign, and will shortly reopen the San Francisco office of the Blaw-Knox Company at 528 Second Street.

R. W. WUSTENFELD, formerly sales engineer for the Manhattan Electrical Supply Company, has been appointed Western manager of electrical trades distribution for the White Sewing Machine Company of Cleveland.

JOSEPH T. RAABA has been promoted by the Eureka Vacuum Cleaner Company from the management of the Akron (Ohio) branch to the management of the St. Louis branch office, with headquarters at 617 Locust Street.

L. P. PROSSEN has resigned as mechanical superintendent of the Black & White Taxicab Company, New York City, and become vice-president of the Nilson-Miller Company of Hoboken, N. J. Mr. Prossen will be in charge of the gear cutting, piston and piston-ring departments.

THE GENERAL INSULATE COMPANY, Brooklyn, N. Y. reports an increase of 50 per cent in the sales of its product in 1918 as against the total for 1917. The company early last year placed its entire force on a profit-sharing basis, under which it distributed dividends this month to all employees.

THE PHOENIX UTILITY COMPANY, 71 Broadway, New York City, is the new name for the Phoenix Construction Company. This company, which handles used machinery and equipment, had its name changed because of the existence of two different construction companies with the same name.

SAMUEL ADAMS CHASE has resumed his duties as special representative of the Westinghouse Electric & Manufacturing Company after an illness of about nine months. He has also resumed his work of editor-in-chief of the company's monthly magazine, which is distributed among the company's agent-jobbers. This publication, formerly called *The Triangle* became *The Circle* with the current issue.

THE WESCO SUPPLY COMPANY salesmen all met in St. Louis on Jan. 2 to 4 inclusive for their annual conference with the officers of the company and representatives of the manufacturers of the lines handled. Capt. Charles Scudder of the Ordnance Department welcomed the men as president of the company and outlined its general policies. General Sales Manager G. H. Cohn was chairman of the meeting. He also entertained the men between business sessions.

BROWN-WHITE, INC., Colonial Trust Company Building, Philadelphia, which it was stated erroneously in the ELECTRICAL WORLD for Nov. 23 had been recently formed to take over the business of the Frank W. Watts Company, was, the company states, incorporated in 1914. The item said that H. R. Smith, district manager of the Electric Machinery Company, had recently joined the Brown-White company. The Brown-White company states that this assertion was also in error.

LIEUT. EDWARD S. HOWE, Engineers, U. S. A., will shortly proceed to the Philippine Islands as a commercial engineering representative of the Westinghouse interests, following honorable discharge from the army. Lieutenant Howe is a native of Kingston, Mass., and was graduated in the electrical engineering course of the Massachusetts Institute of Technology in 1910. After a period of service in the shops and Boston office of the Westinghouse company, he spent two years at Medillin, Colombia, S. A., returning early last year to the United States to enter the national service. He spent eight months in various officers' training camps and received his commission shortly before the close of the war.

Trade Publications

LIGHTING UNIT.—The "Reth-Lite" lighting fixture is described in a folder recently issued by the Retherford Brothers Company of Muncie, Ind.

LIGHTING FIXTURES.—An eighty-page booklet about its lighting fixtures has been prepared by the Jacob-Andreson Company of Minneapolis, Minn.

MICA.—In its catalog No. 100 the Keene Mica Products Company of Keene, N. H., describes the mica insulation and other products of this company.

VACUUM CLEANER.—Its positive suction cleaner with a flexible besom is described in a new folder got out by the May Tag Company of Newton, Iowa.

INSULATING MATERIAL.—Insulating materials made by the Sherwin-Williams Company of Cleveland, Ohio, form the subject of a folder from that company.

SEWING MACHINE LIGHT.—A folder about the "Se-To-So" sewing light is being distributed by the Durkee-Davis Manufacturing Company of Rockford, Ill.

FITTINGS AND SWITCHES.—V. V. fittings and safety switches are described in catalog No. 21, a 127-page publication of the V. V. Fittings Company, Philadelphia.

WATER HEATER.—A folder of the Majestic Electric Development Company, 1705 Allegheny Avenue, Philadelphia, has for its subject an instantaneous electric water heater.

MELTING POT.—An electrically heated metal pot for Intertype machines is described in a booklet prepared by the Intertype Corporation of 50 Court Street, Brooklyn, N. Y.

MARINE FITTINGS.—In a catalog prepared by the Cooley Manufacturing Company of Seattle, Wash., its line of electrical fittings and appliances for use on shipboard is described.

WASHING MACHINE.—A folder which illustrates and briefly describes the electric and the multi-motor styles of its washing machine has been prepared in two colors by the Hirschy Company of Minneapolis, Minn.

LAMP EXTENSION REEL.—A circular descriptive of its automatic extension reel for lamps in garages, factories and other places is being distributed by the Cincinnati Specialty Manufacturing Company of Cincinnati, Ohio.

TRACTORS AND TRUCKS.—Electric tractors and industrial trucks for use in manufacturing plants, freight terminals and warehouses are the subjects of four recently issued bulletins of the Buda Company of Chicago.

COAL-WASHING TABLE.—A bulletin is being distributed by the Deister Concentrator Company of Fort Wayne, Ind., dealing with the No. 7 Deister-Overstrom diagnonal deck coal-washing table by the use of which undesirable impurities are separated from the coal itself.

RUST AND CORROSION PREVENTION.—Protecting iron and steel from corrosion and rusting by the use of the coatings and cleaning preparations made by the Dearborn Chemical Company of Chicago is the subject of a booklet issued by this concern.

THREE-PHASE LOW-TENSION EQUIPMENT.—Bulletin No. 302 is the latest publication of the Delta-Star Electric Company, 2433 Fulton Street, Chicago, having for its subjects unit-type three-phase wiring supports and heavy-duty plugs and receptacles. Illustrations, dimensions, catalog numbers and other information are included.

ELEVATORS AND CONVEYORS.—In its general catalog No. 18, a 480-page publication just prepared by the Gifford-Wood Company of Hudson, N. Y., applications, descriptions and illustrations of this company's elevating and conveying machinery are given together with other information helpful in the solution of handling problems.

SPOT LIGHTS.—In booklet No. 205 recently issued by the Anderson Electric Specialty Company, 118 South Clinton Street, Chicago, the "Autoreelite" an automobile spotlight with a reel which makes it also a trouble light and portable lamp, is dealt with. Extension lights for lamp-socket connection are shown and described.

VALVES.—The Ohio Brass Company of Mansfield, Ohio, illustrates some of its brass valves in a new circular.

LIGHT AND POWER PLANTS.—The Perfection Storage Battery Company, Rhodes Avenue and Fortieth Street, Chicago, is distributing a twenty-four-page catalog about its "Perfection" direct-connected automatic and semi-automatic lighting plants and its "Jupiter" belt-driven sets. Information, specifications and illustrations are given about these plants as well as about lighting fixtures and appliances for use with the sets.

STOKERS.—Two interesting advertising leaflets have been prepared by the Sanford Riley Stoker Company of Worcester, Mass. One, a two-colored folder entitled "Coal Runs the Machinery of Peace," contains a perspective view of the Riley underfeed stoker showing its method of operation, while the other publication tells about the stoker service offered by this company and as illustrations has replicas of the business cards of its various officials and district managers.

ELECTRICAL AND RAILWAY SUPPLIES.—An unusually complete and up-to-date reference book of the products marketed by the Union Electric Company of Pittsburgh, Pa., has been published by that company in the form of a cloth-bound catalog of 1124 pages. The numerous electrical and railway supplies and apparatus made by the many manufacturers for which the Union Electric Company is agent have been illustrated, described and list-priced in this new catalog, No. 8.

MACHINE GUARDS.—The Expanded Metal Engineering Company, 8 West Fortieth Street, New York City, will have ready for distribution in a few days a booklet on "Steelcrete" machine guards which should be of interest to those contemplating the installation of machine guards. The booklet, which is thirty-nine pages in length, tells where guards are usually necessary and what types should be used in individual cases in addition to stating the features of "Steelcrete" mesh guards.

New Incorporations

THE MARINE ELECTRIC COMPANY of New York, N. Y., has been incorporated by H. Scoti, O. E. Miller and R. Elkan, 15 Whitehall Street, New York City. The company is capitalized at $30,000.

THE MAXIM ELECTRICAL CORPORATION of New York, N. Y., has been chartered with a capital stock of $25,000 by S. M. Lnopf, F. F. Buttner and J. Harris, 1547 Broadway, New York, N. Y.

THE SANITARY PHONE CORPORATION of New York, N. Y., has been incorporated with a capital stock of $50,000 by M. L. Abbott, B. D. Colen and V. H. Emerson, 433 Riverside Drive, New York City.

THE NATIONAL ELECTRIC WELDING COMPANY of Philadelphia, Pa., has been incorporated by F. R. Hansell of Philadelphia; E. M. MacFarland and J. Vernon Pimm of Camden, N. J. The company is capitalized at $50,000.

THE LIBERTY LAMP WORKS, INC., of Harrison, N. J., has been incorporated by Daniel J. Delaney and Morris H. Rosenberg. The company is capitalized at $25,000 and proposes to manufacture lamps and scientific apparatus.

THE ANYLITE ELECTRIC COMPANY of Fort Wayne, Ind., has been incorporated by George A. Jacobs, Leonard Sykes and Rhys Davis, all of Forth Wayne. The company is capitalized at $50,000 and proposes to manufacture and deal in all electrical and mechanical appliances and specialties.

THE UNDERWOOD CONTRACTING CORPORATION of New York, N. Y., has been incorporated with a capital stock of $200,000 to do a general contracting and electrical business. The incorporators are: H. T. Underwood of New Orleans, La.; M. Hicks, 149 Broadway, New York City, and H. L. Celler, 850 Kelly Street, the Bronx.

THE AMERICAN BOSCH MAGNETO CORPORATION of New York, N. Y., has been incorporated by S. F. Johnson, W. P. Sheppard and G. H. Hubner, 42 Broadway, New York, N. Y. The company is capitalized at $2,400,000, and proposes to manufacture magnetos, etc. The German-owned Bosch Magneto Company will be absorbed with the works at Springfield, Mass., and Plainfield, N. J.

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New England States

BURLINGTON, VT.—Mayor J. Holmes Jackson has signed a contract with the Public Electric Light Company of St. Albans under the terms of which the latter will supply electricity to the city of Burlington for a period of ten years. The plant of the Public Electric Company at Fairfax, it is understood, will be enlarged to provide for the increased service.

CAMPELLO, MASS.—Bids will be received about March 10 by the A. E. Keith Company for the construction of power plant, 64 ft. by 71 ft., to cost about $56,000. Jenks & Ballou, Grosvenor Building, Providence, R. I., are engineers.

WEST DUDLEY, MASS. — Contracts have been awarded for the installation of machinery in the new hydroelectric power plant for the Burmas Paper Company now being erected at West Dudley. The power house will be 45 ft. by 54 ft., the concrete dam 150 ft. long and 10 ft. high. The cost of the plant is estimated at $50,000. Thomas F. McGovern of Southbridge is contractor.

Middle Atlantic States

BROOKLYN, N. Y.—Arrangements have been completed by Julius Kayser & Company, 45 East Seventeenth Street, New York City, for the construction of a new boiler plant at its local works on Classon Avenue, to cost about $50,000.

BROOKLYN, N. Y.—Plans are under consideration by Lindley M. Garrison, receiver of the Brooklyn Rapid Transit Company, for extensions and betterments to the system, calling for an expenditure of about $9,000,000. The proposed improvements will include new electric power stations, to cost more than $3,000,000, the purchase of line and railroad equipment, etc.

BUFFALO, N. Y.—Bids will be received by the City Council until Feb. 4, for the erection of a new cable and wire plant, to be used for municipal purposes, and the installation of a new police signal flashlight system in different city districts. George S. Muck is Mayor.

THIELLS, N. Y.—Bids will be received by F. A. Vanderlip, president of board of managers, Letchworth Village, 7 Wall Street, New York City, until March 4 for building addition to power house, installing equipment and underground piping system, to cost about $300,000. The plans provide for installation of new boilers, piping, feedwater heaters, filters, meters, feed pump, steam turbines, etc. Lewis F. Pilcher of Albany is state architect.

UNION, N. Y.—The Village Board has rejected all bids received for the municipal lighting system. The board is still of the opinion that the lighting system could be operated more advantageously under private management. New bids will be received by the Village Board on March 1 for the municipal lighting plant. John M. Payne is village clerk.

BERNARDSVILLE, N. J.—The Bernardsville Station Garage has contracted with the New Jersey Power & Light Company of Dover to supply electricity for its new garage and repair shop. The building will be about 50 ft. by 175 ft. and will have electrically driven machinery.

GLOUCESTER, N. J.—Plans have been prepared for the installation of four new boilers at the plant of the New York Shipbuilding Corporation.

IRVINGTON, N. J.—Extensions and improvements to the electric street-lighting system are reported to be under consideration by the Town Commissioners.

IRVINGTON, N. J.—Bids will be received by the Board of Education until Feb. 1 for alterations and improvements, including electrical work, at Public School No. 6 on Madison Avenue. A. C. Christian is chairman of the building committee.

MERCHANTVILLE, N. J.—Plans are under consideration by the Borough Council for the installation of a new fire-alarm system in Merchantville.

HARRISBURG, PA.—The board of managers of the Mont Alto Sanatorium is considering plans for the installation of a new electric lighting plant at the institution.

JOHNSTOWN, PA.—The Pennsylvania Central Railway Company contemplates the purchase of one 1200-volt direct-current rotary converter equipment for its power station during 1919.

PHILADELPHIA, PA.—Plans have been filed by the Pennsylvania Railroad Company for the erection of seven new buildings at Greenwich Point, Philadelphia, to cost about $138,000, including a machine shop, to cost $30,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

PHILADELPHIA, PA.—Final arrangements have been completed by the City Council for the construction of the proposed new fire house and police station, to be located at Twenty-fourth and Ritner Streets, to cost approximately $350,000.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 31, under Schedule 7702½, for one motor-generator set with switchboard, for Philadelphia yard.

PHILADELPHIA, PA.—Plans have been prepared by the Navy Department (Specification 3682) for the installation of a new pumping unit and auxiliary apparatus in connection with the erection of a number of new buildings at the Government Naval Hospital Reservation.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 3, under Specification 3687, for construction of emergency hospital buildings at Gray's Ferry Road, Philadelphia, to cost about $500,000.

PHILADELPHIA, PA.—An expenditure of approximately $20,000,000 at the League Island, Navy Yard, Philadelphia, is contemplated by the Navy Department, Washington, D. C., including new construction and work now under way. Of this amount $5,000,000 will be used for the construction of a drydock, 210 ft. wide by 1064 ft. long, with arrangements for two vessels at the same time. The dock will be built to carry 35,000,000 gal. of water and provided with a high-pumping system for emptying. A railway system will also be built in connection with dock. Plans include two 900-ft. shipways with six-story machine and structural shop, pattern and storage shops, a forge shop, 300 ft. by 700 ft., a foundry 500 ft. long, and a galvanizing plant, etc., to cost about $3,000,000.

BALTIMORE, MD.—Bids will be asked by the Electric Commission for the purchase of electrical supplies, to cost about $120,000. For further information address C. W. Logan, president of the electric commission, 315 Courtland Street.

MYERSVILLE, MD.—The Hagerstown & Frederick Railway Company of Hagerstown is planning to rebuild its local substation and warehouse. Loss about $7,500.

HAMPTON ROADS, VA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to rebuild the power plant (recently destroyed by fire) at the local naval operating base.

HAMPTON ROADS, VA.—The Construction Division, War Department, Washington, D. C., is planning improvements and alterations to the Debarkation Hospital No. 51, to cost about $195,000 The plans provide for the erection of nurses' quarters, construction of barracks for enlisted men, mess barracks, diet kitchens, etc.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., in the near future, under Schedule 3646, for furnishing fuses and fuse elements at the Eastern and Western yards.

WASHINGTON, D. C.—Plans for a new naval transport and a repair ship, each of 10,000 tons, have been approved by the Secretary of the Navy. The repair ship represents a modern floating repair plant, consisting of a machine shop, brass and iron foundry, boiler and blacksmith shop, coppersmith shop, pipe and sheet-metal shop, pattern shop and carpenter shop, electrical shop, drafting room, optical shop and gryro-testing room. The ship is about 484 ft. long over all, with a beam of 70 ft. and draft of 19 ft.

North Central States

GRAND RAPIDS, MICH.—Bids, it is understood, will soon be asked for the erection of a T-shaped building for a convent, by the Dominican Sisters, to cost about $350,000.

RAVENNA, OHIO. — The Cleveland, Alliance & Mahoning Valley Railroad Company expects to purchase during 1919 three 200-kva. transformers, an engine lathe, wheel press and boring mill for its substation.

TOLEDO, OHIO.—The stockholders of the Toledo Railways & Light Company have authorized an issue of $3,200,000 in bonds, the proceeds to be used for improvements and extensions to the light and power system. Plans for the proposed improvements are now being prepared.

DAWSON SPRINGS, KY.—Plans are under consideration by the Karlsbad Hotel Company of America for the erection of a hotel, to include casino, sanitarium, club house, bath house, etc., to cost about $4,000,000. W. W. Ahlsschlager, 133 West Washington Street, Chicago, Ill., is architect.

MANCHESTER, KY.—H. H. Hardinge, president of the Columbia-Panama Coal Company, is reported to have acquired a site in Goose Creek Valley on which it is proposed to erect a sawmill and rock crusher and also an electric power plant.

MORGANTOWN, KY. — H. Eberman, owner of the local ice plant, is reported to be contemplating the installation of additional equipment, including an electric generator.

ANDREWS, IND.—The capital stock of the Andrews-Largo Telephone Company has been increased from $10,000 to $35,000.

BOSWELL, IND.—The capital stock of the Farmers & Merchants' Coöperative Telephone Company has been increased from $12,000 to $50,000.

DECATUR, IND.—The Commissioners of Adams County have granted the Pleasant Mills Light & Power Company a franchise to erect an electric transmission line from the county infirmary to Pleasant Mills and Bobo. Electricity to operate the proposed system will be secured from the municipal electric plant at Decatur.

HOLTON, IND.—The County Commissioners have granted O. P. Shook, George Struckman and Clarence Steinmetz of Holton a franchise to construct and operate an electric light plant here.

INDIANAPOLIS, IND.—The power plant and drying room of the United States Encaustic Tile Company, West Sixteenth Street, were recently destroyed by fire, causing a loss of about $30,000.

RICHMOND, IND.—Extensive improvements to the municipal electric light plant are reported to be under consideration. D. B. Davis is city engineer.

CHICAGO, ILL.—Plans have been prepared by the Victor Manufacturing & Gasket Company, South Troy Avenue, for the erection of a new plant, 200 ft. by 600 ft. on Twelfth Street, to cost about $250,000.

CHICAGO, ILL.—Contract has been awarded by the Acme Malting Company, 175 West Jackson Boulevard, for the construction of a new power house at Cortland and Kilbourn Avenues, to cost about $15,000.

CHICAGO, ILL.—The Ilg Electric Ventilating Company, 147 Whiting Street, it is reported, has postponed the erection of its proposed factory at Elston Avenue and Snow Street. The cost, including site, is estimated at $750,000.

CHICAGO, ILL.—Plans are under consideration by the trustees of the University of Chicago, 134 South La Salle Street, for the construction of a laboratory and hospital near the Cook County Hospital on the West Side, also hospital on the South Side, to cost about $400,000 each; divinity and administration buildings, to cost about $250,000 each. Plans have been prepared by B. Goodhue, architect, Boston, Mass., for erection of chapel on the university grounds, to cost between $1,500,000 and $2,000,000.

CICERO, ILL.—Walter J. Conlon of the Conlon Electric Washer Company, which manufactures the Western Electric washing machines and other appliances, has purchased a site on the Baltimore & Ohio Chicago Terminal Railroad in South Fifty-second Avenue, on which a plant will be erected, to cost about $250,000. The first unit will contain about 75,000 sq. ft. Two additional units will be added later in the year. Work, it is understood, has begun on the plant. Frank D. Chase, Inc., of Chicago, industrial engineer, has charge of the work.

FREEPORT, ILL.—The Stover Manufacturing Company, it is reported, is planning additions and improvements to its plant, involving an expenditure of about $500,000. W. A. Hance is president.

BEAVER DAM, WIS.—The City Council is considering changing the arc lamps now in use for 60-cp. nitrogen-filled lamps.

BELOIT, WIS.—Plans are under consideration for extension of the ornamental lighting system in Beloit. Arthur Sweet, Palace Building, Milwaukee, is engineer.

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GALESVILLE, WIS.—The Davis Mill Company, owner of the local electric light plant, contemplates building an addition to power house and installing a 100-hp. engine. B. W. Davis is manager.

MILWAUKEE, WIS.—Bids will soon be asked by R. E. Oberst, architect, 353 National Avenue, for the erection of a service station, 60 ft. by 127 ft., one story, at 596 Jefferson Street, for the Storage Battery Company, 137 Oneida Street, to cost about $25,000.

PRAIRIE DU CHIEN, WIS.—Application has been made to the City Council by the Mid-Continental Utilities of Lancaster for a franchise to erect an electri transmission line from the city limits to its power plant.

ELK RIVER, MINN.—Plans have been prepared by J. C. Jacobson, 1135 First National-Soo Building, Minneapolis, for the erection of an electric transmission line for the Elk River Power & Light Company. F. D. Waterman is president.

SIOUX CITY, IOWA.—Bids will be received by M. King, president, 634 Davison Building, for the construction of a terminal elevator for the Western Terminal Elevator Company, to cost about $450,000.

SIOUX CITY, IOWA.—The Midland Packing Company, Davidson Building, has awarded general contract for construction of packing plant to Riesche & Sanborn. Bids are being received by Gardner & Linberg of Chicago, Ill., architects, on ice plant, cork insulation for cold-storage building, piping, electrical machinery and electric wiring. The total cost of the plant is estimated at $1,000,000.

FRANKFORD, MO.—The local electric plant of the North Missouri Light & Power Company of New London, it is reported, was recently destroyed by fire.

KANSAS CITY, MO.—The Central Coke & Coal Company of Kansas City is contemplating the purchase of four storage-battery locomotives this spring for use in its mines in Missouri, Kansas and Arkansas.

LOWRY CITY, MO.—The installation of an electric light plant to supply electricity for lighting the business section of the town is under consideration. C. C. Deafenbaugh is reported interested in the project.

ST. LOUIS, MO.—Arrangements are being made by the Inland Machine Company, North Broadway, for the erection of an addition to its plant in the spring, to cost about $150,000.

ATCHISON, KAN.—The Ballor Plow Company, Thirteenth and Utah Streets, contemplates the erection of a new factory, to cost about $250,000. E. V. Jones is secretary.

DOWNS, KAN.—A company to be known as the United Light & Power Company has been organized to build or purchase a central power plant, to be located at Downs, to furnish electrical service in Glen Elder, Cawker City, Downs, Portis, Gaylord and Cedar, Kan. The United Light & Power Company is now negotiating with the Solomon Valley Power Company of Downs for the purchase of its properties. J. G. McClun of Cawker City is president and D. B. Harrison of Downs is treasurer of the new company.

LEAVENWORTH, KAN.—Bids will be received by the Board of Education of Leavenworth, Kan., until Feb. 3 for the erection of an industrial school building at Leavenworth, to cost about $90,000. Separate bids to be submitted on heating, plumbing and electric wiring. T. W. Williamson & Company, Central National Bank Building, Topeka, are architects.

Southern States

ST. STEPHENS, S. C.—The Planters & Builders' Supply Company, it is reported, would like to receive prices on electric plants for farm installation, etc. Frank B. Mansfield is secretary and treasurer.

AUGUSTA, GA.—The City Council has adopted a resolution authorizing Mayor William P. White to appoint a committee composed of three members of the Council and two from the city at large to make investigations relative to the installation of a municipal electric lighting system and the cost of the same.

SAVANNAH, GA.—The Savannah Electric Company is planning to install a 665-hp. boiler at its Riverside power house.

CLARENDON, ARK.—The Commonwealth Power Company, it is reported, contemplates building an electric power plant on the river.

INVERNESS, MISS.—All bids submitted on Jan. 2 for improvements to the municipal electric light plant and water works system have been rejected. New bids, it is understood, will be received in March. The proposed work will include the installation of oil engines, pumps, alternators, miscellaneous line material, cast-iron pipe, hydrants, reservoir, etc. Xavier A. Kramer of Magnolia is engineer.

HOMER, LA.—Bids, it is reported, are being received by George Lewis for equipment for a cotton gin, corn-grinding plant and power plant.

WILBURTON, OKLA.—The Sandstone Coal & Mining Company is reported to be in the market for coal-mining, hoisting and power-plant equipment. T. W. Choat is interested in the company.

FORT WORTH, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 12 for the installation of an electric passenger elevator, etc., in the United States post office and court house in Fort Worth. For details see Searchlight Section.

SAN ANTONIO, TEX.—The power plant of the San Antonio Public Service Company at Villita and South Presa Streets was recently destroyed by fire, causing a loss of about $25,000.

Pacific and Mountain States

CLARKSTON, WASH.—The Lewiston-Clarkston Transit Company contemplates the purchase of a new motor-generator set.

SEATTLE, WASH.—Plans are being prepared by the Pacific Northwest Traction Company for the construction of a building at Sixth Avenue and Olive Street, to cost about $100,000. This building will be erected by the Puget Sound Traction Light & Power Company.

SEATTLE, WASH.—A bond issue for $350,000 for the completion of the construction of the loop of the municipal railway at the plant of the Seattle North Pacific Shipbuilding Company and a bond issue for $200,000 for the East Marginal Way Street Railway for proposed extensions have recently been approved by the Capital Issues Committee.

SEATTLE, WASH.—The construction of two large freight-yard terminals, one to serve Seattle and Tacoma and another to be accessible on the north to Seattle and Everett, will be recommended to the State Public Service Commission of Washington. Tentative plans provide for electrification of all steam rail lines serving the proposed terminals. The plans also call for additional docks and port facilities in the three cities mentioned. The engineering phases of the project are being worked out by R. H. Thomson, former city engineer of Seattle.

TACOMA, WASH.—The Tacoma Municipal Railway is considering the purchase of a 1000-kw. motor-generator set during 1919, also building and equipping a new shop.

TACOMA, WASH.—The city of Tacoma has purchased the Lake Cushman power site on the Skokomish River in Mason County for $300,000. The site embraces 8000 acres.

TACOMA, WASH.—Norton L. Taylor, engineer of the light department, has submitted a report to the City Council relative to creating a storage basin near Elbe. This basin is necessary to allow the Nisqually plant to run at its maximum all the year round. The entire cost of the basin is estimated at $557,960.

KLAMATH FALLS, ORE.—A number of improvements are contemplated by the new City Council, during the year, including a municipal lighting plant and waterworks system. I. B. Struble is Mayor.

KLAMATH FALLS, ORE.—The California-Oregon Power Company, it is reported, is considering the construction of a large dam at the head of Link River for the reclamation of 70,000 acres of land in the Wood River Valley during the present year. George J. Walton is division manager.

REEDSPORT, ORE.—A company has been organized here, to be known as the Reedsport Electric Light Company, to construct and operate an electric light plant. Electricity will be generated at the Johnson mill. Work will begin immediately on the installation of the plant. The company is capitalized at $4,000.

SALEM, ORE.—Warden Stevens of the Oregon State Penitentiary has advised the State Board of Control that the Portland Railway, Light & Power Company has agreed to waive the contract which binds the state to secure all of its lighting service from the company if it is shown that a substantial saving can be made by the installation of equipment to utilize the power which goes to waste during the night while the flax plant is not in operation for lighting penitentiary and asylum. Warden Stevens claims that the cost would not exceed $3,000.

ALAMEDA, CAL.—The Great Western Power Company is extending its system into the city of Alameda through submarine cables into the municipal electric substation recently erected by the city at Pearl Street. This is the second cable extended across the estuary by the Great Western Power Company. The coaling station of the Rolph Shipping Company will use most of the additional power.

RED BLUFF, CAL.—The Council has engaged E. A. Rolinson of Redding to prepare plans for the installation of a new electric lighting system.

SACRAMENTO, CAL.—The city officials, it is understood, contemplate asking for new bids an early date for the construction of the proposed new electrically operated pumping station at the municipal water-works plant.

UKIAH, CAL.—Application has been made to the State Railroad Commission by the Snow Mountain Water & Power Company of Ukiah for permission to issue 7000 shares of capital stock at $5 per share, the proceeds to be used for necessary work and improvements to be made by the company in 1919.

LEWISTON, IDAHO.—Investigations have been made by E. W. Kramer of the hydroelectric department, and I. W. Gerard of the logging department of the United States Forestry Department at Lewiston as to the feasibility of building a dam on the Snake River to develop hydroelectric power for operating lumber mills. It is stated that about 50,000 hp. could be developed at the proposed site.

BRIGHAM CITY, UTAH.—At a mass meeting held recently the City Council was authorized to install a new street-lighting system, to cost about $12,000. The lamp poles now in the middle of Main Street, from Third South to Forest Street, will be removed and ornamental standards erected on either side of the street; also from Main Street to First West on Forest Street.

MANTI, UTAH.—Plans are being considered by the City Council for extensions to the municipal electric system, including enlarging present flume, extensions to distribution system and construction of a hydroelectric plant, to cost about $10,000.

SALT LAKE CITY, UTAH.—The Bamberger Electric Railroad Company is considering the purchase of one automatic substation equipment to convert present manual control.

KALISPEL, MONT.—The Council has adopted a resolution providing for twenty-nine lighting districts in the city.

FORT COLLINS, COL.—Bonds to the amount of $100,000 have been voted for the purchase of the local street-railway system, owned by the Denver & Interurban Railway Company. Of this amount $75,000 will be used to pay for the railway and $25,000 for improvements to the system.

Canada

GRAND PRAIRIE, ALTA.—The Grand Prairie Electric Light Company is contemplating the purchase of a new engine and the installation of an alternating-current system.

LETHBRIDGE, ALTA.—The Lethbridge Municipal Railway Company is contemplating the purchase of a 600-volt, 300-kw., direct-current generator for direct connection to its present engine.

SQUAMISH, B. C.—Plans are being prepared for the provincial government for the installation of a hydroelectric plant at Squamish to supply electricity for lighting and power purposes for the Pacific Great Eastern Railway terminal at Squamish and also for lighting the town. The cost of the proposed plant is estimated at about $40,000.

PETERBORO, ONT.—The Hydro-Electric Power Commission of Ontario is contemplating the construction of a new 1500-kw. rotary substation. The commission operates the Peterboro street-railway system.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 3, under circular 1251, for machine shop equipment, iron and steel cable, wire steel, pneumatic tubes, etc.

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Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 10, 1918)

1,287,393. FLASHLIGHT HOLDER; Martin Molnar, Hellertown, Pa. App. filed July 20, 1918. To be supported by the hand so that light may be directed on paper when writing.

1,287,396. ELECTRIC SELECTIVE DEVICE; Arthur H. Morse, London, England. App. filed Sept. 14, 1916. Of the kind comprising a plurality of electromagnetically controlled switching devices set to be operated in succession when a predetermined signal is received, causing the alarm or other electric circuit to be completed only upon the reception of such signal.

1,287,421. CIRCUIT-CONTROLLING TELEPHONE-RECEIVER SUPPORT; William Pick, Scranton, Pa. App. filed Nov. 7, 1914. When the support is in the collapsed position the talking circuit is broken, but when the support is extended the circuit is closed.

1,287,425. ELECTRIC SWITCH; Clarence D. Platt, Bridgeport, Conn. App. filed Aug. 25, 1917. Relates particularly to the compound type wherein a push-button switch mechanism and a rotary snap-switch mechanism are both combined on the same base.

1,287,432. DRIVING SIGNAL; Henry Rabbes, Los Angeles, Cal. App. filed April 25, 1917. For indicating that a vehicle is about to turn or to stop; it is plainly distinguishable from both the front and rear.

1,287,448. SOLDERING TOOL; Claes Ryden, Cranston, R. I. App. filed May 15, 1918. Has an electrically heated point with means for holding a strip of solder to be carried into contact with the point to cause it to be melted and to flow to the joint being soldered.

1,287,449. ELECTRIC LIGHT SOCKET; Alfred C. Ryder, Montgomery, Ala. App. filed April 29, 1918. A threaded plug or the conventional threaded base of an incandescent light can be forced into position within the socket or forcibly withdrawn therefrom without the necessity of screwing it into and out of position.

1,287,451. ELECTRICAL CUT-OUT; Joseph Sachs, Hartford, Conn. App. filed May 25, 1918. Can be used singly or joined together to form two-wire or multiple-wire units for either main-line or branch-line circuits, and provides tap units for connection to or between the single or combined branch-line cut-outs and the circuit wires.

1,287,462. FUSE DEVICE; Edmund O. Schweitzer and Alfred Herz, Chicago, Ill. App. filed Aug. 20, 1915. Especially intended for outdoor overhead work, but also for protective purposes in electric stations as well.

1,287,491. ELECTRIC SWITCH; John F. Spaulding, Melrose, Mass. App. filed March 16, 1917. For automatically starting and stopping motor-operated pumps, compressors and the like, the switch being controlled by the water or air pressure in the receivers filled by the pumps.

1,287,492. INCLOSED ARC LAMP; Thomas Spencer, Philadelphia, Pa. App. filed Jan. 17, 1913. During the operation of the lamp the inner globe is maintained at a temperature sufficiently high to minimize and substantially prevent the obscuration of the inner globe by the deposit of the products of internal combustion.

1,287,522. CIRCUIT BREAKER; Orne H. Torgersen, Chicago, Ill. App. filed June 11, 1917. The circuit breaker is automatically opened in a rapid manner by a predetermined increase in the air pressure in the system.

1,287,542. LAMP MOUNTING; Francis M. Whitney, San Diego, Cal. App. filed Jan. 20, 1915. May be quickly and easily connected to the conductors.

1,287,567. MACHINE FOR WEIGHING WATER; Daniel K. Allison, Cincinnati, Ohio. App. filed July 8, 1916. Especially adapted for use in bakeries where the weight of the flour and water contained in dough is in a definite ratio.

1,287,581. ELEVATOR SYSTEM; Edward L. Dunn, Worcester, Mass. App. filed Aug. 7, 1909. Relates to automatic signaling systems for dumbwaiters or elevators, wherein the car can be sent to any predetermined floor and automatically stopped.

1,287,587. CONDUIT REDUCER AND CONNECTOR; Leonard M. Hickey, Milwaukee, Wis. App. filed Nov. 29, 1916. For underground wires such as telephones, lighting or power-transmission wires.

1,287,598. X-RAY TUBE; Thomas B. Rider, Los Angeles, Cal. App. filed May 10, 1917. To regulate the focus between the cathode and the anode.

(Issued Dec. 17, 1918)

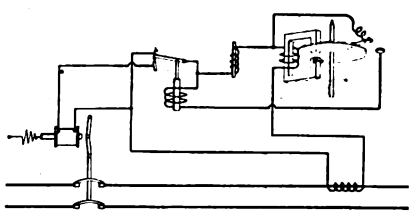
14,572 (reissue). THERMIONIC REPEATER; Alexander McL. Nicolson, New York, N. Y. App. filed Sept. 23, 1914. The input electrode and the cathode are separated by a dielectric film.

14,573 (reissue). WOVEN FABRIC AND PROCESS OF MANUFACTURING SAME; Theodore H. Wickwire, Cortland, N. Y. App. filed April 28, 1914. Produces fabric capable of withstanding the corroding effect of salt air or damp air.

1,287,604. IGNITION LOCK FOR AUTOMOBILES; William Ayling and Alfred A. Ayling, Detroit, Mich. App. filed Nov. 13, 1917. Includes an electric switch, a slide bar for operating the switch and a permutation lock for controlling the operation of the slide bar.

1,287,612. CONDUCTING RIM X-RAY MACHINE; Harry Barnett, New York, N. Y. App. filed May 13, 1916. To produce high-potential and unidirectional as well as oscillatory electric currents for therapeutic use.

1,287,617. ELECTRIC SWITCH; Reuben B. Benjamin, Chicago, Ill. App. filed Dec. 26, 1914. Particularly for closing the



1,287,721—Electric Protective Device

circuit of an electric horn or signaling device on automobiles.

1,287,634. ELECTRIC BATTERY; Newcomb K. Chaney, Lakewood, Ohio. App. filed June 7, 1916. Corrosion of a dry cell is decreased.

1,287,647. ELECTRICAL PROTECTIVE DEVICE; Leslie N. Crichton, Wilkinsburg, Pa. App. filed June 20, 1916. Relates particularly to relay mechanisms and systems employed for tripping circuit interrupters upon the occurrence of predetermined conditions.

1,287,658. ELECTRICAL CONDUCTOR; Charles R. Evans, Akron, Ohio. App. filed March 12, 1917. A durable wearing cover provided for double-conductor cables.

1,287,659. MAGNETO IMPULSER; Ronald K. Evans, Cheboygan, Mich. App. filed July 29, 1918. Relates particularly to mechanisms which produce the maximum current flow or spark introduced into the cylinder or cylinders of the engine by a momentary acceleration of one of the moving parts of the magneto.

1,287,676. ELECTRIC-BATTERY ANODE; Walter Grothe, Fremont, Ohio. App. filed May 15, 1916. Particularly adapted to copper-oxide cells with alkaline electrolyte.

1,287,680. STEERING-WHEEL CONTROL MEANS FOR ELECTRICALLY OPERATED SIGNALS; Roy S. Hanna, St. Petersburg, Fla. App. filed July 26, 1916. Signals on a motor car may be controlled without the driver removing his hands from the steering wheel.

1,287,687. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Aug. 10, 1915. Has special reference to dynamo-electric machines that are adaptable for regeneration and dynamic braking.

1,287,688. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Sept. 9, 1915. Relates particularly to the regenerative control of dynamo-electric machines that are adapted for use in systems of relatively high voltage.

1,287,689. METHOD OF WELDING RAIL BONDS; Albert B. Herrick, Cleveland, Ohio. App. filed March 30, 1917. The resistance across an arc is alternately increased and decreased.

1,287,705. IGNITION SYSTEM; George L. Lang, Newark, N. J. App. filed April 26, 1916. For gas engines in which the source of current supply for ignition is a battery or a direct-current generator ordinarily used for charging the same.

1,287,714. MOTOR-CONTROL SYSTEM; Walter O. Lum, Wilkinsburg, Pa. App. filed Oct. 3, 1913. May be used in connection with planers, elevators and similar machines.

1,287,715. AUTOMATIC SELECTING SWITCH; Frank A. Lundquist, New York, N. Y. App. filed Nov. 27, 1916. Relates to power-driven panel switches of the multi-brush type for use in telephone exchange systems.

1,287,716. AUTOMATIC SWITCH; Frank A. Lundquist, Chicago, Ill. App. filed April 19, 1917. Of the type employed in telephone-exchange systems, and will rapidly select a desired line.

1,287,718. CIRCUIT BREAKER; Samuel C. McKewn, Newark, N. J. App. filed March 15, 1917. For the primary circuit of high-tension ignition systems such as are used in connection with magneto or induction-coil apparatus for internal-combustion engine ignition.

1,287,721. ELECTRICAL PROTECTIVE DEVICE; Joseph N. Mahoney, Wilkinsburg, Pa. App. filed July 3, 1916. Relates particularly to relay mechanisms employed for tripping circuit interrupters upon the occurrence of predetermined circuit conditions.

1,287,722. ELECTRICAL PROTECTIVE DEVICE; Joseph N. Mahoney, Wilkinsburg, Pa. App. filed July 11, 1916. May be operated by current derived from the circuit in connection with which the interrupter is employed.

1,287,725. PROTECTIVE DEVICE; David T. May, New York, N. Y. App. filed May 25, 1917. For protecting electrical circuits from the destructive effects of abnormal currents or impulses.

1,287,734. PROTECTOR FOR TIMER WIRES; Soren J. Norre, Chicago, Ill. App. filed March 30, 1918. For Ford automobiles.

1,287,774. APPARATUS FOR ELECTRIC WELDING; Frank L. Sessions, Lakewood, Ohio. App. filed July 18, 1913. An electrode of indefinite length may be fed continuously automatically at the proper rate of speed to insure the welding of the joint between the juxtaposed edges of two sheets of metal.

1,287,788. ARMATURE WINDING FOR DYNAMO-ELECTRIC MACHINES; Ira B. Stiefel, Wilkinsburg, Pa. App. filed Dec. 6, 1915. To permit a relatively large number of armature conductors of economical cross-section to be placed in each armature slot.

1,287,790. REMOVABLE CONDENSER UNIT FOR MAGNETOS; John F. O. Stratton, Chicago, Ill. App. filed Aug. 21, 1918. Ready accessibility for examination or repair is afforded.

1,287,793. GOLD FILM; Edgar D. Tillyer and Fred M. Bishop, Southbridge, Mass. App. filed May 5, 1917. To be more firm in texture and durable in structure than the present rolled or beaten gold leaf.

1,287,805. TELEPHONE-EXCHANGE SYSTEM; Charles White, East Orange, N. J. App. filed March 8, 1918. Number of circuits required between different switchboards or operators' positions reduced by utilizing the same circuit for various classes of service.

1,287,806. CONTROL APPARATUS; Charles C. Whittaker, Wilkinsburg, Pa. App. filed June 6, 1916. Provides a liquid rheostat of large initial current-carrying capacity that will also have a large resistance range and occupy relatively small space.

1,287,807. PROCESS AND APPARATUS FOR THE ELECTRIC-ARC TREATMENT OF GAS; Frank H. A. Wielgolaski, Christiania, Norway. App. filed Sept. 28, 1916. Products caused to leave the furnace with the highest possible temperature.

1,287,808. STRETCHING OUT DOUBLE OR MULTIPLE ELECTRIC ARC; Frans H. A. Wielgolaski, Christiania, Norway. App. filed Sept. 28, 1916. Method not only constitutes an independent arc-extension method but also will assist elongation of the arc when used in combination with other arc-extending means.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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The Pause for Breath

EVERYBODY to-day recognizes that business is holding up, that the wheels of industry are slowing down, and that a vast number of workers, estimated by some in the millions, are temporarily jobless. The causes are plain enough. Government contracts in enormous amounts have been canceled; their place has not been taken by civilian work; what they bring forth has necessarily been cut down, or works have shut up altogether; still more workers are coming in from the demobilizing army, and buyers are waiting for the fall of prices from their present high estate to the more commonplace level of peace. The condition is a perfectly natural one and must inevitably last until some measure of stability is given to international relations by the determinations of the international congress. We are inclined to think, however, that the real seriousness of the situation is somewhat exaggerated. We have just come through not only the greatest war recorded since mankind came upon the earth but the greatest epidemic of all history. The tremendous strain of effort and anxiety has just been relieved, and the world slackens pace a little to catch its breath for the work of finding again the pace that makes for progress.

That many difficult questions have to be settled is perfectly true. We are in a period when artificially exaggerated demands have forced the price of labor to heights from which it will have to sink now that the supports are being withdrawn. The same is true of prices of material, which shot sky-high under the impulse of government demands for instant delivery and of utterly reckless monetary inflation. This house of bubbles is due to collapse, and the hope of society is that it will not do so too suddenly. The matter to which we wish especially to direct attention now is to beware lest too cautious waiting for something to happen may lead to the loss of valuable opportunity. There is a tremendous amount of work to be done in the electrical industries in the next few years—work of rehabilitation and in the resumption of the general growth that has been temporarily checked. Now is the time actively to prepare for meeting these requirements.

The rest of the world shares our troubles. It has lost more than we have in men and industrial material. It has relatively lost less in the artificial rise of prices. Consequently we have no competitive advantages save in those few things granted us by nature, and what is done must be done by directed effort. In short, this is no time to sit down and wait, hoping that more favorable conditions for competition in the world's trade will come before that competition has fairly developed. Such is not going to be the case, for the rest of the world will get on to the job just as rapidly as possible, in fact is already on the move at the very time when too many Americans are waiting for opportunity to be thrust upon them. If all the technical industries would plan for active work and begin on it at once, the steadying effect of this activity would be very marked. As it is, there is danger that our pause for breath may be so prolonged as to be a serious handicap in the next phase of the eternal struggle for the world's business.

A great principle is involved in the springing to arms of the public utility commissions in various states against the telephone toll rate order of the federal government. The right of a state to regulate intrastate rates is averred to be an exercise of police power of paramount stability, and the finding reached by the court of final appeal on this question will be of great significance.

Support for the Company

SOME utility executives have had to revise their theories about what commissions should and should not do. They have learned to appreciate the fact that, irrespective of the merits of any case, a commission can go only a limited distance in a direction contrary to public opinion. The people, who created the commissions, can kill them. With all their vested authority commissions are human, and it is only to be expected that they will keep in mind the fact that their power comes from the people.

When utilities tried to mold public opinion in favor of the commission having jurisdiction over their territory, their efforts met with no great measure of success. Utility propaganda, when recognized as such, usually back-fires. It has even been said that the only way a utility can help a commission is to damn it. This may have the desired effect in some instances where the utility itself is in bad odor with the people, but it is at best a negative boost. What is required is to inform the public by spreading interesting facts and figures. Not until the people absorb enough of such information to make them appreciate the true conditions will the utilities enjoy the popular support they may be entitled to. How to give the public the required education is one of the problems the industry has to solve. Before the utilities start to try to educate the public, however, it behooves them to reach a point of educational saturation among their own employees and employees' families. Sometimes inquiry shows that this class of citizen is only negatively on the side of the

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company, and it is found that the reason is that the utility did not encourage its employees to be anything more. Here is a far-reaching agency for promulgating utility doctrine if the companies will utilize it. It will require tact and energy for the central stations to get full support from their employees. They can give the employees enough facts and figures to permit them to talk interestingly and intelligently about the company's business, but the results should justify the trouble and expense many times over.

A customer told a meter reader that the increase in rates which had just been put into effect was to pay interest on watered stock. As a matter of fact the company was not earning a fair return on the actual money invested. That meter reader was in an excellent position to correct an erroneous idea, whereas he did not know but that the customer was right. How can such employees be expected to support their company effectively in any controversy when they know nothing of the facts involved? These employees exercise a latent influence on public opinion which the utilities can, if they will, turn into a great dynamic force.

Intensive illumination by floodlamps should not lapse into utter disuse with the close of the war. In the advertising and industrial fields there are wonderful opportunities for ingenious applications of this kind which spell long-hour revenue for the central station, with a service graduated to meet an almost infinite variety of conditions. Do not overlook the low-wattage reflector lamp burned all night and every night as an income producer.

Attracting New Industries

ONE of the initial steps in a campaign for attracting new industries, suggested by the discussion of L. W. Alwyn-Schmidt in this issue, is a survey of the economic possibilities of the district. The war has not passed over the United States without causing great changes in the industrial situation. New industries have sprung up as a result of the interruption of foreign commerce, and many of them are here to stay. Other changes in community conditions make it desirable for the central station to have as thorough a knowledge as possible of the status of industries in its community, and a careful survey will reveal many fields for intensive effort.

In such a survey one may study to see what class of factories the neighborhood is best adapted to hold. Much factory building has been done in haphazard fashion without thorough consideration of the various factors which make for success or failure. Questions like the following will arise: Are there sufficient well-situated factory sites? Is there a prospect of sufficient labor or will it be possible to house newly arriving labor at reasonable rents? Which raw materials are found locally and which can be obtained easily? What facilities exist to help the sale and distribution of manufactured products? What are the prospects for the introduction of new industries which will help those already established and will tend to draw still others? What improvements will be necessary for the purpose of attracting new industries?

Obstacles to Interconnection

THE merits of power-plant and transmission-system interconnections are now pretty well established as a general proposition. The war has accelerated consideration of such possibilities in many communities where shortages in fuel and in generating capacity have retarded the munitions program. Yet if peace were already declared the economic need would still justify the most careful study of inter-plant and tie-line problems in locations where opportunities remain to bring about savings in investment as related to use and in fuel and labor as related to output. Costs are likely to remain at high levels for some time after the war, and the conservation of all sorts of resources is going to be a reconstruction policy of great importance. As one means of realizing broad economies without cutting into the quality of service, interconnection is destined to be a live subject for engineering consideration for a long while to come.

It is pertinent to inquire at this time into the reasons why some clearly desirable interconnection projects are not pushed to completion. Passing by those projects which have been realized to the benefit of many producers and consumers of electrical energy—and these projects are not few—one finds now and then a well-conceived program which makes a good start, receives a fair meed of publicity among engineers, reaches the committee stage, and then slows down and stops. What is the cause of this? Two chief reasons may be cited for the failure of interconnection plans to advance as rapidly as seems justified. The first is the difficulty of raising the necessary funds and the second is the failure of a wide circle of interests outside the immediate engineering field to realize the benefits to be derived from the right kind of coöperation.

The development of a community-broad or even state-wide sentiment in favor of an interconnection plan based upon sound engineering requires that the advantages and safeguards of such a plan be very plainly set forth for the understanding of the public and its representatives. This is no less important than winning the consent of the power-plant and distributing-system owners or operators concerned. It must be made exceedingly clear that the proposed tie-in is not an absorption plan disguised by a cloak of good intentions. Where consolidations are proposed the only safe way is to come out with the facts at once. If the interests associated in the interconnection are to remain separate, it is a great mistake not to emphasize this in the public discussion of the project. The smaller plants, and municipal plants in particular, often look with suspicion upon investigations of their possible relations to a tie-line project, even in cases where the profit of all parties concerned is the only goal of the promoters.

Instances have occurred where engineers seeking interconnection data have been refused admittance to plants through a misunderstanding of the real object of their work. Local politics is sometimes an obstacle which must be overcome by publicity and enthusiastic advocacy of the legitimate project by men competent to set forth the facts. Working out the scheme of coöperative investment and coöperative profit-sharing may take time, but it certainly is within the capabilities of the engineer as a business man and technical expert.

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Electrochemical Engineering

SINCE the beginning of the war there has been no more startling progress made in any particular field of industrial effort than in the various branches of applied chemistry, and particularly in those which are closely related to the work of the electrical engineer. In numerous paths of endeavor for the country's good the work of the chemist has been preëminently great, often in ways not yet disclosed to the public, and in no small measure have these advances been dependent on the resources of electrochemistry, the profoundly interesting border land between two great branches of engineering. In electrometallurgy, the fixation of nitrogen and the building up and purification of products new and old the electrical engineer and the chemical engineer have joined hands to force their way onward. Both in theory and in practice their activities overlap, for to-day the roots of chemical reaction are believed to have a common basis with electrical forces and many of the mysterious actions in one field overlap those in the other. It therefore behooves both chemists and electrical engineers to pay closer attention to their common inheritance than has ever been done before.

Electrical engineering is far more than the mere knowledge of how to transmit power or intelligence. Chemical engineering reaches much deeper than observed chemical reactions. The two when properly developed represent the applied science of which physical chemistry serves as the theoretical basis, but physical chemistry lies outside the ordinary fields of both chemistry and physics as customarily taught. For years it was the mysterious limbo between two sciences; now, when we discuss both chemical and physical phenomena in terms of electrons, it is time to realize that there is coming into existence a correlated applied science, substantially a branch of engineering. The barrier of unexplored mysteries between chemistry and physics is rapidly being broken down and there is going to be a keen demand for those who are able to apply the knowledge gained in this particular line. It is time, we think, for more attention to be devoted to this growing field of activities. Already there have been some meritorious efforts at training men for the particular work here in hand. The trouble lies in the fact that both chemistry and physics, chemical engineering and electrical engineering, have grown so wide in scope and so strenuous in their demands for the student's time that the addition of anything more within a reasonable period of training is practically out of the question.

Is it not time to realize that the student of chemistry who is devoting a considerable portion of his time to studies of quantitative organic analysis and the student of electrical engineering who is spending weary hours over draftsmanship and machine design are merely laying valuable knowledge on the shelf so far as concerns the acquisition of training of the particular sort we are here considering? There is need for a closer union of applied physics and chemistry than has yet been made available to the student on any substantial scale. The chemistry concerned in borderland researches is mostly so-called inorganic chemistry. The electrical engineering deals with ions and electrons instead of dynamos and transformers. The student who approaches the new field either from the chemical or the electrical side alone finds himself with a very one-sided knowledge of the necessary facts. A course in electrochemistry or chemical physics tells only half the story, perhaps much less than half. We believe, therefore, that it will be well worth while for our educational institutions to face the fact that theoretical and practical knowledge in a very important line of work ought to be made possible to the student without his attempting to acquire the simultaneous mystery of the whole of two sciences either of which is too serious a task for the time allotted to student life.

Let us welcome the boys home electrically and put every cross-roads village with central-station service on the luminous map. Why shouldn't every town have an electrical name-plate facing the railroad with appropriate wording in letters of light to serve as a continuous hospitality committee to travelers in general as well as to the lads in khaki and navy blue?

The Use of Chain Grates

THE notes by T. A. Marsh in this issue upon the characteristics of chain-grate working are closely in line with several papers which we have recently published dealing with the improvement of the conditions of combustion. As our readers know, the chain grate is in very large use, having worked its way into popularity after the gradual course of improvement which Mr. Marsh indicates. With a properly designed chain grate uniform combustion over the grate area can be attained together with high efficiency of operation. From the data here given it becomes evident that even at, and sometimes especially at, low boiler ratings this type of stoker does excellent service. Perhaps the most important factor which Mr. Marsh brings to the front is the very one which seems just now in line to be fully appreciated, the great value of adequate furnace space, particularly in burning rather poor fuel. Ordinarily boilers are set with far too small combustion space, especially when the rate of fuel consumption must be pushed hard to carry the plant over the peak. In fact, from the figures which Mr. Marsh here gives the combustion space is commonly less than a quarter of that desirable for economical burning of fuel.

European practice has been much sounder in this respect, working toward maximum efficiency in combustion at a more moderate rate with respect to the grate area. There probably has been too much effort here to lower the initial expense of the furnace equipment at the cost of less complete utilization of the fuel. It is the old story of penny-wise economy, for the loss of 5 or 10 per cent of fuel value means an annual expense to avert which a considerable increase in cost of the boiler settings would be well worth the while. In burning fuel of below the average quality the losses from insufficient furnace volume increase in severity, and indeed skimping in this particular sometimes interferes seriously with the use of fuels which would otherwise be economically desirable. These facts have been repeatedly rubbed in in recent discussions of combustion, and we hope that they will in time be more fully appreciated than they have been in the past. There is room for much reform in the efficient production of steam, and, as we have repeatedly pointed out, right here lies the main secret of high plant efficiency.

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Long-Line Phenomena and Vector Locus Diagrams

Long-Line Transmission Problems May Be Readily Solved by the Use of Rigorous Hyperbolic Equations of Very Simple Form—An Analysis of Equations of This Form with Vector Diagrams for Graphical Interpretation

BY EDY VELANDER
Massachusetts Institute of Technology

IT IS a well-known fact that the distributed capacitance of alternating-current lines gives rise to all sorts of peculiar phenomena as regards voltage and current distribution. Numerical investigations on long transmission lines and cables occur in every-day engineering. The theory has reached the textbook stage, and the expressions for the steady state, in the excellent simplicity of the Kennelly hyperbolic forms,

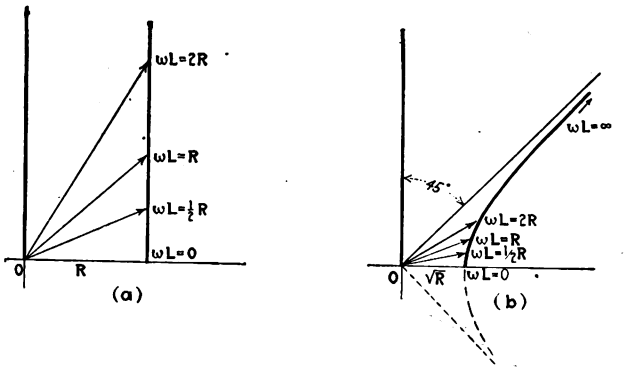

FIG. 1—(*a*) LOCUS OF VERTICAL IMPEDANCE Z, FOR CONSTANT RESISTANCE; (*b*) CURVE TRACED BY $\sqrt{Z}$ FOR CONSTANT RESISTANCE.

are so compact that the whole codex of rigid formulas can be written down on a thumbnail. In spite of all this the thorough understanding of the long-line phenomena is mostly looked upon as a prerogative of the few.

The responsibility lies heavily on the complex hyperbolic functions. The practical engineering mind always looks for some mental picture of the investigated phenomena, some graphical representation of the equations. The difficulty in visualizing the hyperbolic functions has therefore necessarily resulted in a certain suspiciousness vis-à-vis everything "hyperbolic," and the theory has been less appreciated.

Unfortunately, in earlier efforts to visualize the long-line phenomena the ordinary kind of Cartesian two-dimensional diagram was often used. Voltages and currents on a line, however, just as in an ordinary alternating-current circuit, are most clearly represented by plane vectors. The variation of a vector is shown by the trace of its endpoint. This trace in the complex plane, or vector locus, in the consideration of alternating-current quantities takes the place of the ordinary, real curve in a Cartesian diagram, which is sufficient in a direct-current case. The abscissa, or independent variable, in the vector locus diagram is conveniently plotted as a line coördinate along the locus.

The characteristics of a three-phase induction motor are most easily discussed by means of a Heyland vector locus diagram. Correspondingly for the long-line phenomena, as soon as the vector locus diagram is employed in the discussion, the apparent difficulty in getting a graphical representation of the theory fades away; all the fundamental phenomena can be interpreted in an exceedingly simple way, without any approximations whatsoever, and without the lack of generality inherent in the numerical-example way of illustrating the formulas.

THE ELECTRIC LENGTH OF A LINE

A homogeneous electric line is physically defined by its length, D, and the four line constants, r, l, c and g, denoting the resistance, inductance, capacitance and leakance per unit length. The behavior of the line depends furthermore upon the frequency of the impressed voltage, f cycles per second, or its angular velocity, $\omega = 2\pi f$. In the vector notation we may combine these six parameters and get two complex quantities, together completely describing the line. These quantities may be called the virtual impedance of the line, $Z = R + j\omega L$, and the virtual admittance of the line, $Y = G + j\omega C$. R stands here for Dr, the total resistance of the line conductor; correspondingly $L = Dl$, and so on.

In the "hyperbolic theory" the line is said to subtend a certain complex hyperbolic angle, $\theta = \sqrt{ZY}$. The quantity θ represents in a sense the length of the line. This "electrical" or "hyperbolic" length is not measured in miles or kilometers, but in complex hyperbolic radians, and is therefore a numerical vector. It tells, however, to what extent the line is to be regarded as a "long line"; *i.e.*, how much distortion in the distribution of voltage and current is to be expected as an effect of the capacitance and leakance of the line.

To get a conception of the quantity θ, consider its two factors, $\sqrt{Z}$ and $\sqrt{Y}$. The virtual impedance, Z, or $R + j\omega L$, is shown on Fig. 1a. For a very small

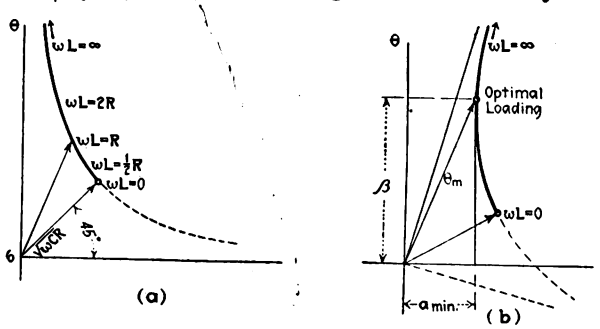

FIG. 2—(*a*) LOCUS OF Θ, ELECTRICAL LENGTH OF LINE, FOR R, C, AND ω CONSTANT, L INCREASING FROM ZERO TO INFINITY; (*b*) SAME AS (*a*) BUT APPLIED TO LOADED LEAKY CABLE.

reactance ωL, Z will be a vector of length R along the real axis. When the reactance is increased the vector Z will vary along a vertical line. In computing $\sqrt{Z}$ we have to recall the rule that the square root of a complex quantity is another vector with half the slope

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and with a size equal to the square root of the size of the original vector. The largest slope our impedance Z can attain is 90 deg. $\sqrt{Z}$ will therefore tend toward a 45-deg. slope. The real vector R will simply be reduced to $\sqrt{R}$, and the locus of $\sqrt{Z}$ will be one-half branch of a hyperbola with the first median line for an asymptote (Fig. 1b).

For ordinary efficient lines the leakance G is very small. The admittance Y will therefore have very nearly 90-deg. slope, and its square root will be a 45-deg. quantity, $\sqrt{Y} = \sqrt{\omega C}/45°$. Let us now consider the product of $\sqrt{Y}$ into $\sqrt{Z}$, the latter being represented by its locus (Fig. 1b). The vector rule is: Multiply sizes, add angles. In the new plot our hyperbola will simply be tipped over 45 deg. and reproduced to a new scale, in proportion $\sqrt{\omega C} \div 1$. Fig. 2a shows the locus of $\sqrt{ZY}$, or the hyperbolic length θ of a leakage-free line whose inductance is increased from zero to infinity.

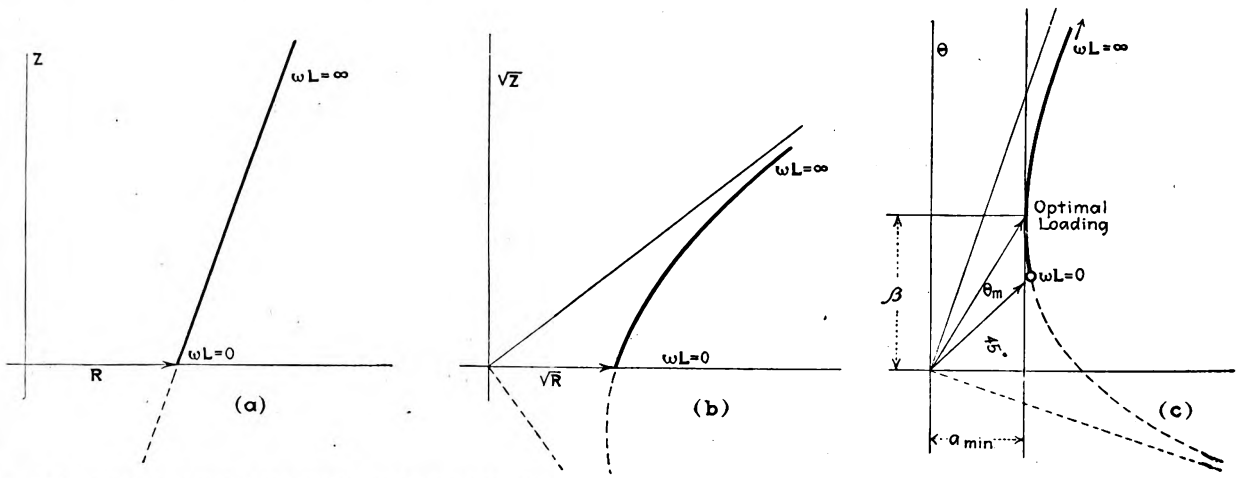

FIG. 3—(*a*) VIRTUAL IMPEDANCE WITH INCREASING NUMBER OF LOADING COILS OF FIXED TIME CONSTANT; (*b*) TRACE OF $\sqrt{Z}$; (*c*) SHOWING EFFECT OF RESISTANCE IN LOADING COILS

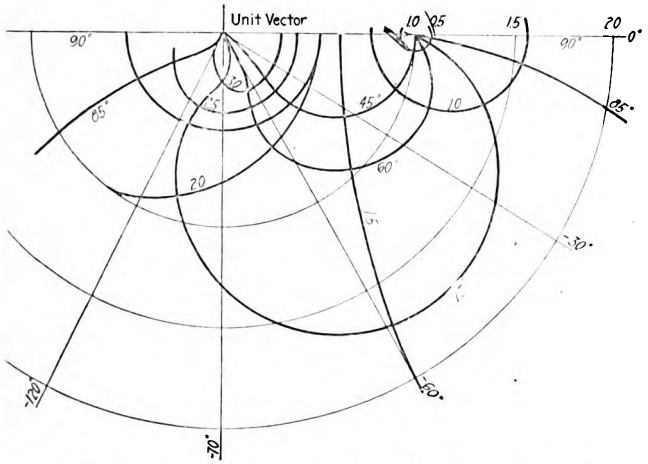

FIG. 4—VARIATION OF VECTOR (TANH θ)/θ WITH SIZE AND SLOPE OF θ. SIZE θ = 0.5, 1.0, 1.5, 2.0, 2.5, 3.0; SLOPE θ = 45°, 60°, 75°, 85°, 90°

The plot shows that the slope of θ always is less than 90 deg. In a leakage-free line it will always be more than 45 deg., reaching this limit when the inductance is negligible; *i.e.*, for a cable. For an aërial line, where the inductance is comparatively very large, θ will have a slope of 80-85 deg.

THE LOADED TELEPHONE CABLE

The quantity θ is sometimes called the propagation constant and denoted as $\alpha + j\beta$. In a very long line—for instance, a long telephone cable—the current and voltage fall off as $e^{-\theta}$; *i.e.*, the received current is only $e^{-\alpha}$ of the sending-end current (lagging β circ. rad. behind it). The limiting length of a telephone cable is therefore determined exclusively by α, the real part of our vector θ.

Now, from a consideration of Fig 2a, it is clear that if by some means we could increase the inductance of the cable, α could be decreased toward zero, and it would then be possible to cover very much larger areas with the same kind of cable and apparatus. According to Pupin's method of "loading" the cable, inductance is added by means of inductance coils, connected in series in the cable, sufficiently small and not spaced too far apart to affect the homogeneity of the line.

When the amount of loading increases θ will travel along the locus of Fig. 2a. In practice, however, there are certain limitations to the method. If there is any appreciable amount of leakage in the cable, $\sqrt{Y}$ will have a slope of less than 45 deg. This means that the whole hyperbola will be turned back just as many degrees as $\sqrt{Y}$ is short of 45 deg. Fig. 2b shows the new conditions, which are far different. A certain minimum value of α exists here, below which it is impossible to go. To this $\alpha_{min.}$ corresponds an optimal amount of loading, so that an additional increase of inductance will make the line less efficient for transmission purposes.

Even if the leakance were negligible, the unavoidable resistance of the loading coils would put a limit to the improvement by loading. Suppose, for instance, that the coils could be made of a certain fixed time constant only. With increasing number of coils the total virtual impedance of the cable would vary as in Fig. 3a, starting from the pure resistance value R for unloaded cable. The square root of Z would have for its locus a hyperbola as before, but the asymptote would now make less

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than 45 deg. with the real axis. The locus for $\sqrt{ZY}$ (Fig. 3c) has therefore in such a case the same characteristics as for the leaky cable.

THE SHORT-CIRCUITED LINE

Owing to effects of capacity and leakance, the virtual impedance Z can never be directly measured. The impedance which the line offers at the generator end, when the far end is short-circuited, may be called the apparent impedance and denoted Z_s. From the hyperbolic theory we take the well-known formula

$$Z_s = z_0 \tanh \theta.$$

Here z_0 is the "surge impedance" of the line, or $\sqrt{Z/Y}$. This formula may be rewritten in following form:

$$Z_s = Z \ (\tanh \theta)/\theta,$$

and suggests then that the influence of the capacity of the line may be conceived as a disturbance taken care of by a correction factor $(\tanh \theta)/\theta$. This function, of course, is a vector. It is shown in the graph of Fig. 4 for different sizes of θ, and for several slopes between the practical limits 45 deg. and 90 deg.

To obtain the apparent short-circuit impedance of a line we have only to pick out of this graph the vector correction and apply this to the virtual no-capacity impedance of the line.

In the graph the 45-deg. curve applying to a cable has an interesting physical significance as it stands. For a cable the virtual impedance is simply R ohms, real, and the size of θ is $\sqrt{R\omega C}$. To a certain scale the 45-deg. line of Fig. 4, therefore, represents the apparent impedance of any short-circuited cable, the frequency being varied from zero to infinity.

CAPACITY EFFECTS IN COILS AT HIGH FREQUENCY

Any kind of a coil has a certain distributed capacitance to ground. There are also a capacity between windings and an internal mutual inductance which complicate the phenomena. As a first approximation, however, the hyperbolic theory can be applied as giving an estimation of the effect upon the apparent impedance of the coil which the capacity to ground may have.

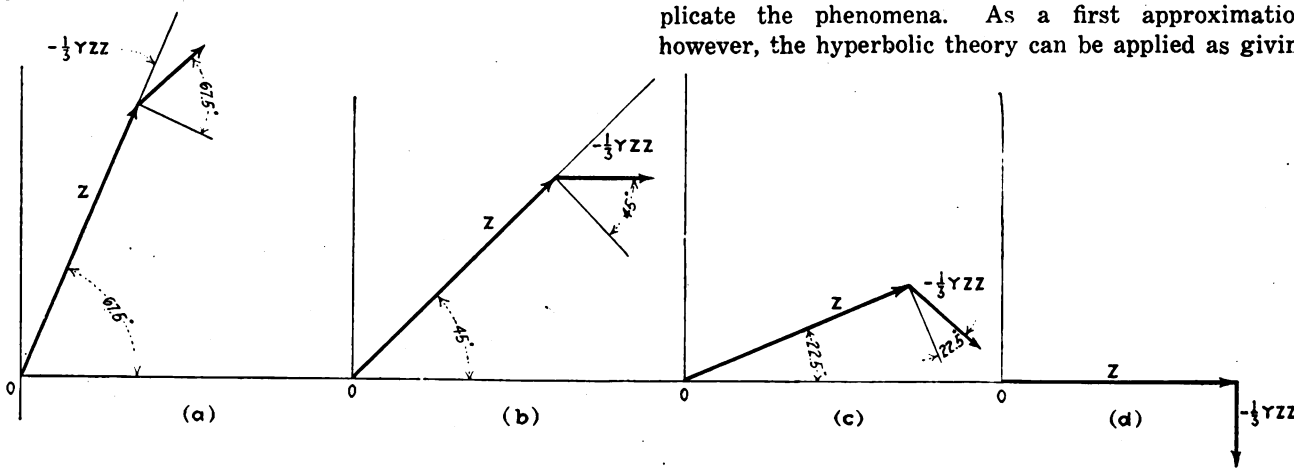

FIG. 5—CAPACITY EFFECTS IN COILS

The simplest case is the bifilar coil, which can be looked upon as a short-circuited cable. The 45-deg. curve in Fig. 4 shows therefore directly what errors may be expected in using a bifilar resistance standard at very high frequency. Fortunately, the apparent change in resistance is very small, even at rather high frequency, but the phase angle of the coil will rapidly grow negative. Even at an apparent phase angle of —5 deg., however, the change in resistance is only —0.06 per cent.

In the discussion of the inductive coil grounded at one end we will go still further in simplification. Developing $\tanh \theta/\theta$ in a power series and neglecting higher terms, we get

$$\tanh \theta/\theta = 1 - \tfrac{1}{3}\theta^2 + \cdots$$
$$= 1 - \tfrac{1}{3}ZY \text{ (approximately)}.$$

The capacity effects will, therefore, appear as a little disturbance vector, $-\frac{1}{3}ZY.Z$, added to the vector Z of virtual impedance. In Fig. 5 the virtual impedance Z and the disturbance vector are drawn for different cases, corresponding to different slopes of Z (leakance neglected).

In a highly inductive coil resistance as well as in-

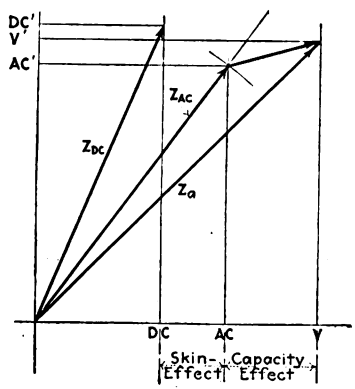

FIG. 6—SKIN EFFECT AND CAPACITY EFFECT IN COILS

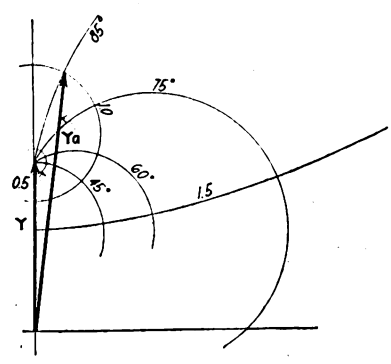

FIG. 7—APPARENT ADMITTANCE OF AN OPEN LINE—$Y_a = Y \ (\tanh \theta)/\theta$

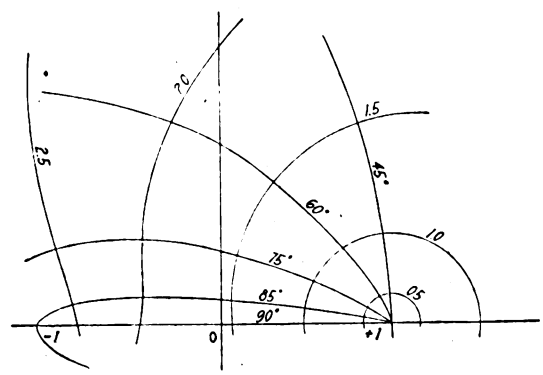

FIG. 8—VARIATION OF THE VECTOR COSH θ

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ductance appears increased. In the intermediate case of $R = \omega L$ the inductance is unchanged, but the resistance is increased. For the coil with very high resistance the change in apparent resistance is less appreciable, but the apparent inductance is greatly diminished. Fig. 5d represents the conditions of the bifilar coil.

This simple discussion gives an interesting interpretation of the errors due to distributed capacity which often obscure the results of high-frequency measurements on skin effect.

In Fig. 6 suppose *O-DC* to be the direct current resistance of a certain sample coil. *O-DC'* represents the reactance of the coil, computed from its low-frequency inductance. The skin effect tends to increase the resistance and decrease the inductance of the coil. Therefore, the virtual impedance of the coil at high frequency may have the components *O-AC* and *O-AC'*. According to Fig. 5a, we obtain the apparent impedance Z_a which is the only thing that can be measured. The effect of capacity is in this case to exaggerate the skin-effect resistance increase and to mask the decrease in inductance. Such errors due to capacity often are overlooked, but will probably account for many discrepancies between theory and observation.

Open Line

To obtain the apparent admittance of an open-circuit line exactly the same correction should be applied to its virtual admittance:

$$Y_a = Y(\tanh \theta)/\theta$$

To show clearly the effect upon the admittance of a line due to the distributed impedance the tanh θ/θ plot is given once more in Fig. 7, turned over 90 deg. so that the unit vector coincides with the admittance of a pure condenser. This graph gives a good idea of the charging current of an unloaded transmission line. Here Y represents the virtual admittance (no leakage) of the line, as computed from its capacity per unit length. The real generator-end admittance will lie somewhere between the lines for 75 deg. and 85 deg. The line takes, therefore, a larger no-load current than would be expected from its capacity, and it takes even at no load a certain in-phase current, thus constantly wasting power.

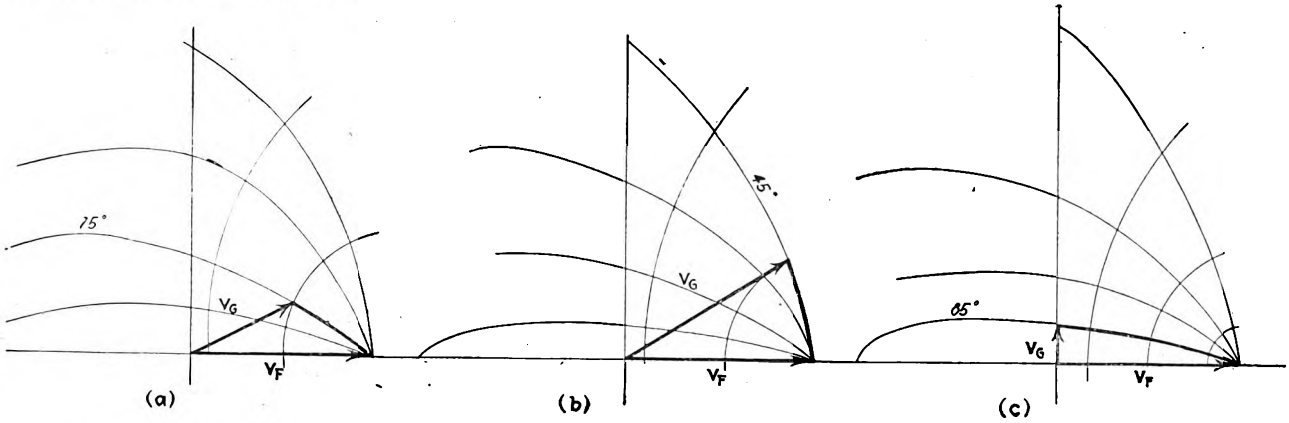

FIG. 9—VOLTAGE DIAGRAMS FOR AN OPEN LINE: (*a*) FERRANTI EFFECT, (*b*) CABLE, (*c*) QUARTER-WAVE LINE

For the voltage on an open line the following equation holds: $V_g = V_f \cosh \theta$, where V_g is generator voltage and V_f the voltage at the free end. From the point of view of our earlier considerations also, cosh θ is evidently to be looked upon as a vector correction factor. As a matter of fact, the graph of cosh θ (Fig. 8) gives a good justification of this notion. For a short line, cosh θ practically coincides with unity, but when the size of θ reaches 1 the deviation is already appreciable.

Figs. 9a, 9b and 9c illustrate the conditions for an aërial transmission line, a cable and a "quarter-wave line" of small resistance; for instance, a radio antenna. The first figure shows that the voltage at the free end of an aërial transmission line always is larger than the generator voltage, due to the well-known Ferranti effect. Fig. 9b shows that such a voltage rise can never occur in a cabled line, a large slope of θ being essential for its existence. The last case shows line resonance

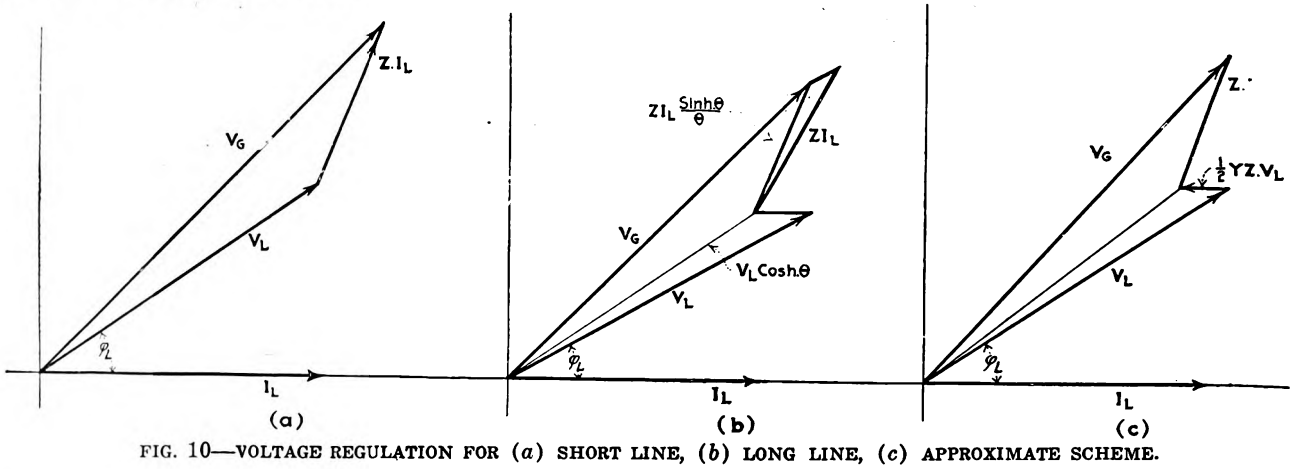

FIG. 10—VOLTAGE REGULATION FOR (*a*) SHORT LINE, (*b*) LONG LINE, (*c*) APPROXIMATE SCHEME.

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in the fundamental mode of oscillation. A relatively small generator voltage is sufficient to maintain a very high voltage at the end of the antenna. This resonance phenomenon comes forth as nothing but an exaggeration of the Ferranti voltage rise.

THE TWO TRANSMISSION PROBLEMS

Among the characteristics of a power-transmission line two quantities are considered especially important,

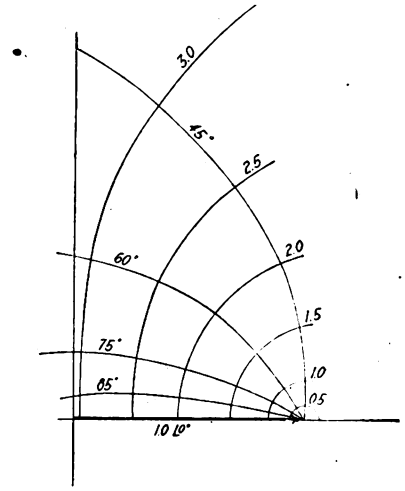

FIG. 11—THE VECTOR SINH θ/θ

namely, the voltage regulation, or the generator voltage in per cent of the voltage at the load, and the current regulation, or the generator current in per cent of the load current.

In the simpler case of a short line, where no appreciable capacity effects are to be expected, the generator voltage is obtained simply by vectorially adding the guaranteed load voltage V_l and the vector drop ZI_l (Fig. 10a).

If the line is electrically long, we have to take resort to the exact formula of the hyperbolic theory. In accordance with our earlier work we will try to get this formula in the same form as in the simpler case, and write therefore:

$$V_g = V_l \cosh \theta + ZI_l \ (\sinh \theta)/\theta.$$

This expression suggests that the long-line problem can be solved in just as simple manner as that for a short line if only certain correction factors are applied upon V_l and ZI_l before adding. Besides our well-known correction factor cosh θ, another hyperbolic function of similar nature appears, sinh θ/θ, which is plotted in Fig. 11.

The exact graphical addition leading to the voltage regulation is shown in Fig. 10b. In accurate work the addition should be made by computation and not graphically, and the correction vectors should then be taken from a table of hyperbolic functions.

For short lines, and when considerations of accuracy are less important, an approximate scheme may easily be derived by using a series-expansion for cosh θ, dropping all terms except the first one:

$$\cosh \theta = 1 + \tfrac{1}{2}YZ \text{ (approximately)}.$$

A comparison of Fig. 8 and Fig. 11 will show that the function cosh θ diverges from unity much more rapidly than does sinh θ/θ. The latter correction, being applied to the relatively small drop voltage, is therefore in reality of a lesser order of magnitude than the cosh θ correction. In our approximate method we should therefore leave it altogether out of consideration, as in Fig. 10c.

When a better accuracy is required, however, the necessary hyperbolic functions should always be taken out of available tables. It has been suggested that the computation for each occasion of the series expansions would be easier for the average engineer. No engineer with ordinary common sense would go all over the series computation to arrive at the value of, say, cos 25 deg. For similar reasons the vector series addition leading to a complex hyperbolic cosine or sine should be looked upon as an instructive exercise for the student, but nothing beyond that.

The computation of the current regulation of a long line may be referred to the solving of a short-line problem in much the same way as the computation of voltage regulation. The simpler physical scheme is in this case a short high-tension line, where the drop can be neglected. The voltage is then V_l all over the line, and the charging current will be YV_l. The generator current will be the vector sum

$$I_g = I_l + YV_l.$$

(See Fig. 12a.) In the exact form the formula for a long line is

$$I_g = I_l \cosh \theta + YV_l(\sinh \theta)/\theta.$$

The formula shows the complete reciprocity of voltage and current. Exactly the same considerations as for voltage hold here. The rigid diagram for a long-line is shown in Fig. 12b, and an approximative scheme, corresponding to Fig. 10c is drawn in Fig. 12c.

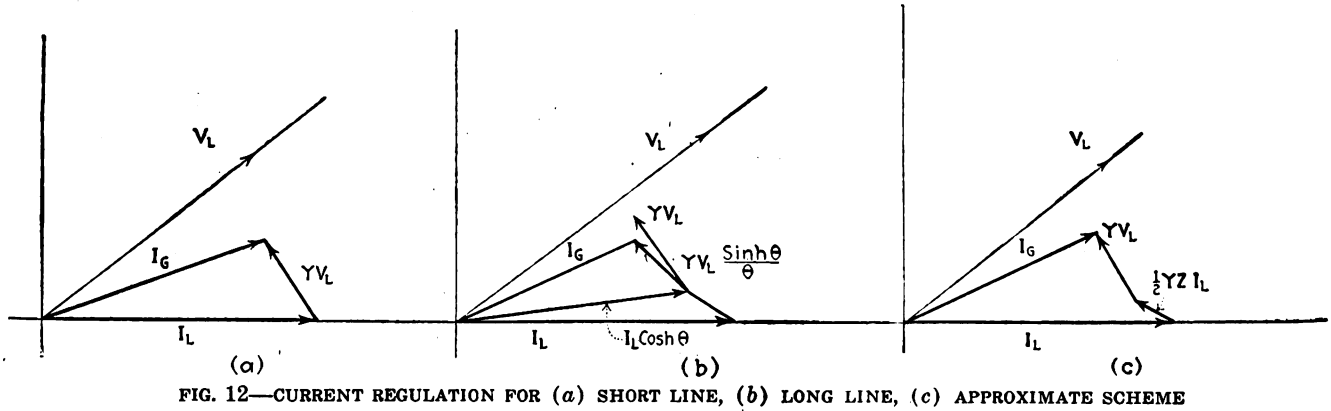

FIG. 12—CURRENT REGULATION FOR (*a*) SHORT LINE, (*b*) LONG LINE, (*c*) APPROXIMATE SCHEME

Similar devices can be used to refer every kind of investigation on regulation, constant-voltage transmission, or any other characteristics of a long power-transmission line, back to the simple corresponding problem regarding a short line.

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CHAIN GRATES AND THEIR GENERAL CHARACTERISTICS

They Have Caused Changes in Furnace Design Which Greatly Improve Efficiency of Boiler Unit Especially at Light Load

BY T. A. MARSH
Chief Engineer of Green Engineering Company

SIMPLICITY, ease of operation and high efficiency over a wide range of operating conditions have been responsible for the installation of a large number of chain grates. With modern chain-grate furnaces, 14 per cent CO_2 may be carried during regular operating periods, and the maximum furnace efficiency corresponds with the maximum CO_2 up to the point where CO is developed. Modern practice has thus increased the combined efficiency of the boiler unit approximately 10 per cent on the average, largely by an agency separate from the stoker itself, namely, waterback and ledge plates to prevent excess air; but this also is part of modern chain-grate design and construction. In the United States alone several millions of boiler-horsepower are served by this type of stoker, but, in spite of the number of installations, comparatively little has been written on the characteristics of the chain grate and recent developments in this stoker and the furnace serving it.

In early chain-grate practice it was impossible to keep the fuel bed at the rear of the stoker as dense as at the front. This was obviously wrong as large volumes of excess air infiltrated through the thin fuel bed at the rear. The introduction of the waterback improved operating conditions. When properly set it permits compression of the fuel bed and makes it possible to obtain the desired density at the rear of the grate. To a certain extent this is under the control of the operator. Excess air around the rear of the grate is eliminated and special plates shut it off at the sides, so that 13 to 16 per cent of CO_2 is not unusual. Waterbacks also help in retaining the coke and in reducing the combustible in the refuse to a lower percentage than was possible with the early installations that did not have this equipment.

In some quarters the opinion has prevailed that boiler operation appreciably below normal rating means low efficiency. The basis for this opinion probably is due to experience in hand-fired practice, where it is difficult to carry a thin light fire and keep it free from holes and excess air. It perhaps is not generally appreciated that chain grates do carry light loads efficiently. In fact, with furnaces of limited design, the economy is better than can be obtained from these same limited furnaces at the higher rates of combustion.

Ratings below normal have not claimed the interest of combustion engineers, owing to the desire to obtain high overloads, so that test data for the most part relate to operation above rating. If a stoker cannot be operated efficiently at low ratings, it is a serious drawback where light loads occur for extended periods. To show what may be accomplished in this direction the accompanying table is presented. It gives results from one type of chain grate under several types of boilers.

It is not sufficient to remark that the chain grate will develop high efficiencies at low ratings. The cause is the interesting item. For the burning of high volatile coals most furnaces have been designed with insufficient volume for the combustion of the gases. Usually the furnace has from one-fifth to one-tenth of the volume needed. The average chain-grate installation in the United States has been designed and provided with draft to burn 25 lb. to 40 lb. of coal per square foot (122 kg. to 195 kg. per sq.m.) of grate area per hour,

CHAIN-GRATE EFFICIENCIES AT LOW RATING

Type of Boiler	Coal Burned per Sq. Ft. per Hr., Lb.	Furnace Draft, In. of Water	Per Cent. Rating	Combined Efficiency
Edge Moor	16.88	0.16	113	81.9
Stirling	16.50	0.09	107	78.3
Stirling	14.40	0.10	91	77.4
B. & W.	7.90	0.03	57	78.4
Geary	20.00	0.18	105	77.5

with a furnace volume capable of obtaining complete combustion from only about 10 lb. (41 kg.) of coal.

In Europe, where there are a great many chain-grate installations, the practice follows the idea of large grate area and low combustion rates. Normal loads are carried with combustion rates of from 10 lb. to 15 lb. per square foot (49 kg. to 73 kg. per sq.m.) of grate area per hour, while peaks are carried with combustion rates of two to three times this amount in this country. Naturally the efficiency of combustion, or true furnace efficiency, is superior to that obtained over a higher range of combustion rates, and since efficient boilers and economizers have been developed also in Europe, there is little wonder that over-all efficiencies are high. Low combustion rates permit complete combustion of the gases in the furnace without the usual 5 to 15 per cent hydrocarbon, or so-called unaccounted for, loss.

SUFFICIENT COMBUSTION SPACE NEEDED

By the same reasoning it is evident that if furnaces are designed with volumes great enough to permit the complete burning of the gases at high ratings, high efficiencies will also be obtained at high ratings. With furnaces having a combustion space of 10 cu.ft. to 24 cu.ft. per square foot (2.15 cu.m. to 7.25 cu.m. per sq.m.) of grate area, chain grates are developing combined efficiencies of from 70 to 80 per cent, which decrease only as the efficiency of heat absorption of the boiler decreases.

In the earlier chain-grate installations it was difficult to obtain as high as 12 per cent CO_2 on account of the thin fuel bed at the rear, and the efficiency was actually higher if lower CO_2 of about 10 per cent was carried. This is direct evidence of insufficient furnace volume.

By providing sufficient combustion space per unit of grate area and guarding against excess at the rear it has thus been possible to increase substantially the efficiency of the boiler unit. Other well-known characteristics of chain grates are continuous ash discharge, minimum clinker, ability to burn low-grade coals and lignites, cleanliness of the grate surface, low labor requirements, and the fact that power for auxiliaries is less than one-half of 1 per cent of that developed. The chain grate covers an important field in combustion service, and it is certain that by a study of the stoker, the furnace and the heat absorber separately there is opportunity for considerable improvement in operating efficiencies.

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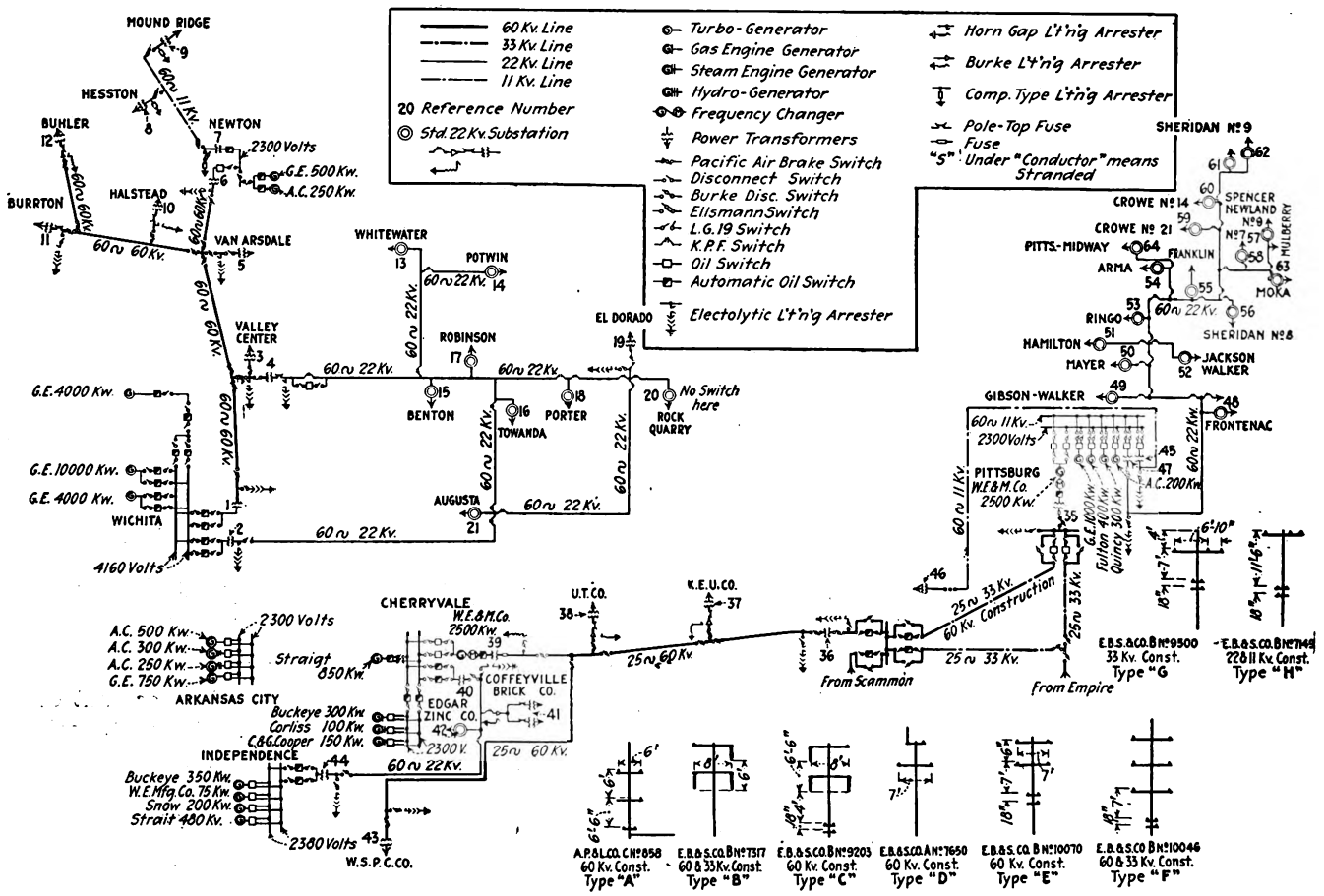
SOUTHWESTERN COMPANIES WILL EXCHANGE POWER

Kansas Gas & Electric Company of Wichita and Empire District Electric Company of Joplin Have Completed Arrangements for Interconnection

CONSTRUCTION has now been completed so that power in amounts up to 10,000 kw. can be exchanged between the Kansas Gas & Electric Company of Wichita, Kan., and the Empire District Electric Company of Joplin, Mo. It is not intended that power in such large quantities will be transmitted from Joplin to Wichita or from Wichita to Joplin, as there is still an open link in the system between Wichita and Independence. The arrangement is made to provide power to .that productive section of eastern Kansas which lies between Wichita and Joplin, centering around the towns of Independence, Cherokee, Cherryvale, Coffeyville, Parsons and Pittsburg. The importance of this territory has been emphasized by war conditions, since it is a region which produces large quantities of oil and coal. The extent of the territory between the cities of Wichita and Joplin can be better appreciated when it is understood that the interconnecting system, if laid down in other sections of the country, would cover the territory between New York City and Reading, Pa., or between Montgomery, Ala., and Meridian, Miss., or between San Francisco, Cal., and Fresno, Cal., or between Minneapolis, Minn., and Mason City, Iowa, or between Columbus, Ohio, and Muncie, Ind.

The problem has been further complicated by the fact that the system of the Kansas Gas & Electric Company operates at 60 cycles while that of the Empire District Electric Company operates at 25 cycles. In the carrying out of this plan duplicate lines have been built from the system of the Empire District Electric Company to a switching station at Cherokee and duplicate lines have been built from this switching station to the city of Pittsburg. These duplicate three-phase lines operate at 33,000 volts and 25 cycles. At Cherokee an outdoor substation consisting of three 2000-kva. transformers has been constructed to step up the energy from 33,000 volts to 66,000 volts for transmission at 25 cycles to the cities of Cherryvale, Parsons and Independence. Three frequency-changer installations have been completed, and through these the two systems are synchronized. The frequency-changer installations at Pittsburg and Cherryvale are each rated at 2500 kw., while the one at Parsons is rated at 928 kw. The Cherryvale installation is typical of these substations. It consists of three 770-kva. transformers for stepping the potential down to 2400 volts, at which voltage it is delivered to the frequency changers. Part of the energy from this frequency changer is taken to three 600-kw., 24,000-volt, 60-cycle transformers to be stepped up and transmitted to Independence. A rather unusual feature of these installations is that the equipment used in connection with the frequency changers is all manually operated.

While the equipment installed is sufficient to permit the interchange of 10,000 kw., the contract between the two companies is of the sort known as a waste-power contract, so that it is improbable that this amount will be transferred immediately.



ONE-LINE DIAGRAM OF LINES AFFECTED BY INTERCONNECTION

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Notes on Demand Meters

Indicating Demand Meters Are Used for Small Installations, but for Important Industrial Loads Recording or Curve-Drawing Meters Serve Many Purposes—Principles Upon Which Modern Demand Meters Operate

BY H. W. RICHARDSON
General Electric Company

THE increased cost of coal, material and labor has forced upon the central station the necessity for effecting economy as well as increasing rates, particularly to power customers. In the attempt to effect economy there has been an increasing tendency to recognize the justice of the differential rates, which indicates that a measured demand is as essential to-day as the watt-hour basis of charge was years ago. It is the aim of this article to familiarize the reader with various demand meters and their application.

The idea that the cost of energy should be based on a fixed charge, proportional to the investment, as well as a variable charge, proportional to operating expense, is attributed to Hopkinson, and his original paper on the subject is still regarded as a classic.

With the growth of the central-station business it became evident that the maximum demand of some consumers resulted in a far greater burden on the plant than the high energy consumption of others, at good load factor. Thus the differential rates, depending upon the customer's demand, have come into wide use, and it is essential that the principles upon which demand-meter operation depend should be fully understood.

Classification of Demand Meters

There are five classes of demand meters:

(1) Instantaneous demand meters; *e.g.*, indicating ammeters and wattmeters, also curve-drawing ammeters and wattmeters.

(2) Time-lagged demand meters—Wright demand indicator, type "W" watt demand indicator and type "RO" watt-hour demand meters.

(3) Devices limiting the supply of current to a fixed amount of demand—excess indicators, flat-rate controllers and circuit breakers.

(4) Devices which differentiate the kilowatt-hours used with reference to a fixed demand or a fixed period of time; *e.g.*, two rate meters and the excess-demand watt-hour meter.

(5) Interval demand meters. This class is subdivided further into three types: (a) Predetermined time-interval-indicating meters; *e.g.*, fifteen, thirty or sixty minutes without showing when the maximum occurred; M-4 demand meter. (b) Predetermined-time-interval graphic or curve-drawing devices, recording the demand and showing the time it occurred; *e.g.*, type "G" demand meters, printometer, type "RA" demand watt-hour meter. (c) Predetermining-time-interval recording meter, recording equal blocks of energy in given intervals of time.

This gives a total of sixteen different devices, of which six are now no longer manufactured, or at least only in small quantities.

Indicating ammeters and wattmeters give the current or power only at the instant they are being read. Curve-drawing instruments give a record of all the variations in the load and the time when they occur. As a rule they are expensive; consequently their application is to power plants and large power consumers, but in such cases their use is highly commendable.

The Wright demand indicator is an ampere-hour device and can be used on either direct or alternating current. It indicates the maximum current that has passed through the indicator since the last time it was set.

There are few two-rate metering devices used at the present time. Instead of a two-rate instrument, two ordinary meters are employed, one recording during the period of the low rate, the other during the time of the high rate. A time switch is used for the purpose of throwing one or the other meter into or out of action at the proper time.

Basis for Energy Charges

The accepted principle of demand devices to-day is to integrate the requirements for energy over a definite length of time, usually fifteen or thirty minutes. In other words, *demand is the average kilowatt-hours integrated over a definite interval of time.* If, then, we measure with a watt-hour meter the energy being used and read the meters, say, every thirty minutes, we secure the demand for each thirty-minute period. The maximum demand will be the largest reading we have secured for a thirty-minute period. If the time is fifteen minutes or sixty minutes, the readings are taken accordingly and the highest is the maximum demand.

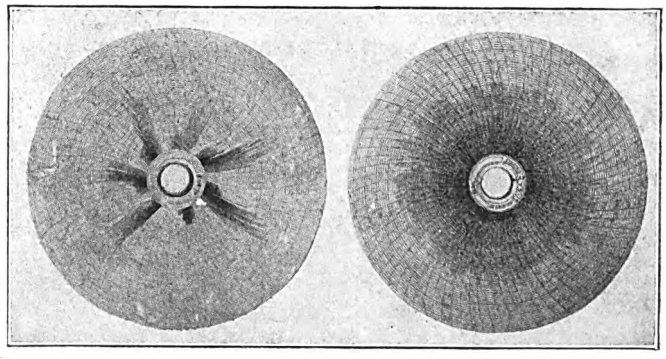

FIG. 1—GRAPHIC DEMAND RECORDS FOR ONE WEEK
At right is shown record of a chemical factory with good load factor. The coal-mine chart, however, has a poor demand characteristic.

The investment of an electric light and power company is for the benefit of all consumers, and the highest

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demand of an individual consumer represents the proportion of the equipment or investment reserved for his use. The use, therefore, of a demand meter in conjunction with a watt-hour meter is held to assist the central station to determine a rate to a customer inversely proportional to his load factor. If the various consumers have a high load factor, it tends to increase the load factor on the station, thus reducing the cost of a unit of electricity.

To illustrate the application of a demand meter to a demand rate, let us take specific figures, for example, $1 per kilowatt of demand and 5 cents per kilowatt-hour. Let us further assume two customers with the same maximum demand, 3 kw., the first consuming 300 kw.-hr., the second 600 kw.-hr. The bill for the first one will be 3 kw.-hr. × $1 = $3, plus 300 kw.-hr. at 5 cents = $15, making a total bill of $18. This is at an apparent rate of 6 cents per kilowatt-hour. The bill for the second customer will be 3 kw. × $1 = $3, plus 600 kw.-hr. × 5 cents = $30, making a total of $33. This is an apparent rate of 5½ cents per kilowatt-hour. Thus the second customer pays the lower rate per kilowatt-hour for energy because his consumption is greater in proportion to his demand.

The demand rate tends to arrive fairly close to the value of the service to the various classes of consumers and closely approaches the larger customers' costs when serving themselves, thereby fixing the value as well as the cost of service.

Non-Recording Types Commonly Used

It will be evident that a demand meter of the indicating type may be applied to those consumers who have an appreciable demand but whose individual load is not sufficiently large to produce a marked effect on the main power plant; that is, it is unnecessary to have a record of the time when the maximum demand occurred.

When it becomes desirable to know the time that the demand occurred, a recording meter provides a graphic record not only of the one highest demand, but also the demand for each fifteen or thirty minutes' interval, the time of day it occurred and the day of the week.

The type "RO" demand meter is a device in which the time interval is secured by delaying or lagging the operation of the mechanism. The watt-hour meter and the demand meter are assembled together under one cover. In the air gap of the electromagnet element of the watt-hour meter there are two disks, one the regular watt-hour meter disk which registers the kilowatt-hours in the usual manner; the second mounted on a rotatable shaft but limited in its movement by a spiral control spring, thus making this second disk virtually an indicating wattmeter. The indicating-wattmeter element tends to advance the demand needle through proper gearing, but is retarded by an escapement (similar to that in a clock) which is actuated by the revolutions of the watt-hour disk. The load on the watt-hour meter will therefore determine the speed at which the escapement will allow the indicating watt-meter disk to move the demand-meter needle up the scale. If the load is steady during the definite time interval, this arrangement permits the indicating-wattmeter element to reach its final and correct position. For example, if the load is 500 watts on a 10-amp., 100-volt, thirty-minute-interval meter, the indicating-wattmeter element will move the demand needle to its final position of 500 watts in thirty minutes. If the load is 1000 watts, the needle will have to move twice as far, but since the watt-hour-meter disk is also running twice as fast, the escapement is operating twice as fast; hence the demand needle is permitted to reach its final position of 1000 watts in the same time as was the case with the 500-watt load.

Time-interval demand meters are designed to operate at a predetermined length of time. The demand meter itself is either electrically or mechanically connected to the watt-hour meter. We know that each revolution of a watt-hour-meter disk equals a certain number of watt-hours. Mounted in the meter or on the register is a set of contacts, so that with every few revolutions of the meter disk contact is made and then broken. The contacts are connected by wires to an electric magnet in the demand meter and to a battery or other source of electric energy, so that every time contact is made the magnet pulls an armature or lever and then through a pawl and ratchet moves a needle over a scale one division at a time; that is, one division for each contact. At the end of the time interval—say thirty minutes—the needle will have moved a certain distance, *i.e.*, proportional to the average kilowatt load during the thirty minutes. If the load on the meter

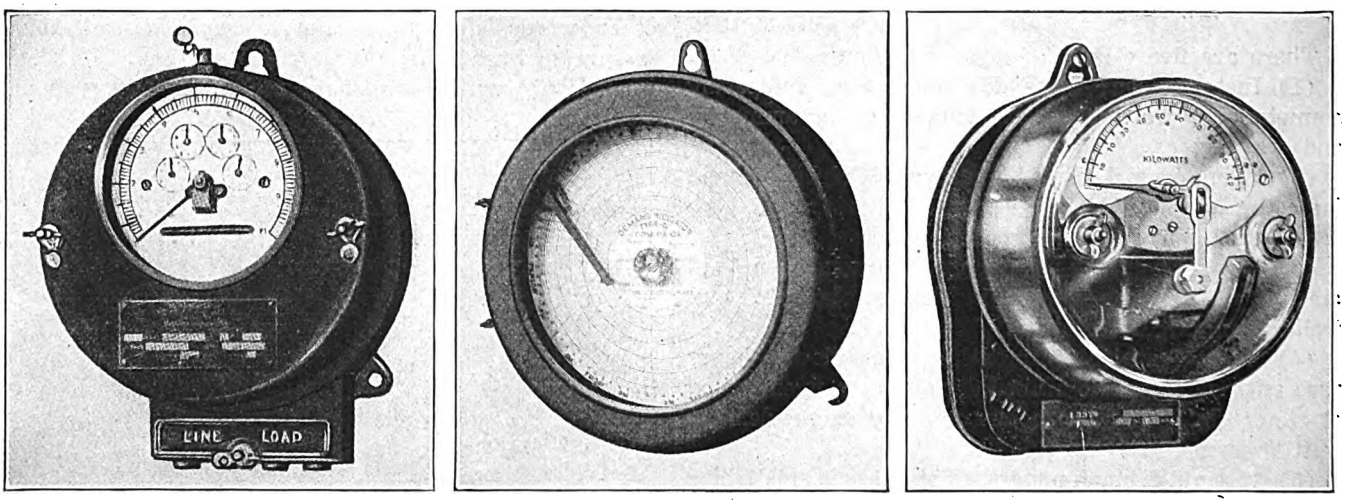

FIG. 2—INDICATING AND RECORDING (CENTER) TYPES OF DEMAND METERS

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is small the contacts will not be made very often and the needle will move but a short distance, but if the load is heavy the contacts will be made frequently (with full load on the meter approximately eighty or ninety contacts during the time interval) and the needle will move quite a distance up the scale. The demand has now been measured and the scale can be calibrated to read directly the kilowatt demand. A clock or constant-speed motor is employed in connection with the demand meter, and at the end of the time interval—*e.g.*, thirty minutes—it trips back to zero the mechanism that is pushing the demand needle, and thus the needle is left indicating the demand. After returning to zero the mechanism again starts, and if during this interval the load is less than the previous interval the needle will not be moved, but if the load is greater the needle will finally be reached by the mechanism and be pushed forward to a new and higher reading.

This is the principle of the type "M-4" demand meter. It does not record the time of day when the demand occurred, simply the single maximum demand since it was last read. It is applicable to small or moderately large lighting and power installations, and if a record of the time of demand is not desired it can be used for larger loads. This type can be used with any capacity or make of watt-hour meter and can be calibrated to read directly in kilowatt demand.

Recording Types Described

The type "G" is connected by wires to the watt-hour meter and operated from the same type of contact device as the "M-4." Each time contact is made a pen or stylus in the demand meter moves up one division. There is a clock to drive the recording chart; it also returns the stylus to zero at the end of each time interval. The chart is made of a special wax-coated paper on which the stylus leaves a permanent legible line, the length of which is proportioned to the demand for that time interval, the longest lines being a measure of the highest demands. The chart has an evenly divided scale, and by reading the length of the line the demand is obtained. An eight-day clock drives the chart and also trips back the stylus to zero at the end of each time interval. The type "G" shows the time of day and day of the week upon which the demand occurred, as well as the demand for each interval of time. It is intended for loads where the time of demand should be known. Like the "M-4," it can be used with any capacity and make of watt-hour meter. It is made front-connected or back-connected, also in portable form for testing.

The type "RA" comprises a 5-amp., 110-, 220- or 440-volt polyphase watt-hour meter, together with a roll-chart graphic demand meter mounted on a single base and under one cover. The recording "V" pen is driven by the watt-hour meter through gearing and draws an ink line, the length of the line being proportioned to the demand. At the end of the time interval a fifteen-day clock which drives the chart trips the pen, allowing it to return to zero. The chart has an evenly divided scale, and thus the length of the line shows the demand. A 1.5-kw. and a 3-kw. chart are used on the 5-amp., 110-volt, and the 220-volt watt-hour meters respectively, thus allowing for 50 per cent overload. If used with instrument transformers, it is therefore necessary to multiply the reading by the ratio of the transformers.

The type "P" demand meter, or printometer, prints in plain figures on a continuous paper tape the kilowatt-hours registered by the watt-hour meter during a given interval. It also prints the time of day in a column parallel to that showing the various amounts of energy consumed. A contact-making eight-day clock causes the record to be printed at predetermined intervals. The printometer mechanism comprises a cyclometer counter operated by a plunger and a solenoid from a set of contacts on the watt-hour-meter register. A star and pin-wheel arrangement permits adjustments of the time interval for printing at five, ten, fifteen, twenty, thirty or sixty minutes. The clock is good for only one time interval; it must be changed if the time interval is changed.

Very often on large switchboards it is desirable to have all printometers print at the same instant. The contacts on the clock are not designed for heavy current; hence a relay is operated by one clock, causing all the printometers to print simultaneously.

Advantages of Using Demand Meters

Some of the uses of demand meters have already been enumerated, nevertheless it is well worth while to investigate further their advantages, as follows:

(1) A customer can readily make changes in the apparatus installed without the annoyance of notifying the power company, as the demand will be readily ascertained.

(2) Frequent inspection of the customer's premises is unnecessary when the demand is measured.

(3) The record obtained will tell when investigations should be made.

(4) The demand meter is a definite guide to the size of power transformer to use to secure the best efficiency.

(5) The customer need not hesitate to add to his installation as he requires, as only the power used simultaneously by such apparatus in actual use will be measured.

(6) From the records of the types "G," "RA" and "P" not only the single maximum but two, three or more next highest demands may be used for billing, dependent upon the schedule of rates in use.

(7) The types "G" and "RA" give directly the load curve not only for each day but also for the week.

(8) From the paper-tape record of the printometer the energy used between different periods of the day or week can be obtained as well as the maximum demand and the time it occurred.

(9) From the records a central station is enabled to know constantly all the vital conditions and hence the cost of supplying a customer or any number of customers.

(10) It is possible to check the schedule of rates or to establish a new one and thus insure additional contracts or the installation of other energy-consuming devices.

(11) Knowing the maximum demand and the kilowatt-hour consumption, the load factor can be easily obtained.

(12) By comparing the sum of the maximum demands of various consumers connected to a transformer

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or substation to the maximum demand at the transformer or substation the diversity factor is secured. This information bears a vital relation to the investment and proper sizes of transformers, feeders, substations, etc.

(13) With a graphic or printed record it is possible to regulate the use of "off-peak" power, determine the use of break-down services, investigate complaints, make special tests of power conditions and assist new-business departments.

(14) Recording-demand meters and printometers are used for data on generators. Using one on each generator will show the time of greatest demand and the coincident demand of all the generators in the station or on the system, thus permitting only the operation of such equipment as is actually needed.

(15) Department stores and industrial plants can use demand meters to determine the cost of supplying energy to various departments, elevators, charging vehicles, etc.

(16) Large hotels can obtain data that will simplify their accounting and prevent errors in estimates for special functions that might otherwise result in loss.

(17) Operators of office buildings will find demand meters useful in checking the demand for energy by various tenants, for elevators, corridor lighting, ventilating systems, vacuum cleaning systems, etc.

(18) The applications and use of demand meters are easily understood.

(19) Their use enables the consumer to pay his share of the yearly fixed charges in monthly installments, proportional to his monthly demand, while the watt-hour meter tells the proportionate cost plus profits based on the actual energy used.

(20) Central stations adopting measured demand generally use indicating demand meters on power or lighting customers of from 10 kw. or 20 kw. to 100 kw. or 200 kw. and recording demand meters above 100 kw. or 200 kw. Portable recording demand meters can first be installed for the moderate-sized customers for a week or month, and the various demands for various days and periods of the day, also the characteristic cycles of operations, can be obtained; then an indicating demand meter may be permanently installed for billing purposes.

When a recording demand meter is installed the interpretation of its record as applied to factory output can be explained to the consumer. Often the consumer will note that during certain periods of the day the demand for electric power is rather low, thus indicating that the production of his factory may possibly be increased. Further investigation of his factory methods and processes will undoubtedly prove this, and the output can be materially augmented without necessarily increasing the maximum demand. This will aid in increasing the load factor; thus a recording demand meter may often serve as a means of firmly establishing friendly relations with power consumers.

Flat rates became obsolete years ago and were superseded by the watt-hour meter as a basis of measuring the amount of power and the length of time used. Estimating a consumer's demand at 55, 65 or 75 per cent of the connected load is not unlike selling energy on a flat-rate basis.

The value of measured demand to a central station versus the estimated demand is clearly illustrated by actual cases shown in the following tabulation:

Estimated Demand in Kw.	Actual Demand in Kw.	Net Gain for One Month	Estimated Annual Gain Based on This One Month Billing
22	25.9	$10.60	$127.30
25	30.7	15.45	185.40
45	82	105.00	1,260.60
53	169	176.45	2,117.30
60	100	90.70	1,088.60
60	168	212.70	2,552.80
65	72	14.80	177.40
65	90	32.40	388.60
100	144	197	2,360.90
100	226	113.50	1,362.20
100	360	220.20	2,642.20
178	336	203.60	2,443.00
236	382	322.10	3,865.00
Total		$1,714.25	$20,571.30

A loss of $1,714.25 in one month on thirteen customers is not to be passed over casually by the central station. These customers were not paying for all the demand they used when the demand was estimated. Some other consumers must have been making up the difference.

AIRPLANE DIRECTION FINDER A DEVELOPMENT OF THE WAR

Major-General Squier Describes How by the Use of Antenna Coils and an Amplifier a Practical Compass Has Been Devised

In his recent lecture before the American Institute of Electrical Engineers at New York Major-Gen. G. O. Squier, in connection with his description of the war's developments in radio apparatus, already reprinted in the ELECTRICAL WORLD, spoke as follows concerning the problem of aërial navigation:

"One of the principal problems of airplane navigation has been the evolution of a suitable compass, particularly for night bombing work. Magnetic and gyroscopic compasses have limitations at present which make impossible reliable air navigation by dead reckoning.

"The use of directional effects of loops or coils for receiving radio signals has resulted in the development of a radio compass for airplanes which gives positive information to the aërial navigator and enables him either to locate his position by triangulation with respect to two beacon land stations or to fly at any given angle with respect to a certain beacon station.

"The apparatus consists of two principal parts—the antenna coils and the tuning and amplifying apparatus. The antenna coils are mounted in the fuselage of the Handley-Page airplane, with suitable means for rotating in azimuth. The amplifier is extremely sensitive, consisting of a detector and six-stage amplifier. A novel feature of the amplifier is the use of iron-core transformers for frequencies of 100,000 cycles.

"The direction of the beacon land radio station is determined by maximum strength of signals, in a highly ingenious maner developed originally by the British. The precision of the directional effect is remarkable. In fact, the radio direction finder may well be called a radio eye, by which the aërial navigator sees one or more radio lighthouses which are sending identifying signals to guide him on his way. These lighthouses, furthermore, have certain advantages over the normal lighthouse in that their ranges may be much greater and they are not invisible in the daytime nor obscured by fog and mist."

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Making a Market for the Central Stations

Basic Principles of Industrial Power Consumption in the New England States—Suggested Means to Increase the Field of Operation of the Central Stations by a Policy of Developing the Industrial Resources of Each Territory

BY L. W. ALWYN-SCHMIDT

DURING the last few years great changes have taken place in the industrial life of the United States. Possibly no industry has been more affected by these changes than the central stations, and it is therefore not surprising that already farseeing central-station managers are wondering what the outcome of these changes will be. There is no doubt that more industrial disorganization must follow. The question is, how far will the industry of the United States be affected by the unavoidable reorientation, and what will be the position of the central stations?

The central stations to-day are better fitted to meet the exigencies of the situation than at any time since the existence of the electrical power industry. Organization methods have been improved. The statistical material supplied by the United States Census Bureau and other organizations has nearly reached perfection. Finally, coöperation between all those interested in public welfare has gained life and has already borne its results in the form of community boosting on a large scale.

The problem facing the central-station manager to-day is, in short, whether there will be changes in the industrial activity of his territory leading to corresponding changes in the demand for power. What can be done to meet such a possibility? What methods can be employed (1) to avoid a sudden decline, (2) to vitalize permanently the sale of power in a given territory?

The answer to these questions is that the chances of a disorganization of the power sales in a given territory depend upon the industrial composition of the sales territory. There is a possibility of preventing a decline in the power sales by attracting new industries to the neighborhood which will add to the consumption of power, and of vitalizing the sales permanently by giving preference to such industries as give promise of fair prosperity and therefore permanence.

The New England States at present are served by 369 central stations, of which there are 82 in Maine, 57 in New Hampshire, 59 in Vermont, 120 in Massachusetts, 11 in Rhode Island and 40 in Connecticut. The industries of these states in 1909 consumed 218,642 hp. of purchased electric power and 419,197 hp. in 1914, and of all electric power, manufactured and purchased, 663,143 hp. in 1909 and 1,107,677 hp. in 1914. Distributed over the individual states progress in power consumption has been as follows:

	All Power		Electric Bought		All Electric	
	1909 Hp.	1914 Hp.	1909 Hp.	1914 Hp.	1909 Hp.	1914 Hp.
New Hampshire	293,991	344,093	21,209	49,171	45,351	102,612
Maine	459,599	487,211	27,203	46,344	54,266	107,700
Vermont	159,445	173,937	12,917	27,477	21,233	47,161
Massachusetts	1,175,071	1,369,722	109,996	200,339	402,492	582,971
Rhode Island	226,740	269,854	13,697	31,572	42,130	91,229
Connecticut	400,275	453,812	33,620	64,294	97,671	176,009

The industrial activities of the New England States are of a very varied character. Of all the shoes made in the United States 43.2 per cent are manufactured in Massachusetts and 7.9 per cent in New Hampshire. Massachusetts also leads the states of the Union in the manufacture of rubber boots and shoes. Nearly half of the brass, bronze and copper products of this country are made in Connecticut. Connecticut also leads the United States in the making of clocks and of corsets. Of cutlery and edge tools, 28.8 per cent come from Connecticut and 17 per cent from Massachusetts. In textiles Massachusetts and Rhode Island have been the pioneer states. The hat industry is an important industry of Connecticut. Although Massachusetts is using probably half of all the leather tanned in the United States, the state takes only second place as a producer of leather and depends on other states for nearly 70 per cent of its consumption. About two-thirds of all the needles and pins made in the United States are of Connecticut manufacture. Connecticut also takes the leading position in the manufacture of plated ware. Paper and paper stock are manufactured in large quantities in Massachusetts, Maine and New Hampshire. Massachusetts is the third among the states producing rubber goods, and Connecticut takes the same position as a producer of silk goods.

THE MUNITIONS INDUSTRY

In 1914 62 per cent of all the firearms and munitions made in this country were manufactured in Connecticut. Owing to the enormous impetus which this branch of the industry gained during the war speculation as to its further value as a power consumer has been very active. Before the war munitions factories purchased about 25 per cent of their total power requirements from the central stations and generated themselves more than three times as much. After the beginning of the war the proportion changed in favor of the central stations. In Connecticut many new plants have been erected, the great majority of which were merely the extension of existing enterprises. With the end of the war there will, of course, be a contraction in operations, with resulting loss of custom to the central stations from this direction.

The boot and shoe industry felt the vitalizing influence of the war trade. Brockton and Lynn, each with nearly $50,000,000 worth of shoes annually to its credit, Haverhill and Boston are the leading shoe centers in Massachusetts. Manchester, N. H., takes the fifth place. The boot and shoe industry of New England is on an average good for 20,000 hp. of purchased electric power and has increased its requirements very much during the last four years. It is an industry which can easily "lay off" part of its machinery, and a reduction in orders for shoes, therefore, immediately results in a re-

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duction of power consumption. Since the outbreak of the war the boot manufacturers of New England have sent out of the country yearly about 3,000,000 pairs of boots above their normal foreign sales. In addition, considerable orders for boots and shoes have been placed by the government. It is likely that not all of this trade will continue.

As the third of the industries of New England affected extensively by the war the textile industry must be mentioned. It is an industry which, while consuming great quantities of electric power, still produces much of it for itself. The great number of operatives incidental to textile manufacture, however, makes districts containing textile mills a valuable territory. The growth of the industry cannot therefore be a matter of indifference to the central station. This is especially the case with cities like New Bedford and Fall River, Mass., where the annual production of cotton goods in each case is valued at more than $50,000,000. Lowell has a cotton goods production of $23,000,000 a year, and in Rhode Island Pawtucket and Warwick are the fifth and sixth among the cotton-goods centers of the United States.

The central stations of New England may now have to face a decline in power demand from these three industries and those allied with them. How far this decline will go is difficult to say. It will be counterbalanced by natural increases in other industrial branches. The New England States possess many industries which have been affected only indirectly by the fluctuations of war business. Cutlery, rubber goods, jewelry, clocks, hats, needles, pins and corsets are all articles which are in continuous demand and the sale of which has not been raised artificially by the unnatural conditions.

Of the industries under discussion the boot and shoe industry uses about 33 per cent of the power it consumes in the form of purchased electricity. The cotton-goods industry is taking only 15 per cent of its total power consumption from the central stations. Foundries and machine shops are taking about 39 per cent, the rubber industry takes 16 per cent and the lumber industry but 5 per cent. Other good central-station industries are the automobile industry, taking about 58 per cent of its total power from the central stations; the paper-box industry, with 39 per cent; the cement industry, with 33 per cent, and the carriage-building industry, with 29 per cent. Electrical machinery takes 32 per cent, and the clothing industry takes 80 per cent or more of its total power requirements from the stations. The glass industry, which in future may play a considerable part in the industries of New England, takes about 8 per cent, the tanning industry 12 per cent, the mineral-water industry 43 per cent. Much stress has been laid on the development of the chemical industry of this country caused by the war, and the New England States seem to offer many advantages for the building up of new chemical plants. The much heralded dyestuff industry, however, so far has taken only 3 per cent of its total power requirements from the central stations. The cutlery industry, so highly developed in Connecticut, and the jewelry industry of Rhode Island are customers of medium importance.

Of more importance to the central station, however, than the growth of already existing industries is the question how to establish new industries and to make such industries prosperous so that they will remain steady customers and attract others of the same class.

The great clay deposits of Maine, already used extensively for the making of bricks and tiles, may open sources of raw materials for the pottery industry of this country, and the large quantities of low-grade lumber formerly lost to the state form to-day a valuable raw material for the paper industry. In a report on the lumber industry issued by the United States Department of Agriculture a series of other industries are named as likely consumers of wood of the cheaper kind. These are the making of fiber board and cellulose fabrics, the production of wood alcohol and acetate of lime from hard woods and of ethyl and grain alcohol from practically all woods, the manufacture of producer gas, and the distillation of naval stores, tanning and tar products. All these are industries which must be established near the raw material they consume, and they are, like most of the chemical industries, appreciative users of electrical power.

As in Maine, the woods of New Hampshire may offer an attraction to many industries now developed only incompletely in that state or absolutely new. The textile industry, however, and the shoe industry may bring the greatest addition to the power consumers in future.

The principal wealth of Vermont consists in its quarries for marble, granite and asbestos, and the great advance made by the stone industry during the last years shows that it has not yet lost its attractions to the investor.

All the New England States seem to offer excellent opportunities for the introduction of a toy industry on a large scale. The toy industry, to be successful, must find surroundings highly developed industrially. Saxony and Thuringia, where the toy industry is at home in Germany, and Bohemia are crowded with industrial enterprises of all descriptions. The reason for this is that probably no other industry requires so much the assistance of auxiliary industries. The lumber, the iron, the textile, the paper, the stone and many other industries must coöperate to make a successful toy industry. Also there must be cheap power, preferably electrical, as this can be had in small units. All this can be found in the New England States. Vermont and Maine would supply the cheap wood, Connecticut the iron and hardware, Massachusetts the textiles, and Vermont the stone. In fact, there is hardly a material needed for toymaking which cannot be secured in the immediate neighborhood if such an industry should be established in the New England States.

One of the principal attractions of Massachusetts is its excellent means of communication. With a network of railroads and tramways it is easy to draw labor to any district where it is wanted, even if it cannot be housed in the immediate neighborhood of the factory.

For the present the best prospects or securing a sound development of the demand for electrical power in the New England States seem to lie in a judicious development of all those industries which have been only indirectly affected by the recent industrial advance and which promise to prosper as a result of returning peace, also in attracting such new industries as those to which reference has been made.

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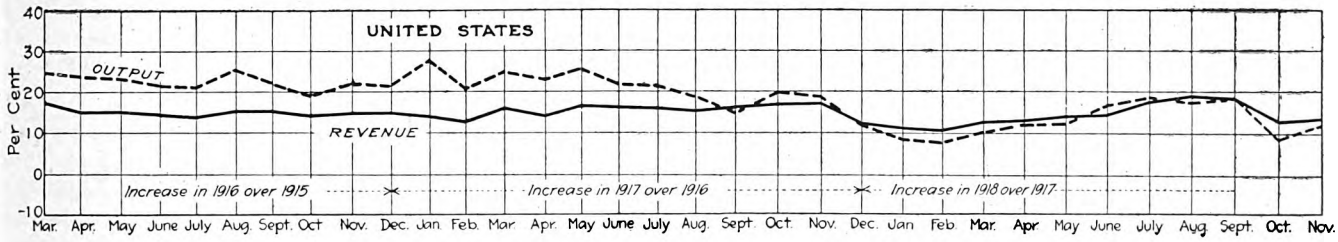
Central Station November Operations



HEALTHY GAINS WERE SHOWN IN THE ARMISTICE MONTH

FROM the reports of central-station operations in November, 1918, received by the ELECTRICAL WORLD, it appears that the sudden signing of the armistice in that month caused no appreciable change in the volume of output or revenue. The returns received from the proportion of the industry which was reported up to this date—47 per cent—indicate a gain in revenue of 13.7 per cent over November, 1917, and in kilowatt-hour output of 12.4 per cent. These figures are not far from the level of increase reported for October. They are better, in fact, for the proportion of the industry reported. On the face of the partial returns November therefore showed a closer approach to the relatively high gains of August and September than did the October statistics.

The general situation probably is that both October and November returns were affected by the growing disorganization of normal industry which characterized the closing weeks of the war. Industries which did not contribute resources to the winning of the war were reaching the end of their stocks of materials without hope of replenishment, and the news of the armistice came so abruptly that cancellations could not reach a sufficiently large volume to affect materially the output of factories and therefore the consumption of electrical energy. December returns will present the conditions in the first full month of arrested war preparations. For eleven months of 1918 increase in revenue as compared with 1917 ranged from 8.2 to 18.5 per cent; in output from 6.5 to 18.5 per cent.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1917	1916	Per Cent Increase	1917	1916	Per Cent Increase
Dec..	58	$28,144,000	$25,026,000	12.4	1,517,001,000	1,362,299,000	11.0
		1918	1917		1918	1917	
Jan..	62	27,035,000	24,977,000	8.2	1,508,353,000	1,422,121,000	6.3
Feb.	60	24,690,000	22,307,000	10.6	1,254,217,000	1,168,288,000	7.1
Mar.	60	25,396,000	22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct..	56	26,254,000	23,228,000	13.0	1,517,866,000	1,392,359,000	9.0
Nov.	47	20,686,000	18,195,000	13.7	1,049,695,000	933,226,000	12.4

Based on the November returns from 47 per cent of the industry, the ELECTRICAL WORLD estimate of operations for the entire industry for that month is: Total revenue, $44,000,000; output, 2,233,400,000 kw.-hr.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and Mountain States		
			1917	1916	Per Cent Increase		1917	1916	Per Cent Increase		1917	1916	Per Cent Increase		1917	1916	Per Cent Increase
REVENUE	Dec.....	64	$3,483,000	$2,999,000	16.1	58	$10,834,000	$9,949,000	8.8	48	$8,935,000	$7,464,000	19.7	82	$4,892,000	$4,614,000	0.6
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan.....	63	3,393,000	2,990,000	13.8	64	9,677,000	9,517,000	1.6	53	8,862,000	7,639,000	16.8	86	5,113,000	4,831,000	5.8
	Feb.....	62	2,995,000	2,272,000	8.0	57	9,473,000	8,658,000	8.6	53	7,779,000	6,746,000	15.3	84	4,443,000	4,131,000	9.5
	March....	62	2,985,000	2,724,000	9.2	59	9,904,000	8,922,000	11.0	53	7,947,000	6,735,000	18.0	84	4,560,000	4,321,000	5.5
	April.....	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May.....	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June.....	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824 000	19.0	84	4,973,000	4,432,000	12.2
	July.....	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug.....	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sep.....	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct.....	63	3,360,000	3,036,000	10.6	51	8,822,000	7,924,000	11.3	50	9,218,000	7,848,000	17.4	81	4,854,000	4,420,000	9.8
	Nov.....	58	3,551,000	3,120,000	13.8	45	8,293,000	7,429,000	11.6	32	4,459,000	3,721,000	19.8	74	4,383 000	3,925,000	11.6
KW.-HR. OUTPUT			1917	1916			1917	1916			1917	1916			1917	1916	
	Dec.....	64	135,703,000	111,342,000	21.8	58	548,316,000	486,368,000	12.7	48	437,264,000	367,534,000	12.8	82	395,518,000	377,058,000	4.8
			1918	1917			1918	1917			1918	1917			1918	1917	
	Jan.....	63	125,212,000	111,339,000	12.4	64	477,200,000	466,158,000	2.3	53	486,291,000	453,009,000	7.3	86	419,651,000	391,624,000	7.3
	Feb.....	62	110,454,000	102,562,000	7.7	57	438,721,000	403,122,000	8.3	53	358,276,000	342,257,000	4.5	84	346,766,000	320,025,000	8.4
	March....	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April.....	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May.....	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June.....	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July.....	62	135,960,000	105,373,000	29.0	62	518,566,000	436,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug.....	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept.....	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct.....	63	139,784,000	128,970,000	8.3	51	481,222,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov.....	58	132.333,000	117,751,000	12.3	45	355,808,000	312,334,000	13.9	32	191,669,000	168,261,000	13.9	74	369,885,000	334,880,000	10.4

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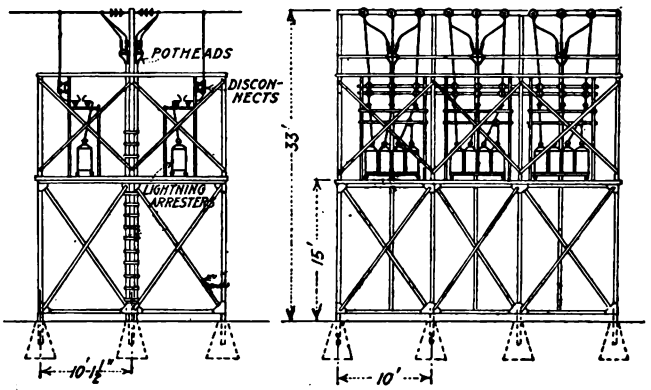
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

STEEL RISER STATION OF PERMANENT DESIGN

Concrete Gallery Floor Supports Arresters and Potheads—Space Provides Protected Junction for Overhead and Underground Systems

There seem to be certain sections of nearly all distribution systems which are commonly built in a more or less temporary manner. On this account the necessity of rebuilding them arises frequently. The natural result is undue expense and unnecessary wasting of materials. Gradually this general fact is being recognized, and steps to combat what appeared to be a growing tendency are being taken. Riser stations between overhead and underground systems are an example



APPARATUS ARRANGEMENT ON STEEL SUBSTATION STRUCTURE

of this class of construction. In some cases, of course, it would be unwise to build a permanent riser station when the trend of growth of the city showed it would have to be moved farther out in a short time. On the other hand, there are instances when good judgment should dictate a permanent installation.

Such an instance recently came to the notice of the Central Illinois Light Company of Peoria. The company took advantage of the situation to build a permanent riser station of concrete and steel for its 13,200-volt lines. It is built on a triangular plot of ground which otherwise would probably remain unused, at a distance of about 1.4 miles (2.25 km.) from the power plant. The site is properly fenced, but as a further protection the live parts of the station are all placed on a floor 15 ft. (4.6 m.) above the ground. The station measures 20.5 ft. wide by 30.25 ft. long by 33 ft. high (6 m. by 9 m. by 10 m.). The framework is entirely of angles, channels and plates. The sections used throughout are comparatively light, but the station carries little weight and is well braced. The supports are set in concrete piers, and the apparatus floor is made of concrete 3 in. (7.6 cm.) thick.

The electrical circuit arrangements are simple, consisting merely of cables brought up from the underground conduit to the top of the station in an iron pipe, where they terminate in disconnecting-type potheads. The overhead lines are dead-ended on strain insulators at the top of the station and are connected to the pothead through open-wire taps. Connections for the aluminum-cell lightning arresters are taken off through disconnecting switches mounted above the arresters on an iron-pipe framework.

Up to the present time only one set of lightning arresters has been installed, but all provisions have been made for others, even to casting the bolts into the concrete floor. It is expected that other 13,200-volt lines which now go to the power house overhead will ultimately go through this station.

1200-HP. MOTOR REPLACES STEAM ENGINE IN ROD MILL

Results in a Saving in Operating Cost and Better Driving Characteristics—Liquid Rheostat Used for Speed Control

A 36-in. by 48-in. (91-cm. by 121-cm.) steam engine which formerly drove a Morgan fourteen-pass continuous-rod mill at the Grand Crossing works of the Interstate Iron & Steel Works, Chicago, has been replaced by a 1200-hp., 360-r.p.m. motor. On overloads the motor will deliver 2000 hp. for one-half hour. In addition to a marked saving in operating costs, this replacement of the steam drive by electric motor drive has made possible a uniform starting torque with starting loads as high as 2000 hp. This is desirable, as formerly the steam engine caused difficulty in starting under load. The simplicity of the induction motor as compared with the steam engine means less trouble of every kind. There is no loss of time caused by stops on center. The possibility of flywheel racing is eliminated as it cannot run above the synchronous speed of the motor. This electric drive has been in successful operation for four months.

The motor is equipped with liquid rheostat control, which provides greater flexibility in this instance than the magnetic type would have afforded. The liquid rheostat control is, moreover, lower in initial cost and maintenance. The rotor leads are brought out to plate terminals in the rheostat. A small motor circulates the electrotype of the rheostat around cooling coils to keep the temperature down.

A desirable feature of this drive is its flexibility. As the speed reduction of the motor to the main drive shaft of the rod mill is four to one, a reducing gear stand is employed, the motor being connected to the spindle of this through a shaft 4½ in. (10 cm.) in diameter. This shaft is made large enough to take the starting torque

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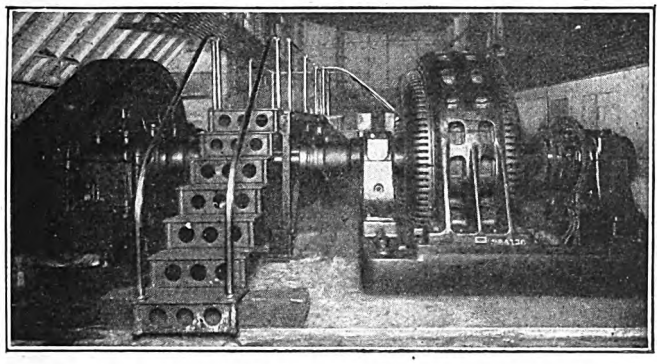
and is also designed to break in case of excessive strain between the motor and driving system, thus protecting the motor and reducing vibration in the slots of the rotor.

The driven gear, which operates at 90 r.p.m. is connected to the crank disk of the former engine by a steel shaft 19 ft. (6 m.) long and 7 in. (18 cm.) in diameter.



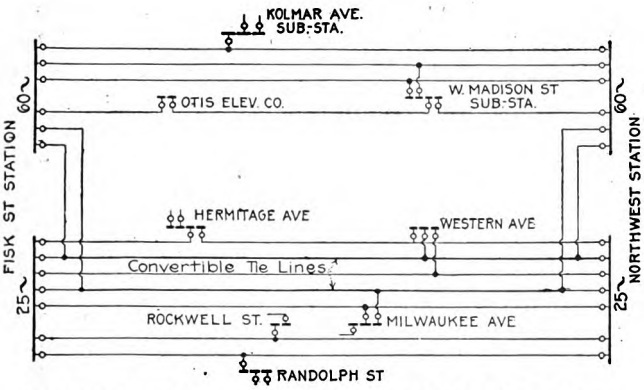
SIMPLICITY AND RELIABILITY FAVOR ELECTRIC DRIVE

This long shaft is necessary to take up the "whip" or torsional strain set up between the 22-ft. (7-m.) flywheel on the main shaft of the mill, which drives the finishing gear trains through a belt, and the large 8-ft. (2-m.) diameter-driven gear in the reducing gear stand.

TIE LINES ARRANGED FOR USE AT TWO FREQUENCIES

To Save Investment in Copper Scheme Is Devised to Permit Operation of Certain Lines on Either 25-Cycle or 60-Cycle System

Between its Northwest and Fisk Street stations the Commonwealth Edison Company of Chicago operates two sets of lines. One group operates at 9000 volts, 25 cycles, and the other at 12,000 volts, 60 cycles. All of the lines are usually loaded at intermediate substations. Ordinarily it would have been the practice to have available spare capacity enough in each group of tie lines to take care of an emergency. The increasing



BY USING TIE LINES INTERCHANGEABLY FOR 25-CYCLE OR 60-CYCLE SERVICE LESS RESERVE CABLE IS NEEDED

price and the scarcity of copper have, however, led to the development of a plant by which one set of spare lines can be used for either the 25-cycle or the 60-cycle system. The scheme is merely one of providing a system of electrical connections and switching interlocks, so that the lines can be switched to either the 25-cycle or the 60-cycle bus but can by no chance become connected to both. The convertible tie lines are normally operated as a part of the Commonwealth Edison's 25-cycle system.

The general layout of the two systems of tie lines between the Northwest station and the Fisk Street station is shown in the diagram. When the convertible lines are switched from the 25-cycle to the 60-cycle system the substation load intermediate between the two stations which they may be serving is then served from other 25-cycle feeders.

While this idea for saving tie-line copper has been discussed here as it pertains to lines between two principal generating stations, it has also been found applicable for lines between a generating station and a substation where the substation carries both 25-cycle and 60-cycle loads, and it might also be worked out for service between two substations.

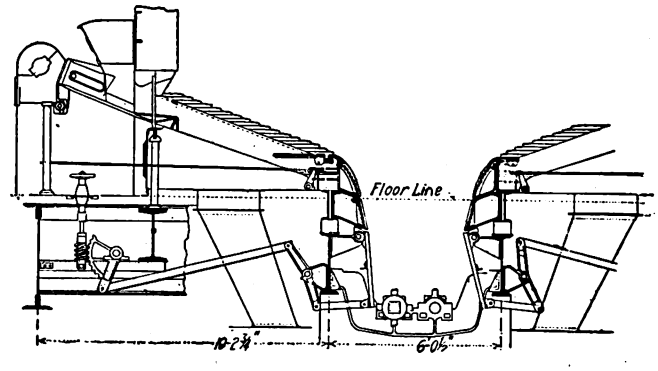
REBUILT ASH DISCHARGE FOR DETROIT FURNACES

Toe of Stoker Is Curved to Eliminate Break in Fire and Special Clinker Grinders Have Been Developed

The Detroit Edison Company's engineers have done a great deal of work in the development of clinker grinders. Considerable difficulty was encountered at first on account of the fact that there was a breaking of the fire where the fuel left the underfeed part of the stoker, going into the ash well. A section of a boiler and stoker equipment installed at the Delray plant of the Detroit Edison Company is shown herewith.

The installation is a 2365-hp. Stirling boiler equipped with a twenty-six-retort underfeed stoker with clinker grinders. It will be noted that the grate surface in the installation, as it now stands, is curved. This construction was adopted in order to eliminate breaks in the fire.

These facts were brought out by J. G. Worker of the Westinghouse Electric & Manufacturing Company before a recent meeting of the station-operating committee of the Ohio Electric Light Association.



BOILER AND STOKER AT DELRAY PLANT OF THE DETROIT EDISON COMPANY

This equipment is ordinarily operated at about 150 per cent of boiler rating, but higher capacities can be obtained when necessary. The coal ordinarily used contains about 13,200 B.t.u. as fired and 10 per cent ash. Under these operating conditions the combustible in the ash runs from 14 per cent to 18 per cent.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PREPARATION OF WOMEN FOR INSPECTION WORK

Owing to Lack of Previous Mechanical Training, It Has Been Found Necessary to Teach Them Only One Operation at a Time

The Consolidated Gas & Electric Company of Baltimore has been training women for inspection work, such as is usually handled by the so-called "troublemen," it is reported by the federal Board for Vocational Education.

The woman worker is sent out with a repair man on the job for about a week. During this time she learns what she can of the conditions which are the chief cause of complaint. After this week of road work she is placed in a class for instruction, three or four women being trained for the work at one time. The class instructor takes up the adjustment of various forms of lighting and heating apparatus, together with such other problems as are encountered in the regular routine of the work. This class instruction continues for about two weeks, at the end of which period the woman resumes her road work. A workman accompanies her about one-half of the day. This time is gradually reduced until after two or three weeks she works alone, except for one hour of the day, when she is accompanied by another workman.

The superintendent of the complaint department states that this type of instruction is essential to give the woman the necessary confidence in herself. He also states that because of the lack of general mchanical information and the opportunity to use tools, he finds it necessary to teach only one operation at a time; that is, he will put the women at the adjustment of lamps first, gradually work them into the adjustment of other appliances, and then into general trouble repairing. The company had eight women in this service on Nov. 1 and considers an increase in the number desirable.

TEACHING EMPLOYEES TO BRING ABOUT GOOD WILL

Hartford Company Issues Set of Instructions Designed to Cause Courteous Treatment of Customers by the Company's Servants

That the customer must be satisfied is coming more and more to be the slogan of electric lighting companies. Evidences of this policy are becoming more frequent. One good example of it is offered in the set of instructions recently issued to the employees of the Hartford Electric Light Company. These instructions, which are printed in the following column, lay special emphasis on the impolicy of wrangling with customers or making promises without being sure that they can be kept.

NOTICE TO EMPLOYEES OF THE HARTFORD ELECTRIC LIGHT COMPANY

This company is operated to sell electricity, and incidentally such other equipment or appliances as will make electricity available. Without customers there would be no Hartford Electric Light Company.

These are simple facts, easily understood. It therefore behooves every man and woman in our employ to remember this always and to see that every customer is treated with courtesy and proper consideration.

See that you do your part to make the customer feel that everybody's business is appreciated, and impress upon him the "no trouble to show you" spirit. When a customer walks in meet him halfway by showing an interest in what he wants or any information he may be seeking.

At rare intervals some perverse member of our force disagrees with some customer as to the rightness of this or that. He maintains that he had no instructions to make a quick connection, when the customer says he had, or that the order was for 60-watt lamps instead of 40-watt, or that this was ordered and not that.

Either may be right.

These are permanent instructions: No employee of the Hartford Electric Light Company is allowed the privilege of arguing the point with the customer. He must adjust the matter at once in a pleasant and satisfactory manner to the customer, or call his superior to adjust it. Wrangling shall have no place in the Hartford Electric Light Company.

The very good reason that our business is successful is that we give good service at reasonable rates and we have the right kind of people to handle the business. Every one from the errand boy to the president of the company is working to give the customer the service he wants.

It is the object of the Hartford Electric Light Company to sell to its customers just what is wanted and give with it the very best of service. Service means the limit of courteous, efficient attention from each particular employee to each particular customer or order. It rests with every employee of this company whether the customer goes away disappointed or pleased. We have a reputation for rendering service which the head of every department is instructed to maintain.

If the customer asks for a quick connection, do not get rid of the matter by answering: "It will be made right away," without knowing or getting information from the proper department whether it is possible to accommodate the customer. Sometimes it is impossible to make the delivery the customer wants, and sometimes no trouble at all when you explain the importance of the delivery to the proper department.

Always remember the customer pays your salary. He is your immediate benefactor.

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DISCONTINUANCE OF FREE FUSE POLICY PROFITABLE

Harrisburg Company Also Expects by Teaching Customers How to Renew Fuses to Increase Energy Consumption

The Harrisburg (Pa.) Light & Power Company states that it is beginning to notice the result of the institution of a charge on fuse plug renewals, reported in the ELECTRICAL WORLD for Nov. 2. A few months ago the company discontinued free renewing of burnt-out fuse plugs and made a charge of 10 cents each for all sizes of plugs and a further charge for time in delivering and installing. The revenue from the sale of fuse plugs now amounts to from $50 to $60 a month, and the income for delivering and installing is quite an item, formerly charged up under the head of "gratuitous service" and lost.

A steady effort is being made to educate the consumer as to how to renew his fuse and to impress upon him that he should be provided with extra plugs and be ready to restore the service promptly whenever a blow-out occurs. This in itself will amount to considerable money in the course of a year in energy consumed during the period when, in the past, the meter stood idle waiting until the troubleman could get around to put it in running order again.

WAR PROVES STRENGTH OF BUDGET AND EXPENSE PLAN

Rapidly Changing Conditions of Recent Years Also Cause Changes in Operating Methods of Chicago Company's Committee

While the budget and expense committee idea as a method of planning and executing operation of central-station properties is not new, this plan as applied to the operation of the Commonwealth Edison Company, Chicago, has withstood the war period so well that it seems appropriate to review some of the facts concerning the company's plan and to point out some of the changes which the war period has made it seem advisable to work into the plan. The budget and expense committee system, as it was originally adopted by and operated by this company, was described in a paper by T. J. Walsh before the Philadelphia convention of the National Electric Light Association in 1914. This paper contained illustrations of the various forms and records employed in keeping data for the committee and also described the method by which each department head received the information necessary to make a scientific study of the particular expenses for which he is held responsible.

Before America entered the war the company was using a budget preparation period of twelve months, but afterward, when it became apparent that conditions in the industry would change with great rapidity, the period for which budgets were prepared was reduced to three months. The belief is now expressed that, since the advantages of using the shorter period have been thoroughly demonstrated, the company will not revert to its former practice. The chief advantage of the shorter period is the greater ease of foreseeing conditions and contingencies that might arise during a period of three months than over a period of twelve months.

Now, as in the past, the tangible work of the budget committee finds expression in its reports on the operation of the company and its departments. These are kept both in tabulated and graphic form. Tabulated data are reduced to unit figures, the units for each department being selected as those which will most accurately portray the changes in the surrounding conditions. Meter department data, for instance, use the number of meters as the basic figure in arriving at unit cost. Likewise the bookkeeping department bases its units on the number of customers. Many of these departmental reports are carefully subdivided to bring out information which will be particularly valuable in determining the correctness of company policies. An instance of this is the detailed information kept on the renewal of incandescent lamps.

The graphical data have a dual use. On these curves the unit figures are plotted in a solid line for the current year. Alongside this curve a broken line shows the similar units for the preceding year. On the margin may be indicated in figures the average unit figure for each of several preceding years.

In scanning these curves the committee not only looks at the current point on the curve but carefully observes the general trend of the graph. This observation is one of the most valuable practices that grow out of this method of operation. If the trend of the curve is upward and if the factors that enter into the formulation of unit figures are within the control of the officers of the company, as would be the case with cost of delivery of lamps and appliances or gratuitious repair of cord and appliances, corrective measures can be and are taken. In fact, action has been taken in this particular instance by instituting a delivery charge and by discontinuing considerable of the gratuitious service which the company had formerly rendered for its patrons.

On the other hand, if the factors controlling the data on which the curve is based are not within the control of the committee, as is the case with the price of coal, an upward trend of the curve can only be taken to indicate that it is necessary to reduce expenses in other quarters or to find methods of increasing the revenue. The committee is just as quick to take under consideration a plan for increasing the revenue of the company as a plan for decreasing the expenses. The topics discussed at its meetings, which are held weekly at a stated hour, range all the way from broad questions of general economics to those of departmental expense.

Taken on the whole, it is thought there are two important things which the employment of a budget and expense committee plan of operation permits a central-station company to do. First, it permits the officers of the company to formulate in advance a more or less accurate and definite idea of what expenses and income will be over a stated period. Second, it is necessary for department heads to plan for their expenditures in advance and to provide estimates of these expenses. Moreover, they strive, on account of company and departmental pride, to limit the expenditures in the operation of their departments to the figures which are shown.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Changing a Direct-Current Machine to a Synchronous Converter.—M. W. SMITH.—The purpose of this paper is to show the relation between a direct-current machine and a synchronous converter, and in a general way to show the possibilities and difficulties in changing a direct-current machine to a synchronous converter. Enough of the principles and relations are shown to allow each particular case and combination of windings to be worked out.—*Electric Journal,* November, 1918.

Connections for Voltage Transformations.—E. G. REED.—Connections used in practice for obtaining various voltage and phase transformations are taken up as follows: (1) Single-phase, (2) three-phase by the various combinations of the star and delta, (3) three-phase open delta, (4) three-phase T, (5) interconnected star. —*Electric Journal,* November, 1918.

Transformers for Electric Welding.—W. S. MOODY.—Transformers for electric welding fall into two distinct classes, those for spot welding and those for arc welding. The main requirements of the first type are the ability to carry exceedingly heavy currents ranging from 50,000 amp. to 75,000 amp. and a compact construction, owing to the fact that the transformer is of necessity an integral part of the welding machine. The very large currents necessary for heavy work and the consequent heating require some artificial means of cooling the windings, and water circulation through hollow conductors is the means generally employed. The arc-welding transformer is required to supply a constant current ranging from 60 amp. to 250 amp. and an open-circuit voltage of from 100 to 150. Some means must be provided for changing the current supply to meet the requirements of the work. Mr. Moody enumerates the service requirements of each type of transformer and describes the construction that has been found best to fulfill these requirements.—*General Electric Review,* December, 1918.

Wave-Shape Standard.—HAROLD S. OSBORNE.—The paper gives a review of the work done during the past three years by a sub-committee of the standards committee of the Institute appointed to make recommendations for changes in the Institute's rule regarding the wave shape of alternators. After a very careful consideration of the question and a large amount of experimental work the sub-committee last spring made recommendations that for the present the 10 per cent deviation rule should be retained without change (except in wording), and that trial use should be made of a supplementary wave-shape factor. The new factor, based on the relation between voltage wave shape and interfering effect in telephone circuits, when power and telephone lines parallel each other, is called the "telephone interference factor." The committee invites the broadest discussion and trial use of the new factor. No attempt will be made to decide upon limiting values of the factor until after wide experience shall have been obtained in its use, and the committee will welcome assistance on the part of any interested in collecting information to this end.—*Proceedings A. I. E. E.,* January, 1919.

Reconnecting Induction Motors.—A. M. DUDLEY.—In this article is discussed the reconnection of the stator winding for a change in the number of poles. The effect on the shape of the magnetic field of changing the throw of the coil is described, and how reconnecting a given winding for different numbers of poles has the same effect as changing the throw of the coil.—*Power,* Jan. 7, 1919.

Changing the Speed of Induction Motors.—GORDON FOX.—It is shown that by rearrangement of the coils induction motors may be adapted to the operation at a considerable variety of speeds.—*Railway Electrical Engineer,* December, 1918.

Lamps and Lighting

Fundamentals of Illumination Design.—J. R. COLVILLE.—This is the first article of a series dealing with illumination design and covers fundamental concepts. It deals particularly with measurement and photometry.—*Central Station,* December, 1918.

A Method of Shipway Illumination.—F. B. WEBER.—The temporary character of the ways and the extreme flexibility required of the illumination make the problem of efficiently lighting shipways one of some difficulty. In this article an effective system as worked out by the Northwest Steel Company of Portland is described.—*Journal of Electricity,* Dec. 1, 1918.

Generation, Transmission and Distribution

Firing of Pulverized Lignite.—M. C. HATCH.—With the extensive lignite fields of the West and Southwest and the scarcity of other coal, any means which may be devised for the economical use of this fuel will be of utmost importance to Western industry. That lignite may be efficiently used in its pulverized state for locomotive and stationary furnaces has been demonstrated both in the Northwest and elsewhere.—*Journal of Electricity,* Dec. 15, 1918.

Lubricating Central-Station Machinery.—NEWTON HARRISON.—Tabulated data are given for the friction coefficient for different loads and lubricants. General methods of lubrication are compared, and the proper lubrication of different machines such as dynamos and motors, steam turbines, etc., is given.—*Central Station,* December, 1918.

Power-Plant Management.—ROBERT JUNE.—This is the fifth article of a series on power-plant management

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devoted particularly to standard practice for hand firing. It deals especially with the maintenance of the proper thickness of fire and the elimination of smoke.—*Central Station*, December, 1918.

Exhaust Steam at High Back Pressures.—CROSBY FIELD.—A system of charts based on thermodynamical formulas and data with reference to boiler pressures and cut-offs.—*Chemical and Metallurgical Engineering*, Jan. 1, 1919.

Properties of Liberty Fuel and Results of Economy Tests.—Liberty fuel, the invention of Captain Weisgerber, consists of kerosene treated chemically with the result that its oxygen content is increased, so that when the fuel is vaporized and admitted to the engine cylinder there is present some of the oxygen needed for the process of combustion. The heat value attributed to this liquid fuel per gallon is 127,900 B.t.u. as compared with 119,200 B.t.u. for commercial gasoline and 112,300 B.t.u. for export gasoline. Curves showing the relative economy of Liberty fuel and export gasoline are presented in this article.—*Power*, Jan. 7, 1919.

What Percentage of CO_2 Can Be Obtained?—Fuel saving urged by the Fuel Administration is difficult, if not impossible, without a knowledge of the percentage of the CO_2 formed. The percentage of CO_2 found in the flue gases from a boiler depends on the efficiency of combustion, but the maximum percentage attainable is governed by the percentage of hydrogen in the fuel.—*Power*, Dec. 31, 1918.

Control of Concentrated Boiler Water Is Essential.—HARTLEY L. SMITH.—The writer states that corrosion and the deposition of scale are due solely to the chemical nature of the water in the drums and tubes. This is totally different from that of the feed water and is not a mere difference of concentration. He discusses the methods used for the control of concentration in boilers, shows how the ratio of concentration from feed water to boiler water is determined, and describes the calculation of boiler concentration control charts.—*Electric Railway Journal*, Dec. 21, 1918.

Traction

Automatic Electrically Driven Water-Station Pumps.—It is shown how a railroad conserves labor and fuel by automatically governing motor and heating apparatus.—*Railway Electrical Engineer*, December, 1918.

Electrical Equipment at the Scranton Shops.—The extensive use of alternating and direct current in operating steam tools and other devices used in the shops of the Delaware, Lackawanna & Western Railroad is described.—*Railway Electrical Engineer*, December, 1918.

Interurban Cuts Power Consumption One-Half.—Revolutionary methods in interurban railway operation and car design involving cutting the weight of the interurban car by one-half indicate new tendencies in the operation of electric railways.—*Electric Traction*, November, 1918.

Installations, Systems and Appliances

Selecting an Arc-Welding Equipment.—J. W. HAM.—A brief summary of the various phases of arc welding that must be taken into consideration when selecting equipment.—*General Electric Review*, December, 1918.

Study of the Joining of Metals.—J. A. CAPP.—The purpose of this article, as stated by the author, is to report an investigation made to determine the best practice in making butt welds by the Thomson electric-welding machine. Three classes of welds were made,namely, (1) with high current applied for a relatively long period, (2) a smaller current applied for a shorter time, and (3) a current just large enough to produce a welding temperature when applied for the minimum length of time. A microscopic study of these welds shows that the degree of excellence is increasing in the order given, the welds made under condition (3), after annealing, being hardly distinguishable from the body of the sample bars made under each of the three different conditions.—*General Electric Review*, December, 1918.

Electric Welding for Shipbuilding.—W. S. ABELL.—The improvements in electric welding have opened up considerable possibilities of its extended application in shipbuilding. It is the author's opinion that until some practical experience on a fairly large scale has been obtained welding should be applied to the structural members of a vessel exceeding 300 ft. (90 m.) in length, but even for smaller vessels there is ample scope for the introduction of this system of construction. It would appear safe to say that for vessels of moderate dimensions the use of electric welding will become exceedingly common, with possibilities of extension to vessels of larger size as experience is gained and further research approaches to perfection in the process of welding. With added experience he holds there is no question that the process will be extended to larger vessels.—London *Electrician*, Nov. 22, 1918.

Industrial Controllers.—H. D. JAMES.—This is the twenty-third number of a series on industrial controllers, this article being devoted particularly to the following protective devices: (1) Overload, (2) low voltage, (3) phase reversal, (4) phase failure, (5) shunt field failure. These devices are taken up in considerable detail.—*Electric Journal*, November, 1918.

Oscillating Phase Advancers.—C. W. KINCAID.—Oscillating phase advancers are used in connection with wound-rotor induction motors to increase the power factor of the current taken from the line by the motor. They are distinguished from other types of phase advancers in that they do not rotate continuously in the same direction but make only a few revolutions in one direction before they reverse and rotate in the opposite direction. The applications of oscillating phase advancers to induction motor practice are explained in this article.—*Electric Journal*, November, 1918.

Electrophysics and Magnetism

Mean Power and Power Factor in a Non-Sinusoidal Alternating-Current Circuit.—H. PÉCHEUX.—The author presents a method of calculation for determining the power factor of a network by the use of oscillographic curves of voltage and current. This method was formerly employed by the author (*Revue Générale de l'Electricité*, Feb. 3, 1918) for the determination of the non-sinusoidal emf. of an alternator.—*Revue Générale de l'Electricité*, Nov. 30, 1918.

Determination of Electric Fields of Insulators by the Electrolytic Method.—W. ESTORFF.—The author describes an electrolytic method which he has used for

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investigating the electric stresses on insulators. The method is based upon the similarity existing between the representation of the lines of the electric field and the lines of current flow in an electrolyte. The equipotential lines between two electrodes are obtained by means of a probe, using a Wheatstone bridge and telephone. Alternating current is employed in order to get rid of polarization effects. The probe forms the tracer of a pantograph arrangement by means of which the equipotential surfaces can be traced out on an enlarged scale. The method is first applied to the examination of a suspension insulator, and, as an example of the utility of the method in aiding the design of insulators, it is shown how the distribution of the field is changed by altering the insulator from (1) a chain of four similar insulators with equal disks to (2) a similar chain but with enlarged end disks, (3) a similar chain but having increased capacity of the end members, and (4) a similar chain combining both modifications (2) and (3). The electric field diagram shows the more equally distributed field obtained by arrangement (2) as compared with (1), but this advantage is obtained at the expense of increased total capacity, which means that a larger number of lines of force terminate on the end plates, and results in diminished dielectric resistance.—*Science Abstracts, Section B,* October, 1918. (Abstracted from *Elektrot. Zeits.,* February, 1918.)

Electrochemistry and Batteries

Cost of Synthetic Nitric Acid in France.—Before the war nitrate of soda cost 24 francs per 100 kg. c.i.f. a European port, or 1.50 francs per kilogram of nitrogen. Although this price doubled during the hostilities, it will probably return with normal conditions. Can France obtain nitric acid from the atmosphere cheaply enough to compete with that imported from Chile? The author says no, if the Birkeland-Eyde process is used, and yes, if a more efficient process or an improvement on the Norwegian method can be employed. During the war much progress in this direction has been made by the French Service de l'A. N. S. (acide nitrique synthétique). Its methods are still secret, but among the lines of work followed is that of the over-oxygenization of the air by the Claude process. In place of the ordinary atmospheric proportions of 21 per cent oxygen and 79 per cent nitrogen, it is possible by this process to employ a mixture with only 72 per cent of nitrogen, corresponding to N_2O_5, which increases the output of the oven 30 per cent, making it possible to obtain from large ovens 780 kg. of nitrogenous acid per kilowatt-year. But even with this result the price of a kilogram of oxygen, with energy at 2 centimes a kilowatt-hour, would be 2.33 francs, or much more than the cost of the Chilean article.—*Journal du Four Electrique,* Dec. 1, 1918.

Electric Steel Furnaces; Utilization of Scrap.—Before the war munitions makers found themselves accumulating large quantities of borings, turnings of high-grade steel which were of comparatively little value although they contained chrome and nickel and other costly elements. The real difficulty was to remelt these scraps without losing their valuable contents. When the munitions works began to make enormous quantities of these turnings it was realized that something should be done to make use of these waste products. It was recognized that by the electrical process it was possible to remelt without losing a large percentage of the alloying metals. Two types of industrial electric furnaces which have recently been put on the market are briefly described. Of the Greaves-Etchells it is said that it is now possible to have "boils" of as much as 12 or 15 tons entirely of scrap as compared to a limit of about 2½ tons before the war. Concerning the Stobie type of furnace special attention is given to the prevention of leakage of heat around the entrance of the electrodes into the furnace.—London *Times Engineering Supplement,* November, 1918.

Telegraphy, Telephony and Signals

Radio-Telegraphy in Germany and in France.—M. BOUTHILLON.—In 1900 the German Wireless Telegraph Company established at Nauen an experimental station where electric waves were produced with a 35-hp. plant. To-day with 1000-hp. generating capacity, the plant is able to send messages more than 10,000 km. In 1912 there was one tower 200 m. high and three 150 m. high. To-day the former tower, which was destroyed in a storm, is replaced by two towers 250 m. in height. In 1915 connection was established with Sayville, N. Y. In that year 1,300,000 words were sent by wireless from Nauen; in 1916, 2,580,000 words, and from January to September, 1917, 3,680,000 words—an increases rendered possible only by raising the speed of transmission from 100 to 250 words a minute. In France it is now possible by the automatic duplex service to reach during at least six hours a day in summer and twelve hours in winter an output of 140 words a minute. This output is susceptible of great increase by the employment of multiplex apparatus permitting the sending or receiving of many telegrams with the same antenna; but the comparison with Germany favors the enemy country.—*L'Industrie Electrique,* Sept. 25, 1918. (Abstracted from *Génie Civil,* Aug. 3, 10 and 17, 1918.)

Miscellaneous

National Factories; Their Utilization for Electrical Industries.—This article deals with the possibilities of using munitions plants for electrical manufacturing purposes. While a large number of these plants are of flimsy construction and are therefore to be scrapped, there are nevertheless many plants well equipped and more substantially constructed which might well be used for other purposes instead of being dismantled. In all cases first-class internal railroads of standard gage have been laid down, and water supplies, sewage arrangements and fire-hydrant services, etc., are complete. The buildings, moreover, are well lighted and heated, frequently provided with hydraulic power, electric power and sometimes gas. Housing and canteen accommodations are usually connected with the factories, and these points should be considered by electrical manufacturers who are factory hunting.—London *Electrical Review,* Dec. 6, 1918.

Works of the Union Cable Company.—The layout of a cable factory may seem simple enough at first glance, but it requires considerable thought to avoid overlapping of effort and the rehandling of raw material and semi-manufactured material. The Dagenham works of the Union Cable Company are described in this article.—London *Electrician,* Nov. 15, 1918.

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Readers' Views and Comments

Power Factor of Arc-Welding Sets

To the Editor of ELECTRICAL WORLD:

SIR: Power factor is being held up by many of the direct-current arc-welding apparatus manufacturers as a bugaboo to account for the difference in first cost and cost of operation and maintenance between direct-current and alternating-current arc-welding machines. As a matter of fact, the power factor of the latter is no worse than is the case with any induction motor-generator direct-current set on an average all-day run of arc weld, and further because of the alternating-current set making but one simple change and demanding but 3 kw. to 5 kw. as against 7½ kw. to 75 kw. for direct-current sets, it causes less disturbance on a power line. Arc welding is intermittent, either on full or all off, and a short circuit is used to start the arc. No more primary current is drawn by our alternating-current set on short circuit than when running, while a direct-current set draws from one and one-half to twice full-load current, and when an induction direct-current set starts up from two and one-half to four times full-load current is drawn, while our alternating-current sets draw no more current starting than when in operation. Moreover, during operation our control of the current and volts is more even than any direct-current set, no wild peaks of either being allowed, and the primary wattage, and hence current because voltage is constant, is smooth and without peaks or hollows.

Power factor is not efficiency—our set is the most efficient of all welding sets and equal in power factor to any. It is also the lightest in weight, and hence portable; has no maintenance, and consumes no power when not in actual operation. All direct-current sets take a continuous flow of power to keep them ready for striking the arc.

Power factor is the ratio of kva. asked for to kw. used. It is like sending for goods on approval. If half are kept, that is similar to 50 per cent power factor; the goods not kept are returned to stock, and no one pays because no one used them. Fifty per cent power factor means that out of 100 amp. 50 amp. is kept and 50 amp. returned to stock. The meter registers only 50 amp., the other 50 amp. was out of step and did not combine with the volts to make watts.

"Volts" and "amperes" are only terms of mathematical convenience; the only term that exists is watts, or the rate of energy, which, when taken over a period of time, is what is paid for, *i.e.*, kilowatt-hours.

Our power factor in welding runs from 35 to 65 per cent—a fair average being 50 per cent—while our power factor in cutting runs from 65 to 90 per cent—a fair average on heavy cutting being 80 per cent. Our demand for the heaviest sort of welding is 5 kw., and our demand for the heaviest cutting is 50 kw. If apparatus were rejected for such power factors, the induction motor would be thrown out, and it is the most widely used piece of electrical apparatus in the world.

"Power factor" is another term that does not exist in reality and is no relative of efficiency. Remember the user pays for kilowatt-hours, and our machine is guaranteed to deposit a pound of metal for less than 2 kw.-hr., and no other machine has as yet equaled this low figure.

The reader will probably ask himself "Why are direct-current machines?" That is the question we are asking, now that we have proved that a pure metallic arc can be used on alternating current directly; but horse cars are inferior to electric cars, yet horse cars were in use in New York City two years ago.

C. J. HOLSLAG,
Electric Arc Cutting & Welding Co.
Newark, N. J.

Interconnection at Springfield, Ill.

To the Editor of ELECTRICAL WORLD:

SIR: My attention was called by our superintendent to a misleading article in the issue of the ELECTRICAL WORLD under date of Dec. 21, page 1189, entitled "Will Not Interconnect Springfield (Ill.) Plants." The impression is given that the city had refused to hold a meeting to consider the possible saving which might be made by giving the city's electric load to the private company. This is directly contrary to the facts. The city had been ready and waiting for a meeting so that it might have an opportunity to present its case, and it was because of a letter from the State Fuel Administration, clearly indicating that the city was to be given no opportunity to be heard, that I, as commissioner in charge of the Springfield water, light and power plant, sent a long telegram direct to Dr. Garfield setting forth the situation.

It had been stated by the state fuel administrator that 5000 tons of coal could be saved. In view of the fact that the total coal burned by the city light and power plant for a whole year was only 6361 tons and that there were only three months during the year—namely, December, January and February—during the peak of the heating load, when it would be possible to save any coal by giving the Springfield Gas & Electric Company the city's electric load, it was obvious that the Fuel Administration had been grossly deceived. It was found after careful study by the engineering department of Dr. E. W. Bemis that there would be a total saving of 342 tons during those three months in case the weather was normally cold, and that if the city was permitted to return to the company the same amount of current during the summer months, there would be a saving of 980 tons of coal owing to the greater efficiency of the city plant. The city is now using about 4½ lb. of coal per kilowatt-hour as against the company's 6.2 lb. per kilowatt-hour under its most favorable conditions. The output of the city electric plant is about 3,000,000 kw.-hr. per year, about two-thirds being sold for commercial use and one-third for public light and power. The city now has about 1700 consumers and the gas and electric company about 6000.

Inclosed is a copy of the telegram to Dr. Garfield, which is self-explanatory. Will you kindly print this letter and telegram, to correct the erroneous impression conveyed in the article referred to, and greatly oblige?

WILLIS J. SPAULDING,
Commissioner of Public Property.
Springfield, Ill.

TELEGRAM SENT TO DR. GARFIELD

Relative to situation Springfield, Ill., concerning interconnection municipal light plant with Springfield Gas & Electric Company's plant for transfer of city's electric load to company, wish to advise we are today in receipt of copy of letter from Harold Almert, director of conservation, Chicago, Ill., to A. S. Cobb, director states' conservation, Washington, D. C., in which Almert represents, first, saving from interconnection of between 4000 and 5000 tons of coal; second, that material for connection is on hand and connection easily made within a few days at expense of Springfield Gas & Electric Company; third, that Springfield Gas & Electric Company is charging street-railway company 1.25 cents, which Almert states has been in effect for some time, and that company has asked State Public Utilities Commission for increase to 1.4 cents, which he says is a fair rate; fourth, recommends that the fuel department request city to permit connection and shut down its electric plant on basis of 1.4 cents per kilowatt-hour, "and then let the city decide whether or not they are willing to coöperate and aid the government in this conservation." Considerable correspondence has heretofore been had between city and Almert, in course of which city advised Almert that actual saving would be very slight, and city was promised full hearing at Springfield. Almert's letter to Cobb admits Springfield Gas & Electric Company has presented its side to him, but makes above recommendation without the promised hearing and without opportunity for city to reply to or refute company's statements.

City has employed Dr. Bemis, whose engineering staff has made full investigation and report, copy of which Dr. Bemis will to-day mail to you. Inasmuch as transfer of the city's electric load to company would result in no saving at its combined water and light plant except that of actual cost of fuel consumed for electric current, a rate of 1.4 cents would mean loss to the city of almost $3,000 per month. In addition, street-railway rate is not an old rate but one permitted during war only. Prior to war the rate to street-railway company was less than 1 cent. No shortage in coal now exists or has existed for some weeks in this section. Mines are shutting down for lack of orders. City does not wish to be put in light of refusing coöperation with administration where no need for proposed change exists. Springfield Gas & Electric Company has fought city's plant since inception in every posible way, including elections and court proceedings. Local manager of company made statement in early summer that within four months he would have transferred to his company city's full electric load. We believe Almert being misled by company to further latter's interests in this fight. Are to-day mailing complete copies of correspondence as supplement to Dr. Bemis' report.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

SECRETARY LANE ASKS FOR $200,000 FOR POWER SURVEY

Appropriation by Congress Requested for Use by Geological Survey that Country May Obtain "Economical and Dependable Power"

Secretary of the Interior Lane has asked Congress to appropriate $200,000 for use by the Geological Survey in investigating the power supply for the Boston-Washington industrial region. In asking the appropriation he said:

> Because conditions are most critical on the north Atlantic seaboard, and because transportation and industry are most congested in that region, an investigation of this territory will lead to the greatest immediate return in fuel economy and transportation efficiency.
>
> As a reconstruction measure it is necessary that a comprehensive plan of power supply for industrial districts be worked out as promptly as possible, so that the country may obtain the advantages of economical and dependable power during the period of international competition to follow.

The matter was referred to the appropriations committee.

STILL NO AGREEMENT ON THE WATER-POWER BILL

Hope in Washington for a Meeting of the House and Senate Conferees, but Many Obstacles to Action Before March 4

Many efforts have been made by the Senate conferees on the water-power bill to reach an agreement with the House conferees, although no hopeful action had been taken in Washington at the time this dispatch was filed. The Washington representative of the ELECTRICAL WORLD reports that the House conferees, who include members of the House committee on interstate and foreign commerce, have been occupied with the hearings concerning the packers. This has been an element which has militated against action on the part of the House conferees. On the other hand, however, Representatives Sims, Ferris and Haugen, three of the House conferees, aside from any other duties which have been occupying their attention recently, have remained firm in their refusal to give in on any of the points involved in the House bill, and, Senators state, they have refused to meet Senate conferees in the conciliatory spirit which the Senators say they are ready to exhibit on their own part.

By the time this is published it is possible that a meeting of the conferees will have been held. There is hope in Washington among those who are looking forward to the possible passage of the water-power bill that a meeting, if not held by the end of this week, will be held around the first of next week.

Representatives Lever, Esch and La Follette are urging action on the part of the conferees which might bring about the passage of the bill. Senator Shields is still absent from Washington, ill at his home in Tennessee, but the acting chairman of the Senate conferees, Senator Bankhead, is quoted as being willing to meet the House conferees more than half way in order to obtain the passage of the bill before March 4.

THE BUSINESS OUTLOOK FOR WHITE-CEDAR POLE INDUSTRY

Slow Readjustment of Values to Follow Similar Change in Prices of Commodities Used by Producers—L. L. Hill President

The twenty-third annual meeting of the Northern White Cedar Association was held at the Hotel Radisson, Minneapolis, Jan. 20, 21 and 22. In the opening address President Gerich said:

> "The year 1919 will develop a readjustment of values much greater in some commodities than in others. Our industry should work with cautious optimism, knowing its costs, watching its expenses, and it would seem to me that with a gradual readjustment of values, not only of our own products but of those we use so heavily in producing poles, the cedar industry should have a gratifying peace future of prosperity."

Among the other topics discussed by the various committees and the delegates were the railroad freight rates, insurance, the labor situation and the substitution of metal and other commodities for forest products.

The following officers were elected for the ensuing year: President, L. L. Hill of the Page & Hill Company, Minneapolis; vice-president, L. A. Furlong of the Valentine-Clark Company, Minneapolis; treasurer, W. B. Thomas of Manistique; secretary, H. B. Boucher of Minneapolis; directors, B. Finch of Duluth and M. J. Bell of Minneapolis.

NATIONAL COMMITTEE CLOSES ITS OFFICE IN WASHINGTON

Curtailment of War Activities Eliminates the Necessity of Co-operation with Various Departments of the Federal Government

Deciding to close the Washington office, the National Committee on Gas and Electric Service, of which John W. Lieb is chairman and George W. Elliott secretary, sent this letter to government departments:

> The curtailment of all war activities as a result of the signing of the armistice and the gradual relinquishment of direct and indirect supervision by the government of industrial activities incident thereto practically eliminates the necessity of the coöperation which the National Committee on Gas and Electric Service has been rendering to

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its various departments. The maintenance of the Washington office of this committee, is, therefore, no longer necessary, and it has been decided to close the office in the Munsey Building, Washington, on Feb. 1, 1919.

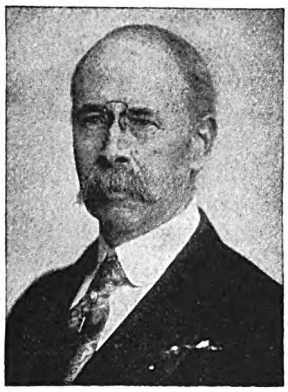
Should there be any service which the committee may be able to render or information which it may be able to furnish to government departments, requests for such information should be directed to the committee's New York headquarters, Fifteenth Street and Irving Place.

We beg to assure you of the committee's hearty appreciation of the opportunity which you have afforded to the gas and electric light and power companies of the country to render service to the government and of its readiness to render any further service that may be desired.

Attitude of Labor in the Readjustment Period

BY J. C. HOBART

President Triumph Electric Company, Cincinnati



THE attitude of labor in the readjustment period is one of the most, if not the most, important problems confronting the country. The statement attributed to Mr. Gompers, representing labor, that "reductions in wages would be resisted to the last trench," and that attributed to Mr. Barr, as a representative of employers, that "the last economic penny must be exacted from wage earners," get us nowhere and may lead to serious trouble if not to anarchy.

Three short years ago the people of this country were regarded by other nations as a nation of money grubbers. In three short years we have acquired a world reputation as a nation of idealists. Recently we have demonstrated our ability as a nation to transform our idealism into successful practice.

Leading statesmen of this and other nations are crediting President Wilson with voicing the sentiments of the great mass of the people of all nations. President Wilson is telling those people that the recent victory for democracy means that we are never going back to conditions that existed before the war. He is promising the peoples of the world greater freedom in the pursuit of life, liberty and happiness, greater opportunity for self-expression, and the peoples of the world are translating these promises to mean something more and something better than they ever had before.

When we pause and remember that the people of this country working for wages represent perhaps five times the voting strength of those paying wages, we cannot escape the conclusion that if these promised conditions are not provided the people of the nation have power to secure them in their own way.

What "labor," what people who work for wages, really gained during the period of the war was an increase in the ratio between wages and the cost of living, and that gain they are going to be very unwilling to relinquish. I don't believe we should wish them to do so. If we were wage earners, we would contend for the same thing—that is, the increase of the ratio of wage to the cost of living. A high ratio means an increased purchasing power, an increased consumption of everything we produce and a happy and contented people. There is nothing apparent in the immediate future to indicate any material reduction in the cost of living.

President Wilson has asked for $100,000,000 for food relief of foreign nations. While this is a small sum in comparison with our other war costs, it represents larger purchases of all food products. It is a necessary expenditure. We cannot see whole peoples starve, but it is not probable that prices of food in this country will decline under these conditions. The demand of foreign nations for raw and finished materials for reconstruction and to build up their industries is greater than the visible surplus supply, and until these demands are satisfied we can expect small reductions from present price levels. Until such reductions take place wage scales should not be reduced.

Serious as is the problem of a high wage rate, I can conceive that many wage earners attach even more importance to their conception of the promise of "a greater opportunity for self-expression." This is generally understood to mean a voice in the determination of the conditions surrounding them in their daily lives and occupations. When we remember that government departments during the war period were insisting that employers holding government orders arrange for their employees to elect their own representatives, when we know that such industrial leaders as Mr. Schwab and Mr. Rockefeller advocate the same principle, and when we remember the overwhelming voting power of the wage earner, we must realize that unless the employers, the men most thoroughly qualified by their intimate knowledge of the problems of industry, come forward and provide the proper machinery to permit this "self-expression," the workers will provide it themselves and many expensive and annoying experiments will result.

I believe the patriotism, the idealism—if it is called such—that under the stress of war actuated employer and wage earner alike, each ready to give his all, ready to make the supreme sacrifice of life itself at his country's call, is as powerful an influence in peace as in war and requires only the proper leadership to make it effective.

Every member of a national industrial organization should carry the message to his local organization—chamber of commerce or whatever it may be—in his home town that the prosperity of the nation depends on the prompt action of the leaders of industry inspired by the same spirit of self-sacrifice that called them to the support of our government in the crisis of war. Industry should coördinate its forces and continue its war-time coöperation with the government in the solution of the problems of peace, and until a national policy is adopted there should be no reduction from present wage levels.

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MEETING AT CHICAGO OF ELECTRICAL INSPECTORS

Western Association Has Fourteenth Annual Meeting and Considers Codes and Their Application—C. K. Cregier Elected President

The Western Association of Electrical Inspectors at its fourteenth annual meeting in Chicago on Tuesday, Wednesday and Thursday of this week agreed that the rule applier is doomed. The inspector who has neither the common sense nor the experience to supplement code instructions will be supplanted. Dana Pierce epitomized the general sentiment when he said: "Let us all try to become better engineers while being no less efficient as inspectors."

Frank L. Lucas in his presidential address said that different interests had endeavored to get inspectors to approve sub-standard work on account of conditions which it was claimed had to be met to win the war. Nevertheless, he was glad to report that the code standard had been maintained, and he hoped to see all attempted encroachments in the future meet with the same intelligent resistance as in the past. Some manufacturers, contractors and others think the inspectors should be willing to take a chance. Many inspectors, on the other hand, proscribe everything not proved.

Dana Pierce, chairman electrical committee of the National Fire Protection Association, advised inspectors to look at their problems from both sides and attempt to bring all contenders to a common viewpoint. There is a feeling that the National Electrical Code is being too generally used by inspectors as an inhibitor, when it is in reality a most constructive instrument if applied in the proper spirit. Mere rule appliers cannot do this. Such men look to the rules for information which their own knowledge and experience should supply. When they do not find an answer to the problem in the code these rule appliers too often condemn what any one with horse sense and a knowledge of common engineering principles would pass. Mr. Pierce thought the solution lay in the development of inspectors along engineering lines.

Charles W. Babcock, assistant city attorney of Milwaukee, Wis., said city ordinances must be reasonable and in accordance with accepted practices in the business to stand the test in court. His advice to any one wishing to draw up a valid ordinance was: "Don't be too greedy and don't be too specific as to detail."

A paper was read by J. B. MacNeil, electrical engineer for the Westinghouse Electric & Manufacturing Company, on "The Economy of Small-Capacity Circuit Breakers." He reviewed the whole field of circuit-breaker applications and explained where and why each type could be used to the best advantage.

The gain to the industry by necessary standardization effected during the war was dwelt upon by W. H. Merrill, president of the Underwriters' Laboratories, and F. S. Wilhoit, Cutler-Hammer Manufacturing Company. A few examples were given of what was done to reduce to a minimum the number of styles, sizes and types of apparatus during the war. For instance, authority was given to cable manufacturers to use B. & S. gage wires in stranded cable instead of drawing special sizes of wire to make the number of circular mils a round figure.

The manufacturers have benefited by the changes no less than the users, and there is every indication that standardization will spread to other lines, notably motors. Since the armistice was signed makers of panelboards have increased the single war-time standard to two standards because the Eastern States specify the war standard requirement of line switches without fuses, but in the West they insist that fuses be furnished.

The Bureau of Standards has as an experiment combined its Electrical Safety Code with the National Electrical Code. Dr. Morton G. Lloyd, electrical engineer for the bureau, explained the scope of the combined work and asked if the association wanted the bureau to print it. The inspectors thought this would imply an indorsement which it was not desired to give at this time. The motion to recommend the publishing of the combined code was consequently voted down.

Dana Pierce voiced the majority opinion when he said that it would be a fine thing to have a combined code for the protection of both person and property. It would be best, however, to keep the safety code separate until it can be developed in sufficient detail to permit its enforcement and until plans are perfected for its proper administration. Under present conditions no provision has been made for changing the safety rules as occasion demands.

It was also felt that approved apparatus under the combined code would come to mean approved from both fire and safety standards, whereas safety in operation depends more on the manner and place of installation than on the apparatus itself. F. A. Barron, engineer for the General Electric Company, discussed devices to protect the windings of small motors which are thrown across the line at starting.

The discussion of the report of the association committee on the National Electrical Code brought out the fact that in this country about a hundred fires are reported as being caused by heating appliances every day. This is the main reason why the annual fire loss due to electrical causes is $16,000,000. A resolution was passed recommending a change in the code rule to require an insulating bushing instead of the present metal bushing where flexible cords pass through the metal covers of outlet boxes. No one present had experienced in practice any trouble with the metal bushings, and the change was recommended on purely theoretical grounds.

The committee on installation and operation of induction motors compiled some useful tables of wire and fuse sizes required by the code for induction motors. Tables and formulas were developed by the committee on rubber-covered wire which gave the size of conduit required for any number of wires of the same or different gage.

D. W. Elyson, engineer for the General Electric Company, read R. A. Barron's paper on the construction features of automatic railway substations.

One entire session was given up to a discussion of the very many problems of the electrical inspector.

The officers for the ensuing year are: C. K. Cregier, Chicago, president; K. W. Atkins, Kansas City, first vice-president; O. M. Frykman, Minneapolis, second vice-president, and W. S. Boyd, Chicago, secretary-treasurer.

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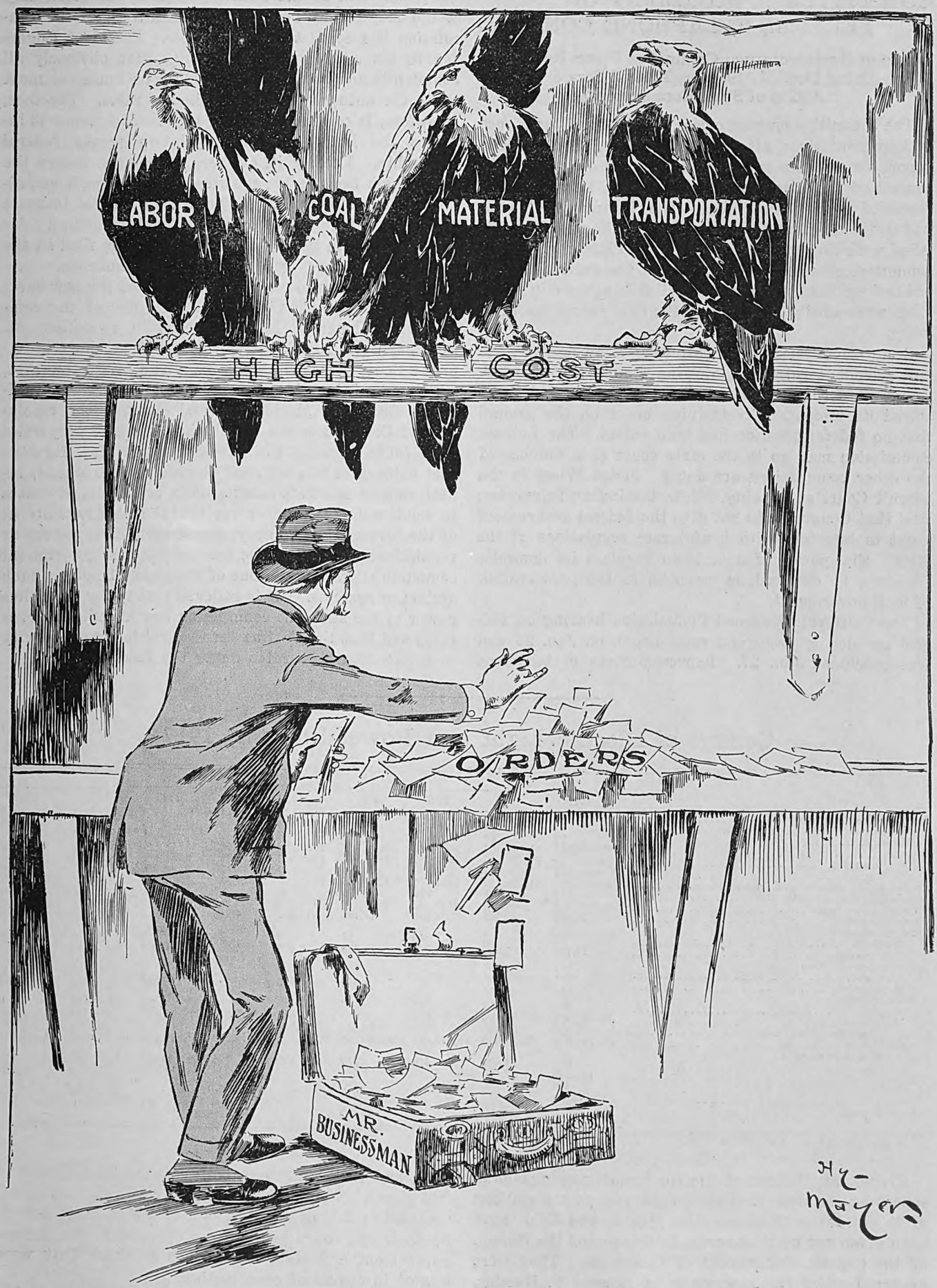

"If they'll come down a perch, they'll get these orders!"

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COMMITTEE IS FOR LIMIT ON FEDERAL TELEPHONE CONTROL

House of Representatives Committee Passes Resolution Fixing Dec. 31, 1919, as End of Period— Action of State Commissions

The committee on post offices and roads of the House of Representatives, after a hearing, voted on Jan. 28 to report a resolution extending the period of government control of the wire systems to Dec. 31, 1919. This is regarded as a compromise. The Postmaster-General had testified before the committee that he would be satisfied with an extension to Dec. 31, 1920, and various committee members had urged that the period be limited to from three to six months. Public ownership provisions were wholly discarded in the final committee resolution.

State commissions are continuing their fight on the new telephone rates, and varying results are reported. The United States District Court at Indianapolis dissolved its temporary restraining order on the ground that no federal question had been raised. The Indiana commission may go to the state court as a number of the other commissions are doing. Judge Wiest in the Circuit Court at Lansing, Mich., issuing an injunction, held that Congress did not give the federal government right to interfere with lawful rate regulations of the state. The power of a state to regulate its domestic concerns, he declared, is essential to the preservation of local government.

The California Railroad Commission hearing on federal revision of telephone rates began on Jan. 25 and was concluded Jan. 27. Representatives of telephone companies and of the Attorney-General admitted they would obey federal orders rather than those of the commission if a conflict on rates arises. President Edgerton in his citation made the point that obviously all complaints and petitions from utility or consumer must go to the authority which establishes rates. The case, therefore, is considered vitally important because it involves the issue of state regulation versus federal ownership. Feeling in California strongly favors the commission because it regulates after thorough examination of local conditions, whereas the federal increase of rates has been arbitrary and without opportunity for the consumer to be heard. A bill has been filed in the United States court by the California commission.

The New England company inaugurated the new rates Tuesday in spite of the suspension order of the commission. Chairman Macleod promptly requested Attorney-General Atwill to apply to the Massachusetts Supreme Court to compel the company to suspend the rates, whether by injunction or mandamus. In his communication Chairman Macleod pointed out that the resolution of Congress under which the telephone properties were taken over by the President "provided, further, that nothing in this act shall be construed to amend, repeal, impair or affect existing laws or powers of states in relation to taxation or the lawful police regulations of the several states, except where such laws, powers or regulations may affect the transmission of government communications or the issue of stocks and bonds by such system or systems." It is believed that under the police power of the state the commission has jurisdiction over rates and that the Postmaster-General has no authority to revise intrastate rates under the federal statute.

Census of Electric Light and Power Stations, 1917

	Utah			New Mexico			Nevada		
	1917	1912	1907	1917	1912	1907	1917	1912	1907
Number of establishments	47	45	31	29	21	15	14	8	9
Commercial	25	28	22	25	18	15	13	7	9
Municipal	22	17	9	4	3	..	1	1	..
Income	$5,444,807	$1,549,265	$665,241	$894,207	$497,895	$292,682.	$938,929	$618,942	$372,108
Electric service	$4,965,930	$1,530,060	$627,332	$874,317	$488,422	$289,962	$833,088	$607,597	$352,959
All other	$478,877	$19,205	$37,909	$19,890	$9,473	$2,720	$105,841	$11,345	$19,149
Total expelses, including salaries and wages	$4,018,963	$1,206,729	$461,675	$844,575	$449,516	$226,937	$662,359	$428,255	$245,291
Number of persons employed	1,215	401	198	256	158	83	190	147	78
Salaries and wages	$937,869	$365,399	$159,686	$223,510	$119,088	$66,981	$144,012	$113,636	$77,264
Total horsepower	226,595	60,588	35,950	17,108	11,015	4,548	16,832	15,420	6,980
Steam engines:									
Number	15	6	10	37	32	26	5	6	4
Horsepower	34,189	1,000	1,279	13,226	8,428	4,035	1,100	2,210	235
Internal-combustion engines:									
Number	..	..	..	22	9	..	8	8	6
Horsepower	..	..	..	3,252	1,770	..	617	670	485
Waterwheels:									
Number	112	63	45	7	9	6	21	13	9
Horsepower	192,406	59,588	34,671	630	817	513	15,115	12,540	6,260
Kilowatt capacity of dynamos	147,359	37,935	33,592	12,713	7,981	3,789	12,353	10,513	5,690
Output of stations, kw.-hr	466,995,136	86,634,658	61,672,661	17,244,768	9,027,824	4,614,349	53,846,178	44,969,772	29,621,730
Stationary motors served:									
Number	1,046	1,044	406	729	639	195	970	553	411
Horsepower	126,555	37,490	5,519	7,626	4,084	1,231	15,874	12,384	6,850
Number of street lamps:									
Arc	2,638	321	*	13	247	*	14	204	*
Incandescent, etc	7,697	5,237	*	2,288	627	*	1,003	401	*

* Not available.

Preliminary figures of the forthcoming quinquennial report on the central electric light and power stations of the states of Nevada, New Mexico and Utah have been given out by Director S. L. Rogers, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley, chief statistician for manufacturers.

The statistics relate to the years ended Dec. 31, 1917, 1912, and 1907, and cover both commercial and municipal plants. They do not, however, cover electric plants operated by factories, hotels, etc., which generate energy for their own consumption, those operated by the federal government and state institutions or those that were idle or in course of construction.

The figures are shown in detail in the accompanying table.

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FULL RESUMPTION OF DETROIT PEACE INDUSTRIES CERTAIN

Alex Dow Says He Will Make No New Departure Until Uncertainties Peculiarly the Result of War Are Disposed Of

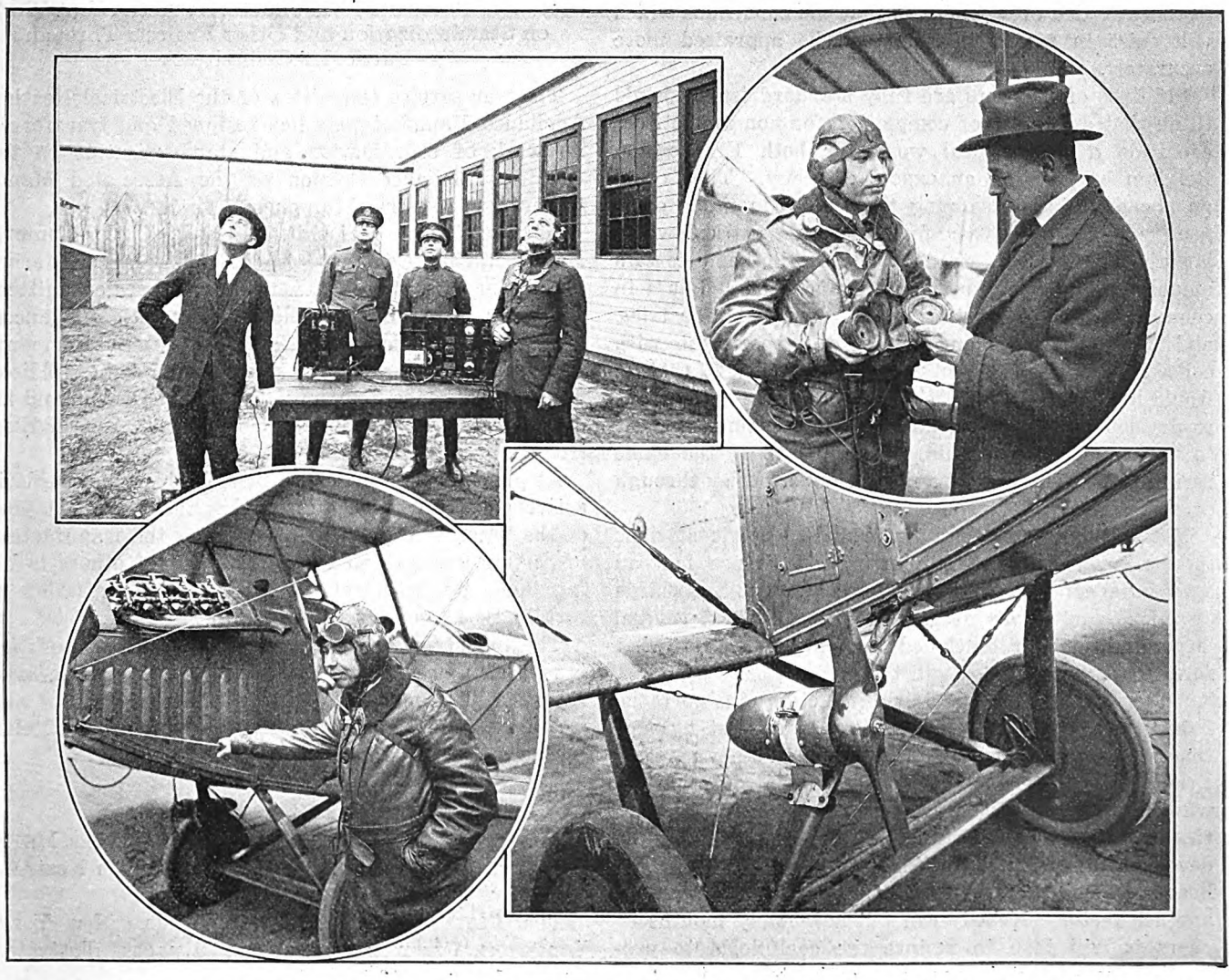
In his annual report to stockholders President Alex Dow of the Detroit Edison Company touches on operating ratio, construction requirements and the outlook. He says on these points:

The operating ratio is still too high, 67.2 per cent as compared with 63.8 per cent in 1917 and 54.5 per cent in 1916. The cost of coal is, of course, the chief cause of the excess; but all wage rates continued to increase during the year, and we are to-day paying the highest hourly, weekly and yearly rates that we have ever paid; and tax requirements also are large. Further, to our loss, the quality of the available coal has not been up to standard, and the necessity of accumulating during the summer a large reserve stock had made an abnormal expense for handling coal into and out of stock piles.

At the present time we have on hand or in process of delivery much equipment, ordered in 1915 and 1916, and at the relatively low prices of these years, the delivery of which was delayed by precedence given to war work. Among this material are turbines and boilers for the St. Clair River plant, which was to have been constructed in 1917 and on which we may begin work during 1919, and some of the material for a 30,000-kw. addition to our Delray power plant, which addition will be proceeded with at once. We have, however, avoided committing the company to any general construction program for 1919. We have no doubt that increased capacity will soon be required and are clear that certain expenditures must be made; but costs of work done in the next few months are sure to be abnormally high, and, on the other hand, the expected demands of our public for more service may be delayed by any one of a score of possible happenings.

Full resumption of the peace industries of the territory which we serve is certain. The doubt is as to the duration of the period of readjustment. Local opinion is that the restoration of normal activities in that territory will be rapid and that in the meantime there will be no serious disturbances of industry, trade or finance. We are, nevertheless, proceeding with special caution, and will make no new departure until those uncertainties which are peculiarly the result of the war shall have been disposed of.

The Wireless Telephone in Airplane Service



The Western Electric Company has made public some facts in regard to the use of the wireless telephone in army airplanes. It was a problem to exclude the noise of the engine and the air. A wind-driven generator was used to supply electrical energy to vacuum tubes. The photographs tell part of the story.

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FAVORS COMBINATIONS TO TEST EXPORT TRADE

Pierce C. Williams, United States Commercial Attache in Paris, Points Out Desirability of Their Formation by Electrical Manufacturers

Pierce C. Williams, commercial attaché in Paris of the Bureau of Foreign and Domestic Commerce, Department of Commerce, has just returned from France and was in New York for a short time before going to Washington. The commercial investigations made by Mr. Williams in France had to do with the general problem of industrial reconstitution, but his observations brought out several points which apply specially to the electrical industry, and these were discussed by him in an interview with a representative of the ELECTRICAL WORLD.

Mr. Williams expressed the opinion that wherever practicable it would be desirable for smaller manufacturers in the electrical industry to form combinations for export purposes under the provisions of the Webb-Pomerene act. "My own feeling," he said, "is that this is not the time for a small individual manufacturer to spend money in sending a representative to France. Buyers there now will get only the goods they need to have. In three or four months the situation may be more settled everywhere so that the conditions which will exist in export markets can be appraised more accurately.

"If lines of products are fully standardized, I should think that a number of competitors or non-competitors could do a very useful work for both France and Belgium by forming an export company. They could go ahead without involving themselves in much overhead expense until they find what the market would absorb in volume of trade. There will be a certain amount of collective buying in France and Belgium in connection with reconstruction of damaged industries, and that means an opportunity to experiment with collective selling. I am convinced, however, that it would be a mistake for each manufacturer to undertake to develop markets individually and to commit himself to the expenses that this would involve if the same results can be obtained at a much smaller outlay through combination."

Mr. Williams said that the central electric stations in the invaded districts of northern Frtnce had an aggregate capacity of 300,000 kw. About two-thirds of this capacity was destroyed. He said that several large questions are included in the problem of what form the reconstruction will take.

"Much of the industrial destruction in northern France," said Mr. Williams, "has been offset by new construction in central France. Cities in other parts of France have grown enormously. The question of whether France will want to industrialize communities will have to be settled with recognition of the development of other sections during the war. The heavy damage done to coal mines by the Germans is another factor. Nobody can tell how many months or years it will take to restore the coal fields to productiveness, but it is generally estimated that a long time will be required. The delay in operation of the coal mines will probably affect the restoration of the power stations.

"If a manufacturer here is looking to France for much business to tide him over, I am afraid he is looking in vain because the business is not there now. I think that perhaps there may be a demand for small supplies in the next few months, but the question of whether our manufacturers do much may depend upon their merchandising methods, their prices and their ability to finance their customers by extending them credit. Later there will be more business, but France will supply everything she can through her own factories to meet her own needs."

Mr. Williams added that two of the French electrical manufacturing companies were in the invaded districts and their plants were virtually destroyed. He said that there would be strong competition from the Swiss electrical manufacturing companies for the French business.

Mr. Williams expects to remain in the United States for two months to discuss French and Belgian trade questions with manufacturers interested. His headquarters will be at the Bureau of Foreign and Domestic Commerce, 734 Custom House, New York.

HEATING DEVICE STANDARDS UNDER CONSIDERATION

Section of Associated Manufacturers Actively at Work on Standardization and Other Projects Through Particular Committees

The war service committee of the Electrical Heating Appliance Manufacturers has resigned and transferred its work of coördination and standardization to the Heating Appliance Section of the Associated Manufacturers of Electrical Supplies.

This section, of which F. D. Goode, Cutler-Hammer Manufacturing Company, is chairman, is considering the matter of standardization through three committees according to product as follows: Domestic appliances, Robert Kuhn, American Electrical Heater Company, Detroit, chairman; ranges, George H. Hughes, Edison Electric Appliance Company, Chicago, chairman, and industrial heating appliances, H. Fulwider, General Electric Company, chairman.

At present the standardization of plugs and cords is actively under consideration. Also, the order last year of the War Industries Board stopping the manufacture of certain devices and the curtailment of others is being taken up, with relation to the standardization of certain types and sizes in order to minimize stock.

The industrial heating device committee in addition is making a study of the possible uses of electric heat. Efforts will be made not only to widen its use but also to raise effectual guards against the wrong use of electric heat.

Books Received

STORING: ITS ECONOMIC ASPECTS AND PROPER METHODS. By H. B. Twyford. New York: D. Van Nostrand Company. 200 pages, 96 illustrations.

THE FLYING BOOK. By W. L. Wade. New York: Longmans, Green & Company. 275 pages, illustrated. Price, $1.75 net.

GRAPHICAL AND MECHANICAL COMPUTATION. By Joseph Lipka. New York: John Wiley & Sons, Inc. 264 pages, 110 illustrations. Price, $4 net.

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Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 255 of this number.

A. I. E. E., Denver Section.—"The Future of the Public Utilities as Affected by the War" was the topic of Franklin P. Wood, who addressed the Denver Section of the American Institute of Electrical Engineers on Jan. 18.

A. I. E. E., Lynn Section.—On Jan. 22 Rear Admiral John R. Edwards, U. S. N., retired, delivered an address before the Lynn Section of the American Institute of Electrical Engineers on "Industrial Features of the Modern Navy."

A. I. E. E., Cleveland Section.—A. H. Rudd, signal engineer of the Pennsylvania System, Philadelphia, had railway signaling systems for his subject at the Jan. 20 meeting of the Cleveland Section of the American Institute of Electrical Engineers.

Institute of Radio Engineers.—A paper on "The Uni-Control Receiver" will be presented by Roy E. Thompson at the meeting of the Institute of Radio Engineers to be held on the evening of Feb. 5 in the Engineering Societies Building, New York City.

San Francisco Electrical Development League.—At the regular Monday luncheon on Jan. 20 the league was addressed by John A. Britton and C. P. Cutten, the subject being relations between public utility commissions, public utilities and consumers.

Pittsburgh Section, A. I. E. E.—At the Jan. 14 meeting of the Pittsburgh Section of the American Institute of Electrical Engineers W. R. Work was reëlected chairman and J. W. Welsh, special engineer of the American Electric Railway Association, spoke on "Passenger Transportation Problems During the War."

A. I. E. E., Spokane Section.—The Spokane Section of the American Institute of Electrical Engineers met jointly with the American Institute of Mining Engineers, the American Society of Civil Engineers and the Spokane Engineering and Technical Association on Jan. 17 to hear J. C. Ralston speak on "The Big Bend Irrigation Project."

Oklahoma Utilities Association.—The program for the Oklahoma Utilities Association convention to be held in Oklahoma City on Feb. 13, 14 and 15 will include an address by J. B. A. Robertson, Governor of Oklahoma. W. D. Humphrey, chairman of the Corporation Commission, will speak on "The Relation of the Corporation Commission and Public Utilities," and others will also be heard. Limited space will be available for exhibition purposes, and for this there will be no charge. J. O. Kammerman, 611 State National Bank Building, Oklahoma City, may be addressed by those interested.

Electrical Industry Organized at Duluth.—On Jan. 16 the electrical contractors and dealers of Duluth, Minn. were guests of the Duluth Edison Electric Company at a dinner served at the Commercial Club. The purpose of the meeting was to bring out the possibilities for the sale of electrical appliances and to create more cordial relations between all concerns engaged in the electrical business. To put this work on a permanent basis an organization representative of the industry was formed. Its officers are: President, George Brown, Western Electric Company; vice-president, W. M. Hogan, Northern Electric Company, and secretary-treasurer, W. S. Heald, Duluth Edison Electric Company. A committee of three was appointed to outline a definite plan of action for the interests in the industry. A monthly dinner meeting will be held each month.

New York Electrical Society.—An interested audience at the meeting of the New York Electrical Society Jan. 27 listened to Arthur J. Baldwin, vice-president of the McGraw-Hill Company, tell of his recent observations on the battlefields of France. Having visited Europe as a member of a delegation specially invited by the British government, the speaker was able to describe many sights that have not been pictured or described before. Lantern slides were employed to illustrate the devastation wrought by the Germans. Mr. Baldwin referred to the warm feeling that England as a whole has for America, saying that old prejudices no longer exist. He emphasized the point that the great lesson of the war should be that peoples are interdependent and not independent. If this principle is not recognized, Mr. Baldwin said, the battles will have been fought in vain.

American Association of Engineers, St. Louis Chapter.—On Jan. 18 the American Association of Engineers installed a chapter of 150 members at St. Louis, Mo. Addresses on the relation of the engineer to society were delivered by H. W. Clausen, vice-president of the American Association of Engineers; Prof. E. J. McCaustland, University of Missouri; C. E. Drayer, secretary of the American Association of Engineers, and Baxter Brown, president of the Engineers' Club of St. Louis. The new St. Louis chapter has urged the local Chamber of Commerce to form an engineering committee to report on civic questions involving engineering practice. The officers of the chapter are: President, L. Winship; vice-president, F. L. Flynt; second vice-president, C. G. Harrington; secretary, R. B. Kerr; assistant secretary, George Grimm, Jr.; treasurer, C. P. Calvert; directors, J. F. Peters, W. E. Playter, E. F. Collins, E. J. McCaustland, L. T. Maenner and H. L. Hopper.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Increase in Rates in California.—The Amador Electric Light & Power Company has been granted by the California Railroad Commission authority to increase its rates, the order being based on the company's showing of costs of power and service and the loss of business due to war conditions. The depression in the mining business in Amador County resulted in a 10 per cent reduction in the number of the company's domestic consumers and more than 15 per cent in the quantity of energy sold in its domestic service during the last two years. It is estimated that the new rates will provide the company with an operating revenue of $39,472. The estimated operating expenses are $24,530, making available for depreciation and return $14,942. The estimated annual depreciation is $4,500, leaving net available for return $10,442. The commission's engineers have fixed the reproduction value of the plant at $150,997. On this sum plus $3,800 working capital the new rates will yield a return of 6.8 per cent.

Rate Increases Authorized in California.—In an opinion written by Commissioner Edwin O. Edgerton, the California Railroad Commission has granted to the Southern Sierras Power Company and the Holton Power Company authority to increase rates by the addition of surcharges, the commission holding that the companies, because of the great increase in the cost of material, labor and supplies, are entitled to a fair return upon their investment and also entitled to sufficient revenue to enable them to carry out necessary betterments and extensions. The Southern Sierras Power Company operates hydroelectric plants in Mono and Inyo Counties. The Holton company distributes electric energy throughout the Imperial Valley. Because both companies are owned and controlled by the Nevada-California Electric Corporation the commission considered the applications as one. Investigation by the commission showed that the excess in cost of operation for 1918 over 1915 totaled $307,518.01, or 69.43 per cent. The gross earnings in 1918 were $1,364,018, with expenses of $856,590, leaving $507,428, or 6.95 per cent, for interest and depreciation. Giving prominence to the fact that the service of the utilities is absolutely necessary, the commission held that the applicants' net for depreciation and return, based upon the 1918 conditions, should be increased to an amount of $700,000 and fixed upon $150,000 as a reasonable annuity for the combined properties.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Members of New York Reconstruction Commission.—Among the members of the Reconstruction Commission appointed by Governor Smith of New York are Charles P. Steinmetz, General Electric Company, and Arthur Williams, New York Edison Company.

Equipping Disabled Men for Usefulness.—A committee consisting of Ralph Ellsman, C. E. Morrison and J. C. Robinson was appointed at a recent meeting of the executive committee of the Empire State Gas & Electric Association to consider the suggestion that the association assist in the institution of educational courses in connection with the work of the Red Cross Institute for the Rehabilitation of Disabled Men or similar organizations to equip disabled men for positions in the gas and electric industry.

Proposed Bond Issue in California.—Declaring that the opportunity to sell its bonds is more favorable now than for some time past, the Western States Gas & Electric Company has applied to the California Railroad Commission for an order authorizing the issue of 5 per cent bonds of the face value of $450,000. The petitioner believes that it can sell the bonds at not less than 82½ plus accrued interest. The proceeds are to be used to reimburse the company for construction expenditures already made and to provide funds to carry out a construction program planned for 1919.

Cleveland Municipal Plant Operations.—Commissioner of Light W. E. Davis of Cleveland, Ohio, has not only promised service to a great number of domestic users this year, but has guaranteed that the rate will remain at 3 cents, notwithstanding the increased cost of coal, labor and materials for the extension to the plant, which is costing about $2,500,000. Mr. Davis said that it is possible to maintain the low rate because the industries are using about 68 per cent of the plant's output. He said that this makes it possible to operate the plant twenty-four hours a day, with small wear on the apparatus, and the substantial profit will overcome the loss on domestic business. Of the $2,500,000 to be used in the extension of the plant, he said that about $500,000 will go to the construction of line extensions to domestic consumers, and this will add about 5000 to the list of 20,000. Through the past year the plant furnished service for war industries largely, and it was not possible to add to the number of domestic consumers.

Heating Hearing in Idaho.—For almost two weeks the Idaho Public Utilities Commission took testimony on the subject of open-air heating by electricity to determine whether or not it was feasible. The commission has not yet submitted its findings. Forty-three hydroelectric companies were cited to appear and give testimony. Most of them did so. Their testimony was to the effect that open-air heating by electricity is not practicable.

"Service Bureau" of San Francisco Engineering Societies.—In San Francisco there has recently been established an "Engineers' Service Bureau" which is intended to serve as a clearing house (1) through which engineers in search of employment may get in touch with prospective employers and (2) through which employers may find technical men promptly as they are needed. The bureau is being conducted at the San Francisco Engineers' Club through the Joint Council of San Francisco engineering societies. In this organization are represented local sections of the American Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society of Mining Engineers and American Chemical Society.

United States Naval School of Engineering Is Established at Pittsburgh "Tech."—The arrival in Pittsburgh recently of a detachment of naval officers marks the establishment by the government of a United States naval school of turbine engineering at the Carnegie Institute of Technology. These officers have been in every instance chief engineers of ocean tramp steamers with experience in the operation of reciprocating steam engines. They have been detailed to the institute to learn the principles and operation of engines of the turbine type, for service in the near future on the ships of the new merchant marine. The course of instruction is under the joint direction of officers sent by the Navy Department and of members of the faculty of the institute.

Seeks Control by Public Utility Commission.—The Kansas Gas & Electric Company is preparing a bill to be presented to the Kansas Legislature asking that it be placed under the Public Utility Commission and that all existing charters in its twenty cities and towns be revoked. The Kansas franchises terminate at various times, causing endless confusion in the general business. The bill provides that, while the company shall not be relieved from any of the obligations imposed upon it by these franchises, it shall not be required to plan its business upon the supposition that such franchises will terminate at certain dates, but shall continue so long as satisfactory service is rendered. According to the present law no franchise may be granted any corporation for a longer period than twenty years. The Kansas Gas & Electric Company contemplates expending $12,000,000.

Suggests Colleges Coöperate in Commission Work.—Gov. John H. Bartlett of New Hampshire says regarding the Public Service Commission in his message to the Legislature: "This commission has been a necessity and is still useful and beneficial. The railroad situation is going through an evolutionary period and no one can say now what may later be easy to decide with reference to this commission. It could gradually be reduced to one member in a state of this size, and its expenses reduced by supervision and by possible coöperation by our colleges in the scientific work."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Liability for Maintaining Pole in School Yard.—Those responsible for maintaining within a school yard a pole carrying electric wires are held not liable in the Maryland case of Grube versus Baltimore for injury to a bright boy, ten or eleven years old, who, knowing that climbing the pole was not permitted, reached the climbing spikes from a fence and ascended the pole until he came in contact with a wire, which burned him and caused him to fall, to his injury (L. R. A. 1918 E. 1036).

Line of Road in Establishing Transmission Line.—When the landowner in planting trees and erecting fences along the line of a public highway incloses and retains the possession and uses of a part of the land lying within 33 ft. of the section line, a corporation undertaking the erection of an electric transmission line along the road under the privilege granted to it by law may assume the line of such road to be where such trees and fences are found until the line is otherwise definitely fixed and established, the Supreme Court of Nebraska held in Saline County versus Blue River Power Company (169 N. W. 785). Defendant undertook the construction of an electric transmission line along a public highway. The statute then in force provided: "Whenever practicable the poles shall be set upon the line of such highways." By the terms of an injunction order entered by the district court defendant was required to set its poles "upon the line of such highways." An appeal was prosecuted to this court. While the appeal was pending the statute was amended to read: "Whenever practicable the poles or towers shall be set in such highway and adjacent to and not more than six feet distant from the line thereof." Held, that the statute in force at the time of entering the judgment in this court will control.

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

Judge James H. Reed has resigned as president of the Philadelphia Company, Pittsburgh, Pa., which controls the Duquesne Light Company, Pittsburgh Railways and other properties. He will remain as chairman of the executive committee and vice-president, and will retain a more or less active connection with the company.

James D. Callery, who has been president of the Duquesne Light Company, Pittsburgh, Pa., succeeds Judge James H. Reed as chairman of the board of the parent company, the Philadelphia Company.

Arthur W. Thompson, vice-president of the Baltimore & Ohio Railroad and a federal director of railroads, has been elected to succeed Judge James H. Reed as president of the Philadelphia Company and to succeed James D. Callery as president of the subsidiary, the Duquesne Light Company, Pittsburgh, Pa.

M. O. LEIGHTON

M. O. Leighton, consulting engineer of Washington, D. C., has been chosen as chairman of the newly formed national service committee of the Engineering Council. Mr. Leighton, who has made a particular study of the hydroelectric development of this country, was one of those who testified before the congressional committee on the possible commercial development of navigable rivers and streams in forest preserves, indicating also to what extent canalization of navigable streams would result in improvements to navigation as well as in water-power possibilities. He has made a study of the application of water power to many uses, including industry, central stations, electrochemistry, and especially railroad electrification. Mr. Leighton was born in 1874. He was graduated from the Massachusetts Institute of Technology in 1896. He engaged chiefly in hydraulic work and in 1906 was appointed chief hydrographer of the Geological Survey. He continued in this work until 1913, when he took up consulting work. He has been a member of a number of government commissions to study waterways and hydraulic possibilities.

John W. Graham, president of the Idaho Public Utilities Commission, has declined reappointment in order that he may engage in banking.

M. J. Musser, who is employed by the Central Illinois Public Service Company, has been transferred from Mattoon to Beardstown as district manager.

H. E. North, formerly with the Minneapolis General Electric Company, has been appointed manager of the contract department of the Oklahoma Gas & Electric Company, Oklahoma City.

James H. Class, formerly superintendent of the municipal light plant and waterworks, Ogallala, Neb., has been connected with the Intermountain Railway, Light & Power Company, Denver, Col., as manager of its property at Holdredge, Neb.

George W. Elliott, secretary of the National Committee on Gas and Electric Service, who has been seriously ill in a hospital in New York during the last few weeks, is now, his many friends will be glad to learn, on the road to complete recovery.

Walter F. Crossley, formerly general superintendent of the Cairo (Ill.) Railway & Light System, part of the Illinois Traction System, has been transferred to Springfield, Ill., where he will be engaged as a special representative for the Illinois Traction System.

D. L. Wishon, who for the last fifteen years has been civil engineer in charge of reconnaissance work for the San Joaquin Light & Power Corporation, has been appointed to succeed E. D. Farrow, Jr., resigned, as general agent and manager of the Bakersfield (Cal.) district.

J. Paul Clayton, who has been associated with the Middle West Utilities Company, Chicago, has been elected a vice-president of the Central Illinois Public Service Company and has moved to Mattoon, Ill. Mr. Clayton in 1917 went from Mattoon, where he was contract agent for the Central Illinois company, to take charge of the commercial department of the Middle West Utilities Company.

Homer C. Bender has been appointed superintendent of public utilities of Spokane, Wash., a new position. He will be engaged in making personal investigations, gathering data, inspecting utility work under way and in preparing for rate and other hearings before the Public Service Commission. Mr. Bender is a graduate of the Massachusetts Institute of Technology and was for four years connected with Stone & Webster in hydroelectric work.

Major Samuel W. Greenland has received his honorable discharge from the chemical warfare section of the United States Army and has returned to take up his duties as general manager of the Fort Wayne & Northern Indiana Traction Company. During his absence from the utility, Major Greenland has been supervising the erection of a 20,000-kw. steam-driven generating station and a rotary station of the same capacity at the Edgewood (Md.) Arsenal. He also looked after the operation of the utilities at Edgewood.

Milton H. Wagner, transmission engineer of the Dayton Power & Light Company, who resigned on Nov. 1 last to become connected with the United States Fuel Administration at Washington, was transferred on Dec. 16 to the Department of Commerce with the Bureau of Standards, with the title of electrical engineer. His work will be

M. H. WAGNER

principally in connection with the National Electrical Safety Code. Mr. Wagner is a graduate of electrical engineering of the University of Cincinnati. In 1909 he became connected with the Dayton Power & Light Company. He was the first chairman of the transmission and distribution committee of the Ohio Electric Light Association and continued in that capacity for six years. He is also a member of the technical section of the National Electric Light Association and a member of the sub-committee on overhead lines. He has been chairman of the Dayton Power & Light Company section of the National Electric Light Association and while serving in that capacity organized all of the various activities of the company under one organization, which became known as the Dayton Power & Light Welfare Association of the N. E. L. A.

Obituary

John H. Greer, president and treasurer of the Fisher-Chase Manufacturing Company, Columbus, Ohio, manufacturer of fuse and disconnecting switches, died recently of pneumbnia.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

PREVAILING CONDITION IN COPPER-WIRE MARKET

New Standards for Rubber-Covered Conductors Provide for Discontinuing Some Small Sizes and Easier Manufacture of Circular-Mil Sizes

January is hardly the time of year to look for heavy buying in the wire market. While the month has provided few orders of a large size, it has created a market for small amounts in many instances. Only absolutely necessary extensions have been made, but considerable maintenance and repair work has been carried into effect.

With the departure last week of the committee of copper producers for Europe, the price of copper will probably hold rather steady until word from them is received. Since the price of wire depends largely on the price of the base copper, as soon as the large buyers have decided that the bottom level has been approximately reached, the larger orders may be expected to come in. The price of copper in most cases has been on a 23-cent base, but one case is known where it has been as high as 27. Some of the smaller producers have been selling as low as the 20-cent base, but it is probable that as soon as their stock becomes pretty well depleted they will raise their price somewhat. Quotations in the open market this week went below 20 cents for spot shipments of electrolytic. Little copper is being sold to the wire manufacturers, as their stocks as a rule are ample for current production and at the prevailing price.

There have been many inquiries received by the larger wire producers for quotations on large orders. One manufacturer has a standing order which is to take effect when he, the manufacturer, is satisfied that copper has become satisfactorily low and stable.

Some inquiries on bare trolley wire have come from South American countries. In the South the month of February should begin to show an increase, but throughout the country generally buying in any large amounts will probably not be felt before March and April. Where in season there would be found an order for 30 or 40 miles of trolley wire, there is now found nearer 2 or 3 miles.

There have likewise been inquiries for copper-clad trolley wire for both foreign and domestic use. Until the metal market shall have found itself substitutes are being used. There have been cases where bare copper wire has been used, although copper-clad may have been more desirable, just as where in one case in South America condenser tubes have recently been made of iron, even with their short life, as being cheaper in the end than present copper. Deliveries in bare trolley wire are running three to four weeks, as it is not stocked; it is, however, kept in rods.

Considerable standardization on rubber-covered wire and cable has been effected. Code, 30 per cent and 40 per cent are insulation standards. No. 8 B. & S. gage and smaller rubber-insulated N. E. C. with double-braided wire and twin wire will not be manufactured. Single-conductor single-braid will be substituted therefor. The number of standard colors of flexible cords has been limited to black, green, yellow, red and white. Lamp cord and brewery cord are the standard types of N. E. C. flexible cords.

In the manufacture of stranded conductors wires of even diameters have been eliminated and approximate diameters substituted therefor. Thus where 400,000 circ. mil is called for a cable of thirty-seven strands of No. 10 B. & S. gage wire, giving 384,095 circ. mil, will be sold. The same will hold good for other sizes. In some cases the approximate size will be nearer the even hundred than in the above instance, but in no case will it be very far off. There are the same number of steps between the present No. 16 and 2,000,000 circ. mil as formerly, and each step approximates more or less closely the former corresponding step.

DIFFERENCE OF OPINION OVER PRICE GUARANTEES

While Some Electrical Manufacturers Have Made Guarantees for Next Few Months, Others Are Opposed to Pursuing Such a Policy

A difference of opinion seems to exist among manufacturers of electrical supplies and appliances regarding the practicability of giving guarantees against a drop in prices over a definite period. Some manufacturers have already made such guarantees. A producer of high-tension apparatus has in effect guaranteed against a drop until March 1. A well-known line of lighting fixtures has been guaranteed againist a decrease until April 1. There have been other concerns that have taken similar action.

On the other hand, there appears to be a well-defined opposition to doing this sort of thing. Inquiries made of appliance manufacturers showed little sympathy with the policy of giving such guarantees. It is well known that the prevailing high prices, particularly on heating goods, have been and are now especially acting as a drag on large sales. More than once the trade has asked for lower prices. With such a sentiment it is not strange that the manufacturers do not care to guarantee against drops. It has also come to light that the most insistent demand for guarantees has come from retailers without the electrical industry. Furthermore, the demand has been for guarantees over the first half of the current year. It is apparent that these interests wish to lay in stocks and at the same time take no risk.

HOPEFUL OUTLOOK IN THE WATT-HOUR-METER MARKET

Lower Labor Costs May Bring Down Prices, but Not in an Amount Sufficiently Substantial to Justify Holding Off Purchases of Meters

Conditions in the watt-hour-meter market justify the belief that 1919 promises to be a year of excellent business in this field. Factory stocks of the smaller-sized meters are ready for immediate shipments, and large orders can be filled as readily as before the war. Both labor and material are in ample supply to meet the demands of a real boom in building should that materialize within the next two or three months. This accumulation of smaller-sized meters is the result of the extremely conservative policy adopted by the central stations regarding line extensions and new services during the latter part of the war, coupled with the belief on the part of manufacturers that the curtailment of demand is merely temporary. The central stations are by no means short of meters as yet, but contracts are being renewed here and there in anticipation of a healthy development of service. Orders are still slow in coming in, and extended buying may be delayed until after the fifth Liberty loan. If the building trade picks up, as seems likely, the business in meters will increase accordingly. A quiet market for power meters seems likely to prevail.

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Watt-hour meters for residential service moved very slowly last year in comparison with 1916. The restrictions of the Fuel Administration and the cessation of free line extensions by central stations, coupled with maximum conservation of building materials and labor, caused the sales volume in meters for home use to fall probably 40 or 50 per cent below the previous year's figures. Just before the armistice the demand for such meters represented a mere hand-to-mouth buying, and the extent of revival this year is in large measure dependent upon central-station activity. A beginning has been made in returning to a pre-war basis of financing extensions, as at Providence, R. I., Cleveland, Ohio, and elsewhere, and it is natural to expect a rapid growth in commercial effort among central stations as the year advances.

Manufacturers have been turning out large quantities of meters of all sizes for war service, and the industrial meter market last year was fully as good as in 1917. Some meters will be purchased this year in connection with the remodeling and rehabilitation of industrial plants, rearrangement of power and lighting distribution circuits, interchange of energy supplies and consolidation of loads; but until the readjustment of industry reaches a more stable plane orders are likely to show great variation in their specifications and volume. It is probable that deliveries will be very satisfactory in industrial meters this spring, despite the fact that the industrial demand is difficult to forecast. Early inquiries, nevertheless, will assist.

METAL MARKET SITUATION

Some Slight Reductions Noted, but Buying Is Quiet —Foreign Business Hoped For

The lowering of ocean freight rates gives promise of renewed buying in foreign markets. In the copper market the absence of the leading interests is expected to have a still more quieting effect. Prices are nominal and show a decided downward trend and at present rate should reach 19 cents in a few days. Considerable quantities of high-cost copper are still coming along.

Production is still being cut and will probably so continue till producers are satisfied there is a renewed market for their product. There is sufficient on hand to satisfy any sudden demand that may occur. Some mining companies are operating on 65 to 75 per cent capacity.

General users of tin report a quiet business. Letter No. 10 of Jan. 23 has been sent out to the industry under decision of the government authorizing the United States Steel Products Company to fill all orders at government prices, regardless of quantity. The recent drop in lead to 5½ cents has brought the selling price very close to cost.

NEW YORK METAL MARKET PRICES

	Jan. 21	Jan. 28
Copper:	£ s d	£ s d
London, standard spot	91 0 0	89 0 0
	Cents per Pound	Cents per Pound
Prime Lake	21.00	21.00
Electrolytic	20.00	19.25
Casting	18.25	18.00
Wire base	22.75*	22.75*
Lead, trust price	5.50	5.50
Antimony	7.50	7.50
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	13.00	13.00
Spelter, spot	7.35	7.00
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	15.50 to 16.00
Brass, heavy	9.00 to 9.50	9.00 to 9.50
Brass, light	7.50 to 8.00	7.00 to 7.50
Lead, heavy	4.50 to 4.75	4.50 to 4.75
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

* Nominal

THE WEEK IN TRADE

SMALL-order business is now about all that is being handled. Utilities are beginning to borrow money, and some good business from this quarter is expected. There is a decided scarcity of dwelling accommodations in the United States. This condition is becoming accentuated day by day. Of ninety-one real estate boards interrogated by the Department of Labor fifty-nine replied that in their cities a non-fulfilled demand existed for houses and apartments, while twenty-four stated that at the present time this same condition exists to an acute degree. Only four of the ninety-one replied that there was little demand for housing accommodations.

Wire is lower again this week, but other prices remain steady.

Labor disturbances are becoming more numerous and appear to be springing up all over the country. A very decided surplus of labor is piling up.

NEW YORK

The statement last week from one of the largest real estate companies in the city that "Savings banks are now becoming more active in the loan market" should bring with it new assurance about building, from the viewpoint of mortgage possibilities. Further ground for optimism is afforded in the recall of governmental restrictions on loans by banks and trust companies. Remodeling of private dwellings into small apartments continues. One tall apartment house has just been announced for Fifth Avenue at Sixty-sixth Street. Except for insulated wire, which took another drop, prices show no change over last week. Government cancellations have so far been gradual.

There is still a dearth of very large orders in practically all electrical construction material, but maintenance and repair orders are keeping constantly in motion a small volume of business.

TRANSFORMERS.—Prices remain quite steady. While isolated industrial plants have stopped buying in any quantities, the central stations are purchasing sufficient transformers to maintain their lines and take care of a very fair amount of immediate new business. The latter are not, however, laying in any stock of transformers so early in the year, but this may be looked for in March and April.

LAMPS.—Orders are running rather high and are holding a steady level. This no doubt follows the discontinuance by the lighting companies of their former lamp-renewal policies. The previously large periodic peak sales to the lighting companies in this locality have flattened, and trade is now more evenly spread out. However, the volume of trade is expected to decrease as the days grow longer. Local stocks are ample. Considerable buying in high-voltage lamps indicates activity in the export trade.

PORTABLES.—The dry-goods stores have virtually sold out their entire stock. Sales as a rule are very high with dry-goods stores, but last year they had difficulty in procuring sufficient stock. The lighting companies consequently found a larger demand on their stock, and it is understood that as a result they are making plans to cultivate this business more intensively this year.

FLEXIBLE ARMORED CABLE.—Several jobbers have fair stocks and are not ordering anew till they have cleared pretty well their present supply; those not stocked are buying in small quantities for work in hand. One manufacturer is still running full on old orders. The drop in price of copper has not yet been found to affect this product.

NON-METALLIC FLEXIBLE CONDUIT.—Manufacturers claim that the pre-war price of this product was so cut by competition that it did not yield a fair profit. The

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present prices they figure are none too high. The drop in cotton is speculative and has not effected any drop in price of the product, manufacturers state.

HEATING APPLIANCES.—There is a large local stock of radiant radiators on hand, due to the warm winter. These are being offered by some jobbers at lower prices. In one instance heaters are being offered to the trade at one-third less than the high early winter prices. There were more heating devices billed by manufacturers during the month of December last, it is reported, than for any previous month, and one large manufacturer expects to have all his back orders billed and shipped within the next two weeks. All of these back orders were accepted on the basis of shipping price. One of the local utilities recently placed orders for its requirements for the first half of the current year.

WIRE.—A further drop in wire prices occurred this week. One manufacturer dropped from 27 cents to 24 cents, rubber-covered base, another from 27 cents to 25 cents and a third from 28 cents to 25 cents. One producer who has been on 34-cent base for a few weeks changed this week to a cost basis. Rubber-covered base ranges from 24 to 29 cents.

MILL-TYPE LAMP.—In order to meet the demand for a more rugged lamp, tungsten-lamp manufacturers are selling in limited quantities until thorough service tests have been completed a specially constructed lamp in which the filament mount is fastened to the stem in the base by a short piece of steel wire. This tends to absorb vibrations, preventing them from reaching the filament. The filament has an extra number of anchors to prevent one filament leg overlapping another. These extra anchors make the lamp slightly less efficient than the standard lamp, and, on account of the expensive form of construction, the price is higher, the lamp listing at 45 cents clear for 110-volt to 125-volt circuits and 48 cents clear for 220-volt to 250-volt circuits. It is made in two sizes, 25 watts and 50 watts. A definite form of construction will not be settled upon until more experience has been obtained from the lamp in service.

CHICAGO

The interest of the trade is gradually swinging around more and more to the activities of public utilities. In the past week the Public Utilities Company of Evansville, Ind., has sold $3,000,000 of ten-year bonds at a price yielding about 6.65 per cent.

While the building operations have not been up to expectations, it is a notable fact that the total value of building permits issued week before last amounted to $572,250 as against $44,500 for the same week in the preceding year.

The price situation is one that is being studied very closely now both by the sellers and buyers. J. L. Replogle, who purchased steel for the allied nations during the war, has given out an interview stating that before long pig iron will be selling for $40 a ton and steel at $73 a ton.

Jobbers report that the usual number of orders are being secured but that they do not have the same volume as those secured last January. The reason for this situation is that buyers are purchasing on a hand-to-mouth basis.

It has developed that the distributers of electrical appliances are very much opposed to guaranteeing prices of appliances against decline for a definite period. They raise the point that this procedure would absolutely kill the market for appliances during the guaranteed period because such action would in effect state that prices were going down on a certain date in the future. They offer as an alternative a plan by which the manufacturers would protect the distributers' stock.

CONDUIT.—Virtually no conduit producers are yet in shape to ship a complete order of all sizes. There are always one or two sizes missing in each shipment. Deliveries, however, are easing up, and there is plenty of pipe on the market. Most of the Chicago jobbers have changed to Card 41, taking off the premium which they had placed on shipments out of the Chicago stocks.

POLES.—There seems to be a well-defined notion that prices of poles will be readjusted gradually and then only as the prices of commodities used most by the producer are altered. Labor is a large factor. Pine-pole producers are rather jubilant over the prospect of early imports of creosote oils, which will, they feel, reduce treating costs materially. Inquiries are coming in from central stations.

WASHING MACHINES.—The market is still intensively active. Middle Western manufacturers who have heretofore made only the dolly type are nearly all adding some cylinder-type models to their lines. Prices are quite steady. Deliveries are improving somewhat.

VACUUM CLEANERS.—The trade is watching with some interest an attempt which is being made to get all vacuum-cleaner manufacturers together to form a single central vacuum-cleaner manufacturing company.

BOSTON

Filling of back orders occupies the trade at this time, new business remaining quiet. Deliveries are steadily improving and prices are still firm in most lines. Stocks are fairly large. Credits are carefully watched and collections are somewhat slow, though not much real change is seen from week to week in this departmnt of trade activity. Central-station power business still holds up well. The Narragansett company of Providence, R. I., has resumed its pre-war policy relative to the financing of extensions, and none of the power contracts taken during the past year has been canceled. The Revere Rubber Compay, plant No. 2, recently contracted for 10,000 hp. from this company, and about two years will be required in the development of the load to the above maximum. Labor is becoming more plentiful in Massachusetts, but the recent army plan to retain men in service until they secure work in the civilian field will tend to relieve the overplus now rapidly accumulating in some sections. The tendency toward lower food prices is another factor which appears likely to be helpful in reducing unrest as wages decline.

LAMPS.—No reduction in prices seems likely to take effect before July. Business holds up well and stocks are improving, with resultant good deliveries.

APPLIANCES.—Energetic distributers report some gain in business for January compared with last year. The demand for portable lamps has been well maintained, and many stocks have been greatly reduced through post-holiday sales, even without customary mark-down prices. The influenza epidemic has hurt trade in some localities.

FARM-LIGHTING SETS.—One prominent dealer reports better sales in the first half of January than were booked in the entire last quarter of 1918. The high cost of line construction in thinly settled communities has helped this business get a start, and the publicity campaigns which have been run off have begun to bear fruit. Some purchasing of farm-lighting sets is reported for the merchant marine. Local stock reports offer immediate shipments.

INDUSTRIAL ELECTRIC TRUCKS.—Inquiries are coming in steadily, but for the moment sales are a little dull. The factories are getting into better shape each month to handle a large civilian business.

ELECTRIC COAL LOADERS.—Inquiries are coming in well for the spring business, and the outlook is good despite a present slack period as to orders. Immediate deliveries can be made from stock.

ELECTRIC RADIATORS.—These units are moving well and the supply is keeping well up with the demand at present. The mild winter is leading to a widespread use of such equipment in limited service heating. Here and there retailers are cutting prices a little, but there appears to be no real necessity for it.

PORTABLE LAMPS.—Stocks are a good deal reduced, but many attractive offerings are left. Buyers do not seem to worry about prices, given a varied selection of types.

DISHWASHING MACHINES.—Interest is picking up fast, and one central station has ordered two carloads of machines for early delivery. The servant problem is still acute in many localities and motorized household devices bid fair to "sell themselves" this year.

FLASHLAMPS.—Trade is a little quiet, and one prominent manufacturer is reported to be soliciting orders on the basis of a guarantee against price reductions.

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ATLANTA

Wholesale and jobbing trade is quiet, but probably no quieter than a week ago. Locally, manufacturing and industry continue active. Retail sales are as good as, if not better than, this time last year. Dealers in machinery note a slight falling off in collections, probably due to holding of cotton. High prices in materials retard building. Some activity is noted, mainly in the nature of repair work. The return of many soldiers has eased the labor situation.

The future of cotton prices is an item that is holding the center of the stage at this time. The entire cotton and textile industry has been in an uncertain position since the cancellation of war orders. Buyers have withheld orders until more definite information was available as to the disposition of goods owned by the government and raw materials purchased by the mills to cover their contracts, as well as the future trend of prices for the staple. Recent announcement of the terms of payment by the government on orders held up because of the armistice, which are considered very fair, will place the industry on a more settled basis. The mills have been running full, but the end of unfilled orders is in sight, with practically no new business being placed. It is expected that some curtailment will be necessary unless new orders are forthcoming. It now looks as if Congress will stop the housing program at Wilmington, N. C., Savannah and Brunswick, Ga. The fleet corporation has ample funds, but the idea is to hold up all work that is not well under way. A number of new plants are locating in the Terrebone gas field, Houma, La. These include the Louisiana Oxygen Company, Louisiana Crushing Company and the Refining Products Company.

FIXTURES.—Although wholesale requirements have dropped off, the call through retail channels appears to be holding up fairly well. This demand is coming from outlying and semi-rural sections. The volume of business in the larger centers has fallen off, and it is not expected that revival will take place until building work gets under way. Remodeling and decorating tends to stimulate sales for standard types. Portables are moving slowly and activity has practically ceased. Stocks are being held to a minimum.

SCHEDULE MATERIAL.—Knife switches, cut-outs, fuse plugs and sockets are moving fairly fast. Shipments are good and stocks are well maintained. Retail sales for repair and maintenance work are good, but on account of the lack of building no large orders are being placed.

TELEPHONE EQUIPMENT.—Jobbers report great activity in the rural or community type telephone systems. The call is growing more insistent, and inquiries are well above those registered for the same period last January. These outfits have been hard to get, but shipments are becoming more free.

WIRE.—There has been a decrease in the movement of weatherproof since last week, owing to the fact that outside construction has slowed up considerably. Rubber-covered, however, maintains its position fairly well. This section has received no notice of change in price this week.

SEATTLE—PORTLAND

The strike of approximately 30,000 shipyard workers and employees in contract shops in Seattle and approximately 10,000 in Tacoma predicted last week materialized Jan. 21. No particular attempts have been made to settle the controversy. The Metal Trades Council, representing the strikers, is determined if possible to call out other unions in a sympathetic strike, and a referendum vote is being taken. Electrical jobbers report that during the week no deliveries of any kind were made to shipyards. Local jobbers as a whole do not believe there is a possibility of a sympathetic strike, but expect that ship owners will sit tight and that a compromise will be effected in the near future. If the strike continues, naturally a general depression will result, including the electrical business.

January, always a slow month, is slightly under normal this year. Firms are engaged in taking inventories and checking up for the past year. Moreover, a feeling of uncertainty prevents heavy buying. Stocks are in good condition in all lines. No shortages are reported. Shipments from the East are coming through as fast as needed, although transportation facilities are still bad. During the week another decrease in wire occurred. Collections are not affected by strike conditions up to date, and continue satisfactory. Floods throughout Washington are doing considerable damage and tying up traffic.

The Seattle municipal lighting plant is closed down temporarily owing to a break of 600 ft. of wooden stave pipe at Cedar River Dam.

The Portland district reports that business in general in electric lines is not so good as it was this time a year ago. The outlook for the future, however, is encouraging. Salesmen are busy with prospects for heavy future orders. Reports from Spokane show that wholesale and retail trade is fair. Manufacturing is quiet, but collections are in good condition. A general feeling of uncertainty pervades the Tacoma district and retail trade is not very active. Merchants are buying cautiously, and it is believed this condition will continue for some time. With most of the dealers pretty well stocked up, no large orders are contemplated at present.

A large amount of public improvement work is contemplated for early spring, and plans are being prepared for a number of big projects in Seattle. Irrigation work promises to be exceptionally active, and numerous inquiries are booked by local jobbers for electrical equipment and material for this work. The Legislature now in session in Olympia is expected to pass on several large irrigation projects which will be undertaken during the year.

SAN FRANCISCO

Business continues at a good rate. Orders are of rather small size, it is true, but there are many of them. Industrial-plant business has fallen to mere maintenance material. The buying public shows an unprecedented interest in electrical household helps, but there is a disposition to investigate various makes before purchasing, an attitude due probably to the present first cost of such devices.

The snowfall is alarmingly light on the Sierras, only 47 in. being reported at Summit, a 7000-ft. elevation, although there is a deeper pack in the lower valleys where the big Pacific Gas & Electric Company lakes are located. Unless the situation is bettered within the next month, the 1918 drought and artificial irrigation will be repeated. Rains have been generous along the coast and central valleys, and indications are for a banner year for all sorts of natural products.

Credits and collections are reported very good—principally because of the gradual weeding out of "lame ducks" or their absorption into factories. It is expected that returning soldiers who have acquired electrical experience in the Signal Corps or Engineer Corps will try to reënter the electrical field. Many have already been given positions in motor-winding shops or with electrical contractors. A 3600-acre tract near Fresno for returned soldiers has been tentatively set aside which may really solve absorption difficulties.

There are few outstanding construction features of the past week, save that the railroads are again at work on such construction as new roundhouses and stations, something that has not been undertaken for the last two or three years.

STREET LIGHTS.—One of the first street-lighting jobs reported after the removal of the non-essential ban is that of Palo Alto, where the trustees have authorized bids.

FANS.—Active solicitation for the summer season will soon begin. It is hoped in the trade that the season will be better than was last year, and possibly the lessening of urgent demands for other sorts of work will put jobbers in a better position to solicit the trade intelligently. Prices run about the same as last year, perhaps 5 per cent higher.

EXHAUST FANS.—Many sales of exhaust fans are reported because of the increasing construction of small restaurants, offices and auditoriums, where they are a necessity.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20% List
Coil to 1000 ft	
	No. 12 Solid
Less than coil	+20% List
Coil to 1000 ft	

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20% List
Coil to 1000 ft	

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20% List
1/5 to std. pkg	
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅛	250	$5.00
¼	250	7.50
⅜		10.00
½		13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅛	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
¾	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅛-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
¼-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅛-in.—	$60.00	$30.00	$26.00–26.50
¼-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
⅛	$0.08½
¼	.08½
⅜	.08½
½	.11½
¾	.17
1	.23
1¼	.27½
1½	.37½
2	.58½
2½	.76½
3	

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
⅛	$0.05	$0.19
¼	.06	.19
⅜	.07	.19
½	.10	.25
¾	.13	.37
1	.17	.45
1¼	.21	.50
1½	.28	1.10
2	.40	1.80
2½	.60	4.80
3		

DISCOUNT—NEW YORK

	⅛ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	⅛ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+5.5% to +3%	+3.5% to +1%
2500 to 5000 lb.	+2.5% to +2%	+5% to +4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List, each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00–$38.00
Coil to 1000 ft.	27.00– 28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00

Standard package, 2200. List per 1000, 20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$32.00
1/5 to std. pkg.	13.60	27.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5 to %5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	+2% to 8%
$25 to $50 list	+5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+35% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	+10% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.54– $0.66
No. 18, full spools	.52– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.435 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$17.50–$25.00	$12.00–$17.00	$12.00–$15.00
12	22.20– 27.09	19.98– 23.22	16.65– 23.22
10	30.20– 32.40	27.18– 32.40	21.75– 27.45
8	37.62– 45.72	34.49– 45.72	30.10– 38.10
6	59.58– 72.36	54.62– 60.30	47.66– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$20.00–$24.00	$15.00–$17.00	$13.50–$15.00
12	25.83– 30.48	25.83– 30.48	25.83– 26.67
10	35.77– 42.32	35.77– 42.32	30.66– 37.03
8	49.84– 50.36	49.84– 59.36	42.72– 51.94
6	79.80–101.28	68.40– 88.62	68.40– 88.62

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$31.75 to $34.75
25 to 50 lb	31.75 to 34.75
50 to 100 lb	30.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$34.76 to $39.75
25 to 50 lb	33.76 to 38.75
50 to 100 lb	32.76 to 37.75

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NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Unit-Type Busbar Spacers

Where short-circuit forces will subject busbar supports to a cantilever pull busbar spacers are desirable. The tensile and compression strength of the supports is greater than their

ANY NUMBER OF UNITS AND CLAMPS MAY BE COMBINED

cantilever strength, but when spacers are installed the cantilever pull on the busbar supports is practically neutralized. Bus spacers are subject only to tensile or compression forces and will therefore withstand much greater forces than supports under a cantilever pull. The Delta-Star Electric Company of 2433 Fulton Street, Chicago, has developed and is marketing new spacers which are of the standard unit-type design.

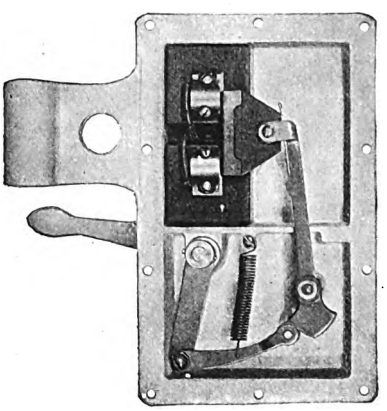
Master Controller

A new multi-speed full-reverse master controller that may be mounted horizontally or vertically, thus permitting in the former case a straight-line movement of the handle and in the latter case a radial movement, has been brought out by the Cutler-Hammer Manufacturing Company of Milwaukee. This master switch is smaller than previous designs and is intended for use with automatic magnetically operated controllers. It is said to be especially useful in connection with steel-mill and crane controllers, where the operator's attention should not be diverted from the work or machine and where space is limited.

An internal-gear drive which is entirely inclosed but is readily accessible by the removal of four screws in the lower portion of the operating handle eliminates the liability of accident to operators through the catching of fingers or clothing in the bevel gears often employed in straight line-drive control. A centering latch operated by a button in the handle indicates to the touch the "off" position of the master, while a strong notching spring is used to indicate the five positions in either direction. A maximum of twelve fingers may be mounted on the finger-board, using six in one direction of rotation and six in the other. The new controller, although very small and compact, is so designed that by the removal of two bolts the entire finger board may be taken from the frame, while the removal of three bolts allows the entire shaft and contact fingers to be withdrawn. Inspection, renewals and repairs are, therefore, said to be easily effected. The construction of the finger board and drum follows the standard practice of this company in that the fingers and segments are clamped to square insulated steel shafts and adjacent contact points are separated from each other by arc barriers.

Inclosed Tank Switch of Single-Pole Double-Break Type

For regulating pumps connected with tanks, sumps, receivers and like receptacles, an inclosed switch of the single-pole double-break type has just been placed on the market by the Blackburn-Smith Corporation, 105 West Fortieth Street, New York City. The movement of a float operated by means of "grasshopper" levers moves a roller across a cam on the end of the electrical contact lever, the roller being held closely to the cam by a spring. This spring throws the contact lever with a positive motion at the instant the roller passes over the cam's center.



FIXED CONTACTS ARE MADE OF CARBON

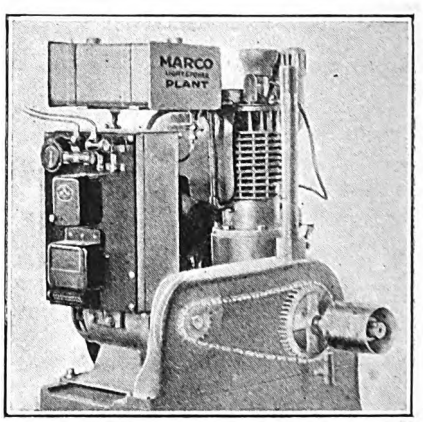
A block of transite ebony asbestos supports the fixed contacts and also acts as an insulating bushing for the incoming wires which are brought through a boss in the back of the case, the boss being threaded to receive a ¾-in. (1.9-cm.) conduit. The fixed contacts are short cylinders of carbon held by set screws in machined brass terminals bolted to and insulated by the transite block. The moving contact is a folded copper strip bolted to a piece of transite which is loosely pivoted in the forked end of the cam lever.

The switch, which may be waterproofed if desired, is furnished either alone or with its accessories, which include a cast-iron stand and bracket, a float of 16-gage spun copper, and the guide rod, which is of seamless drawn brass tubing with aluminum stops and collars.

Chain-Drive Light and Power Plant

A distinctive feature of the new "Marco" farm lighting and power plant being made by the Marmon-Chicago Company of Chicago is the silent-chain drive used to connect the engine and the generator. A number of advantages for the plant are claimed through the use of this method of connection. Belt slipping and the loss of power often characterizing belt-driven plants are done away with, and, unlike some of the directly connected types, the engine of the "Marco" plant, according to its maker, can be geared to run the generator at a high speed without racking the engine, thus making for long life. The chain drive permits the use of a low-speed kerosene engine of 800 r.p.m. geared to an electric generator with a rating of 1800 r.p.m.

The new plant is a single compact unit, the engine, generator and control system being mounted on one base. The air-cooled 4-hp. engine, however, can be removed from the base in five minutes, mounted on field machinery and used to run binders and similar instruments. The engine also may be used to operate churns, freezers and other labor-saving devices indoors, thus making the "Marco" plant a dual power outfit that supplies both kerosene engine and elec-



ENGINE AND GENERATOR ARE COMPACTLY MOUNTED ON ONE BASE

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trical power. Both the engine and the 1250-watt generators are said to have an overload capacity of 25 per cent. While the plant is made in two models, one being a fifteen 20-watt light set and the other a one hundred 20-watt light outfit, the generator and the engine are the same in both cases, the batteries alone differing in size.

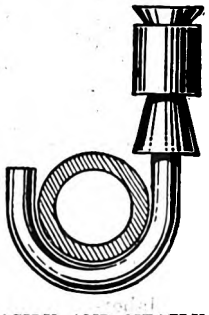
The control apparatus used with these outfits is said to be very effective in regulating the current entering the batteries. By its use the current "tapers off" as each cell becomes charged, thereby preventing injury to the battery through overcharging. The control is designed to maintain a constant voltage regardless of engine speed, and should the governor slip or be incorrectly set the control will prevent overloading the generator and a consequent burning out of lights, fuses or equipment. In this manner meters, rheostats and other puzzling devices are eliminated, says the manufacturer, making the operation of the plant "simplicity itself," only a push button being used to start it.

Heavy Overload Ammeter

A commercial ammeter which it is claimed will withstand a momentary sixty-fold overload is being marketed by Nalder Brothers & Thompson, Ltd., of 97a Dalston Lane, London. Owing to special construction the maker says that this new ammeter is exceptionally "dead-beat" and has a very light movement for its size. The pivots are easily removable for repolishing and the scale is approximately logarithmic, so that it is said an overload of double the normal current can be observed while at the same time the regular scale reading is not impaired. The instrument is spring-controlled and can be read in any position. It is housed in an open-fronted case with an 8-in. (20-cm.) dial to match the power-factor indicator and the rotary sychroniser made by this company.

Combination Expansion Bolt and Hanger

The functions of an expansion bolt and a conduit hanger are combined in a single piece of apparatus manufactured by the Chicago Expansion Bolt Company, 330 West Washington Street, Chicago. This device has a U-shaped body which clamps the pipe and is also provided with an expansion attachment which holds it securely to the wall or ceiling. It is installed by inserting the expansion or straight end of the device into a hole, after the conduit has been placed in the hanger, and driving the metal wedge with a fluted hammer into the lead expansion member which fills the crevices in the hole drilled to receive it. The manufacturer claims that the ¼-in. (6-mm.) size will sustain from 1500 lb. to 2000 lb. (680 kg. to 907 kg.) in direct pull, depending upon the masonry. The advantages claimed by the manufacturer are those of minimum drilling in brick or concrete, less labor required to install, less material required and neatness of installation. The device is made in sizes adapted for all sizes of conduit and can be furnished in galvanized, black or plain finish.



MAY BE EASILY AND NEATLY INSTALLED

Plug That Fits on All Heating Appliances

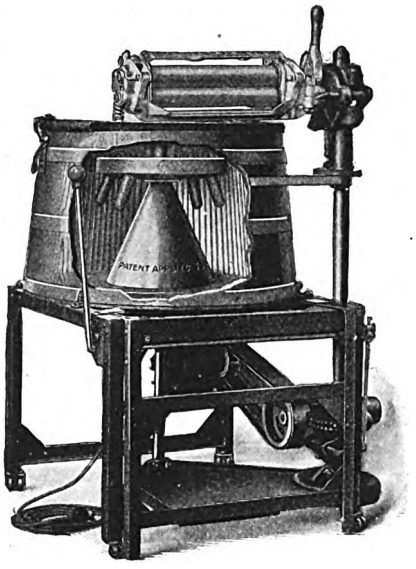
Electrical heating appliances are made with different kinds of terminals so that when an iron, a toaster and a stove of different makes are used in a home it is frequently necessary to have three cords and three different attachment plugs. To eliminate this inconvenience the Redtop Electric Company of 8 West Nineteenth Street, New York City, has just placed on the market the "Fitzall" attachment plug which fits the terminals of all table stoves, heaters, toasters, irons and other electrical heating appliances.

The connector clips used in the new plug are formed of two pieces and offer a flat surface to make contact with a flat terminal and a round surface for making connection with a round terminal. One of the two pieces is made of spring brass and is formed to preserve its resiliency, thus preventing spreading of the clip and insuring a perfect contact even after long use. Another feature of the plug is the elimination of loose nuts, since the machine screws holding the two halves of the case together screw into threaded bushings which are molded into the case. Black heat-proof composition, knurled on the sides and highly polished, is used for the case, which has no spring attached since the openings for the cord are made with rounded edges and therefore prevent fraying.

Improved Dolly-Type Clothes-Washing Machine

An electric washing machine has been placed on the market by the Hirschy Company of Minneapolis which has an inverted cone-shaped device projecting below the usual "dolly" agitator in the center of the tub. Through its use the clothes are kept from collecting in a heap in the center of the washer and are forced into a wide circle and a greater volume of water, the slant of the cone causing the water to be greatly agitated. In this way hot soapsuds are forced through clothes, it being pointed out that the top lip on the cone prevents the clothes from rubbing against the dolly and so eliminates wear and tear.

With the exception of the tub, made of Southern cypress, the entire machine, including the double folding platform for two extra tubs, is constructed of metal. Motors for different kinds of electric service may be obtained and all the machinery and gears are inclosed and out of the way. Attached to the transmission gears is a small pulley which may be used to run an ironing machine or other labor-lightening devices. A lever, conveniently located, controls the operation of the washer, another feature of which is the three-position, tilting, ball-bearing wringer having tension springs to adjust the rolls for thick and thin clothes and a positive safety release which unlocks the top roll when lifted.



CONE DEVICE PREVENTS CLOTHES COLLECTING IN A HEAP

Peanut-Butter Machine

An improved model of the electrically operated peanut-butter machine made by the A. J. Deer Company of Hornell, N. Y., has been placed on the market in two sizes, one having a ½-hp. motor and making about ⅓ lb. (0.15 kg.) of peanut butter per minute and the other being driven by a 1-hp. motor and having a production capacity of approximately ¾ lb. of butter (0.3 kg.) per minute. Because gears are used to connect the motor with the grinders the maker states that the most suitable speed for this kind of work is secured. The use of special steel burrs in grinding the peanuts is said to insure making proper fineness in the butter. All working parts of the machine are heavily tinned and nickeled. Cleaning is simple. The machine, which in its exterior resembles a coffee grinder, may be secured for either alternating or direct current, a conveniently placed snap switch controlling the motor.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An electrician in Spain (No. 28,112) desires to secure an agency for the sale of electric lamps, electrical goods and fittings of all kinds. Correspondence should be in Spanish.

A firm in Norway (No. 28,120) desires to purchase and secure an agency for the sale of engines, boilers, light, heat and power equipment, wireless telephone and telegraph apparatus, internal-combustion engines and railway and tramway equipment.

The following cablegram, dated Jan. 14, has been received by the Bureau of Foreign and Domestic Commerce from the American Consul at Brussels, Belgium: "Please send immediately for Central Committee of Belgian Industries, coöperating with government, catalogs and trade journals for electrical machinery, belting, tanned leather, machine tools, automobiles, motors and hardware for reconstruction."

Rojas, Randall & Company, 26 Beaver Street, New York City, are desirous of getting in touch with reliable manufacturers of telephone and telegraph wire, modern telephone apparatus for Morse, Hughes and Baudot systems and electrical machinery in general, including turbines. This material is to be used in Spain.

The Bureau of Foreign and Domestic Commerce is in receipt of several trade lists from representatives in the Far East which may be obtained from the bureau or through its district or coöperative offices by referring to file number in parentheses: Electrical supply dealers in Bombay, India (9519); leading industrial and engineering firms in Ceylon (9525).

GOVERNMENT SPRUCE BOARD TO SELL MOTORS.—Ten million dollars' worth of equipment owned by the United States Spruce Production Corporation, with headquarters in the Yeon Building, Portland, Ore., is to be sold, and sealed bids for the same will be received by the sales board up to and including Feb. 15. Included in the equipment are alternating-current motors, 440-volt, three-phase, 60-cycle, from 3 hp. to 75 hp., with or without starter.

TO LAUNCH ELECTRIC SIGN CAMPAIGN.—The Federal Sign System (Electric) is just about to launch an effective sales effort on electric signs. This campaign will have several features. An effort will be made to reach responsible executives of central-station companies with information showing electric signs as revenue producers which do not require much extra investment cost. The slogan of the popular campaign will be "Brighten up for the homecoming of the boys." This promises to be quite popular, judging from the results that have been observed in Indianapolis, Minneapolis, Chicago and Cincinnati, where some newspaper copy based on this slogan has been used. In order to assist the central stations in this work the Federal Sign System (Electric) has worked out a plan for carrying accounts where signs are purchased by merchants on time. This will relieve central stations of financial obligations that some of them are ill prepared to carry.

YOUNG BROTHERS INSULATED STEEL OVENS IN DEMAND.—The Bradford-Ackermann Corporation of 30 East Forty-second Street, New York City, Eastern representative of the Young Brothers Company, manufacturer of insulated steel ovens, reports a large amount of interest in electrically heated ovens for japanning, enameling, drying, and core and mold baking. The firm reports business in this line during 1918, closed and in operation, as follows: Curtiss Aëroplane Corporation, Buffalo, N. Y., kiln oven for japanning aëroplane parts; General Electric Company, Schenectady, N. Y., seven ovens, kiln type, for general electric machinery drying and baking; Federal Shipbuilding Company, Newark, N. J., kiln ovens for drying armatures and coils; Fillmore Avenue Foundry & Iron Works, Buffalo, N. Y., kiln oven for japanning; Ericsson Manufacturing Company, Buffalo, N. Y., drawer-pull oven for japanning Berling magnetos; Fairbanks Company, Philadelphia, two ovens (one for France) for japanning aëroplane parts; Taylor-Wharton Iron & Steel Company, High Bridge, N. J., drawer-pull oven for foundry core baking; S. O. & C. Company, Ansonia, Conn., kiln oven, recirculating system, for japanning eyelets, etc.; Sprague Electric Works, Bloomfield, N. J., kiln oven for drying armatures and coils; Connecticut Electric Steel, Hartford, Conn., drawer-pull oven for foundry core baking; Crouse-Hinds Company of Syracuse, N. Y., kiln oven for foundry core baking; Pratt & Whitney, Hartford, Conn., drawer-pull oven for core baking. In addition, the Electro Dynamic Company of Bayonne, N. J., purchased three large kiln ovens, steam-heated, for drying the armatures used in its interpole motors and generators. This company also purchased a special continuous conveyor oven, gas-heated, which is used in the drying of varnish insulations on the armature and field-pole laminations. These laminations were formerly air-dried, requiring about forty-eight hours, and the whole operation now is done, more effectively, in the short interval of three minutes.

C. N. BARNEY, 115 Broadway, New York, has been appointed to act as local representative for the Worthington Pump & Machinery Corporation.

W. K. BROWN has been appointed district manager of the Crocker-Wheeler Company at Newark, N. J. Mr. Brown was formerly joint sales representative of the company with C. E. Ingalls at San Francisco. Mr. Ingalls now becomes district manager at San Francisco for the company.

THE H. W. JOHNS-MANVILLE COMPANY is reported to have purchased a tract of 255 acres on the lake shore at Waukegan, Ill., upon which it intends to construct a three-million-dollar plant to manufacture asbestos and magnesia products. The plant is to have a capacity of 35,000 cars yearly, and it is understood that it will employ 2500 to 3000 people.

CAPT. EDWARD E. ASHLEY, JR., for many years consulting mechanical and electrical engineer for Starrett & Van Vleck, architects, New York City, has resigned his commission in the Air Service of the United States Army to accept an appointment as sales engineer of the Mercury Manufacturing Company, Chicago, Ill., manufacturer of electric industrial trucks.

THE AMERICAN PIPE BENDING MACHINE COMPANY, with offices at 39 Pearl Street, Boston, Mass., announces that it is about to open pipe-bending plants in all large cities throughout the country. The first plant is about ready for operation at Lowell, Mass. "Wonder" pipe benders, manufactured by this company, will be used at all plants. Each plant will have facilities for turning out from 1000 to 3000 bends per day. The present company was capitalized at $100,000. The old company is about to be reorganized with a capital of $1,000,000 to carry on this business.

THE CENTRAL TELEPHONE & ELECTRIC COMPANY, St. Louis, Mo., has recently become one of the agent-jobbers of the Westinghouse Electric & Manufacturing Company. F. D. Phillips, who is president and sales manager of the Central Telephone & Electric Company, started in the electrical business with the Electric Appliance Company of Chicago, Ill., and remained with that company until about thirteen years ago, at which time he came to St. Louis, where he has been identified with the jobbing business up to the present time. In May, 1916, he purchased the stock of the Central Telephone & Electric Company. In line with its new policy the company's warehouse space has been greatly increased, which enables it to carry a larger stock.

J. N. ADAM, who for the past nine years, has been connected with the new-business department of the Public Service Electric Company of New Jersey, has become associated with S. C. Schrenck, Eastern manager for the Belden Manufacturing Company of Chicago. He will cover the Metropolitan district, as well as the southeastern section of the Atlantic seaboard. During his association with the Public Service Electric Company Mr. Adam was very prominent in the various activities of the company, as well as an active member of the Illuminating Engineering Society and the National Electric Light Association. As a member of the former society he served on a number of important committees and has been for the past six years a local representative for New Jersey. He is at this time chairman of the store-lighting committee of the N. E. L. A.

Trade Publications

CUT-OUT BOXES AND CABINETS.—The Allsteelequip Company, Aurora, Ill., has distributed a new electrical cut-out box price list.

VACUUM CLEANER.—A folder on the Eureka vacuum cleaners has been issued by the Eureka Vacuum Cleaner Company of Detroit, Mich.

LIGHT AND POWER PLANTS.—The improved models of its "Alco" farm lighting and power plants are the subject of a folder issued by the Automatic Light Company of Minneapolis, Minn.

MASSAGE VIBRATOR.—A two-color folder about the "Star" massage vibrator has been prepared by the Fitzgerald Manufacturing Company of Torrington, Conn., which makes this device.

EXTERNALLY OPERATED SWITCHES.—The Trumbull Electric Manufacturing Company of Plainville, Conn., is distributing its bulletin No. 2, cataloging "safety service" externally operated switches.

BOILERS.—"The Heine Idea" is the title of a booklet issued by the Heine Safety Boiler Company of St. Louis, Mo. This publication is illustrated and touches briefly on the boilers and superheaters made by this concern.

OIL STORAGE AND DISTRIBUTION.—The latest booklet issued by the Wayne Oil Tank & Pump Company of Fort Wayne, Ind., deals with storage and distribution systems for oils, varnishes, gasoline and similar materials.

INCLOSED TANK SWITCH.—Bulletin SX-60, which is descriptive of its new inclosed switch for regulating liquid levels in tanks, sumps, receivers, etc., will shortly be issued by the Blackburn-Smith Corporation, 105 West Fortieth Street, New York City.

WATERWHEEL-DRIVEN GENERATORS.—The General Electric Company of Schenectady, N. Y., has published a forty-page booklet entitled "Waterwheel-Driven Generators" which contains illustrations of many hydroelectric stations using apparatus manufactured by this company.

HEATING APPLIANCE PLUG.—The "Fitzall" plug, which is said to fit all makes of irons, stoves, toasters and other heating apparatus and which is marketed by the Redtop Electric Company, 8 West Nineteenth Street, New York City, is the subject of a leaflet from that company.

DISPLAY CASE LIGHTING.—The National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, has published a new booklet on display-case lighting with X-ray reflectors. "Scoopettes," "Hoodettes" and other X-ray lighting equipment are described in this illustrated booklet, which also gives general information on showcase illumination.

New Incorporations

THE WILLIS ELECTRIC CORPORATION of Buffalo, N. Y., has been chartered under the laws of Delaware with a capital stock of $100,000 to manufacture electrical specialties. The incorporators are James A. Willis, E. B. Parson and S. C. Dyer.

THE SUNLIGHT ARC CORPORATION of New York, N. Y., has been chartered with a capital stock of $1,000,000 by J. J. Harmer, 2585 Concourse; J. S. Dawley, 218 West Forty-eighth Street, and E. S. Porter, Hotel Thersea, New York City. The company proposes to manufacture a patented arc lamp.

THE HYDRO-ELECTRIC CORPORATION of Philadelphia, Pa., has been incorporated by F. R. Hansell of Philadelphia, Pa.; E. M. MacFarland and J. Vernon Pimm of Camden, N. J. The company is capitalized at $100,000 and proposes to promote and build electric light and power plants, etc.

THE LAURAINE MAGNETO COMPANY of New York, N. Y., has been incorporated by H. Burke, 59 West Forty-fourth Street; T. H. Murphy, 61 Broadway and H. B. Arden, 78 West Thirty-fourth Street, New York City. The company is capitalized at $1,250,000 and proposes to manufacture electric generating machinery

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New England States

QUINCY, MASS.—The Quincy Electric Light & Power Company has petitioned the Gas and Electric Light Commissioners for an approval of an increase in capital stock from $300,000 to $400,000. The proceeds are to be used to take up outstanding indebtedness incurred for extension and improvements to its plant.

TURNERS FALLS, MASS—The capital stock of the Turners Falls Power & Electric Company has been increased by $2,409,100.

NEWPORT, R. I.—Work has begun on the erection of a heating plant and cold storage building at the local naval station, to cost about $1,000,000.

BRIDGEPORT, CONN.—The Fire Commissioners are contemplating the construction of a police station on Caroline and Arctic Streets, to cost about $75,000.

SIMSBURY, CONN.—The capital stock of the Simsbury Electric Company has been increased from $15,000 to $20,000, to provide for improvements made during 1918.

Middle Atlantic States

AUSABLE FORKS, N. Y.—The Ausable Forks Electric Company has petitioned the Public Service Commission for permission to construct a new electric plant at Jay. The cost of the proposed plant is estimated at about $25,000.

CALLICOON, N. Y.—The distributing system, franchise and rights of the Callicoon Independent Electric Company have been purchased by the Livingston Manor Electric Company. The local generating plant was not included in the sale.

CANISTEO, N. Y. — Bonds to the amount of $15,000 have been voted for the purpose of establishing a municipal lighting system in Canisteo. Of this $7,000 will be used to purchase the street-lighting system of the Canisteo Light & Power Company. It is proposed to erect a new building and install a new 35-hp. oil engine to operate the 50-kw. generator in the present plant.

COHOES, N. Y.—Bonds to the amount of $2,500,000, it is reported, have been issued by the Cohoes Power & Light Corporation. Part of the proceeds will be used for extensions and improvements.

ITHACA, N. Y.—Plans are being prepared for the erection of a new boiler plant at the works of the Remington Salt Company at Cayuga Lake, to cost about $25,000.

LIVINGSTON MANOR, N. Y.—The Livingston Manor Electric Company has purchased the distributing system, stock, franchises and rights of the Callicoon (N. Y.) Independent Electric Company. The Livingston Manor company contemplates the erection of an electric transmission line from Jeffersonville to Hortonville to connect with the Callicoon line and also to connect the newly acquired system with the local plant. The above purchase and contemplated changes are subject to the approval of the Public Service Commission.

MONROE, N. Y.—Notice has been filed by the Orange Rockland Electric Company with the Public Service Commission of a merger with the Warwick Valley Light & Power Company.

NEWFANE, N. Y.—A committee has been appointed to take steps to secure improvements to the street-lighting system. J. A. McCollum is chairman of committee.

NEW YORK, N. Y.—Plans have been filed by the United Electric Light & Power Company, 130 East Thirteenth Street, for the erection of a motor-generator house, 74 ft. by 26 ft., one story, on Academy Street, near 201st Street, to cost about $16,000.

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 10, under Specification 3607, for coal and ash-handling equipment at the New York Navy Yard. The cost is estimated at $80,000.

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 10, under Specification 3749, for installing refrigerating equipment at Ward's Island, N. Y., to cost about $30,000. A deposit of $10 will be required for plans.

NEW YORK, N. Y.—Plans have been filed by the Standard Concrete Steel Company, 105 West Fortieth Street, for the erection of a three-story building, 100 ft. by 175 ft., on West Sixty-first Street, near Amsterdam Avenue,, to cost about $200,000. A portion of the building will be used as a machine shop.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—Plans are being prepared by the New York Telephone Company for the erection of a new telephone exchange building, about 100 ft. by 100 ft., at 167th Street and Grand View Place. The company, it is understood, is also considering the construction of an exchange building, 50 ft. by 100 ft., in the Bath Beach district, Brooklyn. McKenzie, Voorhees & Gmelin, 1123 Broadway, are architects for the company.

POUGHKEEPSIE, N. Y.—The Central Hudson Gas & Electric Company has applied to the Public Service Commission for permission to issue $750,000 in bonds, the proceeds to be used for proposed extensions.

SPRINGWATER, N. Y.—Application has been filed with the Public Service Commission by the Springwater Electric Light Company for permission to construct and operate an electric light plant in Springwater, and also for approval of the exercise of a franchise granted by the town authorities in January, 1918.

SYRACUSE, N. Y.—The entire boiler house and part of the plant belonging to Procine & Rossi, 408 East Division Street, was recently destroyed by fire, causing a loss of about $10,000.

WEST ALBANY, N. Y.—The New York Central Railroad Company is planning to erect an engine house at West Albany, to cost about $70,000. W. J. Wilgus, Grand Central Terminal Building, New York City, is chief engineer.

BRUNSWICK, N. J.—Plans are being prepared by Alexander Merchant, 363 George Street, for the erection of a vocational school on Easton Avenue, to cost about $60,000. A mechanical department equipped with machinery is included in the plans.

CAMDEN, N. J.—Plans have been filed and contract awarded to the Fraser Brace Company, 1328 Broadway, New York, by the New York Shipbuilding Corporation for the erection of a new substation at its plant, to cost about $25,000.

ELIZABETH, N. J.—Plans have been prepared by the New York Telephone Company for the erection of a new telephone exchange building at 1192-96 East Grand Street, to cost about $50,000.

NEWARK, N. J.—An appropriation of $100,000 to provide for light, heat and power at the County Hospital at Overbrook for 1919 has been approved by the Board of Freeholders.

NEWTON, N. J.—Plans are under consideration by the township committee for an addition to the electric plant at the local almshouse.

TRENTON, N. J.—Plans have been prepared for the erection of a new factory for the Hutchinson Storage Battery Company, 230 South Warren Street.

ALLENTOWN, PA.—Plans are being prepared for the construction of a new electric lighting plant to be operated in connection with the municipal waterworks system. It is proposed to install a steam-driven electric generating plant, using the excess boiler capacity at the pumping station to generate electricity for street-lighting purposes, etc.

MAUCH CHUNK, PA.—Plans are being prepared by M. G. Prutzman, Court House, for the installation of a new electric plant.

PHILADELPHIA, PA.—The low bid submitted to the city for the construction of the proposed power plant, fire and police station, to be erected at Twenty-fourth and Rittner Streets, was submitted by the Frank H. Stewart Company, 37 North Seventh Street, at $304,245.

WILKES-BARRE, PA.—Plans have been prepared for the erection of a new one-story power plant for the Vulcan Iron Works, 730 South Main Street, at Buttonwood, near Wilkes-Barre. Westinghouse, Church, Kerr & Company, 37 Wall Street, New York, N. Y., are engineers.

SALISBURY, MD.—The Salisbury Ice Company is contemplating the construction of an ice plant. The equipment will include electric motors and hoisting elevators.

MARTINSBURG, W. VA.—Sprinkle Brothers, it is reported, would like to receive prices on electrical equipment for a printing plant.

ALEXANDRIA, VA.—Plans have been announced by the Navy Department, Washington, D. C., for the construction of a new torpedo station at Alexandria. Work, it is understood, will begin in the spring.

HAMPTON, ROADS, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 17, under Specification 3328, for mechanical equipment, piping, etc., for Hampton Roads, to cost about $125,000. A deposit of $10 will be required for plans. Bids will also be received until Feb. 10, under Specification 3300, for installing coal and ash-handling equipment at Hampton Roads, to cost about $60,000. A deposit of $10 will be required for plans.

WASHINGTON, D. C.—Plans are under consideration by the United States Housing Corporation for the construction of a new single-track street-railway system on Seventeenth Street, to cost about $125,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., in the near future, for furnishing at the various navy yards and naval stations supplies as follows: Alexandria, Va., Schedule 3667—two switchboards, fourteen panels and six disconnecting switches. Brooklyn, N. Y., Schedule 3677—27,000 ft. three-conductor cable. Eastern and Western yards, Schedule 3681—miscellaneous charging stations; Schedule 3683—various kinds of wire and cable. Bids will be received until Feb. 3, under Schedule 7718¼, for searchlight carbons at the Eastern and Western yards. Bids will also be received until Feb. 10, under Schedule 7730¼, for furnishing three-conductor cable at Hampton Roads. Applications for proposal blanks should give the schedule desired by number.

North Central States

BAY CITY, MICH.—The City Council is considering building an addition to the municipal electric light plant, to cost about $125,000.

DETROIT, MICH.—The Edmunds-Jones Corporation of Detroit is considering an addition to its works, to cost about $35,000. The company manufactures lamps.

KINDE, MICH.—Bonds to the amount of $10,000 have been voted for the installation of an electric lighting system in Kinde.

LANSING, MICH.—The City Council has authorized an issue of $25,000 in bonds, the proceeds to be used for extensions to the present ornamental lighting systems.

CINCINNATI, OHIO.—Steps have been taken by the united boulevard lighting committee to request the city authorities to put into effect at once the contract with the Union Gas & Electric Company for ornamental lamps in the downtown business section. Contracts have been signed and all necessary arrangements have been made with the Union Gas & Electric Company for the installation of ornamental lamps in practically all the streets between Central Avenue and Broadway and Fourth and Eighth Streets, to cost about $100,000. For further information address Thomas J. Ryan, president of the Business Men's Club.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Feb. 6 for transformer cases for the division of light and heat. Specifications may be obtained upon application to Room 204 City Hall.

MILAN, OHIO.—Steps have been taken by farmers living in the vicinity of Milan to organize a company to operate an electric plant to furnish electricity for lighting their dwellings and operating farming machinery, etc. It is proposed to locate the power house in Milan. Roy M. Fish, George Brandt, George Mason and others are interested in the project.

ANDERSON, IND.—The city of Anderson has applied to the Public Service Commission for authority to issue $90,000 in bonds for extensions and improvements to the municipal electric light plant and waterworks system.

INDIANAPOLIS, IND.—The erection of a two-story addition to the municipal garage is under consideration.

PRINCETON, IND.—Work will begin at once by the Princeton Light & Power Company on the installation of a new street-lighting system. The present arc lamps will be replaced with large incandescent lamps. The new system was ordered two years ago, but was held in abeyance owing to war conditions.

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SOUTH BEND, IND.—The erection of a social center building at the Notre Dame University, to cost about $50,000, is under consideration.

SOUTH BEND, IND.—The Studebaker Corporation is planning to complete its new automobile works in South Bend during the present year. The plant will provide an increased manufacturing space of 2,000,000 sq. ft., and will consist of machine shop, foundry, forge shop, assembling department, stamping plant, heat treatment shop, car-testing plant, tool works, etc. The power plant having a generating capacity of about 8000 kw., has been completed.

CHICAGO, ILL.—Arrangements are being made by the railroads interested in the new $3,000,000 union station in Chicago for resuming work on the station. Construction work was started several years ago, but was delayed first by a strike and later by the war.

CHICAGO HEIGHTS, ILL.—Plans are being prepared by R. C. Clark, architect, for the construction of a fertilizer plant, 240 ft. by 520 ft., on State Street and Chicago Heights Terminal Transfer Railroad, to cost about $500,000, for the Armour Fertilizer Works, Union Stock Yards, Chicago.

ELIZABETHTOWN, ILL.—The installation of an electric lighting system for the village is under consideration by the Village Council. Richard F. Taylor is president of the village board.

LEWISTOWN, ILL.—The Council is considering the installation of a municipal lighting system in Lewistown.

LADYSMITH, WIS.—Plans have been prepared by the L. C. Meyers Company, engineer, 53 West Jackson Boulevard, Chicago, Ill., for the construction of a dam near Ladysmith for the Big Falls Water Company. The cost is estimated at about $2,000,000.

MILWAUKEE, WIS.—The construction of a new ice machine house is contemplated by the Plankinton Packing Company in connection with the proposed improvements to its plant at Muskego Avenue and Canal Streets, to cost about $200,000. Harry C. Culver is manager.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company has been asked by the County Commissioners to submit a bid for the installation of electric lamps on Burnham Street between the city limits of Milwaukee and the city limits of West Allis.

MINNEAPOLIS, MINN.—Contracts, it is reported, will soon be awarded by the Northwestern Telephone Exchange Company, Fifth Street and Third Avenue, for the erection of an eleven story ,132-ft. by 147-ft. exchange building on Third Avenue South, between Fourth and Fifth Streets.

CUMBERLAND, IOWA.—Extensive improvements are contemplated by J. V. White, owner of the local electric light plant, which will include the erection of electric transmission lines to Bridgewater and Massena.

COLUMBIA, MO.—Application has been made to the State Legislature by the managers of the State University for an appropriation to build a gymnasium, woman's and home economics buildings and power house.

COLUMBIA, MO.—Plans are under consideration for the erection of a machine shop at the University of Missouri. J. P. Jamieson, Security Building, St. Louis, is engineer.

FULTON, MO.—The board of managers of the State Hospital will petition the State Legislature for an appropriation for power plant. The cost of the power station is estimated at $40,000 and the equipment at $27,000.

MILLER, MO.—The Council has granted J. P. Alexander a franchise to install an electric lighting system in Miller. The Delco system, it is understood, will be used.

ODESSA, MO.—Plans are under consideration for disposing of the municipal electric light plant and entering into a contract with the Green Light & Power Company of Pleasant Hill for electricity for a period of twenty years.

PITCHER, MO.—The Pitcher Zinc Company is considering the purchase of four additional storage-battery locomotives in the spring.

ST. JOSEPH, MO. — Investigations of the electric power situation in St. Joseph are being made by electrical engineers from Chicago with a view, it is reported, to the installation of an independent power plant by the packing industries to supply service to the packing houses of South St. Joseph.

BEATRICE, NEB.—Plans are under consideration by George Steinmeyer of Beatrice, it is reported, for the construction of a hydroelectric plant on the Blue River, near Barneston, 20 miles south of Beatrice. The proposed plant will cost about $125,000 and will supply electricity in Blue Springs, Wymore and other towns and cities.

CANEY, KAN.—The property of the Caney Electric Light Compny, recently sold at a foreclosure sale, was purchased by the bondholders for $23,000. At present nothing will be done in regard to a new plant. The town is considering an expenditure of at least $25,000 for a new lighting plant from which transmission lines will be extended to adjacent towns.

DOWNS, KAN.—The Downs Electric Light & Power Company has sold its distributing system to the city of Downs. Electricity to operate the system will be purchased from the United Light & Power Company of Downs, recently organized.

ELDORA, KAN.—Negotiations are under way between the city officials and the Kansas Gas & Electric Company for the installation of seventy-five additional street lamps and for ornamental lamps on two additional blocks.

HILLSBORO, KAN.—Bids will be received by P. C. Hiebert, vice-president, Hillsboro, until Feb. 12 (extension of date from Jan. 27) for construction of college building for Tabor College, to cost about $100,000. Heating, plumbing and electrical work will be awarded in a separate contract later. William Mampe, Sheidley Building, Kansas City, Mo., is architect.

Southern States

DURHAM, N. C.—The City Council is considering submitting to the voters, the proposal to issue $90,000 in bonds to establish an ice plant.

RALEIGH, N. C.—The capital stock of the Palmetto Power & Light Company has been increased from $200,000 to $500,000.

WILSON, N. C.—The flour mill and the generator, owned by L. P. Woodward, which supplied electricity for lighting the country club have been destroyed by fire.

LOWNDESVILLE, S. C.—Contract has been awarded by the Lowndesville Light & Power Company to H. M. Schumpert for the erection of transmission lines at $5,000. All material except lamps for streets and residences has been purchased.

CORDELLE, GA.—The City Council is considering the construction of a municipal electric light plant.

KNOXVILLE, TENN. — The Southern Machinery Company, Empire Building, would like to receive prices on a 150-kw. to 200-kw. direct-current generator and engine, direct-connected.

LONG BEACH, MISS.—Additional electric equipment, it is understood, will be purchased by the R. Inglis Manufacturing & Commission Company.

NATCHEZ, MISS.—The City Council has engaged an engineer to prepare estimates of cost of the installation of a municipal electric light plant in Natchez.

PICHER, OKLA.—Surveys, it is reported, have been made by J. McNichols for an electric belt railway to connect Picher, Couthat and Cardin.

GALVESTON, TEX.—The Western Union Telegraph Company has petitioned the City Council for an amendment of its franchise allowing all remaining overhead wires to be placed underground. The cost is estimated at about $67,000. Material, it is understood, has been purchased.

HEMPSTEAD, TEX.—Improvements to the municipal electric light plant, including the purchase of an additional engine, are under consideration.

IRVING, TEX.—The Texas Power & Light Company contemplates the installation of a transformer to furnish electricity for the entire town.

TEAGUE, TEX.—The City Council has granted T. L. Childs and associates a franchise to construct and operate an electric light and power plant in Teague.

Pacific and Mountain States

SEATTLE, WASH.—Plans have been prepared by the Puget Sound Traction, Light & Power Company for completing the interior of the substation at Seventh Avenue and Jefferson Street, which was destroyed by fire last November.

SEATTLE, WASH.—The City Council recently passed two ordinances over Mayor Hanson's veto, appropriating $10,000 to complete the Ballard substation and $15,000 for a site for a substation on Spokane Street. The ordinances were passed on the recommendation of J. D. Ross, superintendent of lighting, who states that both projects are necessary and should be provided as soon as possible.

SEATTLE, WASH.—The Light Department has asked for the sale of $750,000 in bonds out of the total issue of $1,755,000 authorized last fall to provide for the following construction work during the present year: Substation on Spokane Street at Whatcom for the purpose of operating the elevated railway, to cost $165,000; completion of Ballard substation to furnish electricity to the northwest part of the city and to operate the north end of the municipal railway, $30,000; for strengthening the present distributing system to relieve the overloaded condition of distributing station transformers, $50,000; for general construction work within the city limits, $100,000; for completing sealing operations at the Cedar River dam (on which about $200,000 has already been spent), $200,000; construction of a new 6-ft. pipe line from the dam to the power house at Cedar River, $125,000; for an interconnection with the lines of the Puget Sound Traction, Light & Power Company, $75,000. The remainder of the $1,755,000 will be expended during the next three years in building a substation at the north end costing about $250,000 and another at the south end, to cost about $200,000, and in other additions to the lighting system to take care of the power to be secured from the Skagit project.

SPOKANE, WASH.—Plans are under consideration by the Great Northern Railway Company for installing a block signal system in the Cascade division between Skykomish and Delta, to cost about $166,000. The company is now constructing a block signal system between Hillyard and Leavenworth, to cost about $200,000.

EL CENTRO, CAL. — The Southern Sierras Power Company of Riverside is planning to erect an electric transmission line from El Centro to Calexico, a distance of 30 miles, to cost about $30,000, Bids, it is understood, will soon be asked for the work.

LOS ANGELES, CAL.—The Southern California Power Company contemplates an expenditure of about $20,000,000 for extensions to its system, to include the construction of a hydroelectric plant, to develop 150,000 additional horsepower, the erection of electric transmission lines and distribution lines throughout southern California.

PASADENA, CAL.—The City Commission has adopted a resolution providing for the purchase of the local distributing system of the Southern California Edison Company for $510,108, subject to the approval of the voters and acceptance of the offer by the corporation.

STOCKTON, CAL.—Application has been made to the State Railroad Commission by the Western States Gas & Electric Company for authority to issue $450,000 in bonds, the proceeds to be used for reimbursing the company for expenditures already made and to provide funds for construction work planned for the coming year.

TULARE, CAL.—The Mount Whitney Power & Electric Company has begun work on the proposed changes and improvements to its local system, involving an expenditure of about $82,000. Of this amount $60,000 will be expended in extending transmission lines to meet the increasing demand of ranchers for power for pumping purposes; another $17,000 will be spent in converting the Tulare lines from two-phase, 6600-volt system to three-phase, 11,000 volts, and $5,000 for two new transformers for the local substation.

GARIBALDI, ORE.—Orders have been placed by the Cummings Lumber Company of Garibaldi for electric generating equipment and motors, consisting of one 1000-kw., three-phase, 2300-volt, Curtis turbo-generator and one 320-kw., three-phase, 2300-volt engine-driven unit for its new mill at Garibaldi. For a time the company will purchase energy from the Coast Power Company of Tillamook.

HELPER, UTAH.—The City Council is planning to rebuild penstock and intake works for the hydroelectric plant, recently destroyed by flood. The cost is estimated at about $10,000.

FLORENCE, ARIZ.—Plans are being prepared by Burns & McDonnell, consulting engineers, Inter-State Building, Kansas City, Mo., for improvements to the municipal lighting system waterworks, to cost about $80,000.

HUMBOLDT, ARIZ.—The Humboldt Improvement Company is contemplating the construction of an electric light plant and waterworks system, to cost about $200,000.

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SUPERIOR, ARIZ.—The Queen Copper Company is contemplating the installation of a power plant, the equipment to include a 100-hp. engine, compressor and hoist. W. E. Defty is consulting engineer.

CUT BANK, MONT.—Steps have been taken by local business men to establish an electric light plant in Cut Bank. Application, it is understood, will soon be made to the City Council for a franchise for same.

GILMAN, MONT.—A committee has been appointed by the Commercial Club to consult with local business men relative to establishing an electric lighting plant in Gilman.

Canada

SYDNEY, N. S.—Contract has been awarded by the Dominion Iron & Steel Company for construction of power station to the Foundation Company, Ltd., 224 St. James Street, Montreal, Que. The proposed power plant will have a generating capacity of 1150 kw.

ELORA, ONT.—The construction of an electric railway to connect Elora and Kitchener is reported to be under consideration.

HAMILTON, ONT.—The Hydro-Electric Power Commission of Ontario has signified its readiness to build a Toronto, Hamilton & Niagara Falls radial railway, provided that the necessary by-laws are carried by the city of Hamilton and the municipalities of Saltfleet and Nelson.

LONDON, ONT.—The installation of an automatic municipal telephone system is under consideration by the city authorities.

Directory of Electrical Associations

Printed in the First Issue of Each Month

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

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AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

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ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

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NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

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NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M. Annual meeting, Albuquerque, N. M., Feb. 17-19.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

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OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary H. A. Lane, 611 State National Bank Building, Oklahoma City. Annual meeting, Feb. 13, 14 and 15, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal.

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RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

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TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, March 25-27.

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Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 17, 1918)

1,287,812. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; Charles E. D. Ahlm, Cleveland Heights, and Harry Y. Hall, Cleveland, Ohio. App. filed April 17, 1918. May be easily disconnected, removed and replaced, allowing the ready substitution of new brushes.

1,287,829. AUDIBLE INDICATING DEVICE; Harold B. Barnes, Denver Col. App. filed Feb. 24, 1917. Used in connection with a snap switch for controlling electric circuits.

1,287,831. SYSTEM FOR COMPENSATING FOR DIFFERENCES OF POTENTIALS; Henry M. Bascom, Brooklyn, N. Y. App. filed May 17, 1917. To insure proper operation of relays or other signal-controlling devices whose action depends upon a balance of electrical or magnetic forces.

1,287,847. SIGNALING DEVICE; John Bond, Brooklyn, N. Y. App. filed April 24, 1918. For use on automobiles, autotracks and other vehicles; indicates the driver's intention to turn to the right or to the left, to slow up or to stop.

1,287,849. ELECTRIC FURNACE; William K. Booth, Chicago, Ill. App. filed April 4, 1918. An improved wall contact or wall terminal and method of construction is provided.

1,287,851. ELECTRIC ENERGY CONVERTER AND METER; Augustus J. Bowie, Jr., San Francisco, Cal. App. filed March 12, 1914. Means for deriving power from and for effecting the indication of or recording of the current voltage or power in high-tension lines.

1,287,886. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, and Charles L. Goodrum, Brooklyn, N. Y. App. filed Oct. 6, 1916. Means for preventing wrong connections by false impulses caused by the careless manipulation of the calling substation apparatus.

1,287,896. ILLUMINATED WEIGHING SCALE; Samuel G. Crane, Toledo, Ohio. App. filed Jan. 27, 1915. For use with weighing scales of the double pendulum type.

1,287,907. METHOD OF AND APPARATUS FOR LOCATING SUNKEN BODIES; Patrick B. Delany, South Orange, N. J. App. filed Dec. 27, 1916. Electrically operated detecting or indicating devices are included in a circuit also including an electrode which is lowered into the water and moved over the bottom or through the water until the object is found.

1,287,913. ELECTRICALLY HEATED RADIATOR; Frank L. Dietzel, West Nashville, Tenn. App. filed June 18, 1918. The water may be heated to the boiling point directly in the radiator, producing steam under sufficient pressure to effect the desired radiation.

1,287,918. PORTABLE ELECTRIC LIGHT; John T. Drufva, Longmeadow, Mass. App. filed July 31, 1917. Accidental creation of a circuit through the lamp and battery by the contact of the device with metal articles is prevented.

1,287,919. PORTABLE ELECTRIC LIGHT; John T. Drufva, Longmeadow, Mass. App. filed July 31, 1917. To be held in the hand and lighted by the manual movement of a slide on the exterior casing.

1,287,952. CURRENT CONTROLLER; Benjamin F. Gardner, Chicago, Ill. App. filed July 24, 1916. Invention relates to an adjustable resistance member and a convenient unitary housing for the same.

1,287,965. COMBINATION TERMINAL BOX AND FIXTURE STUD; William M. Gore, Toledo, Ohio. App. filed Sept. 1, 1917. The box and stud may be used together or separately as desired.

1,287,970. METHOD AND ARRANGEMENT OF APPARATUS FOR THE DETECTION AND MEASUREMENT OF ALTERNATING CURRENTS AND OTHER CURRENTS OF PERIODIC NATURE; Heinrich Greinacher, Zurich, Switzerland. App. filed Dec. 2, 1916. Applying an alternating current directly to a selenium cell affects the electrical resistance of the selenium.

1,287,972. RETARDED ALARM VALVE AND THE LIKE; Allan J. Gross, Chicago, Ill. App. filed Dec. 10, 1914. Gives an alarm in the event of a sprinkler head opening from fire or other causes, and prevents false alarms ordinarily resulting from water hammer and other fluctuating pressure conditions in the water supply of sprinkler systems.

1,287,982. MODULATING SYSTEM; Ralph V. L. Hartley, Brooklyn, N. Y. App. filed Feb. 16, 1917. To improve the quality of speech transmitted by modulators of the magnetic type.

1,287,988. ELECTRIC STARTING AND SUPPLY SYSTEM FOR AUTOMOBILES; John A. Heany, Flint, Mich. App. filed July 28, 1910. A dynamo-electric machine is so arranged and wound that it may act either as a compound-wound motor for starting the engine or as a differentially wound generator for providing current at a substantially constant potential for load circuits.

1,287,989. DYNAMO-ELECTRIC STARTING, LIGHTING AND IGNITION MECHANISM FOR AUTOMOBILES; John A. Heany, Flint, Mich. App. filed Aug. 1, 1910. Means furnished for translating electrical energy for starting an engine and further electrical means for furnishing electrical energy for the starting mechanism and the lighting and ignition system used in an automobile.

1,287,992. PARTY-LINE AUTOMATIC TELEPHONE SYSTEM; Harry E. Hershey, White Water, Kan. App. filed Nov. 23, 1913. Means provided for calling back on a line without necessitating the removal of the guarding potential.

1,288,016. INSULATING DEVICE; Chester N. Johnson, Chicago, Ill. App. filed May 29, 1913. To be secured at the end of a pipe or conduit to prevent fraying of the wire insulation and separate the different leads and insulate them.

1,288,017. TIME-ELEMENT DEVICE; John L. Johnson, Milwaukee, Wis. App. filed June 12, 1911. The time element is made to vary inversely as the abnormality of the controlling condition.

1,288,019. ELECTRICAL MEASURING INSTRUMENT; Manfred J. Johnson, Naugatuck, Conn. App. filed Jan. 24, 1918. Means furnished for compensating the error in the indications of the instrument produced by variations of temperature of the surrounding atmosphere.

1,288,024. BRACKET FOR ELECTRICAL APPARATUS; Julian H. Kendig, Pittsburgh, Pa. App. filed March 11, 1915. For supporting switch terminal and other boxes used for retaining electrical apparatus.

1,288,044. ELECTRIC IMMERSION HEATER; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Feb. 21, 1918. Is of comparatively high electrical resistance and also very compact.

1,288,045. FOOT WARMER; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed March 14, 1918. Designed for use by aviators and motorists and others subject to exposures of extreme cold.

1,288,046. WEATHERPROOF ELECTRICAL HEATER; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed June 15, 1918. An armored heating element is associated with a terminal box in such a manner that access of water to the electrical connections within the box is substantially prevented.

1,288,069. ELECTRIC WATER HEATER; Antonio Longoria, Cleveland, Ohio. App. filed Feb. 21, 1916. A plurality of heating elements may be supplied between the end plates so as to increase or decrease the capacity of the heater.

1,288,094. INDICATING DEVICE OR THE LIKE; Harold P. Manly, Chicago, Ill. App. filed Dec. 14, 1915. For indicating or determining and assisting in the removing of abnormal conditions or faulty operation of devices, elements or combinations of parts, whose construction, operation, action, care or use depends upon the principles of mechanical, electrical, physical or chemical science.

1,288,098. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Feb. 5, 1916. A switch is provided which can perform the functions of both a selector and a connector.

1,288,117. CURRENT MODULATOR; Francesco Morando, Rome, Italy. App. filed Sept. 1, 1914. Relates to the generation of variations of current in electric circuits by physical or mechanical actions.

1,288,128. ELECTRIC CIRCUIT CONTROL; Howard J. Murray, Brooklyn, N. Y. App. filed May 12, 1917. Particularly relates to a circuit closure constituting part of an automatically actuated signaling device for use on motor cars to indicate change in rate of travel.

1,288,160. CONNECTOR FOR BATTERIES; Ward S. Perry, Chicago, Ill. App. filed April 9, 1917. Is adjustable and used for connecting lead wires to a storage battery in an electric lighting and starting mechanism for an automobile.

1,288,240. ELECTRIC FURNACE; Leo L. Simpson, Seattle, Wash. App. filed July 24, 1915. Improvements consist of cooling means comprising a water-jacketed head carbon electrode, water-jacketed furnace cover and water-jacketed copper bottom of the carbon electrode.

1,288,274. HYDRAULIC TRANSMISSION MECHANISM; August Sundh, Hastings-Upon-Hudson, N. Y. App. filed March 12, 1914. Relates to a system of control and is particularly adapted to mechanism comprising a pump operated by a prime mover such as an electric motor.

1,288,275. ELECTRICAL CONTROL SYSTEM FOR HYDRAULIC TRANSMISSION; August Sundh, Hastings-Upon-Hudson, N. Y. App. filed March 14, 1914. For controlling a power unit comprising a fluid motor, pumping mechanism for supplying fluid under pressure to the fluid motor, and a prime mover such as a motor for driving the pumping mechanism.

1,288,303. GROUNDING DEVICE; John C. Vogel, Philadelphia, Pa. App. filed May 29, 1914. Consists of a receptacle adapted to receive and retain a suitable hygroscopic compound and to keep it practically in free communication with the earth surrounding the box.

1,288,304. SAFETY ELECTRIC LIGHT; George W. Wacker, Rutherford, N. J. App. filed May 5, 1917. Provision is made for preventing the ignition of combustible or explosive gases or vapors from the incandescent lamp filament in the event of the breaking of the lamp bulb.

1,288,358. IMPULSE-TRANSMITTING MECHANISM; James A. Wotton, Montclair, N. J. App. filed July 26, 1917. A rotatable toothed wheel engages contact springs to open and close a circuit associated with it.

1,288,365. COIL SUPPORT; Charles R. Young, Bloomfield, N. J. App. filed April 24, 1917. Relates to the mounting of electrical apparatus such as loading coils, repeating coils, transformers and the like within a suitable casing or housing.

1,288,373. ENGINE STARTER; Vincent Bendix, Chicago, Ill. App. filed Dec. 30, 1912. Particularly suited for a gas engine.

1,288,381. ELECTRIC SWITCH; John E. Cavanagh, Meriden, Conn. App. filed March 30, 1918. For controlling the lighting circuits of automobiles.

1,288,386. AUTOMATIC GUN-FIRING DEVICE; Fernan Conill, Port Jefferson, N. Y. App. filed Sept. 28, 1917. For automatically firing a gun when an object is in perfect alignment with the gun sight.

1,288,411. TELEPHONE SYSTEM; Henry J. Herink, London, Eng. App. filed June 2, 1917. Means provided for preventing the registering of calls against a caller under certain conditions.

1,288,418. MOTOR-CONTROL SYSTEM; John D. Ihlder, New York, N. Y. App. filed July 22, 1915. For electric motors used in operating elevators and the like.

1,288,444. ELECTRIC SOLDERING IRON; Edward Schwartz, New York, N. Y. App. filed Feb. 14, 1918. Comprises relatively few parts, each of which is self-contained so that it may be replaced without difficulty.

1,288,449. TELEPHONE SYSTEM; Frank M. Slough, Rochester, N. Y. App. filed Oct. 18, 1913. To shorten the time and lessen the trouble of operation.

1,288,452. CUT-IN AND CUT-OUT DEVICE FOR ELECTRIC GENERATORS; Herbert C. H. Smyth, London, Eng. App. filed Oct. 26, 1915. Comprises magnet coils having a single winding and a keeper in connection with carbon contacts arranged together on a suitable base which also carries an adjusting contrivance for the keeper.

1,288,454. TELEPHONE-EXCHANGE SYSTEM; Harold D. Stroud, Chicago, Ill. App. filed July 25, 1901. Automatic means provided for connecting subscribers' telephone lines with cord circuits, these cord circuits being also provided with manually operated means for uniting the same with telephone lines for completing connection between subscribers.

1,288,456. TELEPHONE ATTACHMENT; Robert C. Groh, St. Paul, Minn. App. filed March 23, 1917. To light up the number dial when a telephone of an automatic system is being used.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 — New York, Saturday, February 8, 1919 — *Number* 6

A Memorial of the N. E. L. A. in the War

A MEMORIAL of some character by which the National Electric Light Association may pay its tribute of honor and regard to those in the industry who served the nation in the war is appropriate. The ELECTRICAL WORLD ventures to suggest that such a memorial be arranged in connection with the annual convention or in such other way as may seem more desirable to those directly concerned. What is done in the N. E. L. A. could be arranged also with the same appropriateness by and for other branches of the industry. Men—and also women—and companies and associations in the industry have contributed to the cause. Their efforts and ability have been given freely. Priceless lives have been sacrificed. Lives have been offered willingly at the risk of sacrifice, bodies have been crippled, personal service has been offered, money has been given and loaned, the output of great plants has been turned to strengthen the war machine. In many forms of direct and indirect service the people and the resources of the industry have been devoted patriotically to the national purpose.

For instance, there have been the long rolls of enlisted men from the industry who took their posts of duty and hazard in various departments of the army and navy. There were the dollar-a-year men and those who gave time, thought and money without even that recognition. Conversion of plants to military purposes, stimulation of output that the fighting forces might have what they required, these present another form of service to the country in which the industry justified its existence. There was the association service exemplified for the central-station industry by the National Committee on Gas and Electric Service. Without the products of electrical manufacturers, without the service of jobbers, without the unparalleled production of power by central stations the nation could never have effected the efficient mobilization of all resources which was finally attained. Are not these of the stuff which the industry should put into a permanent record to be part of its history for reference in the years to come?

One of the simplest forms that a memorial could take is a meeting. The N. E. L. A. annual convention program could be arranged to contain a memorial session. The program might be long or short as the judgment of the executives of the association should dictate. To make a concrete suggestion, several addresses would cover the main points. A tribute to the individuals who were with the colors or in other national work, an account of the central-station part, showing the rigid application of energy to the national requirements, reports from the coöperating committees, would tell the large facts in the story. Supplemented by statistical records of the association, this would be a chapter in the history of the industry which would never be forgotten. The *Proceedings* of the association would contain a report of the memorial concluding the work, and it would not be inconsistent to have a tablet commemorating the service put permanently in the New York headquarters.

The natural spirit of such a memorial as we have in mind is the spirit embraced in the resolution passed at the convention in Atlantic City in June, 1918. Recalling the vigor and the patriotic determination there expressed, we can now remember with pride that it pledged "all that we have and all that we are to the holy cause."

Personal efficiency in many organizations fell off grievously under the stress and temptation of war conditions, but the day of individual stocktaking is at hand. Industrial slackerism is scheduled for the discard, and there never was a time when self-scrunity paid better interest on the expenditure of time and hard thinking involved.

Hydroelectric Energy in Canada

A STATISTICAL analysis of the central stations of Canada recently made by Dominion governmental authorities reveals many interesting facts. One of the most important features disclosed is the outstanding position which water power holds in the electric utility field in Canada. The combined rating of the generating equipment in the 470 generating stations of Canada was in 1917 1,844,571 hp. Of this, 1,652,661 hp., or practically 90 per cent, was water-driven, indicating to what a remarkable extent the Dominion has taken advantage of its natural resources. Of special interest also are the figures relating to the capital invested in hydroelectric central stations. While the average capital cost per installed horsepower of all hydroelectric stations in the Dominion is $188, the actual cost of construction, omitting real estate, transmission and distribution equipment, of seventy representative hydro stations, with an aggregate installation of 745,797 hp., is on the average $69.11 per installed turbine horsepower. Thus not only do the central stations of Canada employ water power to a greater extent than central stations in the United States, but the cost of the development is also on the average remarkably low. While this may be attributed in part to excellent local conditions as regards dam sites and power houses, it indicates the application of

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engineering skill in a remarkable degree. The Dominion is doubly fortunate in possessing abundant water powers and engineers who know how to develop them economically.

"More and better work" will be the slogan of the individual producer who realizes that American wage and living standards are worth the effort necessary to maintain them in competition with cheap labor and lower-grade habits of life elsewhere.

Accidents and Industrial Lighting

WE HAVE repeatedly called attention to the close inverse relation which exists between proper lighting and accidents to workmen. It takes much hammering at evils to make one small reform. We are therefore duly thankful to Professor Clewell for dragging this matter fairly into the limelight in his paper in our current issue, and we hope that the figures therein cited will make some little impression in industrial circles. When we realize that the yearly accident list in our American industries is five or six times the entire casualty list in the American army during the war it is obvious that the situation must be taken very seriously. If one stops to consider that the graves of those who die in industrial accidents in one year would, placed side by side, reach more than twenty miles across country, one realizes that the matter is not a small one to be lightly dismissed by casual reference to the "risks of the calling" and the "carelessness of fellow workmen."

A few months ago a notable paper was read before the Illuminating Engineering Society by R. E. Simpson dealing with the relation of bad lighting to accidents, and to this paper Professor Clewell very properly devotes especial attention. The grim summation of the accident roll means that, to say nothing of death and injuries, there is lost through accidents labor amounting to more than half a million man-years. This is not an imperceptible or negligible fraction of the total labor output of the country; it is a serious business quite outside of its humanitarian aspect. In addition, Mr. Simpson judges that nearly 30 per cent of these accidents were due last year, directly or indirectly, to poor lighting; that is, by curtailment, negligence and false economy at least 100,000 man-years were lost to the country's industries, and this serious loss is quite outside the loss of output which the recent Chicago experiments indicate as a necessary result of poor lighting.

Looking into the subject somewhat in detail, Professor Clewell is inclined to the opinion that, although lighting curtailment when unwisely carried out has been mischievous, a still more serious source of trouble has been the hurried adoption of powerful lights improperly shaded or installed so that they dazzle the workman and throw dangerously sharp shadows upon work and machinery. We are at a period in the development of the incandescent lamp where we are going through just about the same experience that was had ten years ago when the change from the carbon to the metallic-filament lamp was in progress. At that time an indefinite amount of extremely bad lighting was produced by sticking the new lamps into shades and reflectors which had been developed for the old, and which, however good in their original function, were entirely unsuited to the brighter and differently placed filaments of the new lamps. Exactly the same kind of trouble exists to-day in the replacement of the vacuum lamps by the gas-filled type, which again have filaments differently disposed with respect to the sockets and very much higher in intrinsic brilliancy. One has only to make the most cursory inspection of lighting conditions in almost any town to see an astonishing number of cases of misuse of the new lamps, which in themselves are highly advantageous if properly installed. The result of this bad practice in causing accidents is, in Professor Clewell's judgment, a serious matter, and it is high time that remedial measures should be taken and proper shades and reflectors provided to meet the new requirements that have arisen.

Early orders for electrical labor-saving machinery will pay handsome interest before the year is over if current interest in the industrial truck is any guide. The economies of these equipments are capable of absorbing a substantial change in price, should such occur, and a machine at work is productively worth a dozen en route from the factory.

The Microscopic Study of Insulators

WHY insulators break down has been a troublesome problem in the development of electrical transmission. Glass insulators can be inspected for flaws and homogeneity of structure, while the porcelain insulators in almost universal use at high pressures cannot. The paper by Harold G. Tufty in our columns this week gives some clews to the relation of structure and strength in porcelain. This study was made by the familiar method of cutting thin sections of insulator material as in ordinary petrographic work and examining them under the microscope and with polarized light. Polarized light has already been advantageously used in inspecting glass insulators for proper annealing, but here its function was to separate the crystalline from the non-crystalline elements in the insulating material. Ordinarily porcelain insulators are made of a combination of finely powdered quartz, feldspar and ordinary kaolin, the function of the quartz, which is practically infusible at kiln temperatures, being to hold up the structure during firing.

The examination of various samples of insulators, new and old, shows that the quartz has remained entirely unfused, while part of the feldspar has been completely fluxed with the kaolin and the remainder rendered non-crystalline but in part not thoroughly fused with the kaolin. In some of the samples many small particles of unfluxed kaolin were found. It also appears that there may be a very material difference in the proportion of unfluxed feldspar from one part to another of the same insulator. Firing at too high a temperature completely fluxes kaolin and feldspar, leaving the quartz unchanged, and renders the resulting porcelain somewhat porous. Underfiring, on the other hand, leaves a considerable percentage of feldspar unfluxed and leads to a granular rather than a vitreous structure. In the case of several insulators damaged in service the injuries seem to have occurred where the percentage of unfluxed feldspar was low. It would look therefore as if a close study of the relation of firing

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temperature to the fusing of the feldspar would be worth while. The three constituents have quite different melting points, and there probably is a fairly close range of temperature at which the best results from the standpoint of permanent usefulness can be obtained.

The results point to the importance of this petrographic method of investigation as a guide to the production of an excellent and uniform material. In these days of precise pyrometry working for certain temperature is comparatively easy provided that one knows what it ought to be. Grinding the necessary sections is not a troublesome matter, nor does the technique of the investigation offer any particular difficulties. Success is simply a matter of going at the work systematically and examining a sufficient number of samples of known history to connect firing temperature and structure with insulating strength.

Differences of opinion as to practice are entirely consistent with complete agreement on principles. When conferences between diverse interests begin with a definition of the area of intellectual overlap, the outlook for a mutually profitable settlement of issues at stake is greatly improved.

On the Wrong Track

LONG before the crack of an assassin's rifle gave the signal for a war that was to embroil all the great and most of the smaller powers and to cause men from New Hampshire and men from New Zealand to fight side by side in European battles it had become a commonplace to say that the world was growing smaller. This process of shrinking has been immensely accelerated by the war. There is no spot on the globe so remote as not to have felt the contraction. The United States tried in vain to maintain its continental isolation. Duty, patriotism and an enlightened self-interest drew it into the conflict, and to-day two million Americans are or have been in Europe of whom in the ordinary course of events only a few hundred would ever have crossed the Atlantic. Foreign affairs can no longer be a matter of indifference. What happens in France, Italy, the British Isles and the conquered Central Powers is vital to America. Far-off Archangel reacts on Arkansas and the fate of the Kameroons has a meaning for Kankakee.

Notwithstanding this undisputed truth, labor leaders and legislators have been found so blind to the trend of their era as to propose that for four years there shall be, save for a few narrow exemptions, a prohibition of immigration into the United States. The contention is that war-time wages must be maintained and that without the proposed law invading hordes of foreigners will force them down.

Now, the wages increased by the war fall under two distinct headings. There are the wages raised only in proportion, a little more or a good deal less, with the increased cost of living, and there are the wages raised to an amount out of all correspondence with the skill or knowledge required to gain them and with the sums paid in other callings. The first kind of wage increase no one wishes to see reduced. Even if prices of commodities revert toward their former level, such wages should stay approximately where they are, for every improvement in the standard of living of great numbers of people is a benefit to the nation at large and only with such improvement can it continue to grow in culture and civilization. The second class of increased wages is another matter. To maintain them, were it possible, would be an injustice to those equally useful in times of peace who do not share them. The clear-headed among those who have been receiving such wages have seen this from the first and have looked upon them as a temporary windfall blown their way by the storm of war.

Disregarding, then, any selfish movement by war's accidental beneficiaries to maintain their advantage, what is the right way to insure that wage increases which are deserved shall be maintained and others of like sort be made? Not, surely, by affronting the nation's allies, shaming its traditions, slamming the door in the face of eager candidates for citizenship and building up a Chinese wall of exclusiveness, but rather by governmental direction and control which shall make it easy for character and hard for crime to gain admittance, easy for industry and hard for sloth, easy for the embryo American and hard for the determined foreigner, easy for the man who wants to go on the land and hard for him who prefers to mount the soapbox. Now as much as ever before imported brawn and skill are an asset to a country with many million acres of uncultivated land and with hundreds of huge building projects of every sort taking shape in the brains of engineers and men of affairs.

Let the recipients of good wages remember that the surest way to keep them from shrinking, the good old American way, is to earn them. Ambition, energy and training will make the product command the price. Dead-leveling of man power and restriction of output in the long run get the workman nowhere. Competence is not afraid of competition, and there is something wrong with the laborers themselves if, abnormal conditions aside, the most highly paid are not the cheapest.

The ability to see all sides of a problem is a marked trait of the successful engineer, who should be called upon more and more to help solve difficulties arising between employers and employees.

Vector Locus Diagrams

THE article in last week's issue on "Long-Line Phenomena and Vector Locus Diagrams," by Edy Velander, presented a number of interesting quantitative results in the form of graphic solutions obtained by strict hyperbolic formulas. The advantage of this method of presentation is that the precedure is mathematically rigid and is not limited to approximations for particular cases of short lines. Of course, the precision is, like that of all graphical work, confined to the scale and geometrical accuracy of the drawing, but where considerable precision is called for computation can be resorted to, following the lines indicated on the diagrams. There is no escape from the proposition that complex hyperbolic functions are bound to come into extended practical use in alternating-current electrical engineering, and the article gives the reader who is not familiar with these functions a general insight into some of their properties.

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Engineering Aspects of Industrial Lighting—II*

Economic Considerations of the Accident Rate—Relation to Coal Conservation—Well-Lighted Versus Poorly Lighted Aisles—Desirability of More Widespread and Intelligent Use of Reflectors for All Lamps

BY C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

THAT there is an annual loss of the services of more than 100,000 men for an entire year in the industries of this country owing to accidents caused by poor lighting is one of the most startling conclusions brought by a study into the field of accidents and poor industrial lighting during the war[1]. The marked increase in accidents does not necessarily show that artificial light in itself is the cause of the greater accident rate, but that poor artificial lighting conditions may be the underlying cause[2]. This conclusion seems to be verified by the important contribution of R. E. Simpson to the subject. Under the assumption, therefore, that one of the fundamental channels through which accident reduction may be effected is that of improving artificial lighting conditions it is especially important at this time to consider some of the far-reaching conclusions which have come to the attention of the lighting profession within the past year or so under the pressure of war emergency conditions.

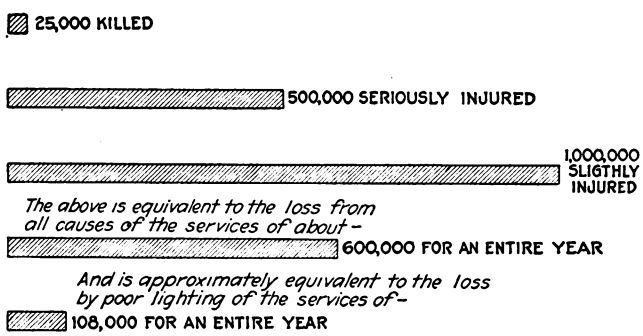

FIG. 1—PROPORTION OF ACCIDENTS IN THE INDUSTRIES ANNUALLY CHARGEABLE TO POOR LIGHTING

ECONOMIC CONSIDERATIONS OF THE ACCIDENT RATE

Mr. Simpson has shown that the total fatal and non-fatal accidents in this country in the industries per annum amount roughly to 25,000 killed or permanently disabled, about 500,000 serious injuries and about 1,000,000 slight injuries. He interprets these figures to mean a loss of the services of something like 600,000 employees for a full year of 300 working days. The significance of these figures is at once apparent, and Mr. Simpson concludes by commenting on the fact that while an economic loss represented by such an "employee time" reduction is not usually felt so keenly because of its distribution throughout the country, any one can at once grasp the full meaning of such figures by imagining this entire labor loss as concentrated in any one of the several important war industries, such as shipbuilding, steel making, munitions or coal mining, in any one of which the total elimination of 600,000 workmen for a year would have been a disaster. (See Fig. 1.)

The foregoing figures stand out very prominently in their relation to the industrial lighting problem when it is considered that in 1910 about 25 per cent of the gross industrial accidents in this country were due directly or indirectly to a lack of proper illumination[3]. From information submitted to the employment management section of the War Industries Board in 1918 it would appear that, while the amount of light used in the industries in 1918 as compared with that in 1910 has probably been increased to some degree at least, the control of the light has received comparatively little attention; that is to say, the use of light-directing devices such as reflectors has not kept pace with the use of increased quantities of light.

This, obviously, represents a very discouraging condition from the standpoint of accident prevention, because if larger lamps have been adopted without suitable reflectors in sockets which previously contained smaller units, the accident hazard produced by glare and its bad effects is probably greater than before. The opinion has been expressed by one authority that if, through labor commissions or other regulating bodies, it would be possible to have every lamp equipped with a suitable reflector, there would be a decided reduction in the number of accidents in the industries of this country.

Taking into account the various factors which have brought about changes in the last eight years, the figure of roughly 25 per cent for the proportion of all industrial accidents chargeable to poor lighting in 1910 has been set at from 18 to 20 per cent for the past year.

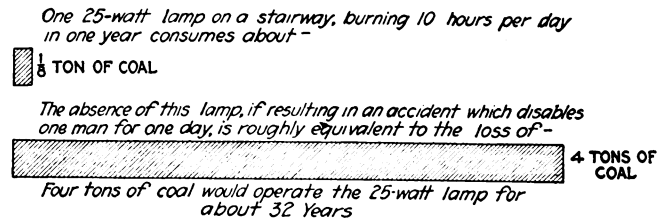

FIG. 2—RELATIONS OF STAIRWAY LIGHTING TO ACCIDENTS WEIGHTED IN TERMS OF COAL EQUIVALENTS (SEE ARTICLE)

Mr. Simpson, in fact, uses the value of 18 per cent in his paper of October, 1918, and on this basis concludes that the services of somewhat more than 100,000 employees were probably lost in 1918 for an entire year owing directly or indirectly to poor lighting.

As pointed out in an earlier article, the relation of lighting curtailment to coal conservation, while receiving intensified attention during the war, is one which

*First installment of this article appeared in the ELECTRICAL WORLD of Jan. 11, 1919.

[1]See "The Relation Between Light Curtailment and Accidents," R. E. Simpson, before the Illuminating Engineering Society, Oct. 10, 1918.

[2]"Relation of Industrial Lighting to Safety," C. E. Clewell, ELECTRICAL WORLD June 16, 1917.

[3]See paper by R. E. Simpson, *Trans I. E. S.* Dec. 30, 1915.

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in the country and consequently construed as the equivalent of so much less coal mined.

Looked at from a slightly different angle, it might also be stated that the gross labor shortage of 108,000 workmen per annum due to accidents resulting from poor lighting is in itself equivalent to the labor required for mining more than 100,000,000 tons of coal annually, whereas Mr. Simpson points to the highly important fact that 10,000 tons of coal would provide 108,000 workmen with ample light for ten hours per day for an entire year.

The same authority points to the further fact that a 25-watt lamp burning ten hours per day is adequate for safe illumination on a stairway and would require about one-eighth of a ton of coal per annum. By cutting out this one lamp, as typical of how curtailment might have been accomplished, one-eighth of a ton of coal would obviously have been saved, but a single accident during the year of such a nature as to cause the loss of one man's time for one day represents an economic loss (if interpreted into its coal-producing equivalent) which if prevented could operate the same lamp over a period of thirty-odd years. (See Fig. 2.)

A good illustration of the foregoing is found among the files of information accumulated for the War Industries Board. It relates to a case where an employee was called upon to pass from one room to another in a plant several times a day. The passage between the rooms was infrequently used, and this led to the installation of a large revolving shaft through this passageway near the floor. The incandescent lamp which was usually lighted in this dark passage had been removed in the winter during the period of lighting curtailment, and on one of his trips through the passage the workman was caught by the shaft and killed. The assumption was that if the lamp had been left in this passage this fatal accident would have been avoided.

WELL-LIGHTED VERSUS POORLY LIGHTED AISLES

Considerable attention has been given to the problem of local versus general industrial illumination from a variety of standpoints, and during the last few years the distinct advantages of the general system have been quite definitely established and have resulted in the adoption of this form of lighting in contrast with the strictly local system in a number of progressive industrial plants.

Last year, however, when reductions in light were being seriously contemplated in the industrial as well as in other fields, the question of curtailing the light for spaces adjacent to machinery and merely maintaining the required intensities at the machines was one of the problems faced. The predominating practice of using strictly local lighting in a great many of the industries at this time, notwithstanding the general acceptance on the part of lighting experts of the many advantages of general factory lighting, has been set forth recently by L. B. Marks[4].

Mr. Marks comments in a general way on this point by explaining that the use of local lamps to the exclusion of lamps for general illumination apparently places aisles and spaces adjacent to machinery in comparative darkness. A natural result is an increase in the accident rate, and whereas the common idea is that a majority of the accidents in shops take place at machine tools or at benches, authoritative figures show that about two-thirds of industrial (shop) accidents occur in moving between sections of the shop or when proceeding toward or away from a machine tool or a bench[5].

While the foregoing statement was made in connection with a discussion of probable increases in accident rates if lighting curtailment was applied generally to the industries, the conclusion which may be drawn from it is equally important to the present aspect of industrial lighting under more normal conditions and is another broad lesson which may be classed among those matters which received special emphasis during the war emergency.

Mr. Simpson, in one of his papers previously referred to, gives the following example, which is directly related to the foregoing comment. He calls attention to the prevalence of accidents even in those parts of a shop which are thought of as better lighted than storage and other less frequently used spaces. The case in point was a workbench over which local lamps were installed with proper reflectors for the illumination of the bench surfaces. Owing to the inadequacy of general overhead lamps, a shadow was cast on the floor by the bench causing several accidents due primarily to the falling of unfinished pieces of work which had been stored in the shadow. A higher degree of general illumination would have practically eliminated accidents of this kind.

The general impression seems to hold that the greatest need of the industries in the problem of improved illumination is a more widespread and a more intelligent use of reflectors for all lamps. The need of reflectors, so often emphasized in these columns from the standpoint of economy, thus becomes a vital consideration from the standpoint of accident prevention, and it deserves the most careful attention of the industries in general.

The writer in an earlier contribution in these columns on "Industrial Lighting and Safety" mentioned the many reasons which render light in one way or another a contributory cause to accidents. In other words, the solution is perhaps not so simple as one might at first suppose, although it is probably safe to assume that with more careful attention to the elementary principles of good shop-lighting systems progress may reasonably be expected in this phase of accident prevention. Fig. 3 A, B, C, D, E and F has been selected from a large list of photographs submitted to the employment management section of the War Industries Board to show space in which the distribution of illumination is such as to suggest small likelihood of accidents from the causes which have been set forth in the preceding notes[6].

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[4]Discussion of paper by P. S. Millar, *Trans. I. E. S.*, March 20, 1918.

[5]Mr. Marks refers to the following authorities in this connection: "Industrial Accident Prevention," statement by Mr. Beyer of the Massachusetts Employers' Insurance Association; also *Bulletin* of the Industrial Commission of Wisconsin, Aug. 4, 1915. *Economic World*, Sept. 18, 1915, statement by Mr. Hansen, secretary Workmen's Compensation Service Bureau.

[6]Figs. 3A and E are due to the Edison Lamp Works of the General Electric Company, Figs. 3B, C and F to the Cooper Hewitt Electric Company, and Fig. 3D to the Ivanhoe Regent Works of the General Electric Company. The writer is further indebted to R. E. Simpson of the Travelers' Insurance Company for valuable information relating to this phase of accident prevention. Figs. 1 and 2 have been designed on the basis of data due to Mr. Simpson.

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Opportunity Is Here: Let Us Meet It

W Must Grapple with the Problems Involved in Transition from an Old Order to a New Order and Forge Ahead with the Conviction that Success Will Attend Our Efforts

BY L. K. COMSTOCK
L. K. Comstock & Company

THE world of commerce and industry is devoting much time and thought to reconstruction, sanely in some quarters, hysterically in others.

The term reconstruction suggests rebuilding in the same mold as that which has been destroyed by the war. Much that the war has destroyed in the world of ideas, whether in commerce and industry or in philosophy, will not rise again. What confronts us is transition from an old and worn-out order to a new. Because the transition is leading the world into a new order, the outlines of which are indistinct and the details still in shadow, the business world, accustomed to the risks it has heretofore taken, holds back in the face of risks it knows not of.

Precedent Not a Safe Guide

Some bankers and industrial managers are waiting for prices and wages to fall because they are too high. They are too high—judged by pre-war standards. They may not be too high judged by post-war standards. Those who form conclusions solely from their own experiences have minds that dwell chiefly in the past, and such minds have not the present facts nor far-sighted judgments ready enough at their command to meet the new, changing difficulties of to-day.

During the war wages reached a level all over the world never known before. Labor cost in the last analysis fixes material costs because all materials represent nothing but accumulated labor.

Labor the world over is convinced that this war was labor's war, and labor proposes to reap the harvest. To see that labor is accorded a new—and who may deny a juster?—recognition, witness the gathering at Paris in the neighborhood of the Quai d'Orsay of the leaders of labor from Europe and America. The President of the United States has said that this war was fought to make the world safe for democracy, and Lloyd George, Clémenceau and Orlando have assented. When the President used these words did he have in mind merely an idea, or whole populations dominated by an idea, the idea of democracy? Translated from political terms into commercial and industrial terms, this means an admission of labor into partnership with capital. But, since labor is its own best customer, it must learn how to operate with its newly recognized partner, capital, so that both shall derive from the partnership maximum benefits.

These two partners have got to view each other with less suspicion; they have each got to try to visualize the other's situation. Capital must teach, not patronize, and labor must hold up its head and say, "I am an American citizen, and I want my share of the good things of life but no more." Autocracy's day in industry, no less than in government, is over.

Labor will not submit without a struggle to any decrease in real wages. In public speech labor says:

"The American labor movement will coöperate with all other agencies to help in this reconstruction time. Our movement is not to destroy, but to construct; but all may just as well understand now as at any other time that the advantages which the workers of America and of the allied countries have gained, and which we hope to extend to the people even of the conquered countries, are not going to be taken away from us, and that we will resist to the uttermost any attempt to take them away."

While it is true that organized labor at present represents not more than 10 per cent of all labor, and still a smaller percentage if managerial and directing brain work is included in the term labor, yet that 10 per cent is organized and skillfully directed, and therefore its power is vastly out of proportion to its numbers. If labor must make a struggle to maintain the present level of real wages, a disaster is in store for the industrial world. It is true that some wages are too high and it is equally true that some are too low, when wage purchasing power is considered, and also if the pre-war measuring stick is used as the unit of measure.

In proportion as labor is organized and skillfully directed, it places itself directly in opposition to the operation of the old theoretical law of supply and demand. This law has frequently been blocked in its operation by both governments and organized labor, not to speak, even softly, of combinations of capital.

Its operation without let or hindrance is hardly to be expected again, except in the broadest sense. In proportion as the transition to a new order spells co-operation, as distinguished from competition, the industrial world will consign the law of supply and demand, as commonly understood, to the limbo where repose many other skeletons of the Manchester school of economists.

Law of Supply and Demand

When there is a scarcity of labor there will be little or no competition, but when labor is plentiful the competent will displace the incompetent labor, and to this extent the law of supply and demand will work, although the rate of wages remains fixed; and in this way production will be increased and therefore cheapened, notwithstanding the wage rate remains unchanged. But if cost of production is to be kept down, something more is required which will give to the wage earner a direct interest in the success of undertakings as a whole.

Transition to a new order will be vain if all parties do not gain something—for the idea of democracy embraces not only labor but capital also.

The electrical industry, as well as the whole industrial world, should move forward unafraid, determined to carve its fortunes out of the future without fear and trembling. There will be no return to "normal" as it

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existed in pre-war days. A new normal is ahead—but, better expressed, a new order is ahead.

PROSPERITY'S RELATION TO RISING PRICES

Prosperity, a word expressing the well being of the industrial and commercial world, has from time immemorial been associated with rising and higher prices. High prices have been usually accompanied by a reciprocal change in the price of gold, and this phenomenon has been coincident with, if not caused by, the production of new stocks of gold in excess of new demands. These events move in circles, and the faster the movement the greater the industrial and commercial activity; and so prosperity is only another expression for activity. Conversely, falling prices—gold appreciation—have always been associated with declining prosperity and business inactivity. And then inflation—paper money—must be considered in its effect on prices. Many billions of dollars of additional money have been issued, and this alone would have a tendency to keep prices up probably for several years, and very likely on or near to the war level.

The period of transition upon which we are entering should not proceed far without centering the attention of far-sighted and wise business men and economists, not only in the electrical but in all industry, on comprohensive plans for properly housing wage earners. The social well being of the wage earner is no less the object of industry than prosperity. For it is not difficult to show that a higher standard of living is a prerequisite of increased production.

The psychology of the business world is such that the units of which it is composed at times of stress and strain—and the present transition is such a period—need stimulation and prodding.

The government, which has been the chief purchaser of labor and materials for the last two years, ought during this transitional period to take the lead and lend its influence as a stabilizer by constructing directly or indirectly public works, such as roads, canals, irrigation works, buildings, hydroelectric plants, housing schemes and other enterprises. The already overburdened taxpayer is heard to object to this plan of government activity or coöperation by saying the national debt is now too great by far to admit of any increase.

There is a vast difference, however, between creating a national debt for an unproductive purpose and creating one for a productive purpose. In one case a loss is incurred when the expenditure is made, and in the second case the government collects money from one set of persons and pays it to another set of persons, and capital handled in this manner is just as available for use in industry in the hands of one set as in the hands of the other; but during the operation the wheels of industry are kept moving until the present sluggishness of the business world is shaken off and courage has returned to take up the post-bellum burdens. There should be sufficient business leadership in the government to take up the lost motion inevitable at the beginning of a great transitional period.

The public debt, even though it be not reduced a dollar, will grow relatively smaller as industry increases production. All industry properly directed increases production, and it is the daily increase in production that increases individual as well as national wealth. Every discovery that makes labor more productive increases the average individual income and decreases the importance of debts.

The Bolsheviki, who seized property, made the mistake of thinking that property is wealth, but they are rapidly discovering that the seized properties have no value except as agencies for producing wealth.

America emerges from the war industrially and commercially stronger than it ever was before. It has become the great creditor nation, and to it now come the manifold obligations belonging to a great creditor nation. It has prodigious capacity for manufacturing steel, brass, electrical apparatus and supplies, machinery and every kind of equipment which the whole world wants; but in order to take advantage of this singularly fortunate position, it must be prepared to do its part as a creditor nation and finance all kinds of construction work and commercial enterprises, taking pay in proprietary interests and foreign securities.

The business outlook is good from every point of view, but advantage of position cannot be translated into activity and resultant profits by lack of courage and industrial timidity. The electrical industry, American business, must grapple with the problem and move forward with a bold stride. It must not turn back and yearn for pre-war prices, but confidently forge ahead with the conviction that success will attend its efforts. Fortune favors the brave. There are fifty persons who can figure out sure failure to one who pushes on without thinking of the possibility of failure.

We shall have new conditions to consider and problems to solve; but it is the American business man's job to go forward to meet the problem and meet it more than half way. To wait for prices to fall is unwise, cowardly and economically unsound, for this process carried to its logical conclusion would result in stagnation and ruin.

A NOTE OF OPTIMISM

All the elements of prosperity are here. We should lose no time in accepting that fact. The factors making for prosperity are all present and accounted for. We must not wait to debate about prices and wages, for these considerations are but the minor factors in the general situation; it might even be said they are no factors at all. The situation might be likened to the turning of the waters of the Chicago River up stream twenty years ago. While the engineers were at work getting things ready for reversing the stream, orators and writers were busy foretelling the dire things that would happen when Lake Michigan should go dry by pouring all its waters through the Chicago River spout at the rate of four miles an hour. Calculations were made of the length of time required for emptying the lake. Calculations were made of the certain decrease in the amount of water pouring over Niagara Falls. The day finally came for reversing the stream. The waters immediately flowed gently up stream, and Lake Michigan after twenty-odd years is still there in all its plenitude and glory, and Niagara Falls is still falling.

What turned the stream flowing in the opposite direction was the opening of the locks. Let the government open the locks of industry and the stream will begin to flow, gently, and the transition period will start.

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Combustion of Lignites and High-Moisture Fuels

Typical Analyses of High-Moisture Fuels of the United States and Canada and Summary of Experience Derived from Burning Fuels of the Kinds Described in Power Plants

BY T. A. MARSH
Green Engineering Company

AMONG the lowest grades of fuels with which combustion engineers must work are the lignites and high-moisture fuels. Many of these fuels contain more than 40 per cent of moisture and less than 6000 B.t.u. when mined. From such fuel it is evident that even after obtaining satisfactory combustion the net heat delivered to the boiler is small, owing to the low initial heating value and the loss from evaporation of the moisture in the coal. The problem has presented such difficulties that there is a prevalent opinion that lignites cannot be successfully burned. It is the purpose of this article to describe methods of burning these fuels and results obtained in their combustion.

The lignite deposits of North America occur in five main areas: (1) North territory and Alaska, (2) Alberta and Saskatchewan, (3) North Dakota and Montana (Fort Union region), (4) Texas (Texas region), and (5) Mississippi and southern Alabama (Mississippi region). The lignite areas of the United States are indicated on the map. There are, in addition to these, other areas in Wyoming and Colorado bearing high-moisture coals (20 to 30 per cent) which will also be discussed in this article.

Lignites contain on the average from 20 per cent to 40 per cent of moisture when mined. These fuels have a spongy structure and woody fiber. They slack on the surface within a few hours when exposed, the action being very similar to that of lime when slacked. The drying process, unfortunately, does not penetrate deeply into the pile, but is a surface action. On account of the high percentage of moisture and the slacking property of lignite, it cannot be successfully transported far from the field where it is mined. This has, of course, limited the utilization of this fuel.

Combustion of high-moisture fuels may be divided into two distinct processes, (a) the drying of the fuel, (b) the burning of dry fuel. There are two methods of approaching this problem. They are: (1) By pre-drying the fuel before it enters the furnace; (2) by drying the fuel in the furnace.

Pre-drying lignite at such rates as are desired in most plants is a prohibitive procedure both on account of the apparatus involved and the cost of coal for the process. Unless, therefore, some waste-heat method of pre-drying is developed, there is little to be hoped for along this line.

All furnaces which successfully burn lignite have in them elements or features designed to dry the fuel, preparing it for the latter stages of combustion. Evaporation can occur only from the surface as the fuel burns, leaving exposed the more moist fuel below to dry and burn. This necessitates thin fuel beds. Every one having experience with lignites is familiar with this fact. With hand firing it is difficult to keep the fire thin enough and at the same time free from holes. Two types of stokers are successfully burning these fuels: They are: (1) The plain chain grate and (2) the chain grate with inclined coking plates.

On a plain chain grate the volatile gases burn off rapidly after the fuel is dry, leaving a bed of fuel burning with little flame, similar to charcoal. This burns out to a fine light-white ash. On the type with inclined coking plates excellent results are secured with lignites. In fact, this type of stoker is admirably adapted to these fuels. The coking plates tip the front part of the fuel bed up at an angle to the hotter portion of the fire and ignition is thus hastened. The incline serves as a drying region, and the stirring action obtained by the fuel cascading over coking plates serves to expose practically all surfaces of the fuel to the drying action of furnace temperatures. The fuel, therefore, reaches the grate ignited and ready for rapid combustion.

With these fuels, extremely high draft is not essential for high combustion rates, as it is possible to burn liberal amounts of "coal as fired" per square foot of

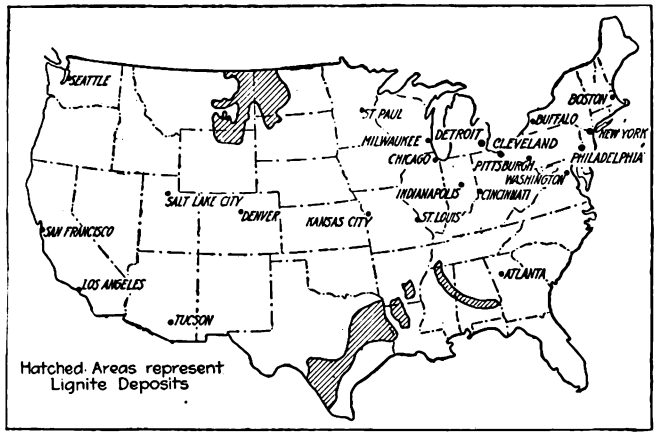

FIG. 1—REGIONS IN WHICH LIGNITE IS FOUND IN THE UNITED STATES

grate per unit of draft. Below is a rough estimate of the relation of the draft in the furnace to the combustion rates of coal as fired:

Lb. Coal as Fired per Square Foot of Grate Surface per Hour	Furnace Draft, Inches of Water
10	0.16
20	0.15
30	0.25
40	0.37

In all calculations of draft involving areas of boiler passes, flues and chimneys allowance must be made for the high rate of coal per horsepower which prevails with these fuels. For instance, if Malakoff lignite containing 7124 B.t.u. is burned at 71.3 per cent efficiency it requires 6.6 lb. of coal as fired per horsepower developed. All calculations should therefore be based on pounds of coal and not on any predetermined table or rules based

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on horsepower developed. It has only been within the last five years that furnaces have been developed to burn these fuels successfully. Moreover, so little has been said regarding this development that many are still uninformed regarding the results that can be obtained from these high-moisture fuels.

A typical analysis of North Dakota lignite follows:

Moisture, per cent	41
Volatile, per cent	24
Fixed carbon, per cent	27
Ash, per cent	8
B.t.u. (commercial)	6,241
B.t.u. (dry basis)	11,932

On account of its high moisture content no successful commercial method has been found for burning this fuel. Large areas of it are waiting the further development of the art of combustion.

That part of the Dakota lignite field which extends beyond the Canadian border however, bears lignites enough lower in moisture to make possible their successful combustion. The lignite of this field is called "Souris lignite." A typical analysis follows:

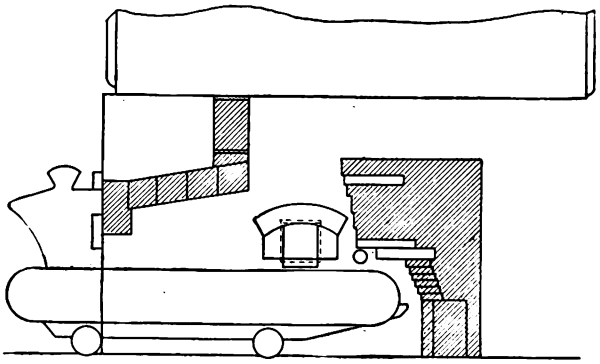
Moisture, per cent	29.7
Volatile, per cent	30.3
Fixed carbon, per cent	31.0
Ash, per cent	9.0
B.t.u.	10,770

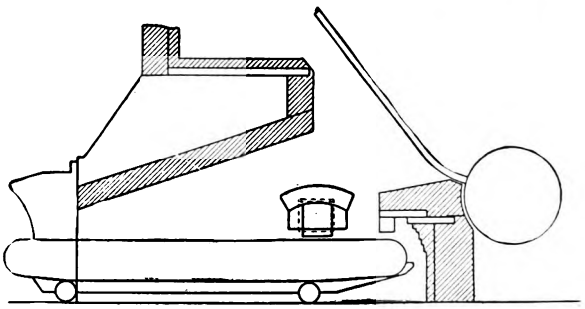
This fuel is being successfully burned in many plants equipped with chain grates. Large grate areas are, of course, necessary. The ratio usually is at least 1 sq.ft. of grate area for each 30 sq.ft. of water-heating surface. A type of furnace successfully burning this fuel is shown in Fig. 2.

There are some important elements in this furnace which may be discussed: First, a liberal igniting arch must be provided; second, there should be a vertical bridgewall or preferably an arch at the rear, reflecting the heat forward and deflecting the gases forward over the fuel. Such a furnace will ignite and burn 30 lb. of Souris lignite per square foot of grate area per hour (145 kg. per sq.m.).

The lignites of Colorado do not contain so much moisture as those lignites already discussed; 30 per cent is about the maximum percentage of moisture found in fuel of this district. Pike View lignite, an analysis of which is given below, is typical. Danville lignite contains a higher percentage of ash and slightly lower moisture than Pike View. Both are found in the Colorado Springs district.

	Pike View Lignite
Moisture, per cent	23.73
Volatile, per cent	35.25
Fixed carbon, per cent	33.23
Ash, per cent	7.79
B.t.u. (commercial basis)	8,511
B.t.u. (dry basis)	1,116

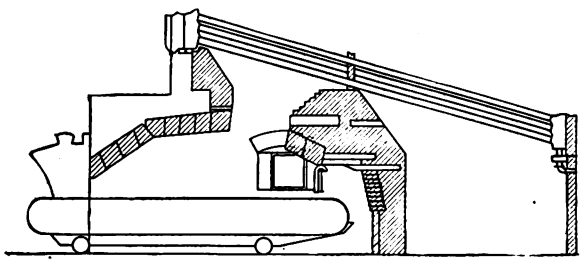


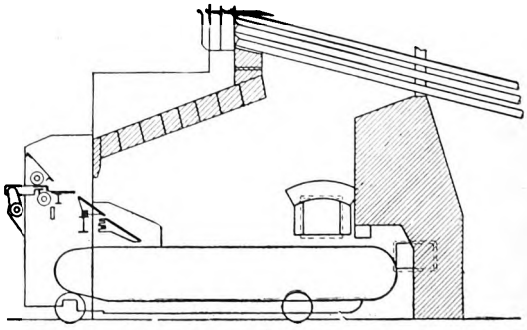


FIGS. 2 AND 3—IN THESE INSTALLATIONS THE FURNACE VOLUMES ARE 224 CU.FT. AND 1383 CU FT. RESPECTIVELY, THE GRATE AREAS 42.5 SQ.FT. AND 156.4 SQ.FT., AND THE FURNACE VOLUMES PER SQUARE FOOT OF GRATE AREA 5.25 AND 8.85 RESPECTIVELY

Several years ago furnaces were developed that would burn these fuels at good combustion rates, but results from modern furnaces would appreciably surpass the rates obtained then. In furnaces that were developed eight years ago the following results were obtained from Pike View lignite:

Type of stoker	Green chain grate
Type of boiler	Babcock & Wilcox
Coal per square foot per hour, actual lb	28
Furnace draft	23.2
CO_2 at damper in per cent	12
Per cent rating developed	128
Combined efficiency	69.7





FIGS. 4 AND 5—IN THESE INSTALLATIONS THE FURNACE VOLUMES ARE 565 CU.FT. AND 662 CU.FT., THE GRATE AREAS 138 SQ.FT AND 88 SQ FT., AND THE FURNACE VOLUMES PER SQUARE FOOT OF GRATE AREA 4.1 AND 7.5 RESPECTIVELY

Many plants are using this Colorado fuel. A typical installation in one of these plants with Stirling boilers is shown in Fig. 3. This setting is giving high combustion rates and high efficiencies from these high-moisture fuels.

The vast lignite fields of Texas are practically undeveloped. In this section of the country lignite must compete with coals of Texas, as well as those of Arkansas, Oklahoma and New Mexico. Moreover, oil and

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natural gas are cheap. With these fuels available, the development of furnaces for burning lignite has naturally been retarded. Many of these lignites have, however, been burned with excellent results on chain grates.

A design of furnace developed for these fuels is shown in Fig. 4. This furnace has, in addition to the ignition arch, a reversed arch from the bridgewall, bringing the heat forward over the fuel bed. This feature is recommended for the combustion of lignites. Some typical data concerning the characteristics of this fuel and its combustion with this furnace follow:

	Malakoff	Treadlow
Moisture, per cent	29.93	29.80
Volatile, per cent	30.96	31.34
Fixed carbon, per cent	25.45	23.71
Ash, per cent	11.66	13.15
B.t.u. (commercial)	7,124	6,906
B.t.u. (dry basis)	10,314	9,838

	Malakoff	Treadlow
Type of stoker	Green chain grate	Green chain grate
Type of boiler	Babcock & Wilcox	Babcock & Wilcox
C_2O at damper, per cent	11.81	12.2
Coal per square foot per hour, lb.	30.6	31.6
Draft in furnace	32	24
Combined efficiency, per cent	71.3	69

Some interesting results have been obtained with the coking chain grate. Such a grate, shown in Fig. 5, has in addition to the usual horizontal chain-grate surface, an inclined coking plate, approximately 3 ft. (90 cm.) in length. When burning lignites this inclined surface serves as an excellent drying zone. Tipped up as it is at an angle to the hotter portion of the fire at the rear, drying progresses rapidly so that by the time the fuel has reached the horizontal chain surface the moisture has been driven off and the fuel has become thoroughly ignited. This method of burning lignites offers possibilities.

Using the same type of furnace as shown in Fig. 5 the inclined coking-plate stoker gives results like these:

Name of fuel	Calvert (Tex.) lignite
Moisture, per cent	30.16
Volatile, per cent	38.33
Fixed carbon, per cent	24.03
Ash, per cent	7.48
B.t.u. (commercial)	7,462
B.t.u. (dry basis)	10,669
Kind of boiler	Babcock & Wilcox
Kind of stoker	Green "L" type, chain grate
Coal per square foot of grate per hour, lb.	36.4
Furnace draft	34
CO_2 at damper, per cent	11.2
Combined efficiency, per cent	67

Considering that the moisture content of these fuels is from 25 per cent to 30 per cent, the efficiencies of from 69 per cent to 72 per cent are creditable, as it is evident that it is not possible to obtain the high efficiencies from these fuels that can be obtained from low-moisture fuels. Such fuels as Calvert lignite with 30 per cent moisture require 372 B.t.u. per pound simply to evaporate the moisture which is in the fuel and heat the resultant steam to a temperature of 500 deg. Fahr. (assuming a temperature in the boiler room of 80 deg. Fahr.). The heat thus used is 5 per cent of the total heat in the fuel as fired and must detract directly from the efficiency of steam generation.

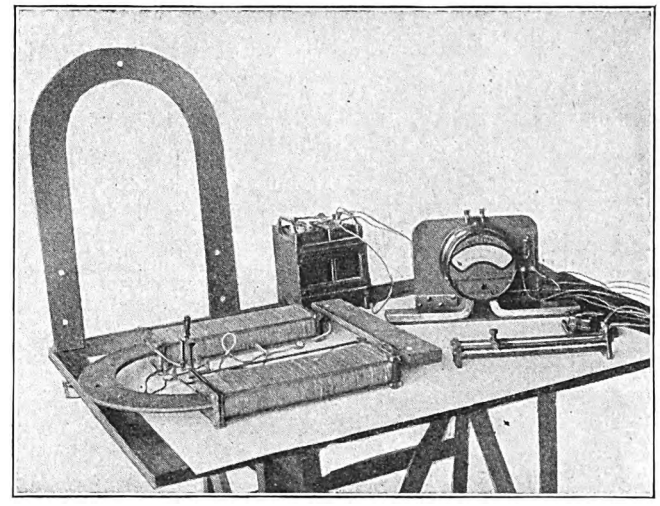
With established results of from 69 per cent to 72 per cent efficiency and with many plants successfully using lignites containing as high as 35 per cent moisture and 6800 B.t.u., plant owners, engineers and designers in localities where these fuels are involved can confidently assume that lignites can be burned satisfactorily.

TESTING PERMANENT MAGNETS BY MEANS OF A VOLTMETER

Magnetometer May Be Devised by Modifying a d'Arsonval Type Voltmeter — Descriptions of Useful Tests

IN DEVELOPING apparatus requiring permanent magnets the National Safety Appliance Company of San Francisco found no suitable magnets on the market and undertook to design, build and test large horseshoe magnets suitable for the work in hand. A direct-current voltmeter was readily rearranged for use in making comparative tests of the permanent magnets. A description of this device, together with the magnetizing process, may be of interest to those concerned with the testing of permanent magnets.

After some experiment it was decided to make the magnets of several laminations of ⅜ in. by 3 in. by 60 in. (9 mm. by 7.6 cm. by 152 cm.) forged magnet steel bent into "U" shape and securely bolted together without air gaps between the laminations. The laminations



APPARATUS FOR MAGNETIZING AND TESTING IRON

were bent with the 3-in. (7.6-cm.) face parallel to the plane of the "U."

The laminations are tempered separately in an oil bath and are made as hard as possible without causing fracture. They are then magnetized by being put in a pair of rectangular coils 15 in. (38 cm.) long, each containing 3775 turns of No. 18 double cotton-covered magnet wire. With the two coils in place a soft-steel keeper having the same cross-section as the magnets is bolted across the ends of the "U," which project beyond the coils. Thus the magnetic path through the two energizing coils is completed to give the maximum flux density.

The magnetizing coils are connected in multiple to the 125-volt direct-current line through a variable resistance and reversing switch. With the circuit closed and all resistance cut out a current of 12 amp. flows through the coils. This maximum current is rapidly reversed several times by the polarity switch and then gradually reduced to zero by means of the variable resistance. It has been found by experience that the sudden shocks of reversed polarity exert a more powerful magnetic influence than is secured by a single charge in one direction only. Under this plan the magnetiza-

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tion of a single lamination is completed in about thirty seconds.

Having magnetized the iron in this way, the next problem was to find means for testing the magnetic strength. No suitable instruments were found on the market so a magnetometer was build up from a direct-current voltmeter from which the permanent magnet had been removed. Soft Norway iron pole pieces were fitted to the instrument, their outer ends projecting beyond its base and the inner portion connected in such way as to take the place of the magnet supplied with the instrument. These pole pieces were long enough so that they would span the open end of the "U" magnets. Tap bolts were used to attach the magnets to the pole pieces so that good contact was assured. A current of known strength was then caused to pass through the moving coil of the instrument, and the deflection of the pointer was read as directly proportional to the magnetic field set up by the magnet on the pole pieces.

The magnetometer scale was divided into 100 spaces for convenience in taking the reading in terms of percentage above or below the strength of any magnet adopted as standard.

The laboratory work on these magnets was done by F. V. Chittenden under the direction of F. F. Bostwick, president of the National Safety Appliance Company.

Photographic Study of Porcelain Insulators

Polarized Light Employed in Examination of Thin Sections of Insulators Some of Which Had Been Properly Fired While Others Were Underfired and Still Others Overfired—Observations on Used Insulators

BY HAROLD G. TUFTY
Research Department, University of Wisconsin

PRELIMINARY studies of insulators through the use of polarized light have been made at the University of Wisconsin under the direction of Profs. Edward Bennett and A. N. Winchell. Briefly the procedure in these studies was to examine thin sections of the insulators about 0.03 mm. thick under the microscope in both natural and polarized light. The polarized light was obtained by inserting two Nicols prisms in the path of the light. In this test sections were examined from flange pieces of 10-in. (25-cm.) insulators received from the Ohio Brass Company and from complete 10-in. (25-cm.) insulators received from the Union Electric Light & Power Company of St. Louis, Mo. This study is thought to be interesting as indicating a possible means of discovering some causes of insulator failure.

In the examination of the insulator sections certain constituents received more detailed study than others. Feldspar received the most careful study. In all cases its percentage and condition were carefully determined. The quartz received considerable attention in the first few sections, but its condition seemed so constant that its study was soon abandoned. The function of the quartz in an insulator is to retain the shape during firing. The remaining constituent of the insulator is kaolin. This substance is isotropic or glassy and is therefore invisible between crossed Nicols prisms.

The numbers printed in Fig. 2 are the numbers of the various sections studied. In each of the types the underlined section will be taken as a typical example and will be explained in detail. In cases where one description is not sufficient several sections will be described. In all the discussions the photographs will bear the number of the sections they represent. A subscript *o* indicates that ordinary light is employed in the photographing, while a subscript *p* indicates that polarized light is used.

The photographs Nos. 1_o and 1_p of section No. 1 show the appearance of a "good" insulator, which gave satisfactory service for nine years. It had not failed at the time of examination.

The photographs show a fairly even distribution of the constituents in the porcelain. In photograph 1_o the brighter particles are quartz, while those which have a more mottled appearance are feldspar. The feldspar as it appears in all the sections has lost its crystalline structure but not all of its original form. The feldspar will therefore be invisible between crossed Nicols prisms, while the quartz, which is crystalline, will be visible. Ordinary light was used in photographing No. 1_o, and as a result both the feldspar and the quartz are visible. In photographing number 1_p polarized light was used, and consequently the only constituent that is visible is the quartz.

The average diameter of the quartz grains shown in two photographs is about 0.0272 mm. Quartz grains were found as large as 0.0816 mm., but there were so few of them of this size that it did not seem worth while to estimate their quantity. The percentage of quartz in the photographs is 13.

During firing some of the feldspar had evidently fluxed with the kaolin to form a glassy matrix, while the remaining portion retained in part its original form. In some cases the boundary between the unfluxed feldspar and the matrix was difficult to determine. This condition introduces a possible error in the determination of the percentage of feldspar, but these cases were so few in number that the condition was not serious. The percentage of feldspar in this section is 28.

In photograph No. 1_o a careful examination will reveal numerous black particles. These particles are believed to be unfluxed kaolin. The number of particles in this section will be taken as a standard for comparisons made with the other sections. At first it was believed that the black particles might have come from the sawing of the insulator while preparing the section. Sections Nos. 20 and 21 were made from pieces of the insulator that were broken instead of

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being sawed. An examination of these slides revealed the same number of black particles that section 1 had. This fact was sufficient evidence to show that the black particles were not a form of contamination.

The crack in section 1 that can be seen in both photographs No. 1_o and No. 1_p is a defect overlooked during manufacture. This defect is so far from the cap of the insulator that it did not have a material effect on the insulating quality. The fracture of the porcelain represented in this type is a smooth, finely granular, non-vitreous break.

Section 4 is an example of a perfectly fired insulator. Its fracture is very finely granular and slightly silky. A comparison between sections 4 and 11 yields surprising results. In both cases the percentages of feldspar, the appearance of the matrix and the quartz and the number of black particles are the same.

Type No. 2 was in service nine years before it was cracked. The information that accompanied the insulator specimens gave no explanation regarding the cause of cracking or the conditions under which this specimen broke. Two sections of this insulator were made, one near the crack and the other at a short distance from it. Both sections appear the same in evenness of field, distribution of quartz and size of grains. There is a difference in the percentages of feldspar of the two sections. The section near the crack has 12.1 per cent of feldspar, while the section a few inches from it has 19.7 per cent. These few cases are not enough to draw definite conclusions from, but it seems as if the quality of the insulator depends on the quantity of unfluxed feldspar present. There are about half as many black particles in this section as there are in section No. 1. The fracture of this insulator was finely granular, and it lacked silky luster.

Type 3 was an overfired insulator. The photographs 6_o and 6_p of section No. 6 show the harmful effects of overfiring. The temperature of overfiring is not known, but it must necessarily have been below 1625 deg. C.—the fusing point of quartz—because the quartz shows no signs of fusion even on the sharpest points. The porosity of quartz in this section is 14.1 per cent. The quartz seems to have no bearing on the quality of the insulator. Even at the high temperature of overfiring there are no visible changes in the quartz. At the high temperature of firing the feldspar was completely fluxed, and consequently its percentage is 0. The black particles are practically absent in this section. The fracture of a piece of overfired porcelain is slightly brownish in color. A magnifying glass will reveal long narrow pores. The alignment of the pores follows very closely the outer surface of the insulator.

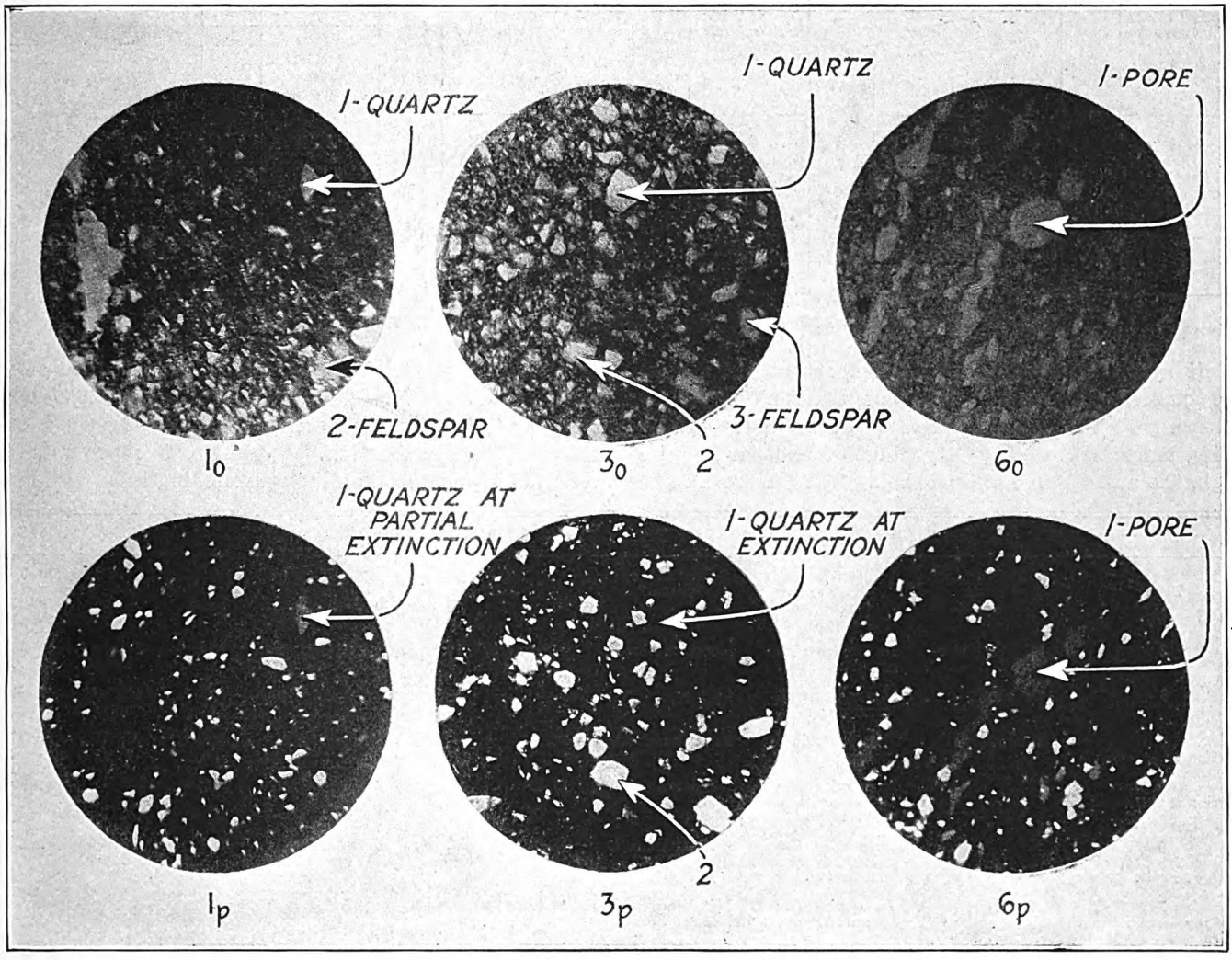

FIG. 1—PHOTOMICROGRAPHS OF INSULATOR SECTIONS REFERRED TO IN FIG. 2 UNDER ORDINARY AND POLARIZED LIGHT (600 DIAMETERS)

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Type 4 was underfired, photographs Nos. 3_o and 3_p showing the results of underfiring. The most important feature of this section is the number of black particles present. The abundance of these particles seems to have a direct relation to the temperature of firing.

Insulator No. 1 was the line disk of a string of eight insulators supporting a 100,000-volt line over a substation roof. It had been in service for five years and two months. Insulator No. 2 had been in service in the same string as No. 1 but on the ground side.

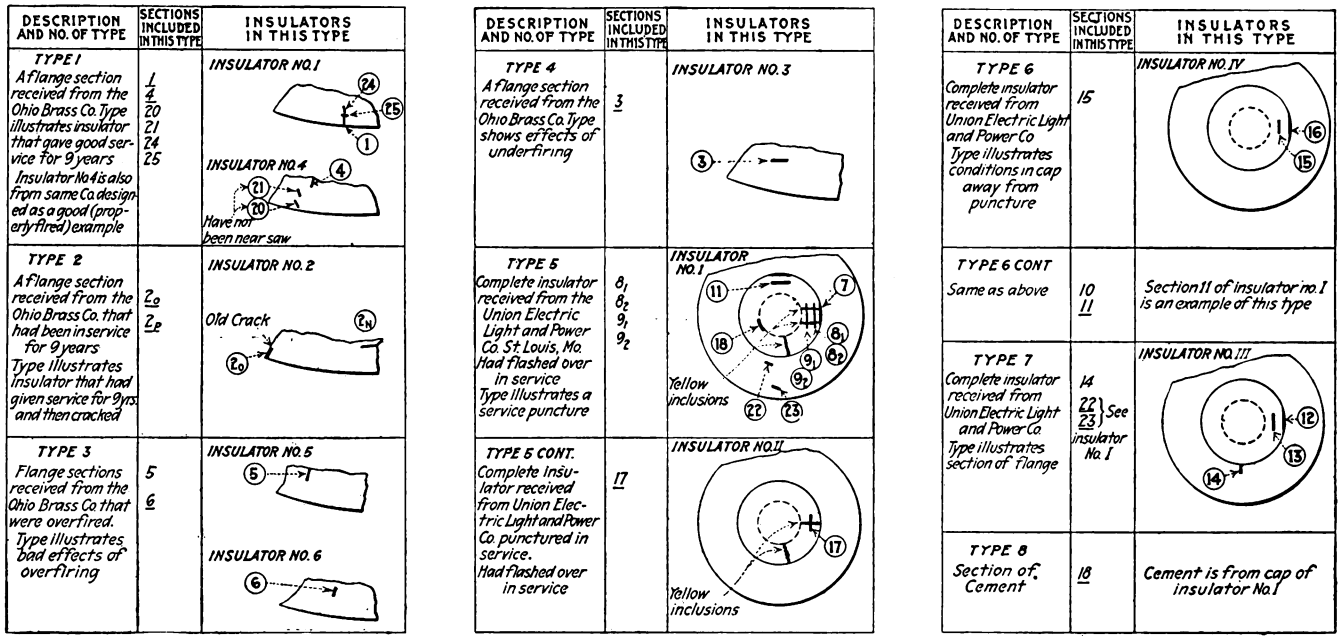

FIG. 2—BRIEF DESCRIPTIONS AND LOCATIONS OF INSULATOR SECTIONS EXAMINED, WITH COMMENTS

Their number seems to have no important bearing on the quality of the insulator, but their study is interesting as the number seems to be an index of the firing temperature. The percentage of feldspar is quite high, the average of the trials being 24.7 per cent. The fracture of the insulator described is coarsely granular and has a dull powdered appearance.

Insulator No. 3 had been in service on a suspension tower. Insulator No. 4 was taken from a 13,000-volt line dead-ended on wooden arms. It was removed on account of reconstruction. Type No. 5 represents a section of a puncture and the surrounding area. Photographs Nos. 17_o and 17_p of section No. 17 are views of a puncture and a part of the surrounding area. In photograph No. 17_o the region of the puncture is in the upper part of the picture where the section seems to be lighter. This increased transparency of the section is due to a more complete fluxing of the feldspar and kaolin. Photograph No. 17_p shows the same view, but here the quartz is the only visible constituent, since both the other constituents are isotropic. In both photographs the edges and points of the quartz are sharp, even in the upper part of the section where the breakdown occurred. This shows that even at the tem-

RESULTS OF INVESTIGATION OF EIGHT TYPES OF PORCELAIN INSULATORS

Type	Manufacturing History	Service History	Percentage Quartz	Percentage Feldspar	Black Particles	Percentage Porosity	Appearance of Fracture
1	Slightly underfired.	In service nine years—O.K.	13	28	Number used as standard.	None	Finely granular, non-vitreous.
2	Slightly underfired.	In service nine years, cracked.	Not determined	12 near crack, 19.7 away from crack.	One-half as many as type 1.	None	Finely granular, non-silky luster.
3	Overfired.	Never put into service.	14.1	0	Practically absent.	4.7	Slightly brownish, non-silky luster.
4 Section underfired.	Underfired.	Never put into service.	Not determined.	24.7	Many more than type 1.	None	Slightly brownish, non-silky luster.
5 Section at puncture.	X	In service five years over a substation.	Not determined.	13.25	Fewer than type 1.	None	Finely granular, non-silky.
6 In punctured cap but away from it.	X	In service five years over a substation.	Not determined.	16.4	More than type 1.	0.1	Finely granular, non-silky.
7 In flange of punctured insulator.	X	In service five years on a tower.	Not determined. Not determined.	16.4 and 14.25.	Same as type 1.	None	Finely granular, non-silky.
8 Piece of cement.	X	In service five years over a substation.	Not determined.	.....	None.	High	.....

Before sections were made from the complete insulators their resistance was measured at approximately 1000 volts and then they were punctured. The following table presents the results in a way that affords a rapid comparison:

Insulator No.	Ohms Resistance	Voltage at Breakdown	Discussion of Results
1	62,300	Under 12,000	Cap heated at point of previous failure
2	157,000	12,000	Same as No. 1
3	420,000,000	39,000	No heating of cap
4	204,500,000	50,000	No heating of cap

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perature developed during the failure the quartz remained unchanged.

The black particles are very evident in the upper portion of photograph No. 17_o owing to the great contrast which exists. They are well rounded—a condition which goes to show that they have been subjected to a high temperature. The percentage of feldspar in this section is very low, being only 13.25.

Type No. 6 is a section of a cap, but is taken at a point far away from point of breakdown. This section, No. 11, is from the same insulator as the one described in type No. 5. The section is very much clearer and sharper in all the outlines and details than section 17. The black particles are quite prominent in this section, which would indicate a rather low firing temperature. The feldspar percentage is higher than it was in the region immediately surrounding the puncture. In this section it is 16.4. There are several small holes distributed over the section. Even though the number of these holes is small, any possible alignment would materially decrease its resistance powers. The pores are estimated to be about 1 per cent.

Sections Nos. 22 and 23 of type No. 7 were obtained to study the conditions in the flange part of the insulator and to compare the results with section No. 11 of type No. 6.

The most interesting fact of this type is that the percentage of feldspar in section No. 22 is the same as the percentage in section No. 11. Section No. 23, which is nearer the edge of the insulator, has a lower percentage of feldspar. The percentage in this case is 14.25. The black particles in both section No. 22 and section No. 23 are the same in number, distribution and form as in section No. 11. In both types (Nos. 6 and 7) the general appearance of feldspar, quartz and the matrix are also the same.

A section of the cement (type No. 8) was obtained in order to study any crystallization of importance and also to determine the truth of the theory that possible crystallization was one of the important factors in the electrical life of an insulator. Photographs Nos. 18_o and 18_p are views of sections of cement. Zinc silicate is the only silicate that expands on crystallization, and a careful examination of the section failed to reveal the presence of any crystals. The crystals that are visible in photograph No. 18_p are impurities from the limestone or blast furnace slag. They have no significant importance, and their composition was not determined.

While this investigation did not yield all the results that were hoped for, a study of the results shown in the table brings out three very noticeable points.

The first is that the quartz is unaffected by any firing temperature and remains practically constant throughout all the types. If the properties of the quartz are very different from the feldspar its presence may be objectionable as it would cause electrical stresses to be set up in the insulator. It is possible that some high-fusing feldspar could be used in place of the quartz with much better results.

The second notable point is that the porosity of all the sections was very low. Even in the overfired case it was only 4.7 per cent, and in many cases it was 0 per cent.

The third point is that there is an absolute lack of any crystals other than the quartz. This disproves any theory that a crystallization may be the possible cause of the deterioration. There may be a slight decomposition of the feldspar into amorphous sillimanite, but these substances require special work for their detection, and in this investigation they were not looked for.

The percentage of unfluxed feldspar seems to have some relation to the quality of the insulator. Sections of the poorer quality insulators have a low percentage of unfluxed feldspar, while the good insulator sections have almost double the percentage of feldspar. In all cases the history of the specimen was so vague that a satisfactory comparison can not be made, and conclusions can only be general.

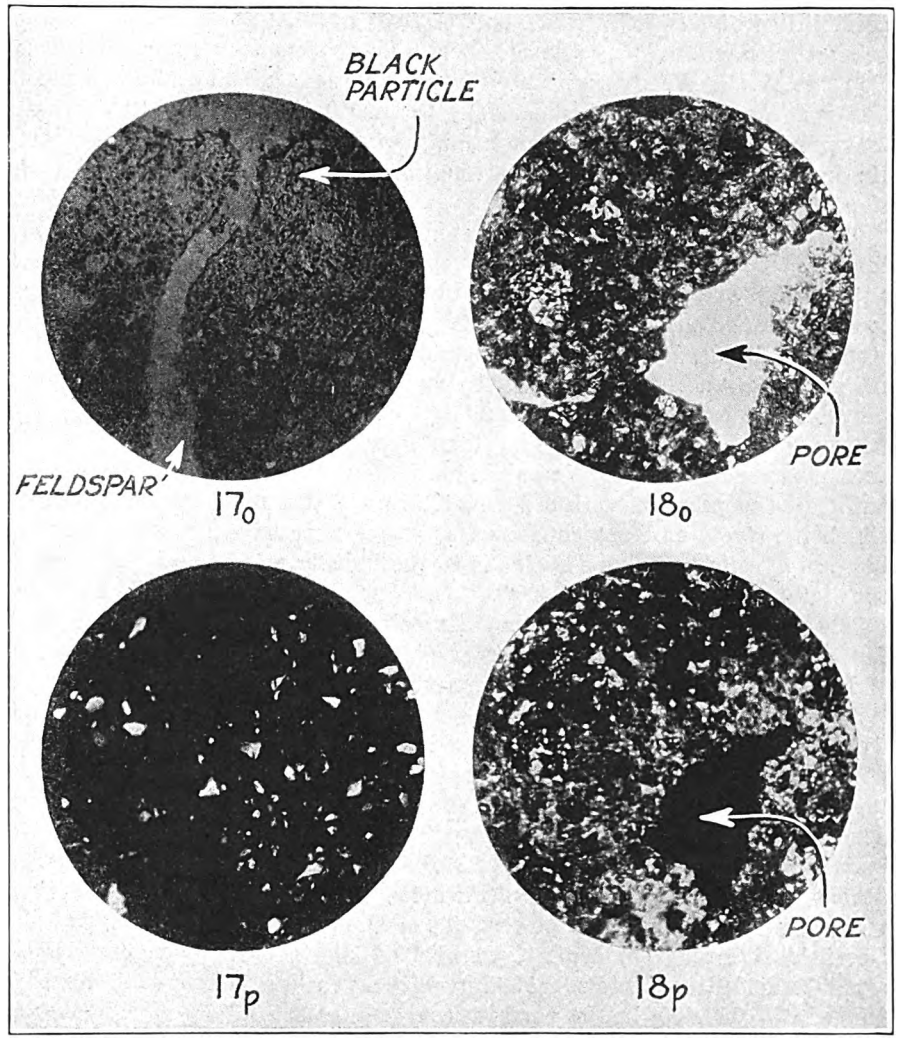

FIG. 3—PHOTOMICROGRAPHS OF INSULATOR SECTIONS REFERRED TO IN FIG. 2 UNDER ORDINARY AND POLARIZED LIGHT (600 DIAMETERS)

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Development of Massachusetts' Water Power

Special Commission Appointed to Investigate the Facilities and Possibilities in This Direction Urges Action—Public Ownership Is Declared to Be of Doubtful Value as a Water-Power Policy

DEVELOPMENT of water-power resources and the compulsory coöperative increase of storage facilities under the regulation of the Waterways Board are recommended in a report of the special commission to investigate the water-power facilities and possibilities of Massachusetts, John E. Beck of Chelsea being chairman. Among the members of the commission are A. R. Weed, chairman of the Massachusetts Gas and Electric Light Commission; Charles T. Main, past-president of the American Society of Mechanical Engineers, and John N. Cole, chairman of the Commission on Waterways.

The report has been ordered printed by the Legislature. Its recommendations are embodied in a bill authorizing and encouraging mill owners and others to improve and utilize fully the water resources of the state, providing that after a reasonable lapse of time the state may acquire at cost such improvements, and that in case of the failure of the mill owners to act within three years the state may take steps to develop such water resources for the public good. The bill also authorizes coöperation with other states in and through which the rivers of Massachusetts rise and flow or having power which might be available to the industries of the state.

The commission points out that the actual output of the developed sites on the twenty-one principal rivers of Massachusetts is about 100,000 hp.-yr., with a potential energy equivalent to 333,811 hp.-yr. annually. Based on mean annual run-off and expressed in wheel horsepower at 80 per cent efficiency, the total potential power is estimated at 506,593 hp. Of this 333,811 hp. has been developed, and the aggregate capacity of the waterwheels installed at the developed sites is 325,382 hp. The undeveloped potential power is 172,782 hp. The undeveloped water power at new power sites on the Chicopee, Deerfield, Farmington, Millers, Quinebaug, Shawsheen and Westfield Rivers totals 88,590 hp., with a yearly output of 776,048,400 hp.-hr. and a coal equivalent of 779,513 tons. The unutilized water power at developed sites on the Charles, Concord, Connecticut (44,300 hp., 388,068,000 hp.-hr. or 389,800 tons of coal yearly in Massachusetts for the last), Ipswich, Millers, Neponset and Westfield Rivers totals 55,959 hp., or 490,200,840 hp.-hr. per year, representing a coal equivalent of 492,389 tons.

The total undeveloped power on these fourteen streams represents a coal equivalent of 1,271,902 long tons of coal yearly, or 1,266,249,240 hp.-hr.* On an operating basis of 80 per cent utilization and service twenty-four hours per day for a portion of the power and fifty-four hours a week for the rest, the coal equivalent† is 664,819 long tons per year for both developed and unused power at the developed sites. In sum, with streams capable of developing between one-third and one-half million horsepower and actually deriving the benefit from but one-third of these amounts the people of the state are paying an extra toll for 1,250,000 tons of coal per year, most of which can be saved through a proper and more complete development of the water resources. With coal at $5 per ton, this means $6,250,000 per year, and at $10 per ton, $12,500,000 per year.

"There is an opportunity now with proper legislation to save most of this coal," the report states, "but it requires concerted action by mill owners and the state to bring this about, and the following improvements: (1) The use of improved hydraulic machinery; (2) the use of water power for a longer period of time or with greater pondage created at the different mill sites; (3) the development of sites not formerly utilized; (4) water storage."

Complications of the Situation

The report points out that it is not possible to carry the installation of waterwheels beyond the point of economic balance between cost and value of return on investment, but the increased cost of coal has made a definite shift in favor of a longer use of stream power. Storage reservoirs cannot do more than partially control the flow, although they are important factors in artificially increasing the run-off of a stream. Many swamps and poor meadows, however, will serve their best use if covered with water. In the case of the Merrimac and Connecticut Rivers the situation is further complicated by lack of jurisdiction due to the fact that the principal headwaters of both rivers are out of the state. Hence it is necessary to make use not only of storage reservoirs but also of larger power installations and longer hours of operation in order that the most complete utilization of the potential energy of the various streams of the state may be secured.

A more specific illustration of the utilization of unused power is given in the case of the Millers River. The source of this power is the storage of eight prospective reservoirs. It is estimated that this stored water, amounting to an average flow of 3,100,000,000 cu.ft. per year, would add to the output of the thirty-one existing plants at their present hours of operation, allowing 20 per cent waste, 8,043,418 hp.-hr., equivalent to 8079 long tons of coal. No allowance was made in this estimate for the initial creation of power at some of the reservoir sites nor for the resulting increase in the power output of the Connecticut River at Turners Falls and Holyoke.

As the law now stands, storage reservoir corporations may be organized and storage created under the general corporation law and the flowage rights of the mill act (Revised Laws, Chap. 196). Mill owners on a stream may unite for this purpose, save in so far as they may be corporations restricted as to holding shares in other

*The horsepower of the sites included in the above total has been obtained by multiplying the mean flow of the stream in cubic feet per second by the fall in feet and dividing the product by 11, which gives the net horsepower on wheels, realizing 80 per cent of the theoretical power.

†At 2.25 lb. per horsepower-hour.

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corporations. But if some owners act while others refuse, those refusing will enjoy the advantage of any improvement in stream flow without sharing in the burden of maintaining the necessary storage reservoirs. This can be overcome, the report states, only by legislation authorizing the creation of storage and the levying and collection of tolls for the use of the stored water even against the will of those refusing to share in the undertaking. Such legislation bears a close analogy in principle to provisions, long on the statute books and sustained by the courts, whereby some of the proprietors of lands, wharves or other real estate or of mills or dams held in common may make needed improvements or repair or rebuild the structures at the expense of all the proprietors, including those unwilling to participate.

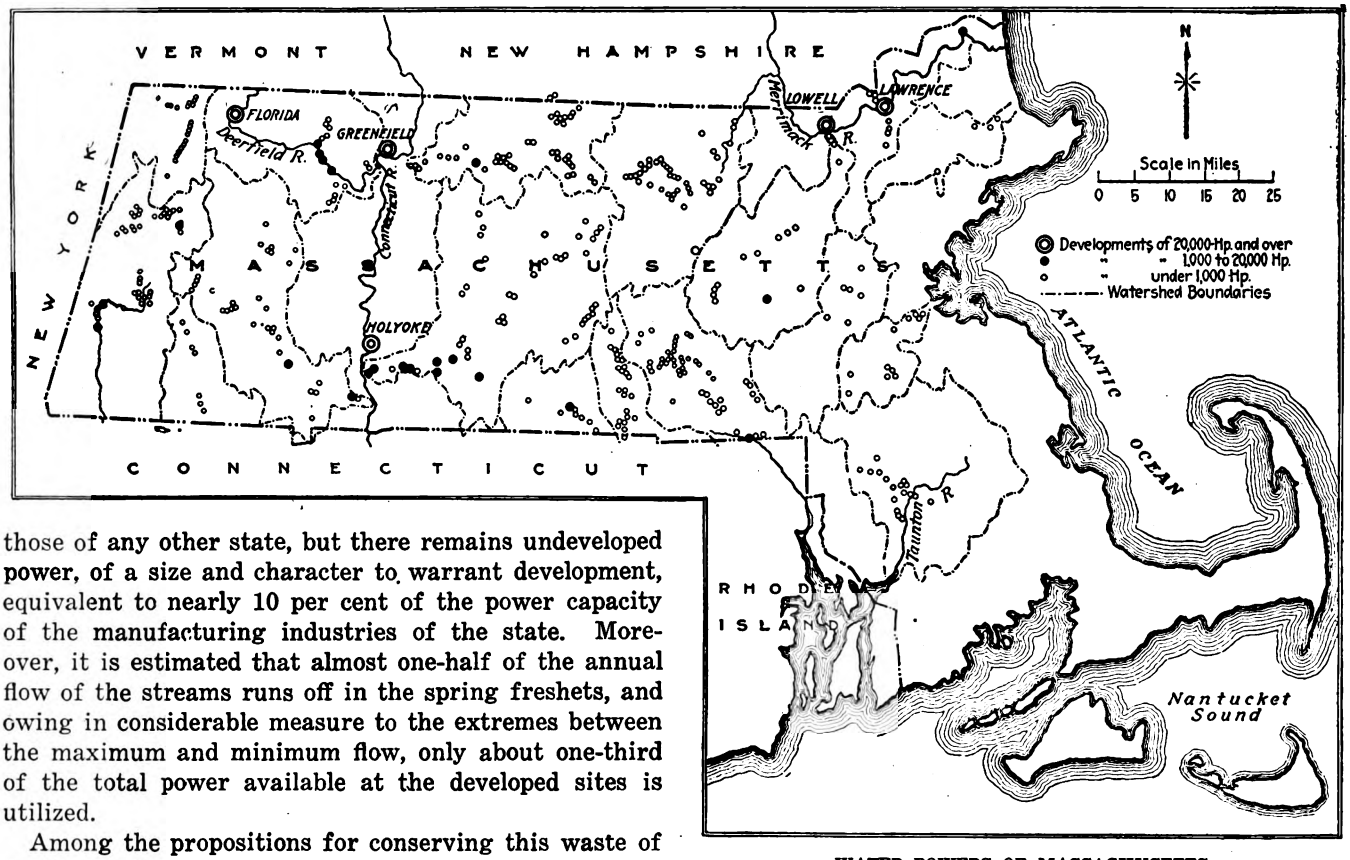
The water powers of Massachusetts are developed to a higher percentage of the possibilities than perhaps those of any other state, but there remains undeveloped power, of a size and character to warrant development, equivalent to nearly 10 per cent of the power capacity of the manufacturing industries of the state. Moreover, it is estimated that almost one-half of the annual flow of the streams runs off in the spring freshets, and owing in considerable measure to the extremes between the maximum and minimum flow, only about one-third of the total power available at the developed sites is utilized.

Among the propositions for conserving this waste of power are, first and most important, the impounding of freshet waters and their release during uniform periods of drought and scarcity, the redevelopment of existing water-power plants along modern lines for more efcient use of water, and the interchange of power by electrical interconnection so that the wastage of water due to lack of continuous operation of existing power plants may be saved.

The commission points out that storage can only be created by dams located as determined by the topography of the watershed, and it may be impossible to acquire the necessary sites (their value for any other purpose is usually small) unless they can be taken by eminent domain. If there are undeveloped sites on streams below the reservoirs, their value is increased by the stored waters but wasted unless they are developed. If the owners of such undeveloped powers fail in a reasonable time to develop them, this should be done for the common benefit of the owners who have joined together to improve the stream flow, or for the benefit of the public. This again involves the exercise of the right of eminent domain, and both instances require legislative sanction for their accomplishment. Any question of the authority of the Legislature to grant such right of eminent domain has been dispelled by the recent adoption of the constitutional amendment relative to the public interest in natural resources.

Regarding public development and ownership, the report says:

"The vital interest of the public in cheap and reliable power for the industries of the commonwealth is so manifest, and water power is a natural resource so definitely limited in extent, that many thoughtful people have urged that any projects for conserving and utilizing as nearly as practicable the full potential power of the streams should be undertaken by the state. Were the streams unfettered by investments in privately owned mills with experience and knowledge of water-power development as it is to-day, there would be great force in the argument for the acquisition and development of this great natural resource under public ownership, connected by electrical transmission and kept in balance with well-located steam stations, so that the whole might form one great reservoir of power for industries, transportation and general use. But such an ambitious solution involves many complex problems in the necessary readjustments of important industrial interests and an enormous public expenditure, the self-sustaining character of which might not be clearly demonstrable. Furthermore, broadly speaking, if the full workable power of the streams is developed and utilized, it is perhaps a matter of little concern to the public at large whether it is undertaken by public or private enterprise."



WATER POWERS OF MASSACHUSETTS

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

PROTECTING INCANDESCENT LAMPS ON ARC-LAMP CIRCUITS

Relay Employed to Prevent Current Surges Produced by Sticking of Arc Lamps in Series with Incandescent Lamps

On one street-lighting circuit in a city in the East where incandescent lamps were connected in series with arc lamps as many as twenty incandescent lamps, valued at $2 per unit, burned out each night owing to surges in the current. To remedy this trouble two solenoids were placed in series with the line and arranged with their plungers in the same vertical line so that they would make and break a contact. The opening of the contact connects resistance in series with the incandescent lamps so they will not be damaged by surges. The plunger on the upper solenoid is normally held away from the plunger of the lower one and will drop and make contact only when the surge in the arc curcuit falls below the normal value. The lower plunger will be forced upward to make a contact with the upper plunger when the surge is greater than normal value, thus allowing for protection in either direction.

A BOILER-ROOM BONUS THAT SATISFIES THE MEN

Amount Paid Increases Each Month Up to a Certain Point, but Is Forfeited by Absence or Lateness

The labor situation in the power plant was one of the most serious problems with which the central stations were confronted during the war and is one that may face them for some time. Activities in other departments can be curtailed and in some entirely suspended and still give the public good service, but the production of power must go on or the business of the company and that of many industries dependent on it for power will come to a standstill. The chief difficulty comes in the boiler room, among the firemen, coal passers and ash handlers, who from the nature of their work can readily shift from one plant to another or from one class of work to something else, and this turnover lowers the efficiency and endangers the continuous operation.

To meet this problem the Empire Gas & Electric Company, of Auburn, N. Y., has devised what it terms an attendance bonus, which, while not original in principle, has some unusual features. A premium of 10 cents per day is paid to each man, provided that he is on duty each day of the calendar month and is not late on his shift. That is, on a thirty-day month he would receive an attendance bonus of $3. The second month he receives 11 cents per day, and the pay goes on increasing at this rate until the bonus becomes 20 cents, or $6 per month, after which it remains constant. Should the man be absent a day or be late on duty any day of the month he loses the entire month's bonus and in addition continues at that month's bonus rate during the next month.

This system has been very popular with the men and has practically eliminated the labor turnover. There are men who have reached the maximum rate without the loss of a single day in the successive months it took to attain it.

The system was devised by Lewis C. Reynolds general superintendent of the Empire Gas & Electric Company.

TWENTY-TWO MILES OF OLD CABLE REINSTALLED

Single-Conductor Street-Lighting Cable of Different Types Is Successfully Used After Being Pulled from Ducts

One of the economies which war conditions taught and which will probably become standard practice is the reinstallation of old cable. Within the last year the ELECTRICAL WORLD has described at least two instances in which large quantities of power cable have been reinstalled successfully. Now an example of a similarly successful job on street-lighting cable has come to light. During the war period the electrical department of the Lincoln Park Commission, Chicago, reinstalled 122,806 ft. (37,000 m.), or about 22 miles, of cable of various sorts on its system. Eliminating the credit for cable sold for junk, the value of this replaced cable was $18,-913.19. These figures on value were arrived at by taking the price at which the cable was purchased less the depreciation. From this it may be seen that the cost figures are conservative in their relation to present cable values.

The method of procedure was to pull the discarded cable from its ducts and roll it on reels. It was then taken to the storeroom, where all lengths of single-conductor cable were spliced and again rolled on reels. No difficulty was encountered in rolling the splices in single-conductor cable on reels, but this was not attempted with the small amount of four-conductor cable which was handled. In all about 650 joints were made in the old cable. Each joint was made by using a soldered copper sleeve, covered with a thin coating of rubber and about eight layers of "linotape" extending back over the lead. The lead sleeve was then wiped in place and the joint filled and refilled with "Minerallac," after which it was sealed.

When the cable was reinstalled the greater part of it went back into service at the same voltage at which it had previously operated. No extra precautions were taken where splices were pulled into ducts, except to instruct men to exercise ordinary care. Forunately,

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the runs as a rule were not long, the longest on the entire park system being 338 ft. (103 m.). Since the cable has been installed there have been a few failures,

DATA ON SALVAGED CABLE REINSTALLED

No. Feet	1915	Total Cost
8,400	No. 6-4 conductor rubber and lead 10,000-volt cable.....	$2,065.00
	1916	
20.296	No. 6 rubber and lead 10,000-volt cable.....	3,145.88
	Electric-fountain junk cable.....	450.00
4,618	No. 6 paper and lead 10,000-volt cable, single-conductor.	369.44
7,881	No. 6-4 conductor rubber and lead 10,000-volt cable.....	3,752.50
	1917	
9.972	No. 6 submarine 17,500-volt single-conductor cable.....	3,972.89
34,817	No. 6 rubber and lead 10,000-volt single-conductor cable	3,343.53
32,544	No. 6 paper and lead 10,000-volt single-conductor cable..	1,568.28
957	No. 6 duplex rubber and lead 600-volt cable.....	106.19
444	Ten pairs telephone cable.....	44.40
	Junk cable.....	1,243.51
713	No. 6-4 conductor rubber and lead 600-volt cable.....	265.20
275	No. 12 duplex rubber and lead 600-volt cable.....	30.25
450	No. 4 standard 600-volt single-conductor cable.....	27.00
510	No. 6-4 conductor rubber and lead 10,000-volt cable.....	124.00
200	No. 10 duplex rubber and lead 600-volt cable.....	9.00
407	No. 6 stranded rubber-covered single-braid 600-volt cable	26.72
275	No. 6 rubber and lead 600-volt single-conductor cable...	8.25
20	No. 6 600-volt single-conductor cable.....	2.16
27	No. 12 stranded 600-volt rubber-covered single-braid cable	8.50
122,806	.....	$20,362.34

but not many more than might happen with new cable.

The table herewith gives in detail the lengths, types and values of cable which was reinstalled from 1915 to 1917, under the direction of Claude Shepard, electrical engineer for the Lincoln Park Commission.

PORTABLE MACHINES FOR DRYING ELECTRICAL APPARATUS

Motor-Driven Blower Forces Air Through Electric Heater to Remove Moisture from Manholes, Conduits, Wet Generators, Etc

On various occasions it may be necessary to dry out electrical apparatus that has become inoperative owing to moisture penetrating the insulation, and delay will prolong the interruption of service. For such cases it may be convenient to use an outfit like the one which has recently been constructed by the Georgia Railway & Power Company to dry out manholes, conduits and electrical machinery which have become damp. The outfit consists of a motor, a centrifugal blower, an electric heater and control apparatus all mounted on a swivel-wheel truck that can be easily moved from place to place. The equipment is said to have 50 per cent higher rating than any that can be purchased in the open market for like purposes. The main switch that stops and starts the motors also controls the electric heater. Furthermore, a lead-wire safety link is connected in series with the cast-iron heating grids so that the circuit will be opened in case the source of cold-air supply is cut off for any reason. Burning up of the heating unit is thus practically prevented.

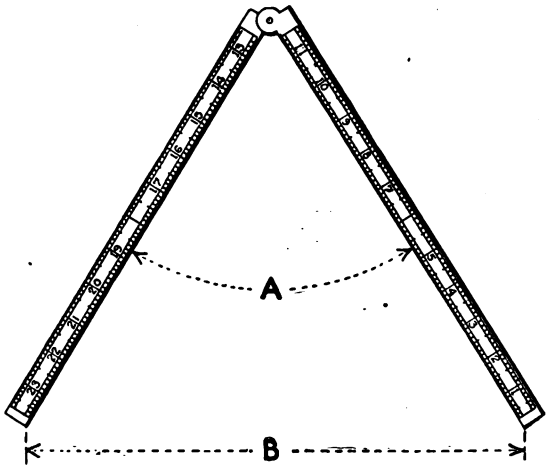
This outfit is intended to supply about 1000 cu.ft. (28 cu.m.) of free air per minute at a maximum temperature of 140 deg. C., which adapts it to be used for drying out large transformers, subway holes or conduits, large generators, etc.

PLOTTING CONDUIT-RUN ANGLES WITH A 2-FT. RULE

Method Which Will Facilitate Bending Conduits So They Will Fit Accurately in Any Given Place

BY TERRELL CROFT

The angle between two lines of conduit can be easily plotted or determined by a 2-ft. rule as follows: To find the angle *A* between the legs of the rule, open the ends so that the edges of the two legs of the rule lie along the center lines under consideration. Then measure the distance *B*. Now refer to the table to find the corresponding angle. For example, if the distance *B* measures 10⅛ in., the angle *A* will then be 50 deg. Conversely, if it is desired to lay out an angle



A Degrees	B Inches Decimal	B Inches Nearest 64th.	A Degrees	B Inches Decimal	B Inches Nearest 64th.
1	.21	13/64	35	7.20	7 13/64
2	.422	27/64	40	8.21	8 13/64
3	.633	41/64	45	9.20	9 13/64
4	.837	27/32	50	10.12	10 1/8
5	1.04	1 3/64	55	11.08	11 5/64
7.5	1.57	1 37/64	60	12.	12
10	2.09	2 3/32	65	12.89	12 57/64
14.5	3.015	3 1/64	70	13.76	13 49/64
15.	3.12	3 1/8	75	14.61	14 39/64
20	4.17	4 11/64	80	15.43	15 7/16
25	5.21	5 13/64	85	16.21	16 13/64
30	6.21	6 13/64	90	16.97	16 33/64

A SIMPLE METHOD OF ASCERTAINING CONDUIT-RUN ANGLES

of given magnitude, lay the rule with its sides spread apart on the floor, or on a piece of paper, and separate the ends of the legs until the distance *B* corresponds with that given in the table for the angle which it is required to plot. Two 1-ft. scales or rulers may be used, instead of a 2-ft. rule, if their corners are placed together at one end.

To find or plot the angle of a conduit-run offset one leg of the rule can be laid along one side center line and the other leg of the rule laid along the offset center line. If it is desired to find the offset angle, the distance *B* is measured and the corresponding value is found from the table. If it is desired to lay off a certain angle, the legs of the rule are spread apart until the distance *B* is that specified in the table for the angle under consideration.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

WOMEN SUCCEED WELL AS OPERATORS IN ATLANTA

They Can Be Depended Upon in Emergency and Will Be Given Every Opportunity for Advancement

The Georgia Railway & Power Company, Atlanta, Ga., is employing in its substations four women as operators. Though they are under the direction of an experienced man operator in charge of the plant, the women are very frequently left entirely alone at the switchboard. In speaking of the women operators, Superintendent George Iler says:

"We are very proud to announce that some of these operators have learned to do considerable switching. One of the women is able to start machines and place them under load, which is very remarkable considering the short training she has had as compared with the training necessary for young men. These young ladies have not had any accidents or errors of any kind.

"We have also noticed a remarkable improvement in application to duty where the women are working. The women have been in service long enough to demonstrate that they are going to be loyal employees and can be depended upon through any emergency. They are paid the regular scale of wages for this kind of work and will be given every opportunity for advancement."

FAILING SUPPLY OF GAS HELPS OHIO COMPANIES

Applications for Electric Service and for Quotations on House Wiring Increase Fast as Reliability of Gas Service Declines

Electric light and power companies in northern Ohio are enjoying a brisk demand for electric service. Homes are being wired and connected to central-station lines at a rapid rate because the natural-gas service is becoming less reliable. The Sandusky Gas & Electric Company is typical of those utility companies reporting increases in electrical customers. It connected more customers in the month of December, 1918, than in any one previous month in the history of the company, although it had not a single salesman on this work. Moreover, there was no impetus to carry it over into December because during the period of the war the company had discontinued its monthly payment plan under the terms of which it contracted with the customer to turn the work over to the electrical contractor, paying him cash for the work and permitting the customer to pay for his wiring on the installment plan.

All of the present wiring business is being handled by the contractor directly, the central station being entirely out of the retail business. According to E. A. Bechstein, vice-president and general manager of the Sandusky Gas & Electric Company, the principal reason for the number of connections made was the fact that during the past winter natural-gas service was so bad that many homes depending on natural gas for illuminating purposes were in the dark a good part of the time. At the 1918 meeting of the Ohio Electric Light Association at Cedar Point Mr. Bechstein predicted that since natural gas is on the wane all over the State of Ohio many other communities will experience the same demand for electric service which has been already noticed at Sandusky.

CONTINUE TO ASK CUSTOMERS TO FINANCE THEIR EXTENSIONS

Alliance (Ohio) Company Feels Its Situation Is Such that It Must Still Enforce War-Time High-Cost Measures to Prevent Losses

Policies regarding the payment of extension costs which grew out of the high-cost era will be continued in force by the Alliance Gas & Power Company, an Ohio subsidiary of the Doherty interests. Customers will still be asked to pay a part of the cost of making line extensions to serve them. Residence customers will be accepted under the terms of a plan (see ELECTRICAL WORLD for Nov. 2) by which the difference between the 1914 cost and the present cost is charged to them and is rebated as additional customers come on. Power customers will pay for the extension (see ELECTRICAL WORLD for Nov. 9) and will receive rebates equal to one-half the power bill for each month during the first two years.

Naturally the company will find prospective customers ready to remind it that the war is over and that war-time practices should be abandoned. These will be met with the statement that high prices of labor and material still prevail. Moreover, these persons will be shown that under the state laws the company cannot earn on the depreciated value of the property. The law says valuations for rate making "shall be based on reproduction new as of a date certain." If the company were to spend $50,000 in the next five years for line extensions and declining values should cause this to depreciate to $35,000, and in eight years the company were to come up for a valuation in connection with rates, it would lose the $15,000 of depreciated value. Therefore customers who want service must make up this probable depreciation to protect the company against loss.

No trouble is anticipated in getting customers to understand this situation. It is more advantageous for power customers to accept it than to put in a new plant, because they do eventually get their money back from the power company, but they could never get it back from an isolated plant.

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RESUMPTION OF DEMAND FOR OUTSIDE LIGHTING

Reading Utility Reports Outlook for Business Encouraging, While Current Business Shows Healthy Growth

The Metropolitan Edison Company, Reading, Pa., reports a most encouraging outlook for new business, especially among merchants who are increasing their lighting facilities. There is a general resumption of the demand for more elaborate outside lighting fixtures, several important installations of this kind having been made during the past month. Electrical contractors are advocating and pushing semi-indirect store-lighting units to replace older systems of installation.

Business for the past month has shown a healthy growth considering the long period of federal restrictions during which no stimulation of any kind on the part of the company was permitted.

COMMONWEALTH EDISON SELLS $1,000,000 MERCHANDISE IN 1918

Retail Sales Show an Increase of 37 per Cent for the Year—Branch Stores Greatest Gainers—Fixtures to Be Sold—The Outlook

Following the close of the very successful year just past E. A. Edkins, general manager of the electric shops of the Commonwealth Edison Company, Chicago, prepared a general summary of the accomplishments. Some of the points prominent in this statement follow:

During the four years since the Edison Building Electric Shop was opened gross sales have been quadrupled. During the calendar year 1918 they exceeded $1,000,000, not including the sales made through the wholesale merchandising department. The increase in gross sales for 1918 over 1917 amounted to 37 per cent.

During the last year the shops have also taken over an additional 6000 sq.ft. of space, which is now known as the appliance section of the electric shop, the old quarters having been assigned exclusively to the supplies and portable lamp section. The section formerly known as the annex is now being remodeled and will shortly be opened as a high-class fixture display and salesroom.

The federal coupon redemptions during 1918 have increased very rapidly. The distribution or coupon certificates through the medium of our monthly bills and from the cashiers' windows on the second floor have enabled us to build up an average attendance of four to five thousand prospective buyers per day.

The development of branch electric shops' business has been equally gratifying, the four outlying stores showing an average increase in 1918 over 1917 of 75 per cent in their gross business.

One of the outstanding developments in 1918 was the opening of numerous lamp-renewal substations in various sections of the city in order to afford customers convenient locations for the exchange of lamps. In some of these lamp-renewal branch bureaus we have been permitted by the lamp department to install a small display of electrical appliances, and these displays have stimulated the sale of appliances in their respective neighborhoods. It is, therefore, quite possible that a few branch shops may be opened in such sections of the city as seem to be in need of this additional service.

Another feature of the year was the campaign on washing machines, which resulted in the sale of over 1500 washers during the year.

Mr. Edkins sets the mark for 1919 at $1,500,000, a 50 per cent increase over the 1918 achievement.

LINE EXTENSIONS ARE NOW FINANCED ON PRE-WAR BASIS

When Cost Is Less than $100 Providence Electric Company Makes Extensions Free of Cost to Customer

The Narragansett Electric Lighting Company, Providence, R. I., has discontinued the financing of extensions on a war basis, and henceforth customers requiring extensions costing less than $100 each will be furnished with line facilities at the expense of the company. The Rhode Island Public Utilities Commission has approved the change. During the war the company required all customers whose service necessitated extensions costing less than $50 each to pay the excess cost of such construction above the normal cost estimated on the 1914 basis. Extensions costing more than $50 each had to be entirely financed by customers. The company refunded the normal cost annually to the customer paying the excess cost, the refund being at the rate of $20 for every $100 paid to the company for energy used by the consumer at the particular location. The company also paid 6 per cent interest on any unrefunded balance of the normal cost, reserving the right to refund at any time all or any portion of the unrefunded portion of the normal cost.

INCREASED POWER RATES SHOW LITTLE EFFECT ON EARNINGS

It Is Deemed Best by the Detroit Edison Company that Schedules Should Lag a Little in Their Adjustment to the Times

Certain increases of electrical power rates were made by the Detroit Edison Company in the past year, but with little effect on its earnings, Alex Dow, president of the company, states in his annual report for 1918. The first increase was an advance of one-tenth of a cent (gross) per kilowatt-hour, made in November, 1917, in the contract rate for large blocks of untransformed high-pressure energy, which is the company's wholesale industrial power rate. In April, 1918, a further increase of a like amount was made. Mr. Dow says:

The cost of fuel is a larger proportion in the total cost of electric power service, which is in use many hours per day, than it is in electric lighting, which is in use daily for only a few hours. It is an especially large proportion in the cost of large blocks of untransformed energy, for which class of service our labor and investment expenses are by comparison small. Therefore it was in that class that the first correction of rates had to be made. In July the contract rate for low-pressure electric power service was increased one-half of a cent (gross) per kilowatt-hour. Neither of these power-rate increases became widely effective during the year, because our power contracts have been made for three-year terms, and a newly filed rate is applicable only to new contracts or to renewals of old contracts.

Electric light rates are unchanged excepting for a rearrangement and reduction of prompt payment discounts on the larger bills ($50 per month and upward), which made our discount practice uniform for all classes of service but made only a minor addition to earnings. The great majority of all our customers thus continue to be served at rates which were established in 1915 and were based upon the costs of 1914 and earlier years.

Had the war continued, we should have had to propose increases of rates for all classes of service. As it is, we cannot say that the rates for electric supply as they stand are adequate for the conditions as they stand or as they are likely to be in the near future.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Alternating-Current Generator Wave Form.—F. D. NEWBURY and S. L. HENDERSON.—The form of the voltage wave of an alternating-current generator is determined mainly by the arrangement and connection of the armature winding, by the distribution of flux in the air gap, and finally by the shape and relative value of the armature reaction. The first two factors determine the wave form at no load, and the third determines the change in wave form caused by the load current. The influence of these factors is discussed in detail in this article.—*Electric Journal,* November, 1918.

Transformer Losses.—V. E. JOHNSON.—Gives tests for condition, internal losses and distribution losses.—*Power Plant Engineering,* Jan. 1, 1919.

Electric Arc Welding in Tank Construction.—R. E. WAGNER.—The adequacy of electric welding, both with metallic and carbon electrodes, in manufacturing processes involving the fabrication of sheet metal, up to heavy boiler plate, needs no better demonstration than that afforded by the Pittsfield Works of the General Electric Company in the construction of many thousands of transformer tanks. Electric welding for this work has almost entirely replaced riveting, effecting a better construction, lower cost of manufacture and a material reduction in the amount of noise and confusion in the tank shop. The author outlines the qualifications of a successful operator, and another very important point that is considered in detail is the intelligent study of the work in hand and its preparation for welding. Any neglect of either of these factors is certain to result in unsatisfactory work. The illustrations afford an idea of the extensive application of arc welding to tank construction, while the tables contain data that will be of assistance in determining the cost of the process.—*General Electric Review,* December, 1918.

Butt Welding of Some Non-Ferrous Metals.—E. F. COLLINS and W. JACOBS.—The process described in this article was the outcome of a search for a satisfactory method of connecting the end rings of the rotor bars of induction motors. One of the first methods employed consisted in bolting the end of the rotor bars to the copper end rings, using lock washers to secure the connection. The high resistance of this joint, which was increased by oxidation as the result of heating, raised the temperature to a point where the temper of the lock washer was destroyed and the connection loosened to a serious degree. The next method was to solder the end rings to the conductors, but poor electrical contact again caused heating and melting of the solder, and the engineers were compelled to look further for a solution of the problem. Electric butt welding gives a perfect electrical joint and admirably fulfills all the requirements; in fact, cases have occurred in practice where the solid copper end ring has melted, leaving the welded joints intact.—*General Electric Review,* December, 1918.

Generation, Transmission and Distribution

Waste Wood as a Fuel Possibility.—O. F. STAFFORD.—The use of sawdust and wood ends as a fuel offers the double advantage of utilizing waste products and of a renewable supply. The conversion of wood waste into ethyl alcohol, food for animals, direct fuel and a powdered charcoal which might be used directly in a specially designed Diesel engine is here suggested as practiced by the head of the chemistry department of the University of Oregon.—*Journal of Electricity,* Dec. 15, 1918.

Inspection and Test of Electric Transmission Lines.—O. C. CALLOW.—Including a discussion of the troubles and losses in overhead transmission and also tests and remedies to get the best efficiency.—*Power Plant Engineering,* Jan. 1, 1919.

Saving the Waste in Penstock Pipe Design.—B. F. JAKOBSEN.—The author treats of the economical use of materials in the design of penstocks for hydroelectric systems.—*Journal of Electricity,* Dec. 1, 1918.

Turbine Operation.—J. WILSON.—Gives methods of inspection and a discussion of operating conditions and checks on operation performance.—*Power Plant Engineering,* Jan. 1, 1919.

Design and Selection of Oil Circuit Breakers.—J. N. MAHONEY.—The author points out why the oil circuit breaker is used in power systems of large capacity. The rating of these switches is discussed, and the effects of the line constant together with auxiliary devices such as automatic voltage regulators are shown. --*Electric Journal,* November, 1918.

Design of Porcelain Insulators from the Theoretical Standpoint.—G. I. GILCHRIST and T. A. KLINEFELTER.—From a theoretical standpoint a conception was formed of the functions which air and solid dielectrics perform when used in combination for insulating purposes. Based on this conception, a large number of tests have been made under commercial conditions which show that it is possible to use air more efficiently than has been customary in the past. Breakdowns of an air path over a surface have been obtained which average as high as 9.4 kv. per centimeter effective value (23,900 volts per inch), over a distance of 17 cm. (6.7 in.). The conditions of design are such that these same averages may be maintained at any voltage by increasing all dimensions of the structure proportionately. The principal thing to be considered is the proper shaping of the terminals in order that points of high intensity may be eliminated and a high average intensity obtained.—*Electric Journal,* November, 1918.

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Traction

Electric Freight Haulage Is an Economic Duty.—A. B. COLE.—It is said that such service is invaluable to the city and country as well. The field is practically unlimited and the service can be developed by making a traffic analysis, providing the proper equipment and using farsightedness and imagination.—*Electric Railway Journal,* Jan. 4, 1919.

Modern Track Needs Good Ballast.—R. C. CRAM.—The author shows why a well-ballasted track is economical to maintain. He describes types of construction, gives the properties and materials necessary for an ideal ballast and discusses ballasting from the standpoint of the best engineering practice.—*Electric Railway Journal,* Dec. 21, 1918.

Installations, Systems and Appliances

Constant-Energy Arc-Welding Set.—P. O. NOBLE.—The author describes a new and ingenious type of arc-welding equipment which combines those characteristics best to perform certain kinds of welding. The success of electric arc welding is largely dependent upon the skill of the operator. The control of the location of the crater can best be effected by the use of a short arc, and the advantage of the system described lies in the fact that it facilitates the maintenance of a short arc and makes it difficult to continue a long one.—*General Electric Review,* December, 1918.

Electric Winding Engines and Mine Hoists.—H. H. BROUGHTON.—In this article of the series the author deals with the spiro-cylindrical drum. After considering the influence of drum profile on performance, and noting briefly the great advantage often obtained by the use of spiro-cylindrical drums, an example is fully worked out for balanced operation.—London *Electrician,* Nov. 1, 1918.

Electrically Driven 38-In. Reversing Cogging Mill.—The mill described is one recently installed in the Cleveland district, designed to roll 3-ton steel ingots 18-in. by 22-in. (46-cm. by 56-cm.) to 4-in. by 4-in. (10-cm. by 10-cm.) billets. The apparatus consists principally of a 4800-hp. motor, three generators, each of 1500-kw. capacity, and an induction motor of 2700 hp.—London *Engineer,* Dec. 13, 1918.

Overhauling and Testing Fans.—M. S. LEONARD.—In this paper are described the detection of leaks and reasons for poor performance of fans.—*Power Plant Engineering,* Jan. 1, 1919.

Adequacy of Welding in Constructing Hulls of Ships.—H. M. HOBART.—Although electric arc welding has been employed for years in many industries, very little of practical value has been written about the process and almost no data were available from which deductions could be drawn to determine the suitability of the process for specific applications. It remained for the exigencies of the war to bring about the pooling of all available information and the collaboration of competing interests to advance the art. The progress has been largely accelerated by the welding committee of the Emergency Fleet Corporation, and it has been the duty of the research sub-committee of the welding committee to determine the relative merits of the many different systems and equipments. The present attitude of the welding research committee is that, although carefully planned research work will undoubtedly lead to further improvements, there are no outstanding technical questions requiring solution in order to proceed at once with the construction of welded ships.—*General Electric Review,* December, 1918.

Applications of Electricity in Ships and Shipbuilding.—J. F. NIELSON.—This article includes a summary of the uses to which electricity has been put in the construction of ships. The author discusses the advantages of using electricity in lifting machinery, in the welding processes of ship construction, the application of electricity to ship propulsion, the advantages of electrically operated steering gear and the use of wireless telegraphy and electric drive for the gyro-compass.—London *Electrician,* Nov. 22, 1918.

Muscle Shoals Nitrate Plant.—ANDREW M. FAIRLIE.—Description of the largest synthetic nitrogen works in the world giving important processes for the fixation of atmospheric nitrogen. The cyanamide and other chemical processes are also given.—*Chemical and Metallurgical Engineering,* Jan. 1, 1919.

Impurities in Boiler Water.—F. F. VATER.—The writer names the impurities as they occur in boiler water, giving characteristics and methods of testing and treating feed water.—*Power Plant Engineering,* Jan. 1, 1919.

Electrophysics and Magnetism

Eye Protection in Iron-Welding Operations.—W. S. ANDREWS.—In welding operations three kinds of radiations must be guarded against, one or all of which may be present to an injurious degree. The problem is to provide a perfectly safe filter that will permit of the greatest degree of visibility and at the same time will exclude the infra-red or heat rays and the ultra-violet rays. Ordinary glass lenses are usually sufficient protection against the latter radiations, but to shield the operator against the heat rays glass of special color or combinations of colors is required. The author shows the spectra of a number of commercial available glasses and combinations of these glasses, and a glance at these charts will show what arrangements of filter will provide the best protection against the radiations of the welding arc.—*General Electric Review,* December, 1918.

Research in Spot Welding of Heavy Plates.—W. L. MERRILL.—The author's record of experiments points to a new and enlarged field for the application of electric spot welding. That the process will eventually supersede riveting to a large extent in all structural iron work is more than probable. With properly designed apparatus and appliances the possibilities of spot welding in the various metal trades are almost unlimited.—*General Electric Review,* December, 1918.

Electrochemistry and Batteries

Undamped Currents in "Super-Conductors."—It is stated that Professor Kammerleigh Onnes has contrived to produce what he terms a "super-conductor"—that is, a conductor without appreciable resistance—by the application of extremely low temperatures. Granted the possibility of such a conductor, one must also assume the possibility of maintaining a continuous current without an appreciable emf. From purely theoretical considerations it has been deduced that the specific

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resistance of mercury at 4.25 deg. absolute would still be measurable but at 2 deg. absolute would become negligible. Experiment, however, elicited the interesting result that when the temperature was reduced to a certain point, viz., 4.19 absolute, the resistance fell suddenly to an almost immeasurable value. This marks the transition from conditions of normal conductivity to "superconductivity." Once the temperature fell below this critical point it was found possible to pass a current at a density of 1000 amp. per square millimeter through a conductor 1 m. long without any appreciable difference of potential between the ends.—London *Electrician*, Nov. 15, 1918.

Balancing and Suspending the Movable Coil of a Marine Dead-Beat Galvanometer.—J. RYMER JONES.—The improvements here described consist of the means provided for balancing the coil, in the method of attaching the suspending wires, by substituting rubbing and self-cleaning instead of the vertically pressing contacts usually employed, and also in the manner of safeguarding the coil by keeping it in a practically central position between the magnetic poles while the suspension slide is being put into or removed from the instrument.—London *Electrical Review*, Dec. 6, 1918.

Units, Measurements and Instruments

New Standard of Current and Potential.—CHESTER T. ALLCUTT.—The serious shortage of standard cells caused by the war has emphasized the need for a substitute for the standard cell used in connection with potentiometers. The new standard proposed as a substitute in a certain class of direct-current measurements is essenially a Wheatstone bridge which will balance for but one value of current.—London *Electrician*, Dec. 13, 1918.

Testing Direct-Current Watt-Hour Meters.—P. B. FINDLEY.—A description is given of one type of direct-current watt-hour meter, then the methods of testing such instruments are described and problems worked out showing their practical application.—*Power*, Dec. 31, 1918.

Telegraphy, Telephony and Signals

Radio-Telephony in Japan.—E. YOKOYAMA.—After outlining the experiments in radio-telephony carried out in Japan since 1906, the "T. Y. K." system is cited. A new system using, in the most favorable case, copper and aluminum electrodes about 0.2 in. (0.5 mm.) apart in rarefied air or other gas at a pressure of about 40 mm. to 70 mm. as the discharger is then described in great detail. The influence of electrode design, gas pressure, electrode material and other factors is considered. Means of securing steady and continued operation are given.—*Science Abstracts, Section B*, October, 1918. (Abstracted from *Proceedings* Inst. Radio Eng., June, 1918.)

Capacity of a Horizontal Antenna.—J. B. POMEY.—A short article establishing the Pederson formula relating to the capacity of a horizontal antenna.—*Revue Générale de l'Electricité*, Nov. 23, 1918.

High-Frequency Alternators.—O. BILLIEUX.—The requirements of wireless telegraphy have forced constructors to seek to produce directly alternating current at high frequency by means of special alternators. The author describes the principles of certain of these devices, and in particular those of Marius Latour, Alexanderson and the Société Française Radio-électrique, the last-named being manufactured by the Société Alsacienne de Constructions Mécaniques.—*Revue Générale de l'Electricité*, Nov. 23, 1918.

Miscellaneous

Engineering Educators' Opinions.—The paper consists of the answers of a number of the leading directors of enginering education in the various universities to a questionnaire sent out to determine what effect the war has had on engineering educational policies with particular reference to the operation of the Students' Army Training Corps. The consensus of opinion seems to be that the S. A. T. C. was so short-lived that it will have little effect on enginering education. It is generally believed, however, that one permanent effect of the war experience will be to stimulate engineering education—*Engineering News-Record*, Jan. 2, 1919.

Water-Power Situation on the Pacific Coast.—MAJOR GEORGE F. SEVER.—The power shortage experienced in the West was not wholly a product of the war, except as natural expansion was in some part crippled by the restrictions imposed. One of the vital parts of the period, therefore, is to be the extension of power development to meet the new industries and agricultural growth. A survey of such projects now in progress in California and others which await development is made by Major Sever.—*Journal of Electricity*, Jan. 1, 1919.

Development of the Vacuum Valve.—The vacuum valve not only is the factor which has made possible the wireless telephone used on aëroplanes, of which so much has recently been said, but it is also associated with many other modern developments in wireless telephony and telegraphy. The manufacturer of this remarkable device as carried out in a San Francisco factory is given in this article.—*Journal of Electricity*, Jan. 1, 1919.

First Electrically Welded Boat.—JOHN LISTON.—A great deal has been published in the technical press about the electrically welded cross-Channel barge recently built in England and now in service. It will be a source of much satisfaction to American engineers, however, to learn that the first electrically welded boat was built three years ago at Ashtabula, Ohio. In view of the meager amount of information on the subject of electric welding that was then available, the employment of the process in the construction of this boat was epoch-making, and that the work was well done and the process is peculiarly adapted to shipbuilding are evidenced by the service record of the boat. It has been put to unusually severe duties and is still in use on the lakes.—*General Electric Review*, December, 1918.

State Electricity—Article telling what has been done and is in process of accomplishment in Germany, Austria and the Scandinavian countries to insure a sufficient supply of electrical energy for industry.—*Engineering*, Nov. 15, 1918.

Theft of Energy.—H. A. HESLIP.—The writer discusses the various forms of energy theft and their detection. Some means for preventing theft are also given.—*Central Station*, December, 1918.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

INCREASED DEMAND FOR ENGINEERING EDUCATION

Registration at Massachusetts Institute of Technology Is Rapidly Approaching Limit of Facilities Available—More Students Expected

The achievements of the engineer in the war have led to a great increase in the demand for a technical education, and the registration at the Massachusetts Institute of Technology, Cambridge, is rapidly approaching the point of saturation with respect to the available facilities. The institute has more regular students than it has ever had before at this season of the year and only a dozen less than the maximum registration at any time in its history.

Despite the fact that practically all the members of the class of 1919, by means of intensive courses through two summers, received their degrees and offered their services to the country before the armistice was declared. nineteen hundred and forty-four students are now registered. The institute is confronted with the alternative of limiting the registration or providing immediately for additions to the existing buildings. It is expected that the registration next fall will reach 2500 and that 3000 will soon be attained. The capacity of the school as at present equipped is about 2000. Fifty-five per cent of the known living alumni of the institute were in military service or in war industries, and at one time the institute, in response to the demands of the government, was caring for seven or eight different training schools. The demobilization of the military forces is constantly tending to increase registrations.

HIGH WATER CAUSES TROUBLE IN PUGET SOUND DISTRICT

Unprecedented Rainfalls Lead to Line Difficulties and Large Municipal Plants of Tacoma and Seattle Are Forced to Shut Down

Continued high water caused by unprecedented rainfall in the Puget Sound district has worked havoc with light and power lines and resulted in scores of small slides, tying up interurban traffic and in many cases railway service. The three-million-dollar power plant of the city of Tacoma at La Grande has been put out of commission by high water, and the city is buying its electric light and power from the Puget Sound Traction, Light & Power Company. The amount of damage will not be known until the water has receded.

The municipal lighting plant operated by the city of Seattle was completely shut down on Jan. 25 because of the breaking of 600 ft. (183 m.) of wooden-stave pipe by a landslide. The load is being carried by the Lake Union steam plant. The slide occurred about halfway between the concrete dam and the power house. Both pipes carrying water to the turbines, one 6 ft. (1.8 m.) and the other 4 ft. (1.2 m.) in diameter, were carried away. Two pile drivers were immediately hurried to the scene by Superintendent L. B. Youngs of the Water Department, who is also acting superintendent of light during the illness of Superintendent J. D. Ross. It is expected that the work will be completed within a week or ten days. Superintendent Youngs states that the accident was caused by a washing away of the earth under the pipes, causing them to break and fall into the canyon.

COST OF THE MUSCLE SHOALS NITRATE PLANT

Estimated on Feb. 23, 1918, According to Assistant Secretary of War Crowell, at $14,000,000—Other Data Given to Congress

Data given by Benedict Crowell, Assistant Secretary of War, to Congressman Nicholas Longworth and presented before the House of Representatives, show that the estimated cost of the Muscle Shoals nitrate project in October, 1917, was $14,534,000, based upon then prevailing wages and material prices. On Feb. 23, 1918, because of lowering cost of cement to the government, the estimate was reduced to $14,000,000. Other facts given by Mr. Crowell follow:

This estimate includes the dam locks, the flowage rights and the power house with hydroelectric machinery capable of generating about 120,000 hp. The power-house substructure will be constructed so as to provide for placing additional units in the future, if desired, in order to utilize the non-continuous or secondary power in connection with steam generating units already installed at nitrate plant No. 2.

If the amount available from the appropriation of Section 124 of the national defense act should prove insufficient to complete the project, it will be supplemented by reimbursing the appropriation for expenditures already made from that fund which might, with equal propriety, have been made from other funds at the disposal of the bureau. Such reimbursement will be deferred until the necessity therefor actually arises.

It is estimated that about three years will be required for the completion of the project.

Of the power to be furnished by the project, it is estimated that approximately 72,000 hp. will be continuous throughout the year. In all but the dryest years it is to be expected that approximately 100,000 hp. can be developed continuously.

The most economical development of power at Dam No. 2 requires the ultimate installation of generating capacity largely in excess of the requirements of Nitrates Plants Nos. 1 and 2, in order that advantage may be take of the large amount of secondary power available at the dam. It is probable, however, that the initial installation will not be greater than required for the operation of the nitrate plants and that no surplus power will be available for use by other plants.

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SECRETARY LANE'S PROPOSAL FOR POWER RESOURCE SURVEY

Presentation of Conditions by Head of Interior Department on Which He Bases Request for Appropriation for Study by Government Bureaus

Secretary Lane of the Interior Department has sent to Congress requests for two appropriations for special investigations and reports on the power supply. One of these is a request for an appropriation of $50,000 for a survey of the power resources all over the United States. This proposed appropriation is embodied in the sundry civil bill, hearings on which are now being held before the sub-committee of the House committee on appropriations. If approved, the work would be done by the Geological Survey. The other request, mentioned in last week's issue of the ELECTRICAL WORLD, is for an appropriation of $200,000 for a report on the power supply for the industrial region of the northern Atlantic seaboard, extending in general from Boston to Washington. If approved, this work would be done by the Geological Survey and the Bureau of Mines in coöperation. The request for the appropriation of $200,000 has been approved by the Secretary of the Treasury and has been forwarded to Swagar Sherley, chairman of the House committee on appropriations.

In a letter to Mr. Sherley explaining the necessity for the appropriation Secretary Lane says:

I am to-day sending to the Secretary of the Treasury a supplemental estimate of an appropriation of $200,000 to be expended in the fiscal year 1920 for a special investigation and report on the power supply for the industrial region of the north Atlantic seaboard, extending in general from Boston to Washington.

I respectfully urge that your committee consider this estimate favorably because I believe the investigation will form the basis for a constructive national policy of the highest economic and industrial significance. The country is now passing through a period of transition which, I firmly believe, will soon be followed by one of industrial activity and expansion. The enormous development of war industries had created an almost insatiable demand for power, a demand that was overreaching the available supply with such rapidity that had hostilities continued it is certain that we should now be facing an extreme power shortage. Happily such a crisis was averted by the signing of the armistice, and the ensuing curtailment in the demand for war materials has carried us past immediate danger of a power famine in the industrial districts for the Northeast.

This subsidence in the demand for power will, I think, not be long continued. In a few months, and especially in the regions mentioned, I anticipate a greatly increased demand for energy, for which present facilities are inadequate. This demand will follow the resumption of industry under the operation of normal economic laws and in the face of international competition, factors that have been largely inoperative during the war. If the country is to reap the full benefit of this returning wave of activity it must be prepared to furnish industry and transportation with an adequate, dependable and economical power supply. Only by increased economy in the production and distribution of power will it be possible for our manufacturers to decrease their production expenses and compete successfully in the world's markets, maintaining at the same time the American standard of wages and living.

That there is opportunity for a system of power supply far more economical and efficient than that now existing in the areas under discussion cannot be doubted. It has for its central idea the development of a plan for the generation and distribution of power on a scale far more comprehensive than now exists in this territory and the more efficient use of the power in industry and in transportation.

This result will be accomplished through the interconnection of existing power centers by means of a trunk-line transmission system of high efficiency. Into this trunk line energy will be fed from hydroelectric plants and steam power stations located at tidewater and near the coal mines. From it will be taken the power required for each principal industrial center and for the electrification of trunk-line railroads and of such branch lines as may be located in metropolitan districts.

Such a comprehensive system of power supply, making use as it would of unutilized or undeveloped water power and of fuel now wasted at the mines, will result in large savings in coal. A very large amount of coal now consumed by steam-power plants can be replaced by the development of water power. Fuel power can be developed near the mines and the wasteful transportation of coal by railroad to that extent avoided. I am reliably informed that as a conservative estimate 50 per cent of the fuel now used by the railroads in this territory can be saved through the operation of trains by electricity instead of by steam locomotives, because of the much higher efficiency that can be obtained in the economical central station in comparison with the wasteful steam locomotive.

The transmission of this energy as electricity instead of the hauling of coal by rail will relieve the railroads of this territory of an enormous freight burden, thereby making available transportation for the hauling of other commodities. This is a matter of far-reaching importance. Not only would the railroads in the immediate territory be relieved of hauling the coal for their own locomotives but other railroads supplying them with coal would be relieved proportionately. This easing of the present strain on trackage and equipment would result automatically in an increase in transportation facilities, the necessity for which the country is now facing.

Such a comprehensive system of power supply will give opportunity for the more continuous use of existing power plants through the operation of the diversity factor; that is, power for which there is no demand at a certain time in one locality can be transmitted to another locality needing power at the moment. Spare units in one power center can then be used to assist other power centers in case of emergency or breakdown. A large amount of spare capacity can thus be brought into service and the capital already invested in existing power stations thus made more productive.

That such economies and efficiencies can readily be obtained has been amply demonstrated by the repeated application of these principles to local situations. It is my conviction that they can be applied regionally with even greater success. My purpose in asking for the appropriation is to make possible the investigation necessary to their practical application in this particular region. The report to follow would present a definite plan for development and estimate accurately the savings to be effected.

I am urging the earliest possible action, because I believe such a plan should be formulated at once before we enter upon a new period of industrial activity, so that the new construction that will be required may be coördinated with such a plan and developments that will not harmonize with the plan may be avoided.

This appropriation is requested not as a substitute for but as supplemental to the other estimate submitted by this department for the investigation of fuel and power problems covering the whole United States. Fundamental studies dealing with principles of power supply and fuel utilization are prerequisite to more intensive investigation of the kind that I am bringing to your attention in this letter.

The wording of the estimate for the proposed $50,000 requested by Secretary Lane is as follows: "General Expenses, Geological Survey.—For a survey of power production and distribution in the United States, including the investigation of methods for the further utilization of water power, and the preparation of reports thereon, one-fourth to be immediately available (submitted), $50,000."

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MIDWINTER CONVENTION PROGRAM OF THE A. I. E. E.

Seventh Midwinter Meeting, to Be Held on Feb. 19-21, in New York, Will Provide Discussion on a Number of Topics

The seventh annual midwinter convention of the American Institute of Electrical Engineers will be held on Feb. 19-21, in the Engineering Societies Building, New York.

The convention will open Wednesday afternoon in joint session with the American Institute of Mining Engineers, at which a symposium on "Electric Welding" will be presented. Members of the American Society of Mechanical Engineers are cordially invited to participate in this session. Wednesday evening will be devoted to a lecture by Dr. John A. Brashear on "An Evening with the New Astronomy," which will be followed by an exhibition of technical moving pictures as adopted by the United States War Department for the instruction of the army in the operation of various mechanical devices. Ladies will be welcome at this session.

On Thursday morning there will be a technical session, opened by an address by President C. A. Adams, followed by the presentation of papers by Dr. C. P. Steinmetz and Harold S. Osborne. Thursday afternoon will be devoted to a technical excursion to the Brooklyn Navy Yard, by courtesy of the Navy Department. Opportunities to visit the prominent electrical plants in New York and vicinity during the time of the convention have also been provided. On Thursday evening there will be a dinner-dance at the Hotel Astor for members and guests in attendance at the convention.

Friday morning's technical session will be under the auspices of the electrophysics committee. On Friday afternoon the final session of the convention will be held under the auspices of the telegraphy and telephony committee.

The program of the convention follows:

Wednesday, Feb. 19, Auditorium, 2:30 p.m.

Joint Technical Session.—"Microstructure of Iron Deposited by Electric Arc Welding," by G. F. Comstock (A. I. M. E.); "Path of Rupture in Steel Fusion Welds," by S. W. Miller (A. I. M. E.); "Welding Mild Steel," by H. M. Hobart (A. I. M. E.); "Electric Welding in Shipbuilding," by S. V. Goodall (A. I. E. E.); "Fusion in Arc Welding," by O. H. Eschholz (A. I. E. E.).

Wednesday, Feb. 19, Auditorium, 8:15 p.m.

"An Evening with the New Astronomy," by Dr. John A. Brashear; technical moving pictures showing various mechanisms in operation.

Thursday, Feb. 20, Assembly Room No. 1, 10:30 a.m.

Technical Session.—Address by President C. A. Adams; "The General Equation of the Electric Circuit—III," by Dr. C. P. Steinmetz; review of work of sub-committee of the standards committee, on wave-shape standards, by H. S. Osborne.

Thursday Afternoon, Feb. 20

Technical Excursion.—Visit to Brooklyn Navy Yard.

Thursday, Feb. 20, Hotel Astor, 7 p.m.

Dinner-dance.

Friday, Feb. 21, Assembly Room No. 1, 10:30 a.m.

Technical Session.—"Ionization of Occluded Gases in High-Tension Insulation," by G. B. Shanklin and J. J. Matson; "The Dielectric Strength of Air Films Entrapped in Solid Insulation," by F. Dubsky; "Abnormal Voltages in Transformers," by L. F. Blume and A. J. Boyajian.

Friday, Feb. 21, Assembly Room No. 1, 2:30 p.m.

Technical Session.—"Aëro Telephony," by E. B. Craft and E. H. Colpitts; "Theory of Transient Oscillations," by John R. Carson; "Telephone Circuits with Zero Mutual Induction," by W. W. Crawford (deceased).

Inspection trips may be made to the New York Edison Company plants, United Electric Light & Power Company plants, Interborough Rapid Transit Company plants, the Electrical Testing Laboratories and the laboratories of the Bell System.

MEETING OF CONFEREES ON WATER-POWER BILL

Brief Meeting Held by Senate and House Members in Washington—Protests Against the Inaction of Congress

One brief meeting of the conferees on the water-power bill representing the Senate and the House of Representatives had been held in Washington in the past week up to the time this dispatch to the ELECTRICAL WORLD was filed. At that meeting no action was taken but attention was called to a debate in the Senate during the week in which Senator Jones of Washington directed notice to the fact that the Northwest section of the country is protesting against the delay in the passage of the water-power bill. The Washington representative of the ELECTRICAL WORLD reports that there is hope that the conferees will have held another meeting by the time this is published.

Senators and Representatives are receiving many letters from their home communities protesting against the inaction of Congress.

ELECTRIC TRUCKS TO BE DISPLAYED IN HARTFORD

Hartford Electric Light Company Plans in Connection with Automobile Show This Month Signalize Co-operative Campaign for Business

The Hartford Electric Light Company will exhibit at the Hartford Automobile Show, beginning Feb. 20, a remarkably varied line of electric trucks, and the occasion will be utilized to demonstrate the practicability of such equipments in the light of local battery service system results and in the perfection of design represented in the most modern electrically driven transportation outfits for road use.

The displays will demonstrate the products of the Commercial Truck Company of America, the Walker Vehicle Company, the Ward Motor Vehicle Company and the Krohn drive truck. Five distinct types of drive will be exhibited so as to show the internal operation of each. All of the electric truck users in Hartford will be invited to inspect and criticise these models.

It is noteworthy that electric truck service at Hartford has been actively maintained despite the obstacles interposed by war conditions, and a new intensity of development and still more vigorous exploitation of the electric passenger and commercial vehicle is scheduled now by the local central-station company in coöperation with the manufacturers and their representatives.

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CALIFORNIA CO-OPERATIVE CAMPAIGN SHOWS RESULTS

Committee Says Service of Industry to the Public Must Be Enlarged Still Further for Readjustment Period and After

In its annual report the advisory committee of the California Electrical Coöperative Campaign describes its organization and outlines the progress of its work during 1918 and its plans for 1919.

"The object of this campaign," says the committee, "is better electrical service to the public, and, as the certain result of that service, more profit to individuals and companies in the electrical industry. The nature of the campaign is educational. It is not a sales campaign."

The field representatives appointed to carry out the plans of the committee have spent considerable effort in increasing the membership of the Contractor and Dealer Association and now there is a local in practically every section of the state.

The committee states that central-station men have in most cases been quick to recognize that a greater number of properly equipped and well-operated electrical stores are essential to giving the very best service to the public and therefore to building up to the greatest extent the use of electric service.

The encouragement given to the dealers by these and other similar acts of coöperation is held by the committee to be in no small part responsible for the improvement in their merchandising activities. In speaking of the work of field representatives and conditions in the state the report says:

The greater portion of their time has been spent in assisting the dealers in improving their business methods. Twelve hundred and fifty calls have been made on 390 dealers. Assistance has been given them in the rearrangement and improvement of their stores, in window decorating, improved selling methods and such other assistance as the individual case demanded.

As evidence of improved coöperation among contractor-dealers, twelve dealers are now engaged in two different house-to-house solicitor campaigns covering seven towns and adjacent territory. In addition to these solicitor campaigns fourteen dealers are actively doing house-to-house soliciting.

During the year twenty-one dealers have moved into better stores in better locations, thirteen dealers have made major improvements in their stores involving extensive remodeling, while twenty-three have materially improved their stores by entirely rearranging them. Five dealers have rebuilt their show windows, and forty-six have shown marked improvement in trimming their windows. Twelve new retail stores have been opened during the year, and their are six contractors who, although they have no stores, are actively pushing the sales of appliances. As a result of these various improvements these dealers are now in a position to increase greatly their sales of appliances.

Although the first organized advertising suggestions were not sent out until late in October, the results for November and December were regarded by the committee as very gratifying. Figures compiled from advertisement clippings in the advisory committee's office show that during these two months eleven central stations used 1388 insertions of campaign copy. This work so stimulated the dealers' activity along these lines that during the same period 252 dealers in 117 different localities used 1622 separate all-electrical newspaper advertisements.

In speaking of the accomplishments in 1918 and the promise of 1919 the report says:

During the last year the central stations were shown more than ever before what could be done by the contractor-dealers in coöperative sales campaigns. In localities where this type of work was actively pursued by the dealers under the indorsement of the central stations very gratifying results followed in almost every instance. Through the campaign activities the contractor-dealers found that the generating companies desire to coöperate and to assist the dealer to succeed. The contractor-dealers in turn have responded enthusiastically and have improved their methods and equipment so that they are showing their coöperation with the central stations in many ways, but particularly by improved service to the general public.

The war is now over, and in contrast to the abandonment of association activities in many other trades, the California Association of Electrical Contractors and Dealers is still in existence and stronger than ever, and the organization of the California electrical coöperative campaign is intact and in operation. There exists therefore an organization which has weathered adversity.

The advisory committee is in much better position to give assistance in the educational development of the contractor-dealers during the present period of readjustment and the periods of active business thereafter because of the continuance of its operations during the past year.

Another evidence of the success of the campaign is the readiness with which the contributors to the fund have renewed their contributions for the year 1919.

The California Association of Electrical Contractors and Dealers, the electrical supply jobbers of California and practically all of the central-station companies have renewed their pladges.

The original plans as drawn in 1917 provided for the participation of these three groups only, but at the last minute, in order to complete the funds to the estimated amount required, five manufacturers were invited to contribute to the aggregate amount of $1,320. Three of these have subscribed increased amounts for 1919, and the other two have subscribed the same as in 1918. The committee felt that there should be a more general participation by the manufacturers, and to that end electrical manufacturers generally have already been, or soon will be, given an opportunity to subscribe. Twenty manufacturers have to date subscribed a total amount of $3,250 to the 1919 fund.

The service of the electrical industry to the people of California must be still further improved and enlarged if our industry is to share to the greatest degree in the prosperity that is to come during and after the readjustment period. Coöperation and educational development are the means by which to insure this improved and enlarged service. The contractor-dealers particularly need to develop in this direction. Coöperation in its broadest sense should be theirs during 1919. The California electrical coöperative campaign is in a position now to bring this about to a much greater extent than ever before.

The members of the committee are:

Lee H. Newbert, chairman, manager commercial department Pacific Gas & Electric Company, San Francisco.

G. E. Arbogast, vice-chairman, manager F. E. Newberry Company, Los Angeles.

R. M. Alvord, local manager supply department General Electric Company, San Francisco.

A. W. Childs, superintendent of sales Southern California Edison Company, Los Angeles.

D. E, Harris, vice-president and sales manager Pacific States Electric Company, San Francisco.

H. C. Reid, Pacific Fire Extinguisher Company, San Francisco; past-president California Association of Electrical Contractors and Dealers.

M. L. Scobey, proprietor "Home Electrical," San Francisco.

K. E. VanKuren, district manager Westinghouse Electric & Manufacturing Company, Los Angeles.

A. E. Wishon, assistant general manager San Joaquin Light & Power Corporation, Fresno.

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FIGHT IN MASSACHUSETTS ON NEW TELEPHONE RATES

Commission Fails to Obtain Temporary Injunction at Preliminary Hearing on Telephone Toll-Rate Matter—Arguments Before the Court

At Boston on Feb. 4 Judge De Courcy of the Supreme Court heard Assistant Attorney-General W. H. Hitchcock of Massachusetts, for the Public Service Commission, and James M. Clark, of Powers & Hall, for the New England Telephone & Telegraph Company, upon the question of the jurisdiction of the commission over the intrastate toll rates recently increased by order of Postmaster-General Burleson in the face of the board's cancellation of the tariff in effect Jan. 21.

Mr. Hitchcock said that a fair and reasonable interpretation of the joint resolution of Congress authorizing the President to take over the telephone systems during the period of the war expressly reserves the right of the several states to control intrastate rates. The police powers of the state, he said, are unamended by the resolution, which particularly states that these are not in any way to be abrogated by the act. The United States Supreme Court has many times declared that the rate-making power is a police power, from Munn vs. Illinois (92 U. S.), the father of all rate cases, as the speaker put it, down. The action of Mr. Burleson in imposing the nation-wide toll rates without giving the states an opportunity to be heard at length represented in the speaker's mind a clear case of an agent violating his authority.

Mr. Hitchcock urged that the court grant a temporary injunction in view of the great difficulty the public faces in regard to securing redress for overcharges if the increased rates are permitted to stand during the present proceedings. The issue will unquestionably be carried to the highest court.

On behalf of the Postmaster-General and for the telephone company, Mr. Clark maintained that the joint resolution gave the President supreme power over rates as well as service during the war period and contended that the commission is without jurisdiction.

Judge De Courcy then assigned the case to the Feb. 11 calendar, stating that he desired to have the pleadings before him before taking action relative to the desired injunction, in view of the importance and gravity of the issues involved.

The Massachusetts Public Service Commission issued an order Jan. 31 canceling the telephone toll rates which were inaugurated by the New England Telephone & Telegraph Company and others on Jan. 21, upon order of Postmaster-General Burleson, and which had been ordered suspended by the commission pending further proceedings. At an adjourned hearing before the commission on Jan. 30 M. B. Jones, then vice-president and now president of the New England company, agreed that the primary issue is one of jurisdiction, and in order that this issue might be raised in the most definite manner and determined promptly he directly challenged and denied the jurisdiction of the board.

PROCEEDINGS IN OHIO

Preparations are being made by the Ohio Public Utilities Commission and Attorney-General Price for proceedings against the American Telegraph & Telephone Company, which is paying no heed to the injunction issued recently in the Common Pleas Court at Columbus restraining it from using the Burleson rates. The Central Union Telephone Company stated that it had taken cognizance of the order, but that a great deal of the long-distance business is handled by the American Telegraph & Telephone Company, on which the Burleson rates are charged.

POWER-PLANT SITUATION IN INDIANA AND KENTUCKY

Coal Is Plentiful, Members of the Indiana Engineering Society Are Told—Stations Rated by Fuel Administration

One whole session of the thirty-ninth annual convention of the Indiana Engineering Society at Indianapolis, Jan. 23, 24 and 25, was given over to the consideration of power-plant subjects. Alex R. Holliday, federal fuel administrator for Indiana, spoke of the phenomenal rise in the price of fuel in that state. Screenings which formerly cost 90 cents per ton rose to $5 per ton. He also said that in 1915 17,000,000 tons of coal were mined, and in the next three years the figures jumped to 19,000,000, 24,000,000 and 30,000,000 tons respectively, the rate in October, 1918, being 36,000,000 tons. Mr. Holliday described the general work of the Fuel Administration and indicated that in Indiana it had been so successful in its campaign of education that there was enough coal on hand in the fall of 1918 to take care of any kind of a winter that might have come, even if the mines had shut down.. He also indicated that there is such a supply on hand at the present time that the mines could shut down for twenty days without any one suffering.

Prof. Frank C. Wagner of the Rose Polytechnic Institute spoke on the "Steam Plants of Indiana in Relation to Fuel Conservation," paying especial attention to the grading of the plants from the Fuel Administration's questionnaires. George W. Hubley, administrative engineer for Kentucky, also gave similar comparative figures for his state. These figures are given herewith:

FUEL ADMINISTRATION'S RATINGS OF INDIANA AND KENTUCKY PLANTS

	Indiana	Kentucky
Number of plants graded	600	557
Number of plants producing power	483	.....
Aggregate horsepower	287,884	.....
Percentage of plants making improvements	38.6	.....
Percentage reporting no deficits in boiler settings	93	.....
Percentage using boiler-feed-water heaters	77	76.9
Percentage weighing coal	57.2	57.3
Percentage measuring boiler-feed water	12	7.3
Percentage using draft gages	12½	11.9
Percentage using CO_2 apparatus	10	5.5
Average grade given plants, per cent	70.13	62.1

H. O. Garman, chief engineer Indiana Public Service Commission, presented a paper on "Public Utilities in the War Period." In his opinion the situation is clearing up much more rapidly than it was expected to do a year ago.

Prof. G. A. Young, Lafayette, Ind., was elected president of the organization, Charles Cheney was elected vice-president, and Charles Brossmann, secretary-treasurer.

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Census Bureau Report of Electric Light and Power Stations—1917

	Wyoming			Colorado			Arizona		
	1917	1912	Per cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	43	20	115.0	69	73	—5.5	29	16	81.2
Commercial	31	18	72.2	53	62	—14.5	25	16	56.2
Municipal	12	2	500.0	16	11	45.5	4	....	....
Income	$1,036,921	$607,095	70.8	$6,364,534	$4,791,340	32.8	$2,141,633	$1,173,186	82.5
Electric service	951,101	595,465	59.7	6,201,865	4,626,693	34.0	1,888,954	1,128,862	67.3
All other	85,820	11,630	637.9	162,669	164,647	—1.2	252,679	44,324	470.1
Total expenses including salaries and wages	$894,375	$445,789	100.6	$4,960,727	$3,997,760	24.1	$1,752,154	$923,258	89.8
Number of persons employed	261	163	60.1	1,269	1,166	8.8	436	217	100.9
Salaries and wages	$259,786	$149,356	73.9	$1,269,608	$999,864	27.0	$451,163	$219,798	105.3
Total horsepower	27,462	11,596	136.8	140,009	131,734	6.3	38,662	22,075	75.1
Steam engines:									
Number	58	45	28.9	105	91	15.4	28	33	—15.2
Horsepower	22,837	10,162	124.7	65,467	56,499	15.9	23,870	12,775	86.8
Internal-combustion engines:									
Number	23	1	2200.0	11	1	1000.0	15	....	....
Horsepower	1,937	100	1837.0	527	80	558.8	3,592	....	....
Waterwheels:									
Number	12	11	9.1	58	64	—9.4	4	4	....
Horsepower	2,688	1,334	101.5	74,015	75,155	—1.5	11,200	9,300	20.4
Kilowatt capacity of dynamos	20,627	8,212	151.2	94,791	71,668	32.3	26,972	14,756	82.8
Output of stations, kw.-hr	27,433,023	11,580,567	136.9	274,223,978	165,196,068	66.0	65,731,753	32,960,084	99.4
Stationary motors served:									
Number	826	672	22.9	8,843	4,780	85.0	1,364	741	84.1
Horsepower	14,957	6,224	140.3	132,013	60,451	118.4	16,505	12,547	31.5
Number of street lamps:									
Arc	339	396	—14.4	3,175	3,859	—17.7	430	454	—5.3
Incandescent, etc	3,728	1,168	219.2	10,238	7,872	30.1	4,194	1,335	214.2

* A minus sign (—) denotes decrease.

	Rhode Island			Delaware, District of Columbia and Maryland			Vermont		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	9	8	12.5	63	56	12.5	59	61	—3.3
Commercial	8	7	14.3	47	43	9.3	43	48	—10.4
Municipal	1	1	....	16	13	23.1	16	13	23.1
Income	$4,714,851	$2,305,176	104.5	†$9,192,308	†$5,388,403	70.6	‡$2,009,515	‡$1,228,361	63.6
Electric service	$4,410,560	$2,204,990	100.0	$9,008,297	$5,304,333	69.8	$1,937,974	$1,182,797	63.8
All other	$304,291	$100,177	203.8	$184,011	$84,070	118.9	$71,541	$45,564	57.0
Total expenses, including salaries and wages	$3,617,656	$1,654,848	118.6	$7,454,423	$4,213,854	76.9	$1,611,292	$824,443	95.4
Number of persons employed	790	511	54.6	1,399	1,249	12.0	443	340	30.3
Salaries and wages	$760,323	$512,771	48.3	$1,270,721	$936,805	35.6	$350,735	$219,897	59.5
Total horsepower	135,871	50,499	169.1	204,131	116,744	74.8	73,760	50,363	46.5
Steam engines:									
Number	23	18	27.8	74	112	—33.9	32	40	—20.0
Horsepower	131,008	46,934	179.1	199,914	111,622	79.1	17,285	14,996	15.3
Internal-combustion engines:									
Number	5	5	....	16	11	45.4	1	2	—50 0
Horsepower	1,125	1,125	....	1,187	1,073	10.6	50	95	—47.4
Waterwheels:									
Number	17	13	30.8	24	33	—27.3	109	108	0.9
Horsepower	3,738	2,440	53.2	3,030	4,049	—25.2	56,425	35,272	60.0
Kilowatt capacity of dynamos	106,017	38,509	175.3	131,288	89,887	46.0	51,751	29,468	75.6
Output of stations, kw.-hr	161,856,170	62,106,528	160.6	326,439,753	118,034,857	176.6	65,079,504	42,659,884	52.6
Stationary motors served:									
Number	5,283	3,690	43.2	.....	.....	....	3,448	1,966	75.4
Horsepower	72,094	28,186	155.8	188,192	76,527	145.9	43,503	23,695	83.6
Number of street lamps:									
Arc	2,065	3,058	—32.5	5,928	5,404	9.7	356	1,013	—64.9
Incandescent, etc	16,203	10,640	52.3	22,483	16,409	37.0	9,046	5,563	62.6

* A minus sign (—) denotes decrease.
† Exclusive of $1,137,531 in 1917, $622,393 in 1912, reported by street and electric railway companies as income from sale of electric energy for light and power.
‡ Exclusive of $224,884 in 1917 and $110,357 in 1912, reported by street and electric railway companies as income from sale of electric energy.

	Mississippi			New Hampshire			Virginia		
	1917	1912	Per Cent. of Increase* 1912 to 1917	1917	1912	Per Cent. of Increase*, 1912 to 1917	1917	1912	Per Cent of Increase* 1912 to 1917
Number of establishments	97	92	18.3	59	59	....	94	67	40.3
Commercial	46	35	31.4	55	56	—1.8	70	53	32.1
Municipal	51	47	8.5	4	3	33.3	24	14	71.4
Income	†$1,302,397	†$1,167,787	11.5	$3,269,929	$2,328,263	40.4	‡$2,417,086	‡$805,022	200.2
Electric service	$1,283,333	$1,146,583	11.9	$3,093,910	$2,200,733	40.6	$2,372,099	$794,858	198.4
All other	$19,064	$21,204	—10.1	$176,018	$127,530	38.0	$44,987	$10,164	342.6
Total expenses, including salaries and wages	$1,047,670	$878,379	19.3	$2,471,441	$1,596,152	54.8	$2,084,916	$567,459	267.4
Number of persons employed	451	407	10.8	732	578	26.6	561	341	64.5
Salaries and wages	$272,046	$263,793	3.1	$603,027	$434,617	38.7	$453,322	$170,884	165.3
Total horsepower	33,288	30,497	9.2	93,331	84,228	10.8	90,930	59,585	52.6
Steam engines:									
Number	130	128	1.6	46	56	—17.9	86	66	30.3
Horsepower	32,245	30,457	5.9	34,794	25,386	37.1	40,235	15,120	166.1
Internal-combustion engines:									
Number	29	1	2,800.0	11	11	....	24	3	700.0
Horsepower	1,043	40	2,507.5	1,228	1,905	—35.5	921	185	397.8
Waterwheels:									
Number	....	....	....	105	115	—8.7	70	63	11.1
Horsepower	....	....	....	57,309	56,937	0.7	49,874	44,280	12.6
Kilowatt capacity of dynamos	23,246	21,863	6.3	65,560	57,768	13.5	65,913	40,512	62.7
Outout of stations, kw.-hr	30,498,101	27,924,183	9.2	160,456,223	126,593,970	26.7	107,580,758	28,724,684	274.5
Stationary motors served:									
Number	1,217	701	73.6	3,743	1,958	91.2	2,243	753	197.9
Horsepower	13,767	7,955	73.1	41,020	18,488	121.9	27,763	8,570	224.0
Number of street lamps:									
Arc	778	1,663	—53.2	67	1,482	—95.5	813	2,513	—67.6
Incandescent, etc	8,240	4,001	105.9	14,768	9,100	62.3	12,813	4,369	193 3

* A minus sign (—) denotes decrease.
† Exclusive of $583,515 in 1917, $273,217 in 1912, reported by street and electric railway companies as income from sale of energy.
‡ Exclusive of $3,325,008 in 1917, $2,007,620 in 1912, reported by street and electric railway companies as income from sale of energy for light or power.

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American Electrochemical Society.—The spring meeting of the American Electrochemical Society will take place at the Chemists' Club in New York City on April 3, 4 and 5.

New Company Section of N. E. L. A. Formed.—Announcement is made that a new company section of the National Electric Light Association is being formed in connection with the Wisconsin Power, Light & Heat Company.

I. E. S., New York Section.—A meeting of the New York Section of the Illuminating Engineering Society will be held in the Engineering Societies Building on Thursday evening, Feb. 13. Preston S. Millar will speak on "Lighting in Wartime," and H. A. Hornor on "Lighting in Shipyards."

Electrical League of Cleveland.—Col. John R. McQuigg, commander of the 112th Engineers in France, spoke on his war experiences before the Electrical League of Cleveland at its Jan. 30 meeting. On Jan. 23 the league was addressed by Dr. D. C. Tremaine of the United States Shipping Board, his subject being "Till the Boys Come Home."

Officers of Western Society of Engineers.—At the annual banquet of the Western Society of Engineers at Chicago on Jan. 22 the election of the following officers for the ensuing year was announced: President, A. S. Baldwin; first vice-president, Kempster B. Miller; second vice-president, William M. Kinney; third vice-president, J. L. Hecht; treasurer, C. R. Dart; trustee, E. T. Howson.

Commonwealth N. E. L. A. Activities Open.—Athletic and social affairs of the Commonwealth Edison Company section, National Electric Light Association, which were summarily dropped during the war, have again come to the front. These activities will be resumed on a larger scale than ever before. The proposed program includes seven important evening entertainments, which will be free to all members in good standing.

Joint Meeting of San Francico Engineering Societies.—On Jan. 24 there was a joint meeting in San Francisco of the local sections of the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers and American Chemical Society, held under the auspices of the Electrical Engineers. The subject of the evening was "A Symposium on Engineering Education," and talks were made by J. W. Beckman, representing the chemical engineers; John A. Britton, representing the mechanical engineers; C. L. Cory, representing the electrical engineers; C. D. Marx, representing the civil engineers, and T. A. Rickard, representing the mining engineers. The purpose was to discuss different viewpoints on the subject in an endeavor to develop constructive comment. A considerable number of those present participated, with the result that some fallacious views were shown to be unpopular and there was general agreement as to the necessity of so equipping the engineer at college that he will be able to take a broad view of the problems he meets later. A grounding in fundamentals was considered more important than endeavoring to fit men for special tasks.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Bolshevism Discussed by General Tripp.—At the recent Westinghouse Veteran Employees' banquet in Pittsburgh General Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, spoke on the menace of Bolshevism, dwelling upon the chaotic conditions in Russia and declaring that largely upon America's stand depends the advancement of the world toward a higher civilization or its retrogression into the darkness of the Middle Ages.

N. E. L. A., Brooklyn Edison Section.—On. Jan. 21 T. J. Jones, general sales agent of the Brooklyn Edison company, addressed the Brooklyn Edison Section of the National Electric Light Association on "The Development of Our Business During the Year 1918." He spoke of the part of Brooklyn and the Brooklyn Edison company in the war. An address was also given by W. W. Freeman, president of the Union Gas & Electric Company, Cincinnati, who is also chairman of the N. E. L. A. public policy committee.

Philadelphia Electric Company Section, N. E. L. A.—G. B. Regar addressed the commercial department branch meeting held on Jan. 28 by the Philadelphia Electric Company section of the National Electric Light Association. His subject was "Curtailment of Lighting Due to the War." On the evening of Feb. 4 Lieut. Edouard V. M. Isaacs, said to be the only American naval officer taken prisoner during the war, will relate his martial experiences before the main section meeting in the Bellevue-Stratford ballroom.

Engineers' Club of Philadelphia.—At a special meeting of the Engineers' Club of Philadelphia to be held in the club house on the evening of Feb. 15 H. F. Moore, professor of experimental engineering at the University of Illinois, will present a paper, illustrated with lantern slides and motion pictures, entitled "The Fatigue of Metals." Major Nevil M. Hopkins of the Ordnance Department, U. S. A. and a member of the faculty of the George Washington University, will give a paper on "The Outlook for Research and Invention" at the regular meeting of the club to be held on Tuesday evening, Feb. 18.

American Institute of Electrical Engineers

Boston Section.—Dr. A. E. Kennelly of Harvard, who has recently been in Europe, spoke on "Some Features of Electrical Engineering in the War" on Feb. 4.

Philadelphia Section.—Guilliam H. Clamer had for his topic "Oscillatory Currents in Electric Furnace Practice" at a recent joint meeting of the A. I. E. E. On Feb. 10 Prof. Joseph W. Richards will speak on "The Importance of the Electrochemical Industry."

Detroit-Ann Arbor Section.—Prof. John C. Parker of the University of Michigan gave a "round-table" talk on "Direct-Current Generators" at the Jan. 31 meeting. Cassius Davis of the General Electric Company will have "Automatic Substations" as his subject on Feb. 14.

Washington Section.—H. A. Hornor will speak on "The New Application of Electricity to Ships" at the Feb. 11 meeting. "Industrial Uses of Electricity" will be the subject of the meeting to be held on March 11, and W. D'A. Ryan will talk on "Illumination" at the April 8 meeting.

Erie Section.—Prof. Comfort A. Adams will speak on the subject of "Arc Welding as Applied to Shipbuilding" at a joint meeting of the Engineers' Society of Northwestern Pennsylvania and the Erie Sections of the A. I. E. E. and the A. S. M. E. This meeting will be held in the Erie Board of Commerce Rooms on Feb. 11.

Baltimore Section.—H. L. Hess of the Hess Steel Corporation recently gave an illustrated lecture on "Electric Furnaces as Applied to Steel Making" when the Baltimore Section met jointly with the mechanical engineers. Col. William H. Walker, commanding officer of the Edgewood Arsenal, will speak on "The Manufacture and Use of Toxic Gases in Modern Warfare" at the Feb. 14 meeting.

Rochester Section.—"The Chicago, Milwaukee & St. Paul Electrification" was the subject of a recent address by E. S. Johnson. S. M. Day of the General Railway Signal Company read a paper on "The Elements of Alternating-Current Signaling" before the meeting on Jan. 24. F. C. Taylor, Rochester Railway & Light Company, recently read a paper on "Increased Production by Correct Illumination."

Pittsfield Section.—A. L. Powell, illuminating engineering department of the Harrison Lamp Works, gave a lecture illustrated by motion pictures and stereopticon slides on "The Manufacture of the Modern Incandescent Lamp" before a recent meeting. Illustrated lectures by William Henry Blood on "The Building of Hog Island Shipyard—A Great Achievement of a Great Epoch" and by Prof. Comfort A. Adams on "Arc Welding as Applied to Shipbuilding" and an address by Allen T. Treadway on "War-Time Legislation" have been given before recent meetings.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

International General Electric Company Officers.—P. M. Haight has been elected secretary and treasurer of the International General Electric Company and W. J. Edmonds auditor. These are in addition to the other general officers mentioned previously in the ELECTRICAL WORLD.

Development Program of Southern California Edison Company. — The Southern California Edison Company has been given authority by the California Railroad Commission to issue $8,000,000 general and refunding twenty-five-year 6 per cent bonds, due January 1, 1944, and $8,000,000 of ten-year 7 per cent serial debentures. None of the aforesaid bonds shall be sold for less than 93 and interest; the debentures must bring 95 and interest. During the hearing it was brought out that the development program of the company for the next three years calls for the expenditure of $18,945,000.

Muncie (Ind.) Company Drops Plea for Higher Rates.—The petition of the Indiana General Service Company, Muncie, Ind., asking for a surcharge on electrical energy supplied twenty-eight cities and towns was dismissed by the Indiana Public Service Commission on the request of R. E. Breed, president of the company. In the motion for dismissal Mr. Breed said that, in view of the termination of the war, it is possible that in the near future the cost of coal, supplies, labor and materials required for operation of electric utilities will be reduced in price to such an extent that it may not be imperative for the petitioner to secure the increases in rates asked for.

New Electric Ordinance for Duluth.—The city of Duluth, Minn., has just compiled in a single ordinance all rules relating to building, plumbing, heating and electrical construction. One of the radical provisions of the ordinance, according to A. W. Lindgren of the Northern Electric Company, is that any one taking out an electrical permit must pay a fee the size of which depends on the nature and size of the job. For the purpose of discussing this ordinance the local electrical contractor-dealers had a meeting recently with the city's building inspector and electrical inspector. It was there decided to distribute copies of the ordinance among all electrical men, including journeymen, in the city, so that every one might familiarize himself with its provisions. It is felt by electrical people that this ordinance will improve the outlook for construction.

Applications of Electroplating.—Appropriations have been requested by the Department of Commerce to permit more exhaustive study by the Bureau of Standards of plating problems and their application to various manufacturing industries. Electroplating forms an excellent illustration of a "key industry," that is, an industry which, while it is not itself of great magnitude, is often of fundamental importance to larger industries. Progress in the art will bring about corresponding improvements in all such industries. Pending appropriation of funds to conduct extended investigations on electroplating, arrangements have been made by the Bureau of Standards to obtain information regarding the kinds and methods of plating now in commercial use.

Canadian Central Stations. — The Dominion Bureau of Statistics, in cooperation with other departments, has completed a census and directory of the central electric power stations in Canada, including only stations developing electric power for sale. The capital invested in power stations reaches a total of $356,004,168, of which 79.5 per cent is invested in commercial stations and 20.5 per cent in municipal or publicly owned stations. The total revenue derived from the sale of electrical energy is $44,536,848, of which $29,135,399 was secured by commercial and $15,401,449 by municipal plants. The primary power installation in central stations totals 1,844,571 hp., of which 1,652,661 hp. is derived from water, 180,800 hp. from steam, and 11,700 hp. from gas and oil. The actual cost of construction of hydroelectric power stations per installed horsepower (omitting real estate, transmission and distribution equipment) for seventy representative stations throughout Canada with an aggregate turbine installation of 745,797 hp. was $50,740,458, being an average cost of $69.11 per installed turbine horsepower.

Government Radio Stations. — The United States has now in operation at Annapolis, Md., the largest radio station in the world, and one of even greater power is nearing completion in the vicinity of Bordeaux, France. The erection of these two stations was for emergency purposes which necessitated that they be of sufficient power to assure direct communication between this country and Europe under any climatic conditions. To the Washington representative of the ELECTRICAL WORLD Admiral Griffin, chief of the Bureau of Steam Engineering, Navy Department, said: "The Annapolis station was the result of an attempt by the enemy to cut the cables which furnished communication between this country and our allies. This station is the finest in this country and far better than the one at Arlington, Va. But by far the most complete radio station in the world is nearing completion in the vicinity of Bordeaux, France. This station was erected by the United States government and will be of such tremendous power that it will overcome any static conditions which may exist. The material for this station is now in France, and notwithstanding the fact that an armistice has been signed, it will be completed. Upon its completion it is probable that the French government will take it over."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Extension Not Justified.—The complaint of Attorney-General T. A. Walters against the Rupert Electric Company based on the rates charged by the latter has been dismissed by the Idaho Public Utilities Commission. An extension of lines for electrical heating was asked, but it was found the cost would be from $5,000 to $10,000, and the commission thought this was not justified. The commission ordered this company to return to all consumers the $10 charge required for installation of meters.

Changing Rates When Company Is Absorbed.—To further the efforts of the Mount Whitney Power & Electric Company to purchase the properties of the H. G. Lacey Company, a utility furnishing light, heat and power in Hanford, Kings County, the California Railroad Commission has authorized the Mount Whitney company to issue $200,000 of 7 per cent preferred stock in payment for the $101,000 of the H. G. Lacey Company's stock owned by the Huntington Land & Improvement Company. The Southern California Edison Company is given permission to purchase the $200,000 of the 7 per cent preferred stock of the Mount Whitney company for $164,353.57 cash, plus interest at 6 per cent from July 1, 1918, to the date of the transfer. In a recent decision the commission held that the rates of the Lacey company are reasonable and yield a reasonable return on the investment, notwithstanding that the rates are lower than those charged by the Mount Whitney company on other portions of its system. At the hearing on the petition H. G. Bauer, representing the Mount Whitney company, said that if the application were granted he intended to make the rates uniform. Referring to this, the Railroad Commission says: "The proposition of authorizing a public utility corporation earning a reasonable return to sell its properties, and then permit the purchasing company to increase the rates charged the consumers served by the corporation whose properties are sought to be acquired because the existing rates of the purchasing company may not be remunerative, does not meet with our approval."

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

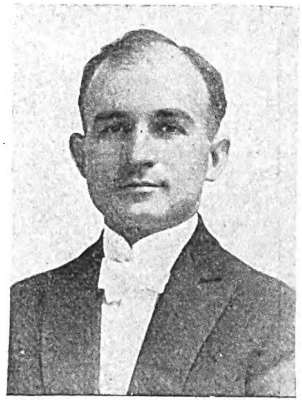
Bert H. Peck, to whom was awarded the Chanute medal at the annual dinner of the Western Society of Engineers on Jan. 22, was graduated from the University of Wisconsin in 1906. After graduation he was employed for

B. H. PECK

one year by the Chicago Telephone Company and left that position to join D. C. & W. B. Jackson, consulting engineers of Chicago, where he remained until 1914. He then was employed by the Public Utilities Commission of Illinois as electrical engineer, which position he still holds. Mr. Peck is a member of the American Institute of Electrical Engineers, the Western Society of Engineers and the Electric Club of Chicago and is a past-president of the Springfield (Ill.) Engineers' Club. Since his graduation from the University of Wisconsin he has also taken the degree of electrical engineer at the same school. The paper upon which he received the award of the Chanute medal was entitled "The Engineering Data Necessary for an Electric Rate Determination." (See ELECTRICAL WORLD, April 20, 1918, page 825.)

R. M. Howard, manager of all departments of the Wisconsin Railway, Light & Power Company, except the La Crosse Street Railway, has been appointed general manager for the company at La Crosse, succeeding Dean Treat, who resigned. Mr. Howard will coöperate with Peter Valier, vice-president, who will be resident executive officer, having jurisdiction over all departments including Winona and Hatfield. Mr. Howard has been with the Wisconsin Railway, Light & Power Company since it was organized in 1913, having previously held the same position for two years with the receiver of the La Crosse Water Power Company. He has heretofore had charge of the power and electrical department of the company, including the Hatfield dam, the hydroelectric power station, the power transmission lines from Hatfield to La Crosse and Winona, the substations and distribution system in La Crosse, the Onalaska electric utility and steam-power stations and electric distribution system in Winona, and the Winona Street Railway. Prior to becoming connected with the Wisconsin Railway, Light & Power Company, Mr. Howard was general manager of the Green Bay Traction Company, the Green Bay Gas & Electric Company and the Northern Hydro-Electric Power Company, Green Bay, which have since been consolidated under the name of the Wisconsin Public Service Company. Before going to Green Bay Mr. Howard was general manager of the Clinton (Iowa) Street Railway for nine years.

C. A. Hall has been promoted from assistant general manager to general manager of the Eastern Pennsylvania Light, Heat & Power Company and the Eastern Pennsylvania Railways, Pottsville, Pa., by the J. G. White Management Corporation, New York, N. Y., the operating managers. Mr. Hall succeeds L. S. Cairns, deceased. In June, 1918, Mr. Hall entered the service of the two Eastern Pennsylvania companies as manager of the electric light and power department and shortly thereafter was advanced to the position of assistant general manager. After leaving school



C. A. HALL

in 1904, Mr. Hall entered the employ of the Consolidated Light Company, Huntington, W. Va. In 1907 he joined the organization of the Ohio Valley Electric Railway, Huntington, W. Va. He became superintendent of the Canonsburg (Pa.) Electric Light, Heat & Power Company in 1909, and following the purchase of this utility in 1911 by the West Penn Power Company, Pittsburgh, Pa., he was made local manager of that company at Canonsburg.

Henry J. Gille, sales manager of the Puget Sound Traction, Light & Power Company, Seattle, Wash., has been elected president of the Northwest Electric Light and Power Association by the executive committee to fill the

H. G. GILLE

unexpired term of L. B. Faulkner, who resigned on account of the pressure of his new duties as president of the Olympia Light & Power Company. Mr. Gille was formerly contract agent for the Minneapolis General Electric Company. He was also at one time associated with the St. Paul Gas Light Company.

Thomas Pitts has been promoted from superintendent of the Hutchinson section of the Southwestern division of the Northern States Power Company to be assistant to the manager at Montevideo, Minn.

Henry G. Kobick, who prior to his enlistment in the aviation section of the United States Army, was superintendent of the employment bureau of the Commonwealth Edison Company, Chicago, has been appointed assistant to the general manager of electric shops for the same company. This position gives him jurisdiction, under E. A. Edkins, of all matters pertaining to merchandise sales and adjustments in all the company's electric shops.

Obituary

Minor Q. Woodward, treasurer and manager of the Pine Bluff Company, died at his home in Pine Bluff, Ark., on Dec. 8, following an attack of influenza. Mr. Woodward was born in Jackson, Tenn., Sept. 27, 1891. He went to Pine Bluff in his early youth, attending the city school until the age of sixteen when he was employed as lineman with the Pine Bluff Water & Light Company. Mr. Woodward advanced rapidly with the company, and prior to his appointment as manager on May 1, 1917, he had been for some time assistant manager and claim agent. In addition to his work with the company, Mr. Woodward took an active interest in civic affairs.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

CONSOLIDATION EXPECTED IN VACUUM-CLEANER FIELD

Arrangements Made by Frantz Premier, General Electric and Edison Electric Appliance to Form Ten-Million-Dollar Corporation

Negotiations which have been pending for some time were virtually completed this week, except for minor details, for a merger of prominent electric vacuum-cleaner interests. According to reports in Cleveland papers, the Frantz Premier Company, the General Electric Company and the Edison Electric Appliance Commpany, Inc., have made arrangements for the formation of the General Vacuum Cleaning Corporation with headquarters at the present plant of the Frantz Premier Company in Cleveland, where operations will be carried on.

The new company was organized under the laws of New York State with an authorized capital of $10,000,000. The Edison Electric Appliance Company, it is reported, will turn its vacuum-cleaner business over to the new company.

The officers of the new company anticipate a very large growth in the vacuum-cleaner business not only for the domestic trade but also for export.

STEPS TAKEN TO INCREASE TURNOVER OF LAMP STOCKS

Distribution Through Agents, Which Is Rapidly Increasing, Now Equal to That Through Central Stations

With the war's demand to eliminate special goods and hold only to standards the desire on the part of lamp manufacturers to determine what are standards and what are non-essentials has been stimulated.

To both the lamp manufacturer and the lamp dealer the question of stocks is a very important one. Excess stocks mean slower turnover of investment to the former and wasted storage space to the latter. Therefore, to increase the rate of turnover and cut down the storage space necessary for stock, there has been effected a standardization of lamps, the importance of which manufacturers are endeavoring to impress upon agents.

In the matter of lamp sales by manufacturers to central stations and agents it is interesting to note that a couple of years ago about two-thirds were to central stations and one-third to agents. Since then sales to lighting companies have fallen off while distribution through agents has increased considerably, so that at the end of the past year each branch of the industry absorbed approximately the same number. It is predicted that in two years they will have changed places—one-third to the central stations and two-thirds to agents.

Gas-Filled Lamp.—In this type of lamp, built in sizes from 75 watts to 1000 watts, the greatest demand has been for 100-watt units, closely followed by the 75-watt size. In the last half of the past year the 75's gained in percentage sold over the 100-watt size, and at the present time they are holding about equal in volume of sales. These are the standard stock sizes for the average agent. The 200-watt size has about one-third the demand of the 100-watt size, and the average lamp agent has very little call for it. The 220-250-volt lamps have little demand in the States, although foreign buying is very appreciable.

Tungsten Vacuum Lamp.—Using 110 to 125 volts, the standard lamps are the 40, 25, 60 and 50-watt, with the sales in the order named. In 1918 the 40-watt size held about 36 per cent of the sales, the 25-watt about 32 per cent, the 60-watt about 19 per cent and the 50-watt about 13 per cent. Some central stations have pushed the 60-watt lamp on account of higher energy consumption, but this capacity has been found by some utilities to give too much light for household uses. In many cases the 40-watt unit, of course, is too small. Several central stations in the East have pushed the 50-watt lamp as best adapted for average household uses, and they are strongly advocating its general adoption. In the past year the 50-watt lamp has nearly doubled its proportion of sales over the previous year among the three other lamps of its class.

Carbon Lamp.—During 1918 about 90 per cent of the lamps sold were tungstens, the remaining 10 per cent being carbons. Until a tungsten lamp is brought out that can compete in ruggedness and price also with the carbon, it has been stated by persons in the lamp industry, there will be a certain demand for the carbon lamp in places where a rugged filament is desirable. The Fuel Administration's recommendations have caused central stations to stop supplying Gem lamps. At the present time the Gem lamp is practically dead.

MINIATURES

Flashlight Lamps.—Seven former flashlight lamps have been placed on the inactive list, leaving nine lamps to supply the trade. Of the five retained for two-cell and three-cell flashlight batteries, dealers, it is understood, will probably stock three. Besides, there is one for a five-cell flashlight battery, two for a single and one for a double standard dry battery. This cut of nearly 50 per cent in flashlight lamps, manufacturers state, will considerably simplify stocks.

Automobile Lamps.—The three-cell, 6-volt storage battery, with or without generator lighting system, is the prevailing type. Of the forty lamps heretofore built for this service twenty-four have been rendered inactive and sixteen retained, exclusive of those for use on the Ford car. At the present time 85 per cent of the lamps are for single contact, and the tendency is toward the grounding system, but until that happens dealers will have to keep stocks of both single and double contact lamps, although the latter may be small. Probably only eight of the sixteen need be stocked.

For Ford car service, which comprises a very large percentage of the automobile business, three lamps are made, but the gas-filled lamp and the large-bulb vacuum lamp seem to have the biggest demand. These are 9-volt lamps burned two in series on a magneto lighting system, but it is anticipated that in the near future a compensator will be installed which will permit the burning of two 6-volt lamps in parallel. However, while present cars are on the road the 9-volt lamps will, of course, have to be stocked.

As there are probably 7 per cent of the automobiles equipped with 12-volt to 16-volt batteries, there is a demand for some lamps for this voltage. Six lamps of this size were dropped from the active list, while twelve were retained. All of the ten lamps for batteries of 18 volts to 24 volts have been placed on the inactive list, so none are regularly carried in stock. The same is true for the twelve lamps formerly carried for electric vehicle service, for operation on 30, 40, 60 and 80 volts.

Candelabra Lamps.—Sixteen lamps have been retained, while four were dropped. Most of this stock goes to fixture

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houses and central stations, so the average lamp dealer is not required to stock them.

Gas-Filled Tubular Projectors.—There have been standardized ten of these lamps for stereopticon and motion-picture service, in three bulb lengths. Two are for 6 volts, two for 12 volts, three for 30 volts and three for normal lighting service of 110 to 125 volts.

ANALYSIS OF THE EFFECT OF PRICE GUARANTEEING

There Are No Indications that Such a Procedure Stimulates Buying for the Purpose of Stock Replacement

Guaranteeing prices against decrease for a certain specified period has a limited number of followers in the electrical manufacturing line. It is held, of course, by those in its favor to be a strong means of strengthening the market and encouraging buying. Most of the guarantees in the electrical field, however, which have been reported cover only through March or April. A guarantee for such a short time can hardly encourage stock purchases unless the goods have a rapid turnover, in which case no guarantee will be necessary. It is very apparent that distributers and dealers are not going to lay in a large amount of stock when it is evident that the trend of the market must be downward. Any attempt to delay this downward trend for a couple of months by a fixed guarantee offers the buyer no assurance that the market will not decline after the guarantee date, and consequently there is nothing to stimulate him to purchase for stock purposes. Apparently, therefore, guarantees of short duration lose their beneficial effects.

If guarantees are made through June 30, as has been the case in some lines of electrical equipment, stocks may be laid in provided that the distributers can foresee a market. It is more likely, however, that the distributers will wait until the supplies are needed. In fact there are no indications that even if prices were guaranteed for a year or more distributers would lay in stocks until a building demand develops.

Furthermore, a guarantee through June 30 gives relief, if any, but for the moment. During the month or six weeks prior to June 30 the same condition arises as came with the signing of the armistice, unless of course a further guarantee is made. Looking back over the past year of government control of prices will disclose this fact very forcefully. Whenever the time for the limit of a government-made price, as in copper, drew near buying began to fall off, and it did not awaken until the new price or set of conditions was announced. There is no reason to believe at the present time that other conditions will result in the electrical field where prices are fixed.

Price fixing is in defiance of the laws of economics and can hardly be expected to stimulate and revive a slow market. It is apparent, of course, that manufacturers are unwilling to sacrifice prevailing high prices and current profits. The writing on the wall has clearly stated for some time that buying must be stimulated by lower prices. This, however, may be accomplished without a very serious loss in total profit.

It is a well-known fact that goods which turn over once a year, bringing say 20 per cent gross profit, do not yield so much profit on the investment as an article with one-quarter the gross profit per sale but with a turnover once a month or more often. Turnover, in other words, is the answer to profits. With high war prices the impulse to buy is dormant. This impulse must be awakened. Guarantees against a drop in price for a short time merely put off the day of awakening.

It is generally recognized, and by merchandisers such as department stores especially, that one way to move goods is to make a concession in price. It is true that labor is still high and that stocks of raw materials purchased at high prices are still on hand. Nevertheless, the profit is there. If there is a latent demand, a cut in price by taking less profit, it seems reasonable to believe, would bring more sales than continued high prices. Sufficient sales, though at lower profit, bring a better total return. Incidentally labor is kept better employed when sales run large. This is not a factor which should be altogether ignored in a consideration of prevailing market conditions.

DETAILED EXPORT FIGURES FOR LAST FISCAL YEAR

Classification Is Made Not Only According to Articles but Also According to the Countries of Import

Detailed figures of exports of electrical merchandise for the fiscal year ended June 30, 1918, classified according not only to articles but also to the countries of import, have just become available. These figures, which were compiled by the Bureau of Foreign and Domestic Commerce, are to be found on the two following pages. In comparing these figures with similar figures for previous years two things must be kept in mind, namely, that prices are higher and that the figures are for the first complete year during which the United States was at war. While the war had been going on for nearly three years, it was not until April, 1917, that this country became engaged. After that, of course, rulings by the War Trade Board limiting exports and making all exports subject to license had an effect upon the exports of electrical merchandise.

METAL MARKET SITUATION

Resale Copper Quoted Last Week at 18.75 Cents to 19 Cents per Pound—Old Metals Decline

During the past week the market has not shown very extensive buying. Nearly all metals evidenced a drop in price ranging from ⅛ cent to 1½ cents. The latter figure is shown for prime Lake copper. Electrolytic copper has sold in the open market at 18.75 cents to 19 cents per pound. The large producing interests ignored these small-lot sales and adhered to their nominal price of 23 cents, but revision of this price is expected in the near future. Until consummers are ready to contract for future supplies in considerable tonnages the producers contend that there is nothing to be gained by reducing the price.

The large amount of scrap copper which the government is offering has a depressing effect on the whole situation as much of this metal can be used in place of the electrolytic copper.

The reduction in freight rates has caused a decline in price of most metals in London.

NEW YORK METAL MARKET PRICES

	Jan. 28	Feb. 4
Copper:	£ s d	£ s d
London, standard spot	89 0 0	88 0 0
	Cents per Pound	Cents per Pound
Prime Lake	21.00	19 50
Electrolytic	19.25	18.50
Casting	18.00	17.75
Wire base	22 75*	22 75*
Lead, trust price	5.50	5.25
Antimony	7.50	7.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f.o.b. smelter	13.00	13.00
Spelter, spot	7.00	6.75
Tin	Govt. price 72 50	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	Govt. price 33.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	14.50 to 15 00
Brass, heavy	9.00 to 9.50	8.50 to 9 00
Brass, light	7.00 to 7 50	7.00 to 7.50
Lead, heavy	4.50 to 4 75	4.25 to 4.50
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

* Normal.

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UNITED STATES EXPORTS OF ELECTRICAL MACHINERY AND APPLIANCES BY COUNTRIES DURING THE YEAR ENDED JUNE 30, 1918

Countries	Batteries	Carbons	Dynamos or Generators	Fans	Heating and Cooking Apparatus	Insulated Wire and Cables	Interior Wiring Supplies (Including Fixtures)	Arc Lamps	Carbon-Filament Lamps	Metal-Filament Lamps	Magnetos and Spark Plugs	Meters and Measuring Devices	Motors	Rheostats and Controllers	Switches and Accessories	Telegraph Apparatus	Telephones	Transformers	All Other
Azores and Madeira Islands	$13	.....	.....	.....	.....	$880	.....	.....	.....	$1,210	$18	.....	$1,113	.....	.....	.....	$900	.....	.....
Denmark	178	.....	$570	.....	.....	2,997	$7,260	.....	.....	.....	3,879	$74	462	.....	.....	$1,376	521	.....	$44,289
Finland	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70
France	100,511	$7,748	444,021	$94	$822	795,659	126,778	.....	.....	3,015	349,987	3,467	305,061	$16,478	$67,473	42,769	186,006	$465,018	859,878
Gibraltar	.....	.....	185	.....	.....	.....	.....	.....	.....	.....	.....	.....	148	.....	.....	.....	.....	.....	.....
Iceland and Faroe Islands	.....	.....	432	.....	.....	7,414	550	.....	.....	.....	315	.....	90	.....	.....	.....	702	.....	4,250
Italy	7,331	149,385	29,890	45	25,568	77,726	77,541	.....	$1,474	24,041	758,868	59,245	180,357	1,554	107,821	8,899	154,410	71,027	893,812
Netherlands	435	622	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	276	.....	70	.....	76,557	.....	91,775
Norway	18,623	100,627	29,890	469	10,680	157,313	7,535	.....	.....	279	12,162	1,634	78,126	445	92,942	.....	.....	101,400	312,101
Portugal	5,907	100	466	.....	126	7,404	12,461	.....	.....	1,241	2,498	68	2,750	16	1,682	.....	1,334	212	8,462
Russia in Europe	50,758	20,623	41,570	18	.....	406,426	1,526	.....	.....	3,550	45,153	13,811	196,781	1,054	14,368	3,680	18,217	76,300	136,903
Spain	30,429	1,189	21,316	7,332	21,898	118,434	18,237	$449	.....	12,568	68,604	74,104	212,782	685	49,026	.....	17,587	74,204	294,100
Sweden	3,175	550	.....	.....	.....	3,933	.....	.....	.....	.....	659	75	1,239	.....	.....	.....	.....	.....	4,925
Switzerland	.....	.....	.....	.....	74	13,856	1,995	.....	.....	.....	401	123	4,096	127	353	.....	2,110	108,373	156,853
England	678,568	56,136	26,379	4,024	1,683	112,426	112,278	.....	.....	4,278	715,464	61,607	849,548	618	63,208	36,672	117,380	1,763	2,226,217
Scotland	27,094	11,274	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,691	.....	.....	300	.....	.....	6,163
Ireland	570	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,333
Bermuda	3,497	.....	.....	86	109	968	712	48	.....	379	289	74	44	.....	343	.....	673	1,181	4,449
British Honduras	4,150	116	14	10	11	1,495	536	.....	144	2,056	539	97	97	8	310	4,035	361	.....	3,588
Canada	1,016,362	794,249	440,516	130,935	212,515	206,678	405,471	5,087	94,293	803,785	490,258	292,632	1,537,963	81,619	251,122	68,649	293,285	238,138	4,583,718
Costa Rica	1,928	880	117	.....	263	916	3,458	.....	102	3,427	226	16	5,503	.....	163	.....	1,382	3,557	17,288
Guatemala	1,858	2,880	2,612	120	583	9,858	2,128	95	85	7,069	432	32	3,629	40	673	1,516	965	571	12,595
Honduras	5,028	1,386	2,816	272	193	4,709	1,738	.....	595	5,208	457	976	759	10	1,768	636	2,237	1,577	14,388
Nicaragua	2,885	30	1,701	224	.....	2,064	725	.....	470	3,398	976	168	4,266	13	391	18	296	614	24,918
Panama	29,309	674	62,468	2,955	17,342	406,078	36,841	150	313	40,438	9,087	34,906	46,916	1,465	86,955	2,930	71,367	52,486	171,530
Salvador	10,467	726	447	1,045	637	11,292	2,429	177	214	9,450	583	1,423	972	57	951	.....	1,356	4,061	9,391
Mexico	75,336	22,535	60,249	20,490	23,284	214,906	67,568	2,687	16,819	252,496	20,573	85,976	162,056	4,731	101,091	3,259	38,815	79,793	421,495
Miquelon, Langley, etc	1,760	.....	.....	.....	.....	97	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	109
Newfoundland and Labrador	41,452	5	2,891	42	231	24,421	7,686	.....	.....	13,311	2,199	4,161	26,492	173	3,159	994	1,933	9,386	21,008
Barbados	1,752	.....	1,935	15	18	459	339	.....	.....	1,414	608	.....	708	295	86	.....	965	481	7,606
Jamaica	8,478	346	2,296	194	115	9,729	1,383	.....	155	4,193	2,627	1,232	9,218	57	735	361	6,067	726	24,145
Trinidad and Tobago	6,100	554	2,992	161	3,616	11,187	1,645	.....	417	5,883	3,926	2,580	4,739	387	1,325	.....	3,696	1,339	21,681
Other British West Indies	3,418	46	7,972	276	.....	2,483	597	.....	.....	1,116	489	795	941	142	5,364	84	1,637	.....	8,009
Cuba	160,582	10,981	309,132	42,482	12,489	625,681	154,064	1,398	10,206	416,356	45,748	60,982	405,266	24,851	139,491	5,882	85,283	133,445	772,381
Danish West Indies	565	1,036	550	16	6	571	671	.....	205	1,407	109	2,145	1,497	70	40	.....	382	.....	2,479
Dutch West Indies	1,246	8	840	44	.....	3,592	455	26	9	1,985	823	.....	657	.....	1,000	.....	995	1,055	17,709
French West Indies	2,291	154	550	85	4	392	727	.....	.....	1,968	999	16	1,153	.....	75	159	1,126	.....	5,646
Haiti	1,012	487	45,065	38	9,587	20,730	4,175	.....	54	1,891	522	2,239	17,410	.....	3,986	72	507	6,985	31,551
Dominican Republic	6,655	564	21,064	970	233	15,929	4,295	332	101	10,438	3,817	2,442	48,385	498	1,912	868	3,820	5,304	59,660
Argentina	151,923	41,562	39,407	23,815	29,419	546,548	108,099	.....	846	355,303	106,610	119,081	264,654	2,620	122,016	159	126,879	79,535	507,687
Bolivia	587	15	703	.....	645	1,453	5,308	.....	.....	5,152	14	31	4,601	217	639	.....	.....	2,366	11,791
Brazil	77,212	18,871	57,167	14,716	16,508	715,552	100,120	111	4,866	440,962	36,740	129,103	163,462	2,440	155,216	6,680	522,779	228,932	491,579
Chile	35,906	14,189	223,909	1,589	19,817	356,762	80,290	.....	3,503	182,956	31,644	33,515	264,785	7,184	179,255	4,458	31,277	96,598	595,250
Colombia	14,547	274	12,790	1,610	1,322	40,444	19,791	25	809	74,095	2,667	2,737	30,378	228	3,679	1,215	6,353	10,842	60,492
Ecuador	3,818	289	9,118	2,276	792	15,461	6,943	70	903	10,039	2,268	1,524	9,656	.....	2,713	88	742	3,358	29,975
Falkland Islands	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
British Guiana	4,897	662	922	284	144	1,331	1,614	.....	.....	6,364	6,031	1,297	6,123	141	1,383	42	2,372	216	7,547
Dutch Guiana	264	.....	25	49	.....	68	.....	.....	.....	98	53	22	295	.....	.....	32	98	.....	431
French Guiana	142	80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61	25	.....	.....	.....	.....
Paraguay	307	.....	.....	.....	.....	1,821	1,093	.....	.....	.....	155	206	5,918	.....	.....	.....	139	.....	13,290
Peru	12,386	5,629	10,475	379	4,784	87,142	26,490	41	3,533	53,125	3,603	14,109	114,455	2,802	23,117	4,406	11,734	74,407	194,679
Uruguay	17,582	31,887	4,654	2,067	24,568	105,792	17,618	.....	9	59,733	12,566	34,923	9,943	.....	17,205	82	13,875	4,245	81,365
Venezuela	29,515	1,139	19,323	3,406	2,230	34,236	7,840	116	399	31,750	4,023	1,350	17,722	90	5,789	3,528	16,606	5,401	54,261
Aden	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	181	.....	.....	.....	.....	.....	.....	.....	280
China	31,125	2,458	109,973	115,976	8,124	97,494	8,832	271	894	27,437	8,386	35,676	141,595	1,662	51,565	.....	91,355	39,847	163,528
French China	75	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	169
Japanese China	.....	.....	15,909	.....	272	.....	582	.....	.....	.....	423	1,536	34,593	59	440	.....	2,539	.....	111,182
Chosen	193	282	.....	.....	94	141	2	.....	.....	183	184	55	87	.....	116	.....	4	1,328	7,648
British India	52,463	43,167	71,558	295,714	5,029	24,276	13,244	900	885	33,623	64,784	7,969	295,928	12,550	8,565	101	57,146	24,523	195,116
Straits Settlements	943	2,400	5,940	1,825	19	.....	1,720	.....	.....	721	11,177	.....	6,340	.....	1,428	.....	3,240	3,205	23,605

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UNITED STATES EXPORTS OF ELECTRICAL MACHINERY AND APPLIANCES BY COUNTRIES DURING THE YEAR ENDED JUNE 30, 1918 (Continued)

Countries	Batteries	Carbons	Dynamos or Generators	Fans	Heating and Cooking Apparatus	Insulated Wire and Cables	Interior Wiring Supplies (Including Fixtures)	Arc Lamps	Carbon-Filament Lamps	Metal-Filament Lamps	Magnetos and Spark Plugs	Meters and Measuring Devices	Motors	Rheostats and Controllers	Switches and Accessories	Telegraph Apparatus	Telephones	Transformers	All Other
Other British East Indies	$342		$224	$6,295		$50,386	$5,080			$620	$4,906	$1,065	$5,395	$40	$163		$580	$699	$1,112
Dutch East Indies	13,442	$11,843	6,974	459	$48					5,388	23,897	569	4,359		17,239	$34,975	6,672	1,655	31,825
French East Indies					748		132			85									214
Portuguese East Indies																			
Hongkong	3,219	891	41,805	57,544	2,975	2,488	1,631	$125	$480	10,761	1,435	3,401	27,162	993	6,393	40,629	379	38,440	33,708
Japan	15,585	124,731	367,103	30,144	8,053	11,584	7,455	485		1,351	26,811	345,328	469,242	10,962	264,347		186,793	150,551	1,296,126
Russia in Asia		4,201								180	27,244		11,618		360				1,826
Siam	7,589		1,500	10,807	4,044	3,787	3,918			60	2,619	3,850	2,931		1,748	160	194	9,030	47,941
Australia	229,720	13,609	103,587	11,434	32,683	203,164	24,264	559		98,009	124,012	80,165	339,652	21,394	163,009	3,634	336,607	65,405	422,009
New Zealand	141,378	12,311	5,757	527	19,428	2,514	4,959	111	640	38,997	44,713	37,905	53,796	3,261	165,949	698	29,427	2,376	107,526
Other British Oceania	3,920					43	425	45		12	1,174		768		86	4,208			261
French Oceania	7,281		830	256	473	614	445		15	1,316	381	1,802	3,950		615	160	194	1,003	6,557
German Oceania	4,490		498	201	10	72	66		20	312	307		270	53	31				3,720
Philippine Islands	31,031	3,252	8,837	17,479	2,457	95,407	16,229		118	30,219	19,942	6,479	52,824	1,365	21,099	6,043	14,963	10,967	104,586
Belgian Kongo																			800
British West Africa	82	25				352	20			25	1,798	90	214				982	285	4,781
British South Africa	149,881	3,490	8,071	6,728	7,133	51,948	3,397		1,185	73,335	52,877	21,164	133,451	8,544	16,722		2,571	49,758	161,337
British East Africa					11	447				2,409	40	143	44		119				767
Canary Islands											172		976						132
French Africa				301							75		2,290						338
Madagascar						246				42	81		816		109				87
Portuguese Africa			64	15	71	420	24				7		1,200				7,751		15,566
Egypt		1,960				70	874				30								50
Total	$3,351,838	$1,525,128	$2,688,169	$818,338	$533,988	$5,730,766	$1,532,309	$13,308	$144,761	$3,182,516	$3,167,325	$1,592,195	$6,598,664	$212,059	$2,229,023	$294,297	$2,566,929	$2,343,968	$16,021,380

THE WEEK
IN TRADE

THE market shows virtually no change. A spurt, however, is expected in the next few months. The Department of Labor is making strenuous efforts to increase new construction and as far as possible keep labor employed.

Wire was a little softer this week and carbon-lamp discounts increased. Aside from these changes the market was very steady.

Labor disturbances are increasing in number and non-employment is growing in extent.

NEW YORK

A few isolated cases of new building projects are continuing to interest the trade. Of most recent note there is reported a thirty-one-story office building for Wall Street, a twelve-story structure on Seventh Avenue, and a marine insurance building on Beaver Street.

If the proposed four-year prohibition of immigration becomes law, the supply of household help will probably be somewhat curtailed. Acting on this assumption, manufacturers of electrical labor-saving devices for the home are looking forward to increased business.

Reports from various sources indicate good business for this season of the year. The government was in the market this week with four specifications for motor-driven kitchen machinery. There is still some pessimism locally, but for the most part electrical distributers are very optimistic and look forward to greatly increased business in the spring. One of the features of the current market is the amount of remodeling that is being done.

Prices are still steady with but few changes reported. Wire is a little softer and carbon-lamp discounts are increased.

LIGHTING FIXTURES.—With the government restrictions removed from glassware, brass and other lighting fixture materials, their supply is once more ample and back orders are being filled. The molders are back at work and now developments in glassware are being perfected which in a short time will be on the market. Most of the work in hand is of the commercial and industrial type, and although some of it is going into new buildings, a great part is being used for replacing old and inefficient types of lighting and in the remodeling of buildings. No reduction in price of glassware and fixtures is expected in the near future.

IRON CONDUIT.—Small amounts of rigid conduit are continually being used in the remodeling business which is occupying the trade at this time and in the few new buildings which are under way. Until the new building era sets in, however, carload shipments are hardly to be expected, but they are looked for later in the spring.

SCHEDULE MATERIAL.—There has recently been and still is a very considerable and interesting demand for schedule material along the waterfront, in shipyards and in dry docks. This is quite outclassing the quiet though steady run of the trade in remodeling and refitting premises where at this time so many tenants are changing locations.

DRY BATTERIES.—Stocks of the standard dry cell and the small dry batteries are very much better than during the war; still, some large dealers have difficulty in keeping sufficient on hand to satisfy their needs. The uses of all sizes of dry batteries are steadily increasing both in the industrial field and in the household, and a high demand holds despite prevailing high prices.

FLASHLAMPS.—With the release of these from government contract both the manufacturers' and the jobbers' stocks are much improved. Their increased demand in the

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industrial field keeps these stocks moving well, especially the long type, both with and without the large reflector.

INSULATING FABRICS.—Owing to a drop in price of linseed and China-wood oils and also in cotton, there is a tendency for oiled insulating fabrics to decline a bit in price. This is not general, however, but due to the decision of some jobbers who are overstocked to clear some of their surplus. Orders in the States are not large but are expected to become so in the next few months. Many inquiries have come to both manufacturers and jobbers for export, and several have turned into large orders.

SMALL MOTORS.—Sales of motors from 1 hp. to 50 hp. have picked up in the last two weeks, according to one large manufacturer. He has good local stocks of alternating-current motors but is rather short on direct-current. Two other large manufacturers report no significant increase in sales and poor local stocks.

CARBON LAMPS.—Effective Feb. 1, on standard packages of carbon lamps the discount has increased from 10 to 25 per cent. and on $500 orders it has increased from 10 and 25 per cent to 40 per cent.

RUBBER-COVERED WIRE.—The base this week averages 26½ cents. Four manufacturers quote on 28 cents, two on 27 cents, one each on 26, 24 and 23 cents, and one on cost. This shows a reduction of approximately ¼ cent over the quotations of last week.

CHICAGO

The industrial situation in Chicago has been somewhat complicated because manufacturers who held government contracts have been slow in filing claims for settlement with the government. Altogether there are 658 ordnance contracts in the Chicago territory. Only seventy-one claims have been filed so far.

Among the manufacturers there is considerable interest in the news that Secretary Lane has asked for an appropriation of $200,000 to be used by the Geological Survey in making an investigation of the power supply for the Boston-Washington industrial region.

An indication of the scope of the work to be carried on by the Sanitary District of Chicago is given by the following figures taken from its annual budget. The estimated grand total of the budget is $15,372,144.79. The estimated appropriation for the engineering department amounted to $9,581,862.86.

Jobbers report that the business of January for 1919 was better than the business for January, 1918. A part of this may be attributed to the fact that January, 1918, contained several heatless Mondays.

There have been no price changes during the week except that copper wire has gone a little lower.

COPPER WIRE.—The range in the prices of copper wire is decreasing and the price is lowering somewhat, the present prices being from 25 cents to 27 cents.

CONDUIT.—Jobbers are still on card 41.

ELECTRIC FANS.—Activity among the Middle Western jobbers in connection with buying fan stock is just beginning. It seems to be accepted that fairly large purchases will be made.

MOTORS.—The demand for motors is considered to be fair, although there is no boom market such as existed a few months ago. There is as yet no sign of a large influx of second-hand motors in this market.

FITTINGS.—Close competition is beginning to be noted in this field, the tendency being toward larger discounts for important buyers.

USED MATERIAL.—It was announced this week that among the construction material which is for sale at Camp Grant, Rockford, there are some electrical goods. Chicago jobbers may purchase a part of these, but some of these wholesalers, knowing the character of materials to be sold at Camp Grant, are not much interested in the proposition, as it appears to them that there can be very little material in stock at Rockford that would be of value to an electrical jobber.

BOSTON

Trade is still marking time to a large extent, waiting for buyers and sellers to get together on prices. Jobbers are gradually completing their stocks, which are in excellent shape as regards most lines. Among the very few shortages reported, metallic flexible conduit is for the moment conspicuous. The scarcity in miniature lamps so often reported in these columns has now practically disappeared. Prices hold remarkably firm, on the whole, but the discount on carbon incandescent lamps was increased Feb. 1. Wire is rather weak at a base around 24 to 26 cents. The volume of trade shows little tendency to increase, though optimism rules in commercial circles. Money is still tight, and a recent two-year borrowing of $500,000 on notes by a large central station in the New England territory was put through only on the basis of 7½ per cent interest. A tendency toward central-station expansion can be seen in slightly more liberal policies regarding line extensions here and there. Electrical contractors are rather quiet except where government or shipyard work occupies them. Wiremen are now plentiful, and returning service men are being reëmployed by many concerns. Collections are fairly good and deliveries excellent in most lines.

CONDUIT.—The demand is moderate, and shipments are coming in fairly well. An insufficient supply of metallic flexible conduit is reported.

MOTORS.—Stocks are in good shape for prompt deliveries up to 50-hp. Beyond this size quotations of sixteen weeks are not uncommon, though odd sizes may be picked up here and there for quicker delivery. As yet the motors released from war plants no longer required have not been cast upon the market in sufficient numbers to weigh it down as to price. Some anxiety is felt, however, as to the future course of motor prices when large stocks of motors are offered *en bloc*, if it comes to that. Trade in motors is rather dull, and so far prices show little downward movement.

WIRE.—The demand is small, government business having shrunk to small proportions. Industrial orders are slow to materialize, notwithstanding the recent falling prices. Some manufacturers are reported to be guaranteeing no further price reductions until April 1. Bare copper wire is quoted around a 24-cent base at Boston, weatherproof at 26 cents base, and rubber-covered wire at 27 cents base. Stocks are fairly good for prompt deliveries.

FANS.—A few orders are being placed, but there is a feeling that recent price advances will be difficult to maintain. A good deal of complaint was heard last year when fan prices moved upward, and many buyers in New England prefer to gamble on cool weather to investing heavily in fans at present quotations.

LAMPS.—The miniature-lamp situation is better than for many months. Stocks of tungsten lamps are in general in good shape. No price changes are in sight at this time. One of the lamp factories is said to have a stock of 1,000,000 lamps now on hand for Ford cars. On Feb. 1 the discount on carbon lamps in standard-package lots was increased from 10 to 25 per cent, and that on quantity orders ($500 or over) was increased from a former basis of 10 and 25 per cent off to 40 per cent off. A limited market still exists for carbon lamps in locations involving extra rough handling.

STORAGE BATTERIES.—Trade in units for automobile service is very good. Stocks of batteries are showing more accumulations in diversified sizes and types. The expected market for batteries for yachting use has not yet materialized, but seems sure to come ere long in view of the new building work anticipated as a result of the taking over of so many private vessels by the government during the war. The industrial truck market is quiet at present, but business looks very promising for road trucks. Manufacturers are getting little new business but are actively filling back orders.

APPLIANCES.—Trade is fairly good for this season. The supply of percolators, chafing dishes, etc., is somewhat below normal.

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ATLANTA

Information at hand indicates that trade is off this week when compared with the early part of January. Manufacturers report a general decline in the volume and value of orders, especially from industrial sources. Wholesalers and jobbers are taking care of current requirements, and no large transactions of note are taking place. The same is true of dealers and retailers, who are marking time and looking forward to reductions along the entire electrical line. The manufacturers are receiving orders from central stations that they did not expect at this time. Smaller central stations are making a limited demand for staples. Nearly all socket appliances are moving well for retail stocks. This section is just beginning to realize the potential market that exists for labor-saving devices, and the manufacturers expect a big business year.

The Charleston (S. C.) Consolidated Railway, Gas & Electric Company contemplates an issue of $1,500,000 common stock to cover improvements made in the plant and transmission system.

FANS.—A large central station placed a substantial order this week for alternating-current ceiling fans which will be utilized in replacing direct-current fans. Prompt delivery is promised. The jobbers are anticipating a bigger fan season than last year.

ELECTRIC SIGNS.—Representatives of Eastern manufacturers are again active and report a large number of inquiries. The "lightless nights" dampened enthusiasm in this line for some time and the effect has not quite worn off. Novelties in electric publicity are being presented, however, and interest is growing.

FLASH LAMPS.—There is no apparent lull in these. Manufacturing concerns that were engaged in supplying government needs are now concentrating their attention on normal commercial channels, and increased activity is noted.

LIGHTNING ARRESTERS.—The central stations as a whole are anticipating requirements in advance of early atmospheric disturbances, and orders are being placed accordingly. There appears to be an increased demand for low-voltage units up to 2300 volts.

METERS.—Manufacturers are pleasantly surprised by the steady volume of orders coming in for the residential type. This line is maintained mostly by the call from smaller central stations for lots of five to fifteen at a time.

TRANSFORMERS.—Following the general lull in industrial activity very few transactions of any note are being recorded. There is a steady demand for the distributing type, however, and excellent shipments are being offered. Southeastern stocks have again reached a normal state.

MOTORS.—The call for large motors has about ceased, and little or no activity is noted this week. Factory facilities have improved and shipment promises have been cut materially during the last month. A lively trade is taking place in the smaller capacities up to 10-hp. District stocks are filling up rapidly, and facilities for quick distribution have nearly reached normal. At present there are no indications that prices will fall off.

SEATTLE—PORTLAND

The strike of shipyard workers continues with no definite steps toward settlement. Both sides are marking time, awaiting the general sympathetic strike of all unions in Seattle set for Feb. 6, which, with the exception of one local, every organized union in the city has voted to join. One hundred and ten unions will participate, representing about 75,000 workers, if the plans of the Seattle labor leaders carry. Tacoma unions will walk out the same day.

During the past week electrical sales, both wholesale and retail, were fair in spite of the strike and the fact that there were no sales to the shipyards. Jobbers as a whole report January a fair month despite unsettled conditions and the period of depression which usually prevails during that month. Stocks are in better shape daily. Collections have not been materially affected by strike conditions.

Wholesale trade in Tacoma is fair, retail trade quiet. Sales to shipyards and industrials last week were negligible. Spokane district reports wholesale and retail volumes as good. The volume of business continues about the same. This is partly due to some relatively large rush orders for equipment for steel ships that are being outfitted.

The demand for the smaller sizes of motors and general accessories during January kept up better than was expected. Stocks are reported in good condition in practically all lines. Houses have practically completed invoicing. There is no new business of any importance to report, nor any price changes or fluctuating conditions.

Orders from Washington have been received in Portland recently for suspension of work on all steel ships that cannot be turned out during the first half of 1919. It is expected that about twenty-five ships will be affected, representing a total contract valuation of approximately $38,000,000. Inquiries in Seattle disclose that no contracts for steel vessels have been canceled. Two Seattle yards have been asked to report on the cost involved in the cancellation of a number of orders for 8800-ton carriers. The Emergency Fleet Corporation has caused suspension of all work on construction of twelve ships at the Todd dry dock construction plant in Tacoma.

Seattle's building record for January shows an increase in the number of permits issued compared with January of last year. During the month 1713 permits were issued for new construction. Eleven permits were for factories and warehouses of considerable importance.

SAN FRANCISCO

The threatened strike of the ship workers in San Francisco Bay yards has been called off by an overwhelming vote. A considerable and varied amount of new building has been reported during the past month, of which the following are indicative:

New court houses at Quincy, Cal., and Phoenix, Ariz.; a large dairy plant at Manteca, a tractor plant at Bakersfield, new hotels at Taft and Bakersfield, the latter being a half-million-dollar investment; new packing plants at Hanford and Whittier, with several new school buildings at Los Angeles, and an especially large number of garages from all sections of the state.

Credits and collections are reported good. There is an increased disposition on the part of electrical contractors to grant weekly or monthly terms of payment for the larger household appliances.

The Western States Gas & Electric Company and the Coast Valley Gas & Electric Company report important extensions to take care of large plants and mines.

STREET LIGHTS.—The municipalities of Palo Alto, Tracy and Fresno report street-lighting projects, the latter city having actually granted a contract for a system along one avenue for $15,000.

LAMPS.—Considerable activity in the signing of new lamp agents is reported.

MOTORS.—Delivery conditions are far better than they were last year. It looks as though there might be a considerable number of motors for irrigation purposes sold on account of the partial drought threatened in the eastern portion of the central valley because of the small snowfall. This will be overcome to some extent by big irrigation projects planned by local syndicates.

SCHEDULE MATERIAL.—Small wiring devices, such as sockets, switches and rosettes, are in steady though rather small demand. Deliveries are good, but so far the demand in many sections is rather disappointing in its aggregate and reflects plainly the waiting attitude of the general public.

SEWING MACHINES.—Sewing machines are now recognized stock items for electrical dealers in this section. The prices of various styles range from $41.50 on vibrating models to $60 on automatic styles, complete with electric motors. A number of department stores and even some of the sewing-machine stores have had to stock such machines to cope with the demand.

MEDICAL DEVICES.—Many dealers have capitalized on the winter influenza epidemic, for display windows of vibrators, medical batteries and heating pads are to be seen, and San Francisco is practically cleaned out of them.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅛	250	$5.00
¼	250	7.50
⅜	100	10.00
½	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
¼-in. single trip	$75.00	$63.75— 69.75
¼-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
¼-in. single strip	$75.00	$63.25 to $63.75
¼-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
3/32	$0.05½	1	$0.25
¼	.06	1¼	.33
5/16	.09	1½	.40
⅜	.12	1¾	.47
7/16	.15	2	.55
½	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/32-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
¼-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/32-in.—	$60.00	$30.00	$26.00–26.50
¼-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+5.5% to +3%	+3.5% to +1%
2500 to 5000 lb.	+2.5% to +2%	+5% to +4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4¾-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00—$38.00
Coil to 1000 ft	27.00— 28.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$20.00 to $21.00
1/5 to std. pkg	17.00 to 17.85
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$16.00	$32.00
1/5 to std. pkg	13.60	27.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	+2% to 8%
$25 to $50 list	+5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+35% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	+10% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.54–$0.66
No. 18, full spools	.52– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.435 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$17.50–$25.00	$12.00–$17.00	$12.00–$15.00
12	22.20– 27.09	19.98– 23.22	16.65– 23.22
10	30.20– 32.40	27.18– 32.40	21.75– 27.45
8	37.62– 45.72	34.49– 45.72	30.10– 38.10
6	59.58– 72.36	54.62– 60.30	47.66– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$20.00–$24.00	$15.00–$17.00	$13.50–$15.00
12	25.83– 30.48	25.83– 30.48	25.83– 26.67
10	35.77– 42.32	35.77– 42.32	30.66– 37.03
8	49.84– 50.36	49.84– 59.36	42.72– 51.94
6	79.80–101.28	68.40– 88.62	68.40– 88.62

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$31.75 to $34.75
25 to 50 lb	31.75 to 34.75
50 to 100 lb	30.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$34.76 to $39.75
25 to 50 lb	33.76 to 38.75
50 to 100 lb	32.76 to 37.75

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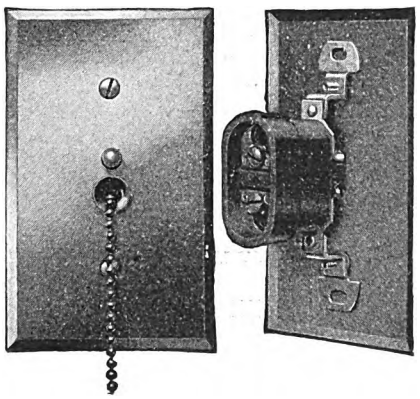
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Wall Switch with Pull Chain for Hospital Call Systems

A device called a hospital call switch has just been developed by the Cutler-Hammer Manufacturing Company of Milwaukee. It is made for installation in a standard switch outlet box



REAR VIEW SHOWS SMALL PROPORTIONS AND CONNECTIONS FOR WIRING

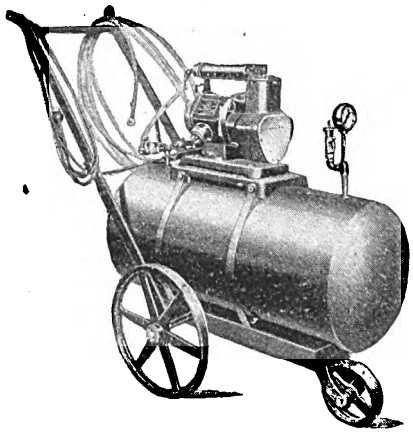
and the wiring does not extend beyond the box. No flexible conductors or push-button switches are required for its use, consequently the annoyance of having these parts broken and soiled is eliminated. Furthermore, as the live parts terminate in the wall, it is pointed out that there is no possibility of the patient coming in contact with them. It is claimed, besides, that the installation is much neater and cheaper. The switch consists of a C-H standard push-and-pull mechanism slightly modified, being operated by a pull chain. A linen cord placed within easy reach of the patient is used to pull the switch "on," the cord being attached to a short piece of chain which extends through a horn in the plate and is attached to a projection on a push-button. A push-button placed above the horn extends through a plate and is used by the nurse to push the switch "off." The plate is the same size as those used for wall switches and receptacles, while the switches and plates are made singly or in gangs. The new device may be used on any standard lighting circuit of 125 volts or less.

Slicing Machine with Two-Speed Motor

A new model rotary knife slicer, equipped with a two-speed electric motor, for slicing hard and soft meats is being manufactured by the A. J. Deer Company of Hornell, N. Y., for use in stores and large kitchens. A feature of this machine is a sharpener and smoothing stone for use on the concave side of the rotary knife, which automatically disappears when the opalite meat table is placed in position. The maker states that from two to seventy-five slices per inch may be obtained through the use of this new machine.

Portable Air Compressor with Storage Tank

A new "Electroflater" outfit, consisting of a ½-hp. electric air compressor and a cylindrical pressed-steel reservoir horizontally mounted on three wheels and provided with a handle, has been announced by the Black & Decker Manufacturing Company at Baltimore, Md. The capacity of the compressor is 2 cu.ft. (0.056 cu.m.) of free air per minute, while the reservoir measures 14 in. by 30 in. (35 cm. by



MOTOR, GEAR TRAIN AND COMPRESSOR COMPACTLY PLACED IN ONE HOUSING

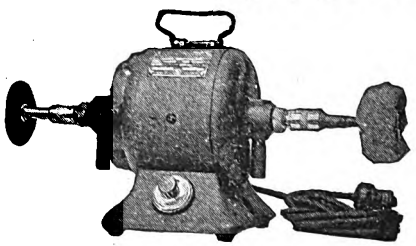
76 cm.) and holds enough air at one filling to inflate five average-size tires from flat to full pressure or ten tires from 40. lb. to 80 lb (18 kg. to 36 kg.). This new outfit is furnished complete with switch, electric cable, attachment plug, pressure gage, safety valve, 25 ft. (63 cm.) of hose, tire connector and all piping and wiring.

A standard Black & Decker No. 2 compressor unit is used in which the motor develops a full 0.5 hp. and operates on alternating current of 60 cycles or less or on direct current. By inclosing the motor, the gear train and the compressor in one housing compactness is secured. Forced circulation of air through this common housing cools the motor and compressor, thus permitting them to be run continuously without overheating. Motor, gears and compressor, including the cylinder walls and piston, are grease-lubricated by capillary attraction. Consumption of energy is said to cost but 0.1 cent per tire.

Portable Motor for Polishing and Grinding

The buffing and grinding motors being made by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., have a wide field of usefulness. They will polish silverware, brassware and glassware through the use of buffing wheels and will grind knives with emery wheels. In factories and shops the burnishing and polishing of small parts can also be done. In addition these motors may be attached to drills, chucks and pulleys for light power work such as driving small lathes and air pumps in shops, in dental and optical laboratories, in jewelers' workrooms and in the home.

The motor is simply constructed, possessing a single speed which is said to result in a greater rigidness and less expensive composition and to eliminate the complications sometimes encountered in multispeed motors. It is silent in operation, has extra long dust-proof bearings, is totally inclosed, and end-play is said to be negligible. A broad and substantial base provides a stable mounting while rubber cushions permit placing the motor, which is portable and has a handle for carrying, on any surface without danger of marring. There are holes in the base for permanent fastening should that be desired. Emery wheels, buffers and pulleys may be attached to both ends of the shaft, which is said to be placed the proper distance from the base to insure convenience in polishing or grinding operations. Nickel bearing caps are furnished to remove the



PULLEY AND DRILLS MAY BE ALSO ATTACHED TO THE SHAFT

chucks, and the snap switch is conveniently located. These motors, which have a glossy black finish, are supplied with a 10-ft. (300-cm.) cord and a separable plug for connecting to an ordinary lamp socket.

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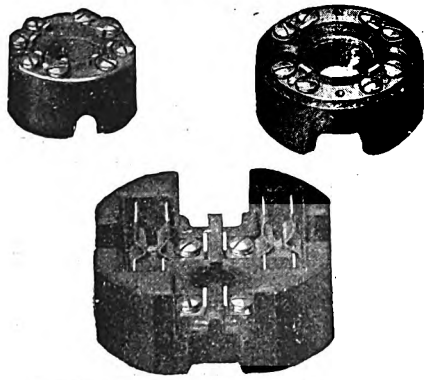
Adjustable Motor Anchorage

Owing to a mistake in the data supplied by the manufacturer, it was erroneously stated on page 202 of the ELECTRICAL WORLD for Jan. 25 that the adjustable anchorages made by the Adjustable Anchorage Company of Detroit, Mich., for lining up motors with machines they drive were suitable for motors of 500 hp. and up. The figure should have been 50 hp. and up.

Connecting Blocks and Cartridge Fuse Base

The Bryant Electric Company of Bridgeport, Conn., has ready for the market two sizes of interconnecting blocks for marine use which are constructed of unbreakable composition and provide means of making connections for branch circuits in junction boxes without the labor and difficulty of using soldered and taped tap-offs. The terminal-plate binding screws are long and heavy and "staked" so that they cannot drop out and be lost. A center hole provides for wire entrance from the back of the box if necessary, and the large groove in the base permits wires to jass through under the block. The dimensions of the smaller size are: Diameter, 1¾ in. (4 cm.), and height, 1 in. (2.5 cm.). The larger block is 2¼ in.



ABOVE—TWO STYLES OF CONNECTING BLOCKS; BELOW—FUSE BASE

(5.6 cm.) in diameter and 1 in. (2.5 cm.) in maximum height. Brass fastening screws are furnished and kept in place by holding washers. Screw spacings are 1⅜ in. (3.5 cm.) on centers, which is standard on all Bryant marine devices.

The cartridge fuse base, also made of unbreakable composition, provides a means of fusing a circuit in a regular 4-in. (10-cm.) junction box. Binding screws are amply long and "staked" so that they cannot drop out. A hole in the center provides for wire entrance to the back of the box. There is said to be ample room between the fuses for additional circuits to pass through the box. Brass fastening screws are furnished and kept in place by holding washers. Holes for screws are 1⅜ in. (3.5 cm.) on centers, and dimensions of the fuse base are 3¾ in. (9.5 cm.) diameter, 1⅜ in. (3.5 cm.) high. National Electrical Code standard cartridge fuses may be used in this block.

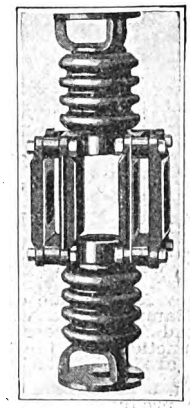
Motored Fan Blowers for Low-Pressure Blast Burners

Fan-motor blowers for delivering a large volume of air at a uniform pressure, which have been designed for use with low-pressure blast burners such as are associated with stereotype, electrotype, confectioners', caldron and soft-metal furnaces, are shortly to be marketed by the Improved Appliance Company of 413 Kent Avenue, Brooklyn, N. Y., in four sizes. They will be chiefly for use in conjunction with blast gas-burning apparatus and will be suitable for installation where the gas burned ranges from 400 cu.ft. to 1500 cu.ft. (12 cu.m. to 42 cu.m.) per hour. These blowers will also be suitable for use in various drying and cooling operations.

The pressure of the air delivered by the new machines will be from 1 ounce to 2 ounces (4.4 g. to 8.8 g.), and the size of the outlets will range from 2 in. to 3 in. (5 cm. to 7.6 cm.). The blowers will be arranged for alternating and direct current at all common voltages and frequencies. Motors of a standard make will be directly connected to the blower proper so that but two bearings need be used. Friction, it is said, is reduced to a minimum, resulting in a large output of air with a low energy consumption. Self-oiling bearings are used and require practically no attention. The blower case is said to be of unique design and is made in two castings to which the electric motor is rigidly bolted. The entire combination is mounted upon an oak panel to facilitate attachment to walls, where the manufacturer recommends placing these blowers, since they will then be more easily kept clean and there will be less possibility of damage. However, where it is desired they may be obtained for floor mounting. The maker says that these new fan-motor blowers offer many advantages over positive pressure blowers, among these being lower initial and operation costs, less floor space requirements and an absence of noise.

Busbar Supports of Unit Type

The busbar support illustrated has been developed by the Delta-Star Electric Company of 2433 Fulton Street, Chicago, and is designed for supporting buses of high ampere capacities. It is said to have an ultimate strength of 6000 lb. against short-circuit forces between buses. With this support the phase conductors are separated into two parallel sets of bars, thereby reducing induction and heating and increasing the carrying capacity per square inch over that secured with the 1¼-in. (3-cm.) spacing which is the usual practice.



INDUCTION AND HEATING ARE REDUCED BY THESE SUPPORTS

Notes on Recent Appliances

Cut-Out and Entrance Switch

A new light-weight double-pole combination entrance switch and cut-out is being made by the Gordon Electric & Manufacturing Company of Waterville, Conn.

Heating Appliance Controller

A thermostat or controller for electric heating pads and other heating devices has been placed on the market by the Electric Appliance Company of Pocatello, Idaho.

Horizontal-Break Oil Switch

An improved design of the Baum "washtub" switch, operating on the horizontal-break principle, is being made by the Pacific Electric Manufacturing Company, 827 Folsom Street, San Francisco.

Small Motor-Generator Sets

A line of motor-generator sets made in fractional-horsepower sizes and rated at 160 watts and from 6 volts to 250 volts is being marketed by the Janette Manufacturing Company, 617 West Jackson Boulevard, Chicago, Ill.

Sewing and Filing Machine

An electrically operated machine which saws, files or laps metal and other light work of this kind has been developed by the Oliver Instrument Company of Adrian, Mich.

Motor-Driven Hammer

A motor-driven hammer for shop use is being manufactured by the United Hammer Company, 141 Milk Street, Boston, Mass., with the electric motor and the controller permanently attached to the machine.

Furnace for Producing Steel from Scrap

An electric furnace adapted to produce high-grade steel for castings and other steel products from steel and iron scraps is being manufactured by the T. W. Price Engineering Company, Woolworth Building, New York City.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A man empowered by landowners in Mauritius (No. 28,207) desires to purchase two electric motors of 13 to 14 kw. and 7 to 8 kw., alternating-current, single-phase, 200 volts, 50-cycle, with all their accessories; also 300 ft. of bare wire. Correspondence should be in French. It is requested that testimonials from persons who have acquired the machines be submitted.

A wholesale dealer in France (No. 28,161) wishes to secure a general agency for the sale of electric lighting devices, electric apparatus, electric wires and cables and incandescent lamps. Correspondence may be in English.

A man in France (No. 28,181) wants an agency for small electrical apparatus. Correspondence in French.

An American firm (No. 28,191) with several years' experience in business in China desires to get in communication with manufacturers of waterwheel generating sets (Pelton wheels), with a view of securing the sole agency for the sale of these goods in China. Manufacturers who would be willing to send factory representatives to work in conjunction with the Chinese sales organization are particularly invited to correspond.

Among the products which Sweden particularly needs from the United States, writes Consul General Albert Halstead from Stockholm, is copper wire. Sweden does not need, he states, turbines or electrical machinery.

A report prepared by the bureau of industry of the Greek Ministry of National Economy on the need of mechanical equipment in Greece states that the water-power development cannot be furthered unless a sufficient number of turbines are imported for that purpose. According to the report it is officially stated that steps are soon to be taken to make Greece's lakes and rivers yield 66,000 hp. The larger sources of power are to be worked either by the state or by companies to which grants are to be made. The power obtained is to be used chiefly in the production of high-tension electric energy for the manufacture of nitrogen fertilizer and also for supplying light in certain cities. The report states that to carry out these plans it will be necessary to import large quantities of generators, transformers, transmission systems, and in general all accessory equipment for hydroelectric central stations.

GREAT BRITAIN BARS VACUUM CLEANERS.—Among the items contained in the list of prohibited imports into Great Britain after March 1, except under special license, are vacuum cleaners.

FOREIGN TRADE IN LAMPS.—Figures are available for the November foreign trade in incandescent lamps. The exports for the month ran up to, roughly, $450,000, of which $423,533 was in tungsten lamps. Of this amount, roughly, $78,000 went to Canada, $69,000 to Argentina and $43,000 to Australia and Tasmania. Other countries took less than $40,000 worth. Imports for the month amounted to 27,970 in metal-filament lamps valued at $819, all from Japan.

BRITISH TO INVESTIGATE BRAZILIAN-MACHINERY MARKET.—The British Department of Overseas Trade and the British Engineers' Association, the *Board of Trade Journal* of London states, will shortly investigate the conditions and prospects for the sale of British engineering products in Brazil. The cost of investigation is being defrayed in equal shares by the association and the government. The subjects to be covered by the investigator include importers, shipping methods, Brazilian law, statistics and the chief competitors of British merchants. The investigation will also include the following industries, so far as they are likely to provide openings for engineering plant and machinery: Shipping and shipbuilding, harbor and dock development, hydroelectrical possibilities and public utility development.

CAMPAIGN FOR BETTER PACKING AND MARKING OF EXPRESS SHIPMENTS.—A nation-wide campaign to put an end to the waste attributed to inadequate packing, wrapping and marking of express shipments has been inaugurated by the American Railway Express Company, which is handling the express business on all the railroads of the country. It is expected that by remedying this evil it will be possible to bring about a marked improvement of the express service throughout the country. A "better service campaign" is to start on Feb. 10. No new packing or marking rules have been adopted for the campaign, but express drivers and receiving clerks in the larger cities, as well as express agents in the smaller points, have been instructed hereafter to request that the rules already in force be more carefully observed. The better-packing, better-marking drive is designed to be of as much interest and value to the shipper as to the carrier, for it is a matter of dollars and cents to both. By removing the causes which are responsible for many shipments being lost or damaged in transit it is hoped that a great reduction in the number of express claims filed will be accomplished. Claims are an incubus to the transportation business and bring much dissatisfaction to the shipper, the consignee and the carrier, with no gain to any of them.

FOREIGN TRADE CONVENTION IN APRIL.—The Sixth National Foreign Trade Convention will be held in Chicago on April 24, 25 and 26. It is expected that the first session of the convention will discuss broadly the need of maintaining foreign trade from the point of view of increased industrial productive capacity and of increased capacity for investment both abroad and at home, dealing with the importance of maintaining full and adequately paid employment of labor and also handling the subject from the point of view of our national fiscal policy. One general session will be devoted wholly to the subject of the American merchant marine, with discussion of American shipbuilding, of the operation of ships from the point of view of the provision of cargo, the establishment of trade routes and organization of concentration centers abroad for return cargoes; the operation of the American navigation system in comparison with the navigation systems of other maritime nations, and finally including a discussion of American national maritime policy. Another general session will be devoted to the broad consideration of general foreign trade problems. Intensive consideration of the means and methods that may best be employed to insure the imperative expansion of foreign trade will be considered and there will probably be a group session devoted to advertising for foreign trade and especially to the foreign advertising mediums and the methods of their use. There will also be group sessions dealing with the work and problems of the foreign trade merchant and with direct selling methods for exporting manufacturers.

ENGLISH MANUFACTURERS CONSOLIDATE.—A consolidation by which the facilities of Dick, Kerr & Company, Ltd., for the manufacture of electrical apparatus will be greatly extended has just been announced from London. This is through the organization of the English Electric Company, Ltd., with an authorized capital stock of $25,000,000 to acquire the controlling interests in the Coventry Ordnance Works, Ltd., the Phoenix Dynamo Manufacturing Company, Ltd., and Dick, Kerr & Company, Ltd. Of the constituent companies the Coventry Ordnance Works have shops at Coventry suitable for the construction of electrical machinery and accessories, with subsidiary works at Scotstoun on the Clyde. The main works of Dick, Kerr & Company are at Preston, with subsidiary works at Kilmarnock, Scotland. At Preston the works are especially equipped for the production of steam turbines and the heavier classes of electrical machinery with car works and lamp works adjoining, while the Kilmarnock works specialize on light railway material. The Phoenix Dynamo Works are at Bradford and are laid out for the production of smaller classes of electrical machinery, ranging from stationary motors of 500 hp. to the smallest type used for fans and loom driving. The Williams & Robinson works are at Rugby and equipped for the production of steam turbines, Diesel engines and similar equipment. The several properties have a total area of over 172 acres and an area of floor space of nearly 3,000,000 sq.ft. Recent announcements to stockholders say: "Your directors believe that the future success of electrical companies will depend upon their capacity to undertake and carry out large schemes such as the electrification of railways, the construction of large central power stations and the development of hydroelectric installations," and "this amalgamation of interests constitutes a complete organization capable of undertaking comprehensive contracts of the greatest magnitude." The managing director of the new organization is Sir Charles Ellis.

THE SQUARE D COMPANY, Detroit, manufacturer of switches, recently opened a new office at 149 Broadway, New York City. J. A. Jaques, district sales manager, who has been placed in charge of the office, was formerly connected with the Pittsburgh office of the company. At one time he was a member of the sales organization of the Western Electric Company. Mr. Jaques will represent Square D interests throughout the metropolitan district.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, Md., maker of portable electric drills and electric air compressors, announces that D. G. Caywood, formerly sales manager of the Brunner Manufacturing Company, Utica, N. Y., has become special representative to carry on the field work in the distribution of the Black & Decker specialized products. Mr. Caywood was among the first to see the wide possibilities of the electric air compressor and has been actively engaged in this

D. G. CAYWOOD

field for the last fifteen years. Graham W. Brogan, advertising manager of the Duesenberg Motors Corporation, has also joined the Black & Decker organization to handle its publicity. Both Mr. Caywood and Mr. Brogan will have their headquarters at the Baltimore factory.

THE ELECTRIC FURNACE COMPANY of Alliance, Ohio, has closed a contract with the Standard Roller Bearing Company, Philadelphia, Pa., for a 190-kw. continuous, automatic heat-treating equipment. The set consists of one 150-kw. electric furnace for hardening and one 40-kw. electrically heated oil-drawing bath. In addition to this an oil-quench bath is to be installed between the furnace and the electrically heated oil-drawing bath. The material which is to be treated in these furnaces consists of alloy steel balls and ball races.

L. S. DEVOS has recently been appointed general manager of the machinery department, American Machinery Syndicate, New York, N. Y., an association of manufacturers for export trade. From October, 1917, to the latter part of December, 1918, Mr. Devos was chief of the inspection department of the United States Air Service, with offices in Paris, France, during which time he came in touch with the factories and dealers of the mechanical field in France and Switzerland. Previous to his entry into the army Mr. Devos was the New York representative of the Selson Engineering Company, Ltd. The syndicate, it is understood, is about to open an electrical department.

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THE TERMINAL MARKET BATTERY COMPANY, 761-763 Central Avenue, Los Angeles, Cal., headed by Roderick N. Harvey, has been organized to manufacture batteries.

THE GENERAL ELECTRIC COMPANY is reported as having purchased at a forced sale the Higbee Glass Company, Bridgeville, Pa., for $90,000.

THE BRYAN-MARSH ELECTRIC WORKS has nearly completed improvements to its plant, at Central Falls, R. I., costing around $60,000.

THE LITTLE ROCK (ARK.) BATTERY COMPANY, it is understood, will increase its capital, and install addtional equipment for battery manufacture.

HERBERT W. GLEDHILL has been promoted from sales engineer to district manager of the Philadelphia office of the Shepard Crane & Hoist Company.

IRA J. FRANCIS, who has been the manager of John A. Roebling's Sons Company, of California, since the middle of 1917, has been elected president of the company to succeed the late Mr. Mooney.

THE DOMESTIC ENGINEERING COMPANY, Dayton, Ohio, is reported as having acquired part of the plant of the Dayton Metal Products Company, which will be used for the manufacture of foreign-lighting outfits.

E. A. BULLIS has returned to San Francisco to resume his former connection with the Federal Sign System (Electric). For the past year he has been in charge of "Dim-A-Lite" sales for the Wirt Company of Philadelphia.

F. S. MILLS, Pacific Coast representative of the National X-Ray Reflector Company, has added Oregon and Washington to his territory. His headquarters are now at San Francisco, where he expects very soon to establish a laboratory.

THE BUSCH-SULZER BROTHERS-DIESEL ENGINE COMPANY, St. Louis, announces that the end of the war enables it to resume work on its stationary Diesel engines and light-weight and commercial marine Diesel engines, which was suspended for several years to devote the entire facilities of the plant to Diesel propelling engines for United States submarines.

THE ELECTRICAL MANUFACTURING COMPANY, Cleveland, Ohio, has purchased from the receivers of the Richard Auto Manufacturing Company nearly five acres of land, with two manufacturing buildings, at the foot of East Seventy-ninth Street, near Broadway and Harvard Avenue, which will be used for its own manufacturing plant. F. T. Kover is the president of the Electrical Manufacturing Company.

H. W. JEANNIN, electrical engineer, announces that he has opened a factory at 110 Eleventh Street, Toledo, Ohio, for the purpose of manufacturing a complete line of single-phase alternating-current motors of the repulsion type. In this new line the rotor will have two windings, one a high-resistance starting winding and the other a low-resistance running winding, the operation being automatic upon closing the line switch.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., has made a number of additions to its line of safety-service, externally operated knife switches. The additions include single-throw and double-throw no-fuse switches in 250, 500 and 600 volts; double-throw fusible switches, 400-amp. to 600-amp. switches in various poles, "Straight Thru" motor-starting switches with under-voltage release coil, and motor-reversing switches.

THE GENERAL ELECTRIC COMPANY has issued to customers the following notice regarding the transfer of accounts from Schenectady to New York: "Beginning Feb. 1, 1919, all records of accounts of customers served by our New York office and its local offices at Buffalo, N. Y., Elmira, N. Y., Erie, Pa., Hartford, Conn., New Haven, Conn., Niagara Falls, N. Y., Rochester, N. Y., Schenectady, N. Y., and Syracuse, N. Y. (formerly kept at Schenectady), will be centralized at the New York office, Equitable Building, 120 Broadway, New York City. All bills for such customers will be rendered from 120 Broadway, New York City. Effective immediately, all payments of bills and open accounts should be sent to the General Electric Company, Equitable Building, 120 Broadway, New York City and all correspondence regarding claims, bills or statements of accounts, etc., should be addressed to the district auditor at that office. This change is for accounting and collection purposes only, and does not apply to inquiries for prices, orders, shipments, etc. Correspondence relating to these should be addressed as heretofore to the nearest sales office. This change affects domestic business only, not foreign business."

THE ROME WIRE COMPANY, Rome, N. Y., writes that it proposes to push the sale of heater cord harder than ever before. The cord is on the approved list of the Underwriters' Laboratories.

THOMAS AND BETTS COMPANY, 63 Vesey Street, New York City, selling agents for The Thomas & Betts Company, is placing on the market a new line of cut-out boxes, split elbows, couplings and T's; pipe straps, watertight connectors and offset fixture studs. The United States Shipping Board, it is reported, purchased large quantities of the watertight connectors.

Trade Publications

PLUG.—A leaflet descriptive of the "T. & W." universal plug has been issued by H. A. Hibbard of Denver, its general sales agent.

FANS.—A booklet descriptive of its "Hurricane" fans has been prepared by the Eck Dynamo & Motor Company, Belleville, N. J.

LAMP GUARDS.—Harvey Hubbell, Inc., of Bridgeport, Conn., is distributing a new circular devoted to Hubbell lamp guards of different styles.

FANS.—Two booklets about its desk, ceiling and ventilating fans have been distributed by the Dayton Fan & Motor Company of Dayton, Ohio.

FANS.—A leaflet having for its subject the fans made by the Fidelity Electric Company of Lancaster, Pa., has been issued by that company.

PULL-SOCKET ATTACHMENTS.—A folder on the Hubbell attachment for pull sockets has been prepared by Harvey Hubbell, Inc., Bridgeport, Conn.

SUPPLY-PART BULLETIN.—The General Electric Company of Schenectady, N. Y., is distributing an index to the various supply-part bulletins it has issued.

LOOM FASTENER.—A leaflet that is descriptive of the K-B loom fastener has been issued by the K-B Manufacturing Company of 287 Second Street, San Francisco, Cal., which makes this device.

FITTINGS.—In a new folder prepared by the Efficiency Electric Company, East Palestine, Ohio, an adjustable insulator support, two types of conduit hangers and a bus cable fitting are described and illustrated.

BELTED DIRECT-CURRENT GENERATORS.—In bulletin No. 40,021 the General Electric Company, Schenectady, N. Y., has given descriptions, illustrations and dimensions of its type LF belted direct-current generators.

WIRING DEVICES.—The M. B. Austin Company, 700 West Jackson Boulevard, Chicago, has distributed a folder that sets forth the savings in material and labor made possible by the use of "Wiremold" and "Wiremold" fittings.

FANS.—Describing its various models of electric fans, domestic catalog No. 1124 of thirty-six pages has been prepared by the Robbins & Myers Company of Springfield, Ohio. A special export catalog No. 1125 may also be procured.

INDIRECT LIGHTING FOR OFFICES.—The National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, has prepared an interesting booklet which illustrates and sets forth the advantages of the "X-Ray" indirect-lighting system for offices.

FANS.—The Emerson Electric Manufacturing Company of St. Louis, Mo., has issued bulletin No. 4008, which catalogs the Emerson line of fans for 1919 and replaces bulletin No. 4005. The company has also prepared bulletin No. 4009, which supersedes bulletin No. 4006 and is about the Northwind electric fans.

ENGINE-DRIVEN CONTINUOUS-CURRENT GENERATORS, COMMUTATING-POLE TYPE.—Form LD, 125-volt and 250-volt, two-wire, and form LoS, 125-volt and 250-volt, three-wire, commutating-pole engine-type generators manufactured by the General Electric Company of Schenectady, N. Y., have been made the subject of a recently issued bulletin, No. 40,020.

FUSES.—"Keep the Wheels Turning" is the subject of a circular being distributed by the Multiple Fuse Company of 450 Fourth Avenue, New York City. The Atlas four-in-one multiple fuse is featured in this circular, which indicates the important place occupied by fuses in industrial plants.

HIGH-TENSION OUTDOOR SUBSTATIONS.—Bulletin No. 47,706, of fifty pages in loose-leaf form, has been issued by the General Electric Company of Schenectady, N. Y. The subject is weatherproof high-tension outdoor substations. Switching, protective and transformer equipment as well as much other apparatus for outdoor substations are dealt with in this well-illustrated bulletin.

DRAWING TABLES. — The Economy Drawing Table & Manufacturing Company of Adrian, Mich., is distributing its catalog No. 17, in which tables especially fitted for engineers, contractors, architects and others are shown and described. Filing cases and cabinets adapted to receive blueprints also receive attention in this thirty-two-page booklet, which is accompanied by a price list effective Jan. 15, 1919.

STEAM-TURBINE HISTORY. — The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has issued circular 1591, which is called "A Historical Review of Steam Progress." Written by Francis Hodgkinson, who has a broad engineering and commercial knowledge of steam turbines, this booklet is intended to be a handbook on steam-turbine progress. The history of turbine engineering is gone into, early machines installed in America are illustrated, and from 1899 to 1917 each year's developments and improvements are recorded. The publication is illustrated with views of the different types of impulse and reaction turbines, and the construction of blading, valve chamber, governor, throttle valve, coupling and oil cooler is shown in detail.

New Incorporations

THE LOWNDESVILLE (S. C.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $5,000 by M. P. McCalla, J. W. McCalla, D. L. Barnes, R. T. Broadwell and others.

THE PHENIX LIGHTING FIXTURE COMPANY of New York, N. Y., has been incorporated with a capital stock of $5,000 by M. F. Schechter, M. Friedman and R. J. Wittstein, 916 Stebbins Street, Bronx.

THE WESTRICK COMPANY of Ridgewood, N. J., has been incorporated by J. S. Rue, M. V. Rice and M. G. Zimmerman, all of Ridgewood. The company is capitalized at $15,000 and proposes to deal in electrical goods.

THE BATTERY SERVICE CORPORATION has been incorporated under the laws of the State of Delaware with a capital stock of $100,000. The incorporators are M. M. Lucey, J. H. Weaver and G. S. Diddison of Wilmington, Del.

THE P. M. DREYFUSS COMPANY of New York, N. Y., has been incorporated with a capital stock of $10,000 to deal in electrical supplies. The incorporators are M. E. Sobel, F. J. and P. M. Dreyfuss, 150 Chambers Street, New York City.

THE ELECTRIC VAPOR HEATER COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000. The incorporators are C. L. Rimlinger, M. M. Clancy and P. B. Drew of Wilmington, Del.

THE CHICAGO TELEPHONE SUPPLY COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $150,000. The incorporators are C. L. Rimlinger, M. M. Clancy and P. B. Drew of Wilmington, Del.

THE PAGE MANUFACTURING COMPANY of New York, N. Y., has been chartered by L. Goldburg, S. Schnaboik and J. Stoitch, 158 Madison Street. The company is capitalized at $6,000 and proposes to deal in electrical goods and hardware specialties.

THE CAPE MAY COURT HOUSE (N. J.) LIGHT & WATER COMPANY has been incorporated with a capital stock of $50,000 to distribute and sell water. The incorporators are James H. Birch, Jr., of Burlington; Mary E. Boyd of Philadelphia Pa., and Frank Maris of Lansdowne, Pa.

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New England States

AUGUSTA, ME.—Application has been made to the State Legislature for an appropriation for construction of power house and other purposes at the Maine School for Feeble-Minded.

DANA, MASS.—The Town Council has awarded a contract to the Gardner (Mass.) Electric Light Company to furnish elecricity for operating the municipal lighting system for a period of five years.

NORTHBORO, MASS.—The Marlboro (Mass.) Electric Light Company is installing two transformers in the Whittaker Bacon Mill to supply electricity for the different buildings of the company.

PROVIDENCE, R. I.—Plans have been prepared by the Revere Rubber Company for the erection of a power plant, 50 ft. by 90 ft., at its works at Valley and Hemlock Streets.

BRISTOL, CONN.—The Bristol & Plainville Tramway Company expects to purchase from 300 to 500 meters (General Electric Company) and 15,000 incandescent lamps, General Electric and Westinghouse Companies' make. G. E. Cockings is manager.

WATERBURY, CONN.—The Connecticut Light & Power Company has petitioned the State Legislature for permission to divert the waters of the Housatonic River at Ten-Mile River and at Bull's Bridge, and also for authority to build a dam at Little York instead of Southville, and for construction of power houses and conduits.

Middle Atlantic States

BATH, N. Y.—The board of directors of the new State Soldiers' and Sailors' Home has petitioned the State Legislature for an appropriation of $24,000 for installation of an electric system, including an alternating-current generator, engine, switchboard, voltage regulator, etc., and $89,200 for heating system, consisting of four boilers, underground heating line, hot-water plant and underground connections.

BINGHAMTON, N. Y.—Application has been made to the State Hospital Commission of Albany to the State Legislature for an appropriation of $15,000 for laundry equipment and $30,000 for an ash-conveyor for the Binghamton State Hospital.

BROOKLYN, N. Y.—Contract has been awarded by the Navy Department, Washington, D. C., for the construction of the proposed extensions to power plant "A" at the local navy yard to the Franco-American Construction Company, 150 Nassau Street, New York City.

BUFFALO, N. Y.—Bids will be received by W. W. Wotherspoon, superintendent of public works, Capitol, Albany, until Feb. 18, under terminal contract No. 107, for installing electric wiring, lighting, power and battery charging equipment for the canal terminal at Erie Basin, Buffalo. Plans may be seen and other information obtained at the office of the superintendent of public works at Albany, at the office of the assistant superintendent of public works for the Middle Division at Syracuse, at the office of the assistant superintendent of public works for the Western Division at Rochester, and at the canal office, Spaulding's Exchange, Buffalo.

COHOES, N. Y.—Contract has been awarded by the city of Cohoes to the Alpha Electric Company, 124 Hudson Street, Albany, for the installation of a new pumping unit in the city pumping station on North Mohawk Street, at $5,652.

MALONE, N. Y.—Bids will be received by Capt. John A. Coffey, secretary of State Board of Armory Commissioners, 158 State Street, Albany, N. Y., until Feb. 14, for construction of addition to State Armory, including heating, sanitary and electric work. Drawings and specifications may be consulted at the above office, at the New York office of the Department of Architecture, 1715 Tribune Building, and at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is state architect.

NEW YORK, N. Y.—Plans have been prepared by Lloyd I. Phyfe, 670 Anderson Avenue, for the erection of an addition, 25 ft. by 39 ft. at the works of the De Forest Radio & Telephone & Telegraph Company.

ROCHESTER, N. Y.—The State Hospital Commission has petitioned the State Legislature for an appropriation of $70,000 to build an addition to power plant at the Rochester State Hospital; also for buildings, one for housing 250 patients to cost $250,000; one for 200 patients, $160,000; 100 patients, $120,000, and for twelve cottages, $70,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

ANNANDALE, N. J.—Preparations are being made by the Borough Council for the installation of a new electric street lighting system. Energy for operating the system, it is understood, will be secured from the Hunterdon Electric Light & Power Company of High Bridge.

JERSEY CITY, N. J.—In the annual budget for 1919 an appropriation of $226,500 has been requisitioned by the Board of Freeholders for the maintenance, operation, etc., of the county power plant.

KEYPORT, N. J.—The Monmouth Lighting Company is building an addition to its boiler plant, in which it is proposed to install a 556-hp. boiler with auxiliary equipment.

NEWARK, N. J.—Bids, it is understood, will be received by the Board of Education about April 1 for construction of school building at Sussex Avenue and First Street, consisting of laboratories, power plant, etc., to cost about $500,000. J. H. and W. C. Ely. Fireman's Building, are architects.

ALTOONA, PA.—Notice has been filed with the Public Service Commission by the Penn Central Light & Power Company of an issue of $70,000 in bonds. A portion of the proceeds, it is understood, will be used for extensions and improvements.

CHESTER, PA.—Alterations and improvements will be made to the local exchange building of the Bell Telephone Company, to cost about $10,000.

HAWLEY, PA.—Plans are under consideration for the erection of a hydroelectric power plant at the Welwood Silk Mills, work on which, it is understood, will begin early in the spring. W. F. Suydam is manager.

HONESDALE, PA.—Arrangements, it is understood, are being made by the Honesdale Consolidated Heat, Light & Power Company for the erection of a new power plant, to cost about $50,000, to replace the plant recently destroyed by fire.

PHILADELPHIA, PA. — Arrangements are being made by the Department of Transit for the completion of the Frankford elevated railway system between Callowhill and Arch Streets, at which point a connection will be made with the Market Street subway system. The cost is estimated at $3,500,000.

PHILADELPHIA, PA.—Plans have been completed by the Susquehanna Collieries Company for equipping its anthracite operations in the Mount Carmel and Shamokin coal field for electrical operation. It is proposed to erect one central plant, to cost about $2,000,000, at Green Ridge, near the Pennsylvania Colliery, with high-tension transmission lines to the Richards, Pennsylvania, Scott, Hickory Ridge, Luke Fidler and Cameron collieries. All steam-driven machinery now used in slopes, planes and breakers will be replaced with electrically operated equipment and the steam plants closed down. Wires will also be strung in the mines for underground operations, including drilling equipment, electric locomotives and lighting.

STEELTON, PA.—The Bethlehem Steel Company, it is understood, will utilize the buildings formerly employed as its No. 2 forge shops, recently closed down, for the electrical department at its works, including warehouse and other buildings.

WILKES-BARRE, PA.—The No. 5 coal breaker at the properties of the Delaware & Hudson Company at Larksville, near Wilkes-Barre, was recently destroyed by fire. The loss, including machinery and equipment, is estimated at $300,000.

WILKES-BARRE, PA. — Improvements involving an expenditure of $300,000 are contemplated by the Wilkes-Barre Company, which will include the installation of new generating equipment. Additional boilers, stacks and condensing equipment are necessary at the North River Street station. A new steam-heating line from Northampton to Ross Street on Franklin street is also planned. It is also proposed to enlarge the gas plant on Water Street.

GEORGETOWN, D. C.—Contract has been awarded by the Fussell Young Ice Cream Company, Twelfth and V Streets, Washington, for the construction of a new power plant at Wisconsin and W Streets Georgetown, to cost about $25,000, to Frank L. Wagner, 1413 P Street, N. W., Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., as follows: Puget Sound, Wash., until March 11, under Schedule 3724—for 28 annunciators. Until Feb. 10, f.o.b., Schedule 7735½—one motor-driven miller. Until Feb. 14, South Charleston, W. Va., Schedule 7749½—one basket for accumulator. Norfolk, Va., Schedule 7751½—three switchboards complete with spare parts. Until Feb. 11, Brooklyn, N. Y., Schedule 7755½—25,000 ft. of silicon bronze wire. Applications for proposal blanks should designate the schedule desired by number.

WASHINGTON, D. C.—The erection of an electrical shop at the local ordnance works is under consideration by the Ordnance Department.

North Central States

BATTLE CREEK, MICH.—The United Steel & Wire Company is planning to double the output of its plant and will erect several new buildings, including an additional building 100 by 200 ft.; dipping plant, 30 ft. by 40 ft.; extension to warehouse, 40 ft. by 100 ft., and a shipping shed, 20 ft. by 80 ft.

LANSING, MICH.—Bonds to the amount of $25,000 have been authorized for the municipal lighting system.

ST. JOSEPH, MICH.—Plans are under consideration by the Auto Specialties Manufacturing Company for the erection of a new machine shop, 80 ft. by 400 ft., one story.

LORAIN, OHIO.—The Utilities Construction Company is reported to have petitioned for permission to issue $1,250,000 in bonds, the proceeds to be used for construction of power plant.

CLEVELAND, OHIO—Two factory buildings and a five-acre site formerly occupied by the plant of the Richard Auto Manufacturing Company have been purchased by the Electrical Manufacturing Company.

CLEVELAND, OHIO—The Glass Coating Company, which recently awarded contract for a new factory, is in the market for three electric traveling cranes. The company is also placing orders for bending rolls and other plate-working machinery.

MAXWELL, IND.—A company has been organized for the purpose of installing an electric system in Maxwell and erecting transmission lines to Greenburg to secure electricity from the municipal electric plant there to operate the proposed local system.

WAUKEGAN, ILL.—Plans nearing completion for the proposed plant of the H. W. Johns-Manville Company of New York, N. Y., and Milwaukee, Wis., to be erected in Waukegan, will involve an expenditure of about $3,000,000. The plant will supplant the works on the outskirts of Milwaukee, which are to be abandoned. Charles R. Manville of Milwaukee is vice-president and general manager of the Milwaukee works.

GREEN BAY, WIS.—Plans are being prepared by the Conradson Machine Tool Company for the erection of its proposed new turret lathe and machine-tool appliance plant in the spring, for which a site of 12 acres has been acquired in Green Bay. A machine shop, experimental shop, drafting room, office and warehouse and shipping building are included in the proposed plans. C. A. Conradson is chief engineer and manager.

JANESVILLE, WIS.—At a special joint meeting of the Common Council, the Board of Education and the Janesville Chamber of Commerce it was voted to erect a new high school building, with manual training and domestic science departments, at a cost not to exceed $500,000.

LA CROSSE, WIS.—The Ennison Ice Cream Company, 118 Main Street, is contemplating the construction of a factory and warehouse, to cost about $20,000. The plant will be equipped with electrically driven machinery throughout.

SHEBOYGAN, WIS.—The Northern Furniture Company has engaged W. C. Weeks, architect, to prepare plans for a six-story addition, 50 ft. by 145 ft., to its plant at South Water and North Jersey Streets. Much new woodworking machinery and two electric elevators will be installed.

HAWLEY, MINN.—The construction of a new power plant at the school in District No. 4, to cost about $15,000, is under consideration by the board of education.

CLINTON, IOWA.—The City Council has entered into a new contract with the Clinton Gas & Electric Company under which the company is to replace the old arc

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lamps now in use, of which there are 211, with type C lamps, and to install 20 additional, which with the 72 now in use will make a total of 303 lamps. The company will also furnish an all-night service throughout the city to supplant the moonlight schedule. The cost of making the change is estimated at from $6,000 to $8,000, and the purchase of the lamps $3,200 additional. Thomas Crawford is general manager.

INDEPENDENCE, MO.—A loan of $50,000 has been voted by the citizens of Independence to the Kansas City (Mo.) Railways Company for the extension of the Independence line from its north terminus at Liberty Street to Sugar Creek.

MACON, MO.—At an election held Jan. 28 the proposal to issue $45,000 in bonds for the installation of a 450-kva. generating unit with condenser equipment at the municipal electric plant was carried. Frank L. Wilcox, Syndicate Trust Building, St. Louis, Mo., is engineer. W. H. Martin is city clerk.

ST. LOUIS, MO.—The Southwestern Bell Telephone Company, Fourth and Locust Streets, and the Kinloch Telephone Company, Tenth and Locust Streets, it is reported, will soon ask for bids for removing 4 miles of overhead telephone and telegraph wires and placing same underground. The cost is estimated at about $100,000.

SIKESTON, MO.—The City Council contemplates calling an election in April to vote on the proposal to issue bonds for the construction of a municipal electric light plant.

COLUMBIA, S. D.—Bonds to the amount of $15,000 have been authorized for the installation of a municipal electric light plant in Columbia.

PLAINVIEW, NEB.—The City Council has decided to engage an engineer to make investigations and prepare an estimate of the cost of enlarging the municipal electric light plant and installing a heating plant, using exhaust steam, for heating the business section of the town, including public school buildings, hospital and public library.

WYMORE, NEB.—The City Council has entered into a contract with the Nebraska Gas & Electric Company to furnish electricity for a period of five years.

Southern States

CHARLOTTE, N. C.—The Southern Power Company of Charlotte, it is reported, is planning another large power development on the Catawba River. According to reports two large dams and power plant will be erected, one at Rhodhiss and the other at Horseford Shoals, 2 miles below Rhodhiss, both in Caldwell County.

ROUGEMONT, N. C.—W. A. Carver is contemplating a water-power development and would like to receive prices on a 50-hp. or 60-hp. generator, also on motors from 1 hp. to 25 hp. and on wire and insulators for 2 miles of electric transmission line.

SUMTER, S. C.—The City Council is considering establishing a municipal electric plant or making arrangements with the Hydro-Electric Company for a new lighting system. Bonds to the amount of $350,000 have been voted for the project.

MIAMI, FLA.—The Miami Ocean View Company contemplates improvements to Star Island, including electric lighting, etc.

MIAMI, FLA.—Contracts will soon be awarded for the construction of a refrigerating plant and storage building on Sixth Street and Avenue B for Armour & Company, Chicago, Ill., to cost about $100,000. J. J. Hamilton, 208 South La Salle Street, Chicago, Ill., is chief architect for the company.

BENTON, ARK. — Arrangements have been made to take over the local electric light plant to be operated in connection with the waterworks plant. It is proposed to purchase a 125-kw. generator and engine to be installed at water plant and to make extensions and repairs to the distribution system. G. A. Smith is superintendent of waterworks.

AUGUSTA, ARK.—The city has recently purchased a 50-kva. General Electric generator directly connected to a Sturdevant engine, with switchboard equipment for same, for the municipal electric light plant.

KNOXVILLE, TENN.—Plans are being prepared by Miller, Fullenwider & Dowling, 6 Michigan Avenue, Chicago, Ill., for the erection of buildings for the University of Tennessee, to include administration buildings; basement finished for mechanical equipment; armory and gymnasium, to cost about $150,000; also erection of agricultural building on the University farm, near Knoxville, to cost about $250,000. The total cost of the buildings is estimated at about $750,000. About $250,000 will be expended to establish and equip an agricultural station in middle Tennessee.

CEMENT, OKLA.—The City Council is considering calling an election to vote on the proposal to issue $50,000 in bonds for electric lighting, waterworks and sewers.

SULPHUR, OKLA.—The plant of the Sulphur Ice, Light & Power Company, it is reported, was recently destroyed by fire.

TULSA, OKLA.—The Sand Springs Railway Company of Tulsa is planning to erect a new station building in Tulsa during the coming year.

DALLAS, TEX.—The Tenth Regiment of Infantry of Texas National Guard is considering the erection of an armory. The building will be 200 ft. by 300 ft. and will cost about $200,000 M. O. C. Hull is captain.

DALLAS, TEX.—The Dallas Railway Company has been granted extension of time to Dec. 1, 1918, by the City Commission in which to begin the construction of its street-railway system and other improvements to cost about $1,200,000.

DALLAS, TEX.—The Southern Traction Company, it is reported, will take steps soon to carry out its deferred project of extending its interurban electric railway from Waco south to San Antonio, via Austin, a distance of about 185 miles. The plan includes the construction of an electric power station at Austin.

HIGHBANK, TEX.—The R. C. Peacock estate, it is reported, will construct a building to replace structure containing store, lighting plant and warehouse, which was damaged by fire, causing a loss of about $35,000.

GOLIAD, TEX.—The local electric light plant of the Goliad Supply Company was recently destroyed by fire.

RANGER, TEX. — Negotiations have been completed by the Southwestern Telegraph & Telephone Company for the purchase of the local telephone exchange and system. Extensive improvements it is understood, will be made to the system.

Pacific and Mountain States

BAKERSFIELD, CAL.—Surveys are being made by the Southern California Edison Company of Los Angeles for a hydroelectric power plant in the Kern River Valley, to cost about $10,000,000. W. Dennis of Los Angeles is chief engineer.

MODESTO, CAL.—Plans and estimates of cost on the Don Pedro dam project have been submitted to the board of directors of the Modesto and Turlock irrigation districts by A. J. Wiley, consulting engineer of Boise, Idaho. The plans include the construction of a concrete arch dam 279 ft. high, 177 ft. wide at base and 16 ft. wide at top, 4 miles above the La Grande dam, to cost $2,787,000; railway from Rosasaco to dam, 8 miles long, $93,000; construction of hydroelectric plant to develop 12,000 kw., below dam, $609,000. The Modesto Irrigation District contemplates an issue of $1,000,000 in bonds, and the Turlock Irrigation District one of $2,000,000.

SAN JOSE, CAL.—The Salsini Packing Company is considering the installation of a complete new unit at its packing plant to double the present output. The cost is estimated at about $100,000 and will include machinery, equipment, electric motors, etc.

SUPERIOR, ARIZ.—A company has been organized, to be known as the Superior Electric Power Company, to construct and operate an electric plant in Superior. The company is capitalized at $100,000. James O'Connell of Superior is president.

GREAT FALLS, MONT.—Bonds to the amount of $250,000 have been voted by the state for the erection of a grain elevator in Great Falls.

DENVER, COL.—Bids will soon be received by the city of Denver for the erection of a garage and warehouse for the Department of Parks at Larimer and Thirteenth Streets, to cost between $700,000 and $800,000. J. B. Hunter is city engineer.

JULESBURG, COL.—Bids will be received by the city of Julesburg until Feb. 26 for construction of a municipal light and power plant, to include power house, one 250-kva. generator directly connected to steam engine, two 250-hp. water-tube boilers, auxiliary steam equipment, concrete or brick chimney, pole-line material, centrifugal pump, etc. Plans and specifications may be obtained from the Henningson Engineering Company of Omaha, Neb., upon deposit of $10. G. S. Kinsman is city clerk.

Canada

EDMONTON, ALTA.—Extensions to the local telephone system, to cost about $262,000, are under consideration. J. E. Lowry is superintendent of telephones.

EDMONTON, ALTA. — Bids will be received by A. G. MacKay, Minister of Municipal Affairs, Parliament Buildings, Edmonton, until Feb. 24 for the construction of administration building service, building, infirmary, three pavilions, power house and tunnels, near Keith Station, Alta. Plans and specifications can be seen and form of tender obtained at the office of the Minister of Municipal Affairs, Parliament Buildings, Edmonton, and the office of the Department of Soldiers' Civil Re-establishment, Engineering Branch, Beveridge Building, Calgary.

MARYVILLE, N. B. — The Nashwaak Pulp & Paper Company is contemplating the construction of a large dam on the Nashwaak River to supply power to operate its new mill.

MONCTON, N. B.—The New Brunswick Water Power Commission is planning to install a record station on the Sevogle River.

NEWCASTLE, N. B.—The construction of a hydroelectric plant to serve the town of Newcastle is under consideration. The cost is estimated at $150,000.

ANTIGONISHE, N. S.—Plans are under consideration by the Town Council for rebuilding the electric light plant, at a cost of about $40,000.

HALIFAX, N. S.—Contract has been awarded by the Department of Public Works, Ottawa, for a power house and laundry for the military hospital at Camp Hill to Rhodes, Curry Company, Ltd., of Amherst, at $210,565.

FORT ERIE, ONT.—Announcement has been made by Sir Adam Beck of the Ontario Hydro-Electric Commission that work will be begun within the next few months on the hydro-radial electric railway to connect Fort Erie with Niagara Falls and Port Colborne. Another project that will be undertaken soon by the Dominion government is the construction of an electric railway between Fort Erie and Hamilton.

LONDON, ONT.—The London Street Railway Company expects to purchase 2 miles of No. 00 trolley wire during 1919.

NIAGARA FALLS, ONT.—The installation of an electrically driven pump for fire protection is under consideration by the Board of Water Commissioners.

PETERBORO, ONT.—The City Council is considering asking the Ontario Hydro-Electric Commission to make further extensions to the street-railway system.

GRAVELBOURG, SASK.—The installation of an electric light plant, to cost about $50,000, in Gravelbourg, is under consideration. S. Chevrier is reported interested.

ROCANVILLE, SASK.—The Town Council is considering the installation of an electric lighting system.

SASKATOON, SASK.—The city Council is considering extensions to the municipal electric street-railway system.

SASKATOON, SASK.—Improvements are contemplated to the municipal electric light plant, to cost about $25,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 19, under Circular 1255, for wire and cable, monotype metal, pumps, steel tapes, condulets, electrical switches, cable grips, etc. Further information may be obtained at the above office.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Feb. 15, for steel, cable wire, brass tubing, sheet lead, copper wire, ammeters, annunciators, batteries, bells, conduit and fittings, cut-outs, lamp guards, insulators, reflectors, slate, rubber tape, voltmeters, etc. Blanks and further information relating to this circular (1253) may be obtained at the above office or at the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

TAYABAS, P. I.—The Tayabas Light & Power Company, recently organized, has increased its capital stock to $150,000. Of this amount there is $100,000 for sale, to be utilized for the construction of a new hydroelectric power plant, which will supply electricity to seven towns, aggregating about 140,000 inhabitants.

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Record of Electrical Patents

Notes on United States Patents

(Issued Nov. 26, 1918)

1,286,040. CONTROL SYSTEM; Walter O. Lum, Wilkinsburg, Pa. App. filed Oct. 6, 1915. To prevent automatically electric railway vehicle motors from attaining a dangerously high speed.

(Issued Dec. 24, 1918)

1,288,460. LIGHTNING ARRESTER; Frank W. Adsti, Chicago, Ill. App. filed Dec. 4, 1916. Means provided for having the gap in the arrester of considerable length.

1,288,474. ELECTRICAL BRUSH CONNECTION AND METHOD OF MAKING THE SAME; Oliver E. Becker, Oak Park, Ill. App. filed April 13, 1918. The leads or pigtails to brushes are made of interwoven or interlaced wires.

1,288,500. SELECTIVE TIME-LIMIT CONTROLLING DEVICE FOR ELECTRIC SWITCHES; George A. Burnham, Saugus, Mass. App. filed July 28, 1911. A prolonged period is required for the operating means to operate the switch.

1,288,501. SELECTIVE TIME-LIMIT CONTROLLING DEVICE FOR ELECTRIC SWITCHES; George A. Burnham, Saugus, Mass. App. filed July 21, 1911. Requires a prolonged period to operate the switch, depending on the value of the overload.

1,288,502. SELECTIVE TIME-LIMIT CONTROLLING DEVICE FOR ELECTRIC SWITCHES; George A. Burnham, Saugus, Mass. App. filed July 21, 1911. Modification of No. 1,288,501.

1,288,503. ELECTRIC MOTOR; George A. Burnham, Saugus, Mass. App. filed Jan. 3, 1913. For connecting a driven member with a driving member and for driving them when connection is made and permitting disconnection immediately upon cessation of the flow of current.

1,288,506. ELECTRIC HEATER; Samuel M. Carmean and James H. Carmean, Kansas City, Mo. App. filed Dec. 8, 1917. The colder air may be taken up, circulated over or discharged through a heating element to raise quickly the temperature of the room.

1,288,507. ELECTRIC HEATING SYSTEM; Samuel M. Carmean and James H. Carmean, Kansas City, Mo. App. filed March 5, 1918. Electrically controlled heating elements heat air as it is delivered from conduits into the rooms of building.

1,288,511. REELING DEVICE FOR ELECTRICAL CONDUCTORS; Albert E. Clarke, Fairport, N. Y. App. filed May 10, 1918. For obtaining a length of cord to correspond with the needs of the user.

1,288,535. ANNUNCIATOR; Vernon Durbin Brookline, Mass. App. filed June 14, 1918. Construction is simplified to reduce cost of production.

1,288,589. ELECTRICAL WELDING MECHANISM; Ralph O. Hood, Danvers, Mass. App. filed June 1, 1917. A certain definite or predetermined amount of electrical energy is supplied for the welding operation and the circuit disconnected thereafter.

1,288,626. TIME-LIMIT RELAY; David L. Lindquist and David C. Larson, Yonkers, N. Y. App. filed July 7, 1914. Is particularly adapted to protect automatically an electric motor or other apparatus from damage caused by a long-continued overload on an abnormally heavy current.

1,288,658. SWITCHING MECHANISM; Luis Nueda, Madrid, Spain. App. filed July 11, 1917. For coupling an organ or harmonium to a piano so that the former instrument will readily respond to the touch of the piano keys.

1,288,709. DUPLEX BALANCING CIRCUITS; Thomas Shaw, Hackensack, N. J. App. filed May 29, 1918. For transmission circuits in which repeaters are employed for the purpose of amplifying telephonic or other signaling currents transmitted.

1,288,722. BATTERY ELECTRODE; Walter O. Snelling, Pittsburgh, Pa. App. filed April 24, 1915. The activity of battery depolarizing materials is increased by the addition of catalytic agents to the usual electrode compositions in galvanic cells.

1,288,724. ELECTRIC SAFETY FUSE; Walter O. Snelling, Pittsburgh, Pa. App. filed March 22, 1915. Means furnished for surrounding the fuse at the instant of fusion with an inert atmosphere in which combustion cannot occur.

1,288,738. ELECTROMAGNETICALLY CONTROLLED SWITCH; Nathan H. Suren, Needham, Mass. App. filed July 22, 1910. Has a strong actuating spring adapted to be released easily, so that it may be responsive to a very light current yet it is not liable to be released by a jar.

1,288,739. INCLOSED SWITCH; Alexander K. Sutherland, New Britain, Conn. App. filed Feb. 1, 1918. Combined in a single relatively simple mechanism are means for locking the cover of the switch casing and also for locking the switch in the open-circuit position.

1,288,740. INCLOSED SWITCH; Alexander K. Sutherland, New Britain, Conn. App. filed March 29, 1918. Automatic locking means provided for keeping the cover closed when the switch is closed and for locking the switch open when the cover is open.

1,288,741. INCLOSED SWITCH; Alexander K. Sutherland, New Britain, Conn. App. filed March 29, 1918. Means furnished for automatically locking the switch in an intermediate neutral position when the switch casing is open and for automatically locking the switch casing when the switch is shifted in either direction to close the circiuts controlled thereby.

1,288,742. QUICK-BREAK SWITCH; Alexander K. Sutherland, New Britain, Conn. App. filed March 29, 1918. Means provided for securing a quick break in switches of the double-throw type.

1,288,743. TELEPHONE TRANSMITTER; Naho Tannaka, New York, N. Y. App. filed Nov. 3, 1916. Of the granular carbon type in which the vibratory part is yieldingly supported.

1,288,747. TRAFFIC SIGNAL LAMP; William O. Thiem and George E. Kremer, Minneapolis, Minn. App. filed March 17, 1914. Driver can indicate whether he intends to continue straight ahead, turn to the right or left, or stop.

1,288,750. ELECTRICAL TRANSFORMER; Chester H. Thordarson, Chicago, Ill. App. filed July 10, 1915. Certain improvements are more especially adaptable to the core type of transformers, while others are capable of adaptation to other types.

1,288,751. LONG-DISTANCE HIGH-POTENTIAL ELECTRIC POWER SYSTEM; Chester H. Thordarson, Chicago, Ill. App. filed Oct. 18, 1915. Abnormal pressures due to surges or other conditions are automatically balanced.

1,288,774. ELECTRIC WATER HEATER; Ernest C. Webster, Oakland, Cal. App. filed Jan. 23, 1917. Means provided for connecting the conducting wires to the electrodes which will prevent leakage of water around the connections.

1,288,775. ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed April 1, 1916. The cathodes are arranged in a novel way to permit an even distribution of the current in all parts of the bath.

1,288,787. ELECTRIC MOTOR SYSTEM; David C. Wright, Wickliffe-on-the-Lake, Ohio. App. filed March 27, 1916. Invention pertains to systems containing dynami braking circuits.

1,288,790. TELEPHONE ATTACHMENT; William Zimmerman, Detroit, Mich. App. filed Dec. 14, 1917. An auxiliary mouthpiece is provided for attachment to the usual telephone mouthpiece.

1,288,820. CUT-OUT SWITCH FOR ALTERNATING-CURRENT MOTOR CIRCUITS; Edward P. Braunwarth, Brooklyn, N. Y. App. filed Dec. 4, 1917. The blades are normally held in closed-circuit position against spring tension by means of a latch which is automatically released by magnetic means when the fuse is blown.

1,288,836. ENGINE-STARTING SYSTEM; William A. Chryst, Dayton, Ohio. App. filed May 25, 1914. An electric motor is used for cranking a gas engine.

1,288,837. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Jan. 16, 1915. Improved signaling means provided for systems of the central-energy type.

1,288,855. AUTOMATIC CIRCUIT BREAKER FOR ELECTRIC IRONS; Andrew J. Faber, March 9, 1917. Maintains the iron at a substantially uniform temperature and prevents overheating.

1,288,866. WELDING APPARATUS; Patrick H. Friel, Kenosha, Wis. App. filed Oct. 5, 1916. Welding may be effected while the articles or parts being united are in transit.

1,288,901. SAFETY FIRE-ALARM BOX; John Hutka, Youngstown, Ohio. App. filed April 27, 1918. The arm of a person turning in the alarm will be automatically detained until the arrival of person authorized to unlock the mechanism.

1,288,916. SEAL FOR ELECTRIC APPARATUS; Frederick C. Keyes, East Orange, N. J. App. filed July 7, 1914. For containers of vitreous material.

1,288,922. FLUSH RECEPTACLE; Charles J. Klein, Milwaukee, Wis. App. filed Jan. 18, 1915. Provides an improved closure for the face plates.

1,288,932. ELECTRIC HEATING AND LIGHTING APPARATUS; Richard G. Ledig and Robert C. Ledig, Philadelphia, Pa. App. filed Jan. 18, 1918. May be used for therapeutic purposes, for lighting, for heating food, for drying fruit and other materials.

1,288,935. VIBRATORY CONVERTER; Oscar M. Leich, Genoa, Ill. App. filed Sept. 28, 1915. Can be supplied with alternating current and will change it into unidirectional current and then modify this unidirectional current into an alternating current of different frequency from the impressed alternating current.

1,288,938. ELECTRIC SYSTEM FOR MOTOR VEHICLES; H. Ward Leonard, Bronxville, N. Y. App. filed March 31, 1914. An improved portable light and battery is related to the electrical system and is maintained in a highly efficient condition at all times.

1,288,947. AUTOMATIC LIGHTING SYSTEM; William K. McIver, Elgin, Ill. App. filed April 26, 1916. A brilliant light is produced, regardless of the voltage impressed on the circuit or of the automobile engine speed.

1,288,951. SAFETY FUSE SWITCH; Claude L. Matthews and Walter A. Heinrich, St. Louis, Mo. App. filed April 13, 1917. Replacement of a blown fuse is made safe.

1,288,980. ELECTRICAL ATTACHMENT PLUG; Johann G. Peterson, Jersey City, N. J. App. filed Nov. 23, 1917. Easily connected to an incandescent lamp socket or its equivalent.

1,289,000. ELECTRIC ENGRAVING APPARATUS; Andrew M. Robinson, Providence, R. I. App. filed Jan. 28, 1918. For graduating tools or otherwise marking metal parts.

1,289,014. COMMUTATOR FOR ELECTRIC MOTORS; Edward Strohacker, Freeport, Ill. App. filed May 18, 1917. Invention refers to a disk commutator wherein the brushes contact with the commutator segments at the side face of the commutator.

1,289,020. WELDING CONTROLLER; Edwin B. H. Tower, Jr., Milwaukee, Wis. App. filed July 19, 1915. Will automatically regulate the welding current.

1,289,022. PROCESS AND COMPOSITION FOR ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed July 8, 1916. Novel electrolyte is used.

1,289,030. ELECTRIC GRAVITY BATTERY; David H. Wilson, New York, N. Y. App. filed March 25, 1915. The internal resistance is decreased and a larger output of current with the same weight of zinc and copper is secured.

1,289,036. CONTACT DEVICE; Arthur A. Kent, Rosemont, Pa. App. filed Sept. 23, 1916. For use in making and breaking a primary circuit in an electric sparking system of an internal-combustion engine.

1,289,055. ELECTRIC FURNACE; Lewis G. Rowand, Brooklyn, N. Y. App. filed June 5, 1917. Intended principally for use in the reduction, or partial reduction, of metals from their ores, oxides and like compounds.

1,289,056. ELECTRIC FURNACE; Lewis G. Rowand, Brooklyn, N. Y. App. filed June 5, 1917. Particularly suitable for the reduction of zinc ores and the recovery of spelter therefrom.

1,289,059. ELECTRIC CONTROLLER; Robert W. Stanley, Cleveland, Ohio. App. filed Oct. 7, 1914. Is particularly useful in connection with motor vehicles.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, February 15, 1919 *Number* 7

The Cobbler and His Last

IN A LARGE sense the main function of a street railway company is to provide transportation, and the manufacture of electrical energy is the chief concern of a central station. Each one is a specialist. If either can do the work in which the other specializes better or cheaper than the other, both are misfits and neither is fulfilling its economic function. Conservation of money, material, fuel and labor is always essential, and the training of the engineer fits him admirably for such a task. We rely upon the engineer and engineering skill to make each dollar of investment yield its full return and not to put capital where it will yield less. Moreover, it is not good judgment to make large expenditures for that which is not a vital part of the business, particularly when the main part of the enterprise requires all the money that it can command. The receiver of the Brooklyn Rapid Transit Company seeks $16,000,000, of which approximately $3,000,000 is required for power-house extensions. Any one familiar with the transit conditions in that city will realize that the $3,000,000 could better be expended in rolling stock. The trend in practice is now, and has been for the past ten years, for railway companies to rely upon electricity supply companies for the energy required in running their cars. If the engineering and economic arguments receive fair consideration, they admit of no other conclusion.

Line extensions by central stations should begin to go forward from now on, with a relaxation of war-time restrictions on new customers' services. With wire selling far below war-price levels, poles easier and labor becoming more plentiful, it is a pity to wait too long before starting to get new business with might and main.

Conservative Central-Station Financing Necessary

A CONSERVATIVE financial policy on the part of central stations should be maintained during the period of reconstruction. It is gratifying that electrical utilities, with the exception of street railways, have borne the shock of war conditions so well, and the fundamental need of the service which the various branches of the industry supply has been a flywheel whose momentum will be hardly less valuable in the future than in the past. This need should be met by a conduct of affairs in the companies which takes the long view in the midst of present temptations to finance utilities without due regard to the maintenance of a strong surplus and ample provision for depreciation.

At present costs of labor, material and money, it is particularly desirable to keep the capital burden low in order to avoid needlessly high continuing fixed charges. For the present at least there is little prospect that rates can justly be lowered. The revenue expected during the transition period from war to peace will scarcely permit price reductions by central stations and power supply systems unless radical downward changes in the cost of coal and labor accompany the anticipated shrinkage in material costs which has begun to be in evidence on a moderate scale. Therefore more weight must be given to depreciation requirements than in the past, and plant and system maintenance in its broadest sense must be cared for by earnings which insure a real strengthening of the physical property. Mere bookkeeping allowances for depreciation, in order that high dividend rates may be maintained, cannot be substituted for the disbursement of revenue and the building up of surplus now vitally important.

In the face of the world-wide unrest which has succeeded hostilities on the battlefield, sound financing is not only economically essential but politically desirable. This is no time in which to declare dividends out of capital or to permit the surplus to vanish. The tendency visible in some quarters to capitalize expenditures properly a part of operating costs should be sharply checked. Capital inflation must be avoided in order that the subsequent burden upon the administration of the companies and the consumers may be made as light as possible without jeopardizing a reasonable return upon the legitimate investment devoted to the service of the public. Extra dividends—and, in fact, inordinately high regular dividends—should not be allowed to feed the fires of Bolshevism in a time like this, when the conservation of every resource should be the program of the whole world. Impairment of surplus was perhaps to be expected during the stress of war, but during the readjustment period one of the first duties of the central-station manager should be to rebuild this important accumulated resource and to make sure that the value of his plant as a whole is not suffering because merely paper allocations are being made to his depreciation fund.

The industry needs to guard against inflation of securities at this time and to see to it that dividends declared are legitimately earned. If this is done, the credit of the central station will be higher in the long run than if extra high dividends are paid for a temporary period. Special care should be taken to promote no consolidations of properties or general extensions of systems whose economic justification is in doubt. There never was a time when the manipulation of prop-

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erties to yield a banking profit was fraught with greater danger. Loss of confidence in electric utilities on the part of the investor is a disaster which sound financing will prevent, and now is the time to avoid anything in the way of speculative administration of such properties. Conservative financial direction, coupled with alertness to take advantage of opportunities for progressive development of the industry through efficient operation and a sound, vigorous commercial policy, will bring the central-station industry through the turbulent channels of the present to a boundless ocean of service opportunity which carries on its calm surface a sure reward for keeping a steady hand on the helm during the storm and stress of war conditions.

Self-restriction in production "to give more men jobs" is a species of economic assassination, not to say industrial suicide. As long as foreign standards of living are materially below our own, so long must our unit costs of production and distribution, combined with our quality of service, be maintained at levels competent to win business against overseas or over-border competition. Electricity is a mighty resource in peaceful conquests of this kind.

Making Water-Power Data Public

THE importance of water-power development along sound economic lines is now so great that full publicity should be welcomed by all advocates of conservation. Surveys of possible sites for storage reservoirs and estimates of the possible increases in power output which could be attained through redevelopment of existing plants or the installation of new equipment on sites at present undeveloped should no longer be kept under a bushel, as it were, for fear that some enterprising promoter will grab the profits before the owners and operators of plants now in service can extend their control and finance the enterprises at their own pleasure and in their own good time.

The price of coal and the drains upon our national supplies of fuel both justify the utmost publicity as to water-power resources, present and prospective.

Unless the people know where the feasible power developments are located, including storage reservoirs economically to be justified as part of particular schemes, legislation permitting interstate coöperation in storage and power interchange is likely to be delayed, and in many cases the expansion of existing facilities and the installation of new plants will be held up through opposition based on ignorance. Difficulties in securing rights-of-way for transmission lines may be multiplied and costs correspondingly increased where the people as a whole have little or no real appreciation of the latent water-power resources of their districts. The utilization of stream power will be along better coordinated lines if a general idea of the resources is well diffused, and in cases where riparian owners desire or ought to coöperate for their mutual benefit there is less chance of friction and the failure of meritorious projects where impartial surveys of the possibilities have been made known to all. Moreover, developments which might otherwise be held back until the loads of existing systems of distribution should call for expanded generating and transmission facilities may, under a general wide-open policy of resources publicity, be accomplished much sooner for the good of all and with splendid savings in high-priced fuel. The investigations and reports upon water resources which have been published this year by several state bodies, notably in New England, represent valuable contributions to the conservation cause.

The entire central-station industry should work as one man to secure henceforth more service outlets in wiring installations. Who can compute the loss of revenue from appliance and energy sales due to outlet limitations? Convenience is an asset in electric service which should be utilized to the limit, and the customer of the future will rise up and call blessed the central-station man and contractor who steer him away from the antiquated standard of one outlet per room.

Radio Development During the War

ALTHOUGH engineering entered into each and every line of military activity, yet there have been certain branches of engineering which were greatly developed and advanced by the war. Among these were aëronautical engineering and radio engineering. It has been said that these branches of engineering were further advanced by four years of war, under the spur of military necessity, than they might have been under peace conditions in perhaps twenty or thirty years.

In aëronautical engineering, the conquest of the third dimension in space and supremacy in the air, rendered necessary for the control of artillery and the furnishing of swift and reliable information at headquarters, exercised a tremendous influence on the construction and use of airplanes and dirigibles. The results achieved are likely to persist in peace and to affect materially cur means of communication in the near future.

In radio engineering the necessity for maintaining communication at all times with front-line battalions, and also with airplanes and distant stations, in spite of bombardment and the destruction of wire communication, resulted in revolutionary improvements in the art of radio communication. Much of the advantage gained is likely to be available for peaceful pursuits.

We print in this number the first of a series of artcles on the development of radio apparatus and methods of signaling, in the hands of the Signal Corps, during America's participation in the war. This history, a relatively small chapter in the entire book of the war's contribution to engineering, is of great interest to electrical engineers.

A very notable element in this radio development has been the vacuum tube, which in England goes by the name of "valve," in France of "lamp," in America of "audion." The capabilities of this device have been advanced and standardized to a wonderful degree, so that it is now possible with its aid to accomplish in radio engineering what was formerly the hopelessly impossible. These vacuum tubes are most versatile in their adaptability. Some of them are generators; others are rectifiers; others, again, are amplifiers or regulators. In fact, the vacuum tube has become so important an element in radio engineering that there would seem to be a danger of the broad subject of vacuum-tube engineering coming to absorb several

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branches of electrical engineering, including radio engineering itself.

As the article points out, the success of the Signal Corps' work in the development of radio engineering and radio apparatus is largely attributable to the wholehearted coöperation of various electrical companies and of their engineering staffs. This active coöperation among American firms and engineers has been one of the great achievements of the war.

Let us cultivate the habit of looking forward as well as of reviewing past achievements. Engineering societies will do well to avoid the temptation to fill their programs with war material to the exclusion of "convalescent period" problems, as it has been aptly put. For years to come we shall all be interested in the glorious things accomplished in the war service of the electrical industry, both abroad and at home. We want to know as much as possible about them, but we must take care not to overlook the bread-and-butter issues of the day, prosaic though they may at times appear in contrast with the historic deeds of 1914-18.

Demand Factors in Motor Service

A PAPER by Henry C. Horstmann and Victor H. Tousley in the current issue deals with what in these days is becoming an important matter. The problem which the progressive central-station man finds continually facing him is that of utilizing to the utmost extent the copper which he has already in place. With labor and material at its present rate, work which requires a heavy installation cost must be looked at askance, while everything that can be put on existing circuits is pretty nearly clear gain in the gross results. Keeping the copper well loaded means also keeping the station working economically, so that there is added incentive to follow up business which does not require extensions. At this point of progress the inspection bureau frequently steps in and insists that the conductor capacity shall be capable of meeting somewhat severe requirements when operating at maximum load. Now, everybody knows that, taking installations as they run, the condition thus specified rarely or never exists and a considerable proportion of the copper is not at any time utilized. As the authors here suggest, it often happens that not more than 20 per cent of the connected load is ever simultaneously in use.

Some day the conceptions of average load and diversity factor will break through the incrustation of the old precedents which armorplate too many inspectors, and current practice will materially improve.

The phase of the matter particularly discussed by Messrs. Horstmann and Tousley is the method of estimation for the demand factors in motors and groups of motors, so that the wiring may be proportioned with some reasonable relation to the actual heating likely to occur. As regards individual motors, the case is comparatively simple. The starting current cuts no particular figure, and the only condition which from the standpoint of common sense needs to be satisfied is that the wiring should be big enough to take care easily of reasonable overloads. When it comes to groups of motors, however, a different method of analysis is necessary; for a group, let us say, of motors which in actual service reverse regularly may play queer tricks with the demand on the supply system. Such motors have usually a fairly definite cycle of operations for which the equivalent heating current can be readily computed, and, according to the nature of the cycle and including both its frequency and amplitude, a multiplying factor can be figured by which the steady current of equivalent heating effect can be readily computed. Now, in groups of motors having cyclic loads the worst condition is imposed when all the motors are at the maximum of the cycle simultaneously. This corresponds to the use of a single motor of the aggregate size concerned, the cycles being in synchronism.

If the group of motors is fairly large, the chance of this maximum possible load occurring is comparatively small, and if the time intervals of use are the same in length, it is no very difficult matter to see to it that the motors do not to any considerable extent get into synchronism. It is the same sort of problem which occurred in some power stations in the days of big reciprocating engines. Once in synchronism the big machines would fairly rock the walls or sway the whole plant to an extent that sometimes made the operators dizzy. A like condition is not very uncommon in textile mills. If in a weave room, particularly when well up in the mill, the picker staffs get into unison, they may produce a vibration which is decidedly disquieting and might possibly become dangerous. A little care in watching the performance of a group of similar motors having the same cycle would ease the demand very materially.

A somewhat interesting case occurs when the cycles are different in length, as in running reversing motors with variable time intervals in machine shops. Here, if the intervals are practically commensurable, the peaks will all get together at an interval proportional to the least common multiple of all their demand intervals. Note well that here for once the engineer finds a practical use for the aforesaid least common multiple, probably one of the nightmares of his schooldays. But, even so, it takes a rather careful investigation, after a general line of procedure which the authors plainly lay down, to determine what the probabilities of the case really are and how far they must be considered in the wiring installation. As a matter of fact, the inspector rather generally takes no cognizance of the fact that non-synchronous peaks do not add up arithmetically, and calls for the limit on the wiring. The time is coming, however, when such matters will be looked at from a rather more liberal standpoint, and the code will tend to become better adapted to things as they are, instead of taking refuge in highly improbable concatenations of circumstances. It is with codes as with safety appliances in general, there is a point beyond which it is not wise to go in complicated regulations or devices, which may actually themselves become sources of trouble.

Electric truck sales are being retarded in some cases by lack of garaging facilities. Quick action here will stimulate an important development, and temporary charging and housing facilities should be provided at low cost rather than by waiting for funds to eventuate to finance a perfect installation. As Salmon P. Chase once tersely put it, "The way to resumption is to resume."

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Determination of Demand Factors to Save Copper

Methods by Which Electrical Inspectors Can More Accurately Gage in Advance the Probable Demand Factors of Different Types of Motor Installations

BY HENRY C. HORSTMANN AND VICTOR H. TOUSLEY

IT IS customary at present among inspection bureaus to demand conductor capacity equivalent to the whole connected load operating at its maximum capacity. Experience, however, has shown that in many cases this leads to great waste of copper. In very many installations it has been found that not more than 20 per cent of the connected load is ever in use at the same time. Tables of demand factors applicable to many classes of business have been worked out and are in existence.

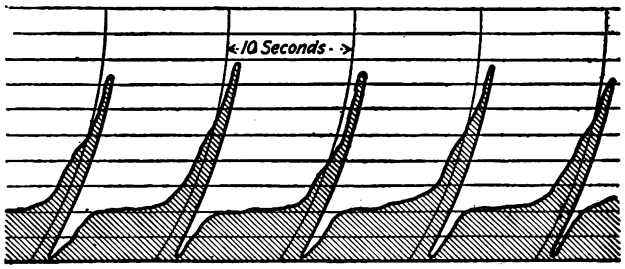

FIG. 1—GRAPH OF CURRENT WHEN LOAD IS OF PERIODICALLY VARYING NATURE

But so far as the authors are aware these are all arranged from the standpoint of the central-station engineer and hardly applicable to individual installations. As a matter of fact, the authors have failed to find any two installations, even in the same line of business, quite alike. It is therefore the purpose of this article to assemble known useful data, adding to them where possible, and to present them in a fashion in which they can be applied by electrical inspectors.

The whole question will here be treated under six headings, namely: (1) Individual motors; (2) groups of regularly reversing motors, such, for instance, as are used in connection with large washing machines; (3) groups of motors reversing regularly, but at variable time intervals, such as planers, etc.; (4) groups of motors in which the current is either entirely on or off, such as passenger elevator and similar motors; (5) groups of motors of indiscriminate characteristics and service, and (6) tabulations of experiences applicable to all classes of light and motor service. The sixth topic will be treated in part two of the article.

Individual Motors.—Many motors are now designed and rated to carry a certain overload, usually 25 per cent, for a short time. This fact should be taken into account wherever it seems necessary. Whenever motors are given a short time rating instead of a rating for continuous use, it seems but just that the conductor be chosen on the basis of the length of time it is in use. In so far as the heating of conductors is concerned, it is unnecessary to pay any attention to the ordinary starting current. The only justification for the excess carrying capacity usually demanded for single motors lies in a possible necessity of providing for overloads.

Groups of Regularly Reversing Motors.—A graphic representation of current values in a series of cycles of operation of a reversible motor operating a large washing machine is given in Fig. 1. In connection with such motors it is quite unusual to reverse without giving the armature time to come to rest. The reversed current through the armature must first bring the machinery to rest and then start it in the opposite direction. The majority of such motors reverse at intervals of ten seconds or twelve seconds, and the average peak current lasts about one second.

In this connection it will be well to note that in order to give this study a practical value we must take a course about midway between absolute accuracy and haphazard guesswork. The heating effect of various kinds of motor loads cannot be accurately determined without the use of graphic current charts, and these are seldom available at the time the installation is planned. The contractor and the inspector are thus, in the majority of cases, compelled to judge by the rated horsepower of the motors required. In order, therefore, to make these tables of use the carrying capacity of conductors required must be based upon the horsepower intended to be installed. It is principally for this reason that the following table has been arranged in the form given.

This table gives factors which express the ratio of the horsepower equivalent of intermittent or fluctuating currents to the heating equivalent of the same currents used continuously. The horsepower value of a fluctuating current is (voltage assumed constant) proportional to the average sum of all the ordinates of a curve representing it; the heating effect of the same current is proportional to the root-mean-square value of the same ordinates. Thus if the root-mean-square value of

RATIO OF HORSEPOWER EQUIVALENT OF INTERMITTENT CURRENT TO HEATING EQUIVALENT OF SAME CURRENT

Per cent time of peak current		10	20	30	40	50	60	70	80	90
Per cent time minimum current		90	80	70	60	50	40	30	20	10
Per cent of peak current in terms of minimum current	200	1.04	1.05	1.06	1.06	1.05	1.04	1.04	1.02	1.01
	300	1.12	1.15	1.15	1.14	1.12	1.10	1.07	1.05	1.02
	400	1.22	1.25	1.23	1.21	1.17	1.13	1.10	1.07	1.03
	500	1.31	1.34	1.30	1.26	1.21	1.16	1.11	1.07	1.03
	600	1.41	1.42	1.37	1.29	1.23	1.18	1.12	1.08	1.04
	700	1.50	1.50	1.40	1.32	1.25	1.19	1.13	1.09	1.04
	800	1.59	1.54	1.44	1.35	1.27	1.20	1.15	1.09	1.04
	900	1.67	1.59	1.47	1.37	1.28	1.21	1.15	1.09	1.04
	1000	1.74	1.63	1.50	1.39	1.29	1.22	1.15	1.09	1.04

a certain fluctuating current is divided by its horsepower value, a factor will be obtained by which the horsepower delivered by a motor may be multiplied to find the current for which conductor capacity should be provided to guard against excessive heating. At least it may be used in this way provided that the

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approximate ratio of peak current to minimum current required by the fluctuating load is known in a general way.

To use the table consider a motor reversing regularly and requiring a peak current five times as great as its running current and during half of the time of each cycle. Where the line pertaining to 50 per cent peak and 50 per cent minimum current time crosses the line pertaining to the 500 per cent peak, the factor is 1.21,

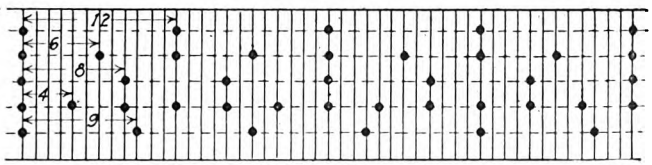

FIG. 2—METHOD OF STUDYING POSSIBLE DEMANDS OF GROUP MOTORS

which indicates that the current to be provided for must be that many times the value called for by the horsepower rating of the motor. The factors here given are correct for single motors and also for the worst possible condition under which a group of motors can operate, that is, with all peaks superimposed. This is a condition which may at times be attained, but if a large group of motors is considered, the chance of its occurrence is exceedingly small, as a mathematical consideration will show.

For instance, the law of combination says that the fraction of the total time during which the peaks of all the motors in use are likely to be superimposed is equal to a^b. In this formula a represents the fraction of the time of a cycle of operation during which the peak is in use and b the number of motors considered. In the case of laundry motors of the characteristics of Fig. 1 the peaks when once coincident will remain so for some length of time or until one or more have been stopped and the combination broken. In the case of elevator motors the combination will almost immediately be broken.

Groups of Reversing Motors with Variable Time Intervals.—In many machine shops the planers are equipped with reversing motors, by which the carriage is made to return at a high rate of speed after making the cut. The length of time during which such a motor moves in either direction is variable, and the power required by the forward and return strokes is also variable. The periodicity as well as the relative demands for current vary and are governed by the work in hand.

Since there is no permanent regularity about any of the operations, no exact forecast as to what will happen at any particular time can be made. A study of the conditions as illustrated in Fig. 2 will, however, assist materially in judging what the current demands of a group of such motors may possibly be at times. The black dots denote motors which are in operation and reversing regularly at intervals of twelve, six, eight, four and nine seconds. Inspection will show at a glance that with any number of motors, if they start in synchronism, the time of coincidence of peaks of all of them will be proportional to the least common multiple of all of their time intervals. In this case it is 72. Hence, at intervals of seventy-two seconds these motors will all come into synchronism as far as their peaks are concerned. Their minima of current will, of course, also come into synchronism regularly.

If they do not start in synchronism, those starting at time intervals which form a multiple of their own time, remote from that of other motors, will work into and out of synchronism in a perfectly regular manner just as those shown in the figure. Those that start at different time intervals, however, will not. As an example, if the motor having a period of six seconds starts either one, two, three, four, five, seven, eight, nine, ten or eleven seconds after the other, it will never superimpose its peak entirely upon the other, though a part of it may overlap. It must, however, be borne in mind that the motors having the shortest periods govern the chances of falling into step. A motor having a period of four seconds, for instance, will have only one chance in four of missing regular coincidence of peaks with other motors having periods of eight or twelve. With motors on this kind of work, then, it may be certain that there will be coincidence of peaks at times, but it will be safe to use about the average multipliers given in the table, the average being determined from the characteristics of the different motors.

Passenger Elevator and Similar Motors.—In the kind of service here considered the current is either entirely on or off. If calculations are to be based upon current or power charts, the equivalent current of a cycle of operation should be determined by one of the methods already explained. The formula and the tables herewith furnished, however, are so arranged that for general purposes it is merely necessary to know the rated horsepower of the whole group and the relative length of time of the "on and off" periods. In the preliminary operation of finding the current required it is to be assumed that the motors are delivering their rated power continuously regardless of the nature of their rating. The formula given below is also independent of the number of motors, and the demand factor obtained is a function of the relative on-and-off periods of the motors, which are assumed to be the same for all.

A conductor is used to the best advantage with reference to heating when subject to a steady current flow. Hence, if another conductor be called upon to transmit an equivalent amount of energy with intermittent

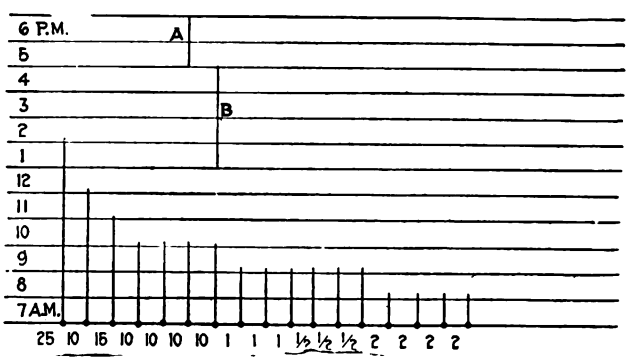

FIG. 3—METHOD OF ANALYZING A MOTOR INSTALLATION

service, the carrying capacity of the second must be correspondingly increased. If the load is of such a nature that the conductor is idle half of the time, it must carry double current during the other half time. But, according to the root-mean-square method of calculation, a double current during half time is equivalent to the

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square root of two times half that current during the whole time. The same relation holds for all other time divisions, so the steady current equivalent to any regularly repeated intermittent load of the nature here considered will be given by the formula:

$$I = i\sqrt{t/t'}$$

where I is the theoretical current which, flowing steadily, would produce the same heating as the actual current, flowing intermittently, and i represents the rated motor current. The actual time current flow, in a cycle of operation, is given by t, while t' is the time of a complete cycle.

This formula will give a multiplier, virtually a demand factor, by which it is possible to find the current having an equivalent heating effect to that required by the motors on the assumption that they are all working under the worst possible condition, that is, all motors taking their maximum current at the same instant.

The factors calculated according to the formula, as applying to the various percentages of time during which the current is in use, are given below. The upper line gives the percentage of time and the lower the multiplying factors.

Percentage of time	10	20	30	40	50	60	70	80	90
Factors	0.32	0.45	0.55	0.64	0.71	0.78	0.84	0.89	0.95

Groups of Motors of Indiscriminate Characteristics.—This classification embraces all kinds of motors as usually found in shops and factories. There are two ways of arriving at the probable demand factors of such groups. One of these consists in consulting tables made up from experience with similar installations. This method has the great disadvantage that it is almost impossible to find two installations nearly enough alike to warrant very accurate comparisons. Such tables should be used only as a general guide and the final determination arrived at only after a careful analysis of the installation to be made.

A simple method of analyzing a motor installation and determining the demand factor is illustrated in Fig. 3. Take any piece of ordinary ruled office paper and number as many lines as there are hours in the day to be considered. Let these lines be horizontal and next draw as many lines vertically across them as there are motors to be considered. Also place each line so that in position and length it may cover the hours of the day during which the motors are thought to be in use. There are two ways in which such a representation can be made. If the motors have no fixed time at which they run, their running time may be laid out at the bottom as in Fig. 3. The main point is to have the lines give a fair idea of the proportionate running time per day. If the stopping and starting intervals are not too short, a series of short lines representing the estimated number of starts may be used. If any of the motors are used only during certain hours, the lines pertaining to these motors may be placed between the horizontal lines pertaining to the hours of the day, as, for instance, *A* and *B* in the figure. These two motors never interfere with each other, but do occasionally come in at the same time with some of the other motors plotted at the bottom of the figure. Considerable judgment must be used in connection with this method. The idea is not to strive to gain absolutely accurate results, but merely to form an opinion as to how many of the motors may frequently be found running together.

MOVEMENT TO CONTINUE FUEL CONSERVATION IN CONNECTICUT

Hartford Steam Boiler Inspection & Insurance Company to Aid in Keeping Up Economies Forced Upon Fuel Users During War

The close of fuel economy work in Connecticut under government auspices has brought many plant owners to a realization of the need of continued efforts to save coal. W. R. C. Corson, administrative engineer of the Connecticut Fuel Administration, has returned to private work as secretary of the Hartford Steam Boiler Inspection & Insurance Company and has been the recipient of many communications favoring a continuance of the power-plant and boiler-house economy service which was successful in cutting down the waste of fuel at the height of the war. The Connecticut Manufacturers' Association has gone on record as favoring such work, and in a bulletin issued Feb. 1 and entitled "Why Not Keep It Up?" the Hartford company places its engineering force at the disposal of its policy holders in Connecticut for the purpose of maintaining and improving upon the operating economies already attained.

In Connecticut the campaign for conservation was conducted with particular vigor and received the cordial response of plant owners and managers. According to the records of the Fuel Administration for Connecticut nineteen-thirty-fifths of the 1917 supply of bituminous coal apparently supplied nine months of the 1918 demand in this territory and at the same rate twenty-five-thirty-fifths of the 1917 supply should be sufficient for the year ending April 1, 1919. Even before the end of hostilities, however, it became evident that the threat of a bituminous scarcity in Connecticut had been greatly relieved. Production of Connecticut industries had not decreased at that time, and it is obvious, the bulletin says, that the more favorable coal situation was due, at least in large part, to the conservation practices of the coal users and of the state.

The company has had word from many plant owners in the state that others feel this and is led to believe that its engineering and inspection organization could be of assistance in the maintenance and further develment of the improvements in fuel efficiency started during the war period. Accordingly the company announces to its policy holders in Connecticut that it stands ready to assist them in this work. Its engineers and inspectors throughout the nation have been in close touch with the power-plant conservation campaign. This is especially true in Connecticut.

This engineering force will be available for the following purposes: To advise and instruct concerning the use of draft gages, CO_2 apparatus, meters and other devices which may have been installed under the direction of the administrative engineer of the former Fuel Administration; to instruct in proper methods of firing the different grades of fuel now being supplied; to investigate thoroughly plant conditions in order to point out where wastes are now occurring, and to provide a general supervision of plant operation. For advice and suggestions which can be given entirely by correspondence no charge will be made, but when it is necessary for one of the company's engineers to visit a plant specially, a moderate charge will be imposed.

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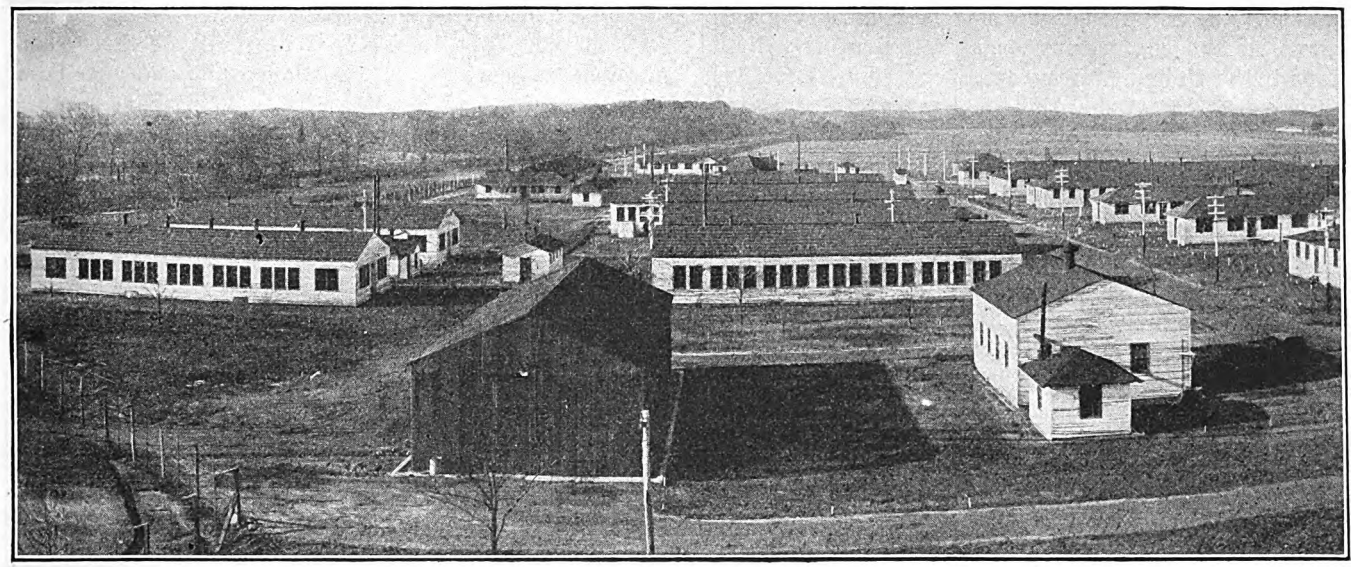

FIG. 1—VIEW OF SOME OF THE LABORATORIES USED BY UNITED STATES ARMY IN DEVELOPING RADIO EQUIPMENT

Radio Development During the War

Problems with Which the Signal Corps Was Confronted When the United States First Engaged in the Conflict—How It Placed Radio-Apparatus Production on Quantity Basis—Nature of Improvements Made

BY NUGENT H. SLAUGHTER
Lieutenant-Colonel, Signal Corps, U. S. A.

The situation which the United States Army faced in April, 1917, in regard to the supply of suitable radio apparatus for use overseas will be outlined in the following article. A brief description of the methods adopted to procure suitable radio apparatus will be given and a brief statement made indicating the success achieved prior to the signing of the armistice. This article is intended to serve as an introduction to a series of articles dealing in a detailed way with various radio development problems which have engaged the attention of the Signal Corps. Among the subjects which will be discussed are vacuum tubes, airplane radio-telephone and radio-telegraph sets, amplifiers, land continuous-wave radio sets, and radio direction finders for use on land and in airplanes. The series will make a complete and highly interesting story, hitherto unpublished, of the remarkable developments which have been made in the radio communication field under the pressure of war-time conditions.

AT THE entry of the United States into the European conflict in April, 1917, the situation existing with respect to the signaling apparatus and methods employed by the United States Army was such as to necessitate immediate and vigorous action on the part of the Signal Corps looking toward the adaptation of the existing methods and apparatus to the new conditions which had arisen on the European battle front. While no detailed information was available regarding the exact status of the communication art on the French front, it was apparent that enormous improvements had been effected by the belligerents. It was equally apparent that the Signal Corps must take full advantage of the progress which had been made by the Allies to enable it to take its proper place as a factor in the conflict, since the Chief Signal Officer of the army is charged with the duty of establishing and maintaining suitable lines of communication between the various parts of the army. Additional problems were imposed by the establishment of the Air Service and the tank corps because the Signal Corps must provide communication apparatus for these also.

Owing to a lack of necessary appropriations, the Signal Corps was practically without any engineering organization and the apparatus in use was largely unsuited to the kinds of communication needed for European warfare. This was perhaps true to a greater extent of radio apparatus than of any other types of signaling devices. Enormous strides had been made in the improvement of radio apparatus by the British, French and Germans, and the military use of radio communication had expanded to an extent never considered probable by this country.

The Chief Signal Officer of the army realized the situation more fully than any one else and immediately took energetic steps to expand the engineering organization sufficiently to handle the development of new signaling devices. At the same time an invitation was extended to the French and British governments to send to this country scientists familiar with the present state of the communication art in Europe for the purpose of acquainting the Signal Corps with the progress that had been made and suggesting lines of development which the corps should follow. As a result of this invitation the French scientific mission arrived in this country only a short time after the entry of the United States into the war. This mission was composed of eminent French scientists who had participated in the development of signaling apparatus for the French army and who brought with them samples of the latest types of French signaling apparatus, of which radio comprised a large part. The conferences which were held between the Signal Corps officers and these French scientists

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the extent of the buildings provided for this purpose. As an illustration of the activity at the radio laboratories it may be mentioned that the testing of airplane radio apparatus required during the month of September, 1918, more than 500 airplane flights. There were included in the laboratory equipment twenty-two airplanes of the latest types.

While much of the radio development work was done by industrial engineering organizations working under

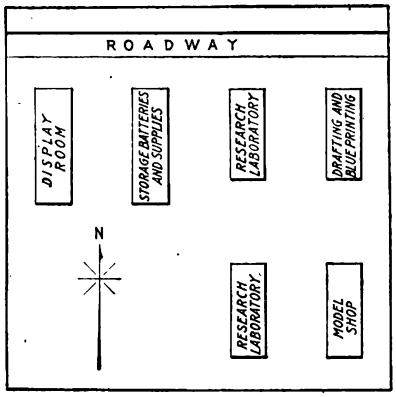

FIG. 3—LAYOUT OF ARMY RADIO BUILDINGS AT LITTLE SILVER, N. J.

the direction of the Signal Corps, a large amount of research and design work was carried out by the radio laboratories. At the time of the signing of the armistice there existed at these laboratories an extremely efficient organization, capable of handling the research, design, drafting, specification, model shop and field testing work incident to the development of radio apparatus in a manner calculated to produce new types of radio apparatus in an incredibly short time. Much credit is due Major Nathan Levinson, commanding officer at the radio laboratories, for the highly successful manner in which this organization has functioned during the past year.

In addition to these laboratories, extensive and effective use was made of the facilities afforded by the Bureau of Standards. A separate Signal Corps radio laboratory was established at the Bureau of Standards, and close coöperation was maintained with the laboratories of the bureau proper and of the Navy Department, under the direction of Captain F. E. Pernot.

The extent and variety of the problems involved in the creation of completed designs for the required radio apparatus were such as to necessitate the full use of the services of industrial research laboratories familiar with or competent to handle these problems. The methods employed by the Signal Corps in the development of the various devices needed were such as to allow the industrial engineering organizations to which various problems were assigned the utmost freedom and latitude consistent with adhering to certain fundamental military requirements imposed by the service conditions under which apparatus would be used. The preliminary design of the various sets was carefully analyzed, and the various problems involved were assigned to companies specializing in the particular line of work involved. As an example, the design of one set was subdivided to such an extent that no less than twenty-one companies were engaged in the solution of the fourteen separate design problems involved. The direction of this development work was largely in the hands of Captain G. F. Gray.

ACCOMPLISHMENTS OF THE DIVISION

The problems which faced the Radio Division in July, 1917, were of two general classes: To prepare the designs of American equivalents of the standard British and French radio apparatus and to create the designs for new types of American radio apparatus which would be superior to any existing types. Work was prosecuted on these two groups of problems simultaneously, with the result that there were soon in production the American equivalent of several of the French and British sets, together with improved and original American types of radio apparatus. The principal classes into which army radio apparatus may be divided are roughly as follows: Airplane radio-telephone sets, airplane fire-control radio-telegraph sets, airplane direction-finding sets (radio compass), land spark radio-telegraph sets, land continuous-wave radio-telegraph sets, and land direction-finding sets. Detailed descriptions of the most important sets will be given in subse-

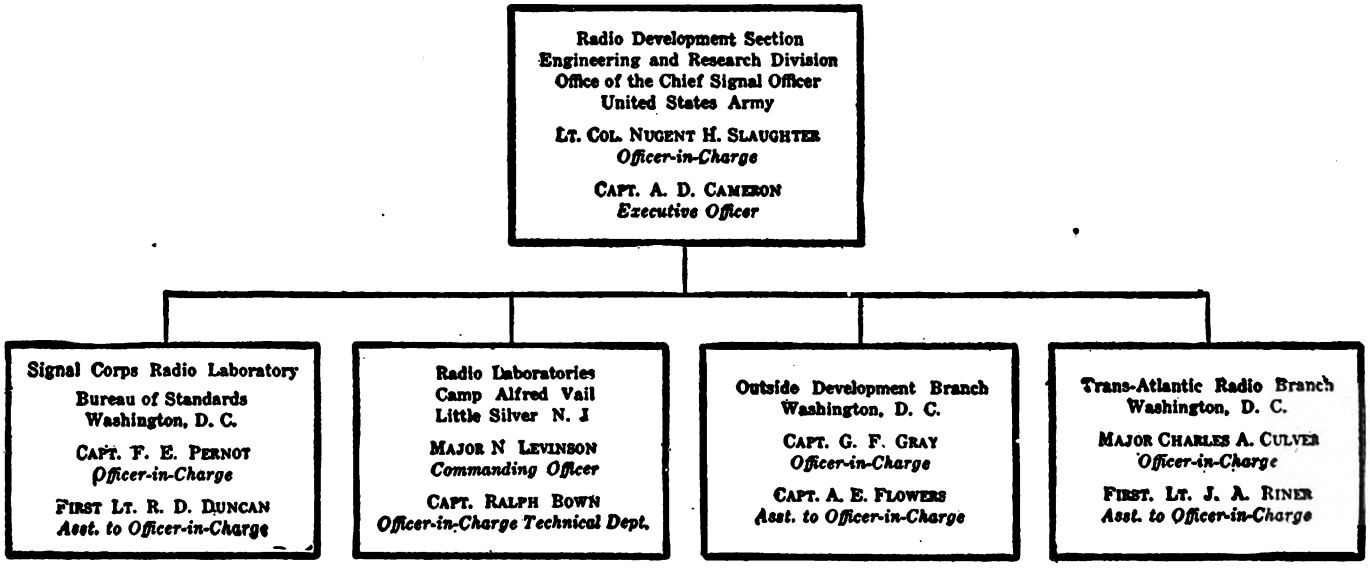

FIG. 4—ORGANIZATION CHART OF RADIO DEVELOPMENT SECTION

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quent articles together with a discussion of the operation and use of the sets.

The most important single problem which confronted the Radio Division in July, 1917, was the evolution of suitable vacuum tubes (or audions), since these vacuum tubes formed the basis of design for the majority of the radio sets and since there existed at the time no vacuum tubes having the desired characteristics. The services of the three foremost vacuum-tube engineering organizations of the country were enlisted, and under the direction of the Signal Corps radio engineers the progress toward satisfactory design and construction of the required types was very rapid. Within less than six months standardized tubes were turned out by quantity production at rates sufficient to insure the requisite supply. Work was continued, however, on the development of still better types of tubes. The improvements that have been made from time to time have been incorporated in the tubes being produced on a large scale, so that tubes of recent manufacture are a very great improvement over those made a year ago.

The most interesting radio set developed by the Signal Corps during the war period was the airplane radio-telephone set, which has had wide publicity in the press. This development is a striking example of the results which may be obtained by utilizing to the utmost possible extent the industrial engineering organizations familiar with the fundamental problems involved in such a set.

As indicative of the extent and variety of the radio development work which has been carried on during the past eighteen months, there is given below a partial list of the types of sets which have been completely developed and placed in production during this period:

Land Radio Equipment:
- Spark sets, sending and receiving (three types).
- Continuous-wave army radio-telegraph sets (three types).
- Radio-telephone set (one type).
- Tank radio-telegraph set (one type).
- T. P. S. (earth telegraphy) (four types).
- Wavemeters.
- Battery-charging sets.
- Radio operating and repair trucks.
- Miscellaneous special equipment.

Airplane Radio Equipment:
- Interphone sets (for use of two to five persons).
- Radio-telephone sets (three types).
- Radio-telegraph sets (three types).
- Direction-finding radio-receiving set (one type).

The variety of this equipment as contrasted with the small number of radio sets in use by the army prior to the present war may be attributed largely to the difference in the method of warfare as carried on in France and the method of warfare for which previous American training and equipment were intended. The extreme concentration of troops and the semi-stationary style of warfare resulted in an extremely large increase in the use of all kinds of communication, and the necessity of a substitute for wire communication during periods when such communication was entirely severed by artillery fire resulted in this enormous increase in the use of radio communication.

The remarkable development and improvement of military radio equipment which has taken place under the direction of the Signal Corps during the last eighteen months will undoubtedly materially change the system of army communications and even the tactical use of military equipment and personnel. A typical example of this development is the airplane radio-telephone, previously mentioned, the use of which has made possible the "voice-commanded air squadron." The military value of an air squadron has been enormously increased by virtue of this device, which enables the squadron commander to direct the movements of the individual airplanes in any manner which circumstances may require.

Certain other radio devices recently perfected, the nature of which cannot be revealed, will undoubtedly affect the tactical use of troops to such an extent as to make certain kinds of radio equipment as indispensable to the operations of military units as the rifle or the machine gun.

It is considered that the art of radio communication in general will be enormously benefited by the revolutionary improvements that have been effected in certain of the parts of radio apparatus, notably the vacuum tube. The application of this device to radio communication has been productive of such phenomenal results that it constitutes to-day a practically indispensable link in any kind of radio communication. Needless to say, the possibilities which are opened up by the availability of high-quality standardized vacuum tubes for other uses than radio communication will be evident to any one who knows the characteristics of these devices.

ACKNOWLEDGMENTS OF ASSISTANCE

In carrying out the program for development of radio apparatus the Signal Corps called upon a great many industrial engineering organizations and individual engineers for assistance in solving the problems incident to this work. The greater part of the actual development work has been accomplished by organizations and individuals outside of the military service, their work being directed to a large extent by the engineers of the Signal Corps. It is impossible to print a complete list of the companies and individuals that contributed effectively to this work, but the contributions which have been made by certain companies have been so noteworthy as to justify mention in this article. Because of its unusually large engineering organization and its familiarity with so many of the fundamental problems which were involved in the development of radio apparatus for the Signal Corps, the Western Electric Company has contributed much more largely to this program than any other organization. However, the contributions which have been made to the development work by the Westinghouse Electric & Manufacturing Company, the General Electric Company, the International Radio Company, the General Radio Company, the DeForest Telephone & Telegraph Company, the National Electric Supply Company and the Marconi Wireless Telegraph Company have been of incalculable value to the Signal Corps during this emergency. It is particularly worthy of comment that all of these companies, and in fact any others with which the Signal Corps worked on the development of radio apparatus, evinced the most whole-hearted coöperation, with the sole purpose of assisting in every way to further the effectiveness of the American army.

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Modern Office Lighting

Lighting System for New Office Building of Edison Lamp Works Was Designed by Illuminating Engineers in Advance of Construction Period—Extensive Tests Indicate the Importance of Careful Maintenance of Fixtures and Walls

BY A. L. POWELL
Edison Lamp Works, Harrison, N. J.

THE lighting installation in the new office building of the Edison Lamp Works of the General Electric Company illustrates the excellent results which can be secured through coöperation of the architect and illuminating engineers. The oft-quoted proverb "Shoemakers' children go ill-shod" does not hold in this instance. This large corporation, devoted to the manufacture and sale of incandescent lamps, has provided every facility for efficient operation of its office force, particularly in regard to the lighting. Clerical employees of a lamp manufacturer, from their environment and training, are particularly susceptible to lighting conditions. Past experience has shown them to be critical of the lighting and prone to demand special equipment. Having now passed through the darkest months of the year, it is interesting to record that the lighting installation herein discussed has been found particularly satisfactory to all users.

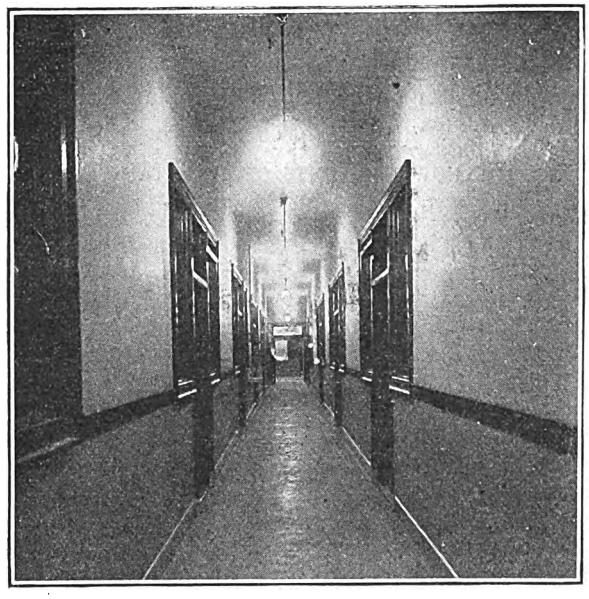

FIG. 1—NIGHT VIEW OF CORRIDOR

Lighted by 50-watt tungsten lamps in stalactite-shape, opalescent inclosing globes with decorated etching.

It is a well-established fact that adequate and proper lighting is an essential to the successful accomplishment of business. Plenty of light must be supplied on the desks. It must be of a suitable character and the sources of supply (*i.e.*, lamps) so placed and equipped that vision is in no way impaired.

From the very inception of the architect's first plans the engineers were in constant touch with him and supervised all features pertaining to the lighting system while the building was under construction. This is a most desirable condition, for in many instances the illuminating engineers are not called into consultation until the building is practically completed, at which point it is difficult to make any changes on account of the relatively high expense.

The new building is in the form of an L, 60 ft. (18 m.) wide with 200 ft. (61 m.) facing the east and 140 ft. (43 m.) facing the south. It is of reinforced-concrete construction throughout without false ceilings, save on the fourth floor. It was therefore necessary at the earliest stages of construction to determine the location of outlets in order that inserts might be set before the pour was made. It was realized that probably some changes might be made in office arrangements, which afterward did prove to be the case. The engineers were thus confronted with two alternatives. The first was to design the lighting on a bay basis, disregarding the layout of offices. The other was to space outlets symmetrically in the proposed offices, disregarding the bay feature. The bays are 20 ft. by 20 ft. (6 m. by 6 m.), and four outlets per bay would have been satisfactory. On the other hand, offices were placed without any particular regard to the arrangement of columns, which, of course, made a standardized lighting layout unsuitable. The second scheme was used, and in only a very small percentage of cases has it been necessary to change the location of outlets to take care of revised office arrangements.

Although indirect-lighting systems were to be used throughout the working spaces, which would permit a rather wide spacing of outlets, at least four were provided in each 20-ft. (6-m.) bay. It was recognized that light at any one point should come from a number of sources, even though well diffused.

CHOICE OF SYSTEMS

The engineers kept constantly in mind, as a primary point, effectiveness of the workers and, secondarily, economy of lighting. In those parts of the building, such as the kitchen, factory restaurants, toilets, passageways, etc., where there are no close demands on vision, and where the decorative element is not important, direct lighting with open-bowl reflectors was recommended. Equipment was chosen which gave a high utilization of light.

For the lobbies and corridors, where the decorative element plays a considerable part, somewhat ornamental and novel equipment was installed.

For the large general and clerical offices a fixture was chosen which was inexpensive and yet ideal from the standpoint of affording eye protection. This was a semi-indirect unit of very dense glass, scientifically designed to give an efficient and suitable distribution of light.

The private offices also have semi-indirect lighting, but a slightly more decorative fixture is employed. A medium-density pressed opalescent glass dish is carried

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by a three-chain hanger. Two designs of bowl are employed, each with two external finishes, ivory and light brown. These are grouped as to floors and sections so that a slight variation is provided without any appearance of the building being a fixture showroom. In the executive offices totally indirect lighting is installed, rich yet plain fixtures being used and simple designs being considered generally the most artistic.

FIXTURES AND GLASSWARE

While no limit was placed on the sum to be expended for fixtures and glassware, yet good engineering demands that cost be kept as low as consistent with securing of the desired results. In a commercial office building such as this there was no real excuse for elaborate ornate metal fixtures. Cast bronze and solid brass fittings have their appropriate places, but for ordinary work other metal, well plated, will outlive the period of obsolescence of the fixtures.

The glassware, however, was carefully chosen, for on this depends the quality, distribution and diffusion of illumination. In the office building simplicity of lines and decoration were kept in mind.

As mentioned above, for semi-indirect units the glassware is quite dense, transmitting but a small proportion of light, giving the best conditions for office work. If light-density glass had been used, the system would lose many of its advantages, dropping back to the direct-lighting class where a number of fairly bright objects are in the field of view. The glassware used is smooth on the inside as well as the outer surface. Roughed glass collects dirt very readily and is difficult to clean. Deep crevices in the glass, although they may be decorative, would have been objectionable from this standpoint.

The gas-filled lamp, with its rather concentrated filament, if incorrectly placed in an indirect unit produces a noticeable circle of very bright illumination on the ceiling. Care was taken to insure the correct relative position of light center and reflecting medium so that the ceiling was evenly illuminated and chain shadows minimized.

WALL AND CEILING FINISH

The question of painting walls and ceilings is one which has received much attention from building operators and justly so. In spite of this the effect of color of surroundings on resultant illumination is not fully realized. By proper painting a great deal more light can be obtained without any additional expense. Citing a concrete case, the summation of a number of tests shows that with semi-indirect lighting in a room with a wall finish of 50 per cent coefficient of reflection, if the coefficient of reflection of the ceiling is raised from 50 to 80 per cent, the illumination at desk level will be increased 50 per cent. Paint is cheaper than electric energy and saves coal.

Efficiency of the lighting system, however, is not the only thing to be considered in this connection; for example, it would have been inadvisable to have the ceilings with a gloss finish, even though this would reflect light well. In this case the lamp filaments would be imaged on the ceiling, and glare and eye strain would result. A flat or diffusing finish was necessary. For the most economical conditions paint should be used which does not rapidly depreciate with time, otherwise the lighting may be fine at first but soon become low in value.

In the case under consideration the offices received treatment as follows: First a coat of sizing or surfacer on the plaster walls and then a coat of water paint (kalsomine type). The ceilings are a light cream tint; coefficient of reflection for tungsten illumination, 64 per cent. The walls might be described as very light buff; coefficient of reflection, 64 per cent. It is true that paint treatment could have been obtained at considerable additional cost which would have had higher reflective power and been more lasting. It is to be anticipated that the depreciation will be rapid and progressive, owing to the porous nature of the surface, which permits it to absorb dirt. Considerably more light would be effective if the ceiling were a pure white. The finish used, however, is pleasing to the eye and thoroughly comfortable. The coefficient of reflection of the wall surface is sufficiently high so that the ceiling does not appear too bright by contrast. The corridors, stairs and lobby are treated with three coats of oil paint. The ceiling is cream (60 per cent), walls medium buff (58 per cent), with a dark-buff dado.

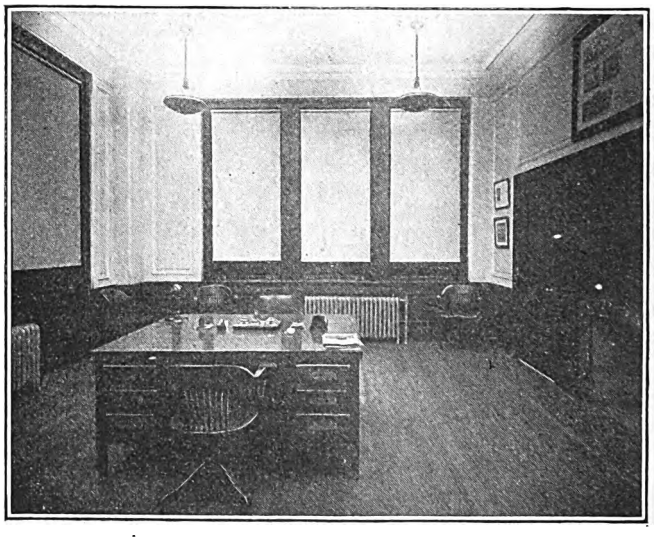

FIG. 3—EXECUTIVE OFFICE ILLUMINATION

Night view of executive office, lighted by 75-watt gas-filled lamps, three per fixture, equipped with individual mirrored reflectors in a spun-brass housing.

ILLUMINATION VALUES

The table shows the equipment and resultant illumination in typical portions of the building. Illumination tests were conducted with a calibrated Macbeth photometer, readings being taken at desk level (2 ft. 6 in.) (76 cm.). A sufficient number were taken in each room and at each station to insure accuracy of results.

The ceiling height throughout is 13 ft. (4 m.), and except where otherwise noted lamps are placed 10 ft. (3 m.) above the floor. Gas-filled lamps are used in all the rooms tabulated. Voltage readings were taken at the time of the illumination tests, and the values given are corrected to rated voltage.

There are certain parts of the building which are not sufficiently important to warrant tabulating; nevertheless, a brief description of the equipment is necessary and desirable in order to make the treatment complete.

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Entrance Lights.—At the main entrance are copper standards 5½ ft. (1.67 m.) in height, surmounted by 12-in. (30-cm.) spheres with 100-watt gas-filled lamps at each side of the doorway. The side entrances are provided with similar lighting equipment, save that bracket fixtures rather than pedestals are employed. Solid copper or bronze is quite desirable for fixtures of this character, used out of doors in a rather salt atmosphere.

Lobbies and Corridors.—General-illumination direct lighting is provided for the elevator lobbies, main stairs and corridors. Eight-inch (20-cm.) and 11-in. (30-cm.) light-density stalactite-shaped inclosing globes are provided with from 50-watt to 100-watt tungsten lamps hung on single chain-and-bracket fixtures in burnished bronze finish. These globes are etched and decorated in brown with a GE monogram design. This is quite inconspicuous but gives a certain distinctive appearance to the equipment. The corridors are 6 ft. (1.8 m.) wide, and 50-watt tungsten lamps are used on 19-ft. (5.8-m.) centers.

Service Rooms.—The auxiliary or service parts of the building, such as stair towers, cloak rooms, toilets, closets, passageways, etc., have 25-watt and 50-watt tungsten lamps in 6-in. and 7-in. (15-cm. and 17-cm.) medium-density opal-bowl reflectors. Brushed-brass stem fixtures are used for the ceiling outlets, while nickel-plated bracket fixtures are used at the mirrors in the toilets.

Kitchen.—The kitchen, 34 ft. by 100 ft. (11 m. by 30 m.), on account of the overhead obstructions, flues, etc., is provided with localized general direct lighting. An average of approximately one watt per square foot is used. Gas-filled lamps rated at 100 watts are equipped with 8-in. (20-cm.) dense opal-bowl reflectors and supported by stem fixtures 12 ft. (3.6 m.) above the floor. The illumination on the tables devoted to the preparation of food averages approximately 6 foot-candles. The serving racks are illuminated to 10 foot-candles.

Basement.—One outlet is provided in each bay of the storage space in the basement. Approximately 0.25 watt per square foot is furnished by 150-watt gas-filled lamps in porcelain enameled dome-shaped reflectors. This is adequate for the purpose.

File Room.—The document and file room is located in the basement. Shelves extend to within 6 in. (15 cm.) of the 10-ft. (3-m.) ceiling. A 2½-ft. (0.76-m.) aisle is provided between stacks. Over this aisle outlets are spaced on 14-ft. (4.3-m.) centers. Clear tungsten lamps rated at 25 watts in 12-in. (30-cm.) porcelain-enameled dome reflectors are used. A switch is provided at each second row so that only the area in which work is being done need be lighted. The files are kept in transfer cases deep orange in color. Index numbers are in pencil or ink, and yet with the lighting provided there is no difficulty in locating the material.

Illumination readings taken with the test plate in a vertical position show the following intensities to prevail on the surfaces of the boxes: Minimum value, 0.2 foot-candle at the top midway betwten units; maximum value, 1.8 foot-candles, opposite a lighting unit 4 ft. (1.2 m.) from the floor; average, between 0.3 and 0.4 foot-candle.

One naturally removes a box from the shelf and looks at its contents in a horizontal plane. Readings taken 3 ft. (0.9 m.) from the floor in this plane show these intensities: Minimum, 1 foot-candle; maximum, 2½.

Photographic Studio.—The photographic studio is established in a penthouse on the roof. A large adjustable window occupies practically all the north wall. A small special panel box is provided so that there is plenty of opportunity for the taking of pictures by artificial light. This equipment consists of a movable stand mounted on castors carrying an adjustable rack with five 1000-watt gas-filled lamps in porcelain-enameled angle-steel reflectors and a small adjustable stand with one 1000-watt similar unit to cut shadows. Diffusing screens of tracing cloth are provided for these light sources.

The dark or operating rooms are provided with small totally indirect units and ruby lamps for general illumination. Conveniently located local lamps with switch control are available for the examination of negatives and prints. A special printing light consists of a number of 60-watt tungsten lamps in a cabinet beneath the table so wired that any group of from two to eight may be turned on.

ILLUMINATION TEST DATA AND SPECIFICATION OF CONTROLLING CONDITIONS

	Dimensions, Ft.	Outlets per Bay	Size of Lamp, Watts	Watts per Sq.Ft.	Average Illumination, Foot-Candles	Utilization Constant	System of Lighting	Reflector Equipment	Catalog Number of Reflector	Type of Fixture
Office cafeteria	32x 76	4	100	1.0	6.3	0.51*	Semi-indirect	11-in. light-density bowl, opalescent reflector inverted	3031—11-in. Druid	Single-chain hanger—three small chains and hooks for glassware, brushed-brass finish
Factory restaurants	60x140 60x 60	1	200	0.5	3.7	0.50*	Direct	10-in. medium-density opal bowl reflector	01225—10-in. Sudan	Short-canopy-type ceiling fixture, brushed-brass finish
Private dining rooms	20x 76	4	100	1.0	5.3	0.42*	Totally indirect	Mirrored glass	X-ray 1321 W	14-in. cream-finish metal casing, single-chain suspension
General clerical office	56x 76	4	150	1.5	9.1	0.43	Semi-indirect	14-in. dense-opal bowl, reflector inverted	3031—14-in. Sudan	Single-chain hanger—three small chains and hooks for glassware, brushed-brass finish
Private office	30x64	4	150	1.5	9.0	0.42	Semi-indirect	16-in. medium-density, opalescent pressed dish	3027x16-in. Druid 161	Three-chain hanger, brushed-brass finish, lamp carried by silk-covered cord extending through hole in bottom of canopy
Private office	18x20	4	150	1.66	8.5	0.37	Semi-indirect	Ditto	3037x16-in. Druid 161	Ditto
Private office	28x20	4	200	2.1	12.9	0.41	Semi-indirect	Ditto	3027x16-in. Druid 162	Ditto
Private office	10x20	2	200	2.0	7.0	0.27	Semi-indirect	Ditto	3037x16-in. Druid 161	Ditto
Executive office	16x20	4	Three 75 W	2.8	8.3	0.24	Totally indirect	Mirrored glass	X-ray 413 A	19-in. composition-casing gold-bronze, light-verde antique finish, four chains
Executive office	16x20	4	Three 75 W	2.8	6.6	0.21	Totally indirect	Mirrored glass	X-ray 1573 A	18½-in. metal casing, brushed-brass finish, wine-colored silk stem and tassel

*These high utilization values are no doubt due to cross reflections from the white table tops.

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Exit Lights.—Over each exit is placed a simple bracket with a 10-watt tungsten lamp and a 6-in. (15-cm.) ruby inclosing globe properly lettered. At each fire alarm a conduit fitting carries a 10-watt tungsten lamp with green-glass-color cap. A similar arrangement is used to designate the location of the fire hose, save that red caps are employed. Watchmen's stations are provided throughout the building but are not denoted by special lighting.

MAINTENANCE OF THE SYSTEM

No matter how carefully an illumination system is designed and installed, if it is not well maintained it soon becomes almost worthless. Dirt and dust collect on the reflecting surfaces, and the lamp bulbs become blackened and burned out. Indirect systems, with their inverted bowls, are, of course, particularly susceptible to this effect. Even an almost imperceptible layer of dust will materially reduce the light output.

Owing to the shortage of labor and the confusion incidental to moving into a new building, the lighting system in certain rooms was neglected for a considerable period. Fortunately, the requirements for light during the long summer days are so slight that the net effect was not bad. Indeed, the condition gave an opportunity for obtaining excellent data on the results of inattention. The following tests are of interest. In each case the fixtures were uncleaned for a period of five months.

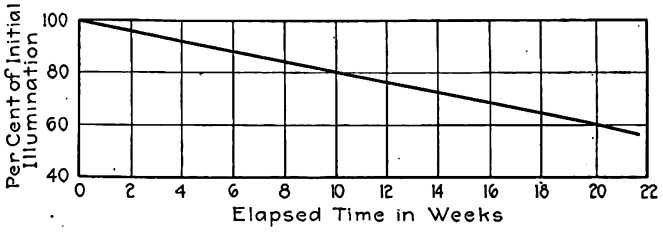

FIG. 4—EFFECT OF INATTENTION TO FIXTURE MAINTENANCE

Curve showing the acquired depreciation due to the accumulation of dust in medium-density semi-indirect units. (The shape of this curve obviously depends upon the type of reflector)

Totally Indirect Systems.—Tests in private dining rooms and executive offices showed an average depreciation of 55 per cent at the end of this period (*i.e.*, twenty weeks). After cleaning, further tests showed that approximately 15 per cent depreciation occurred in a four-week period.

Semi-Indirect System.—A series of tests in typical private offices equipped with the rather shallow medium-density semi-indirect units (pictured in Fig. 2F) indicated the results shown in the curve Fig. 4. This curve is an average of the several rooms, and it was rather remarkable how closely the individual tests followed the average. Tests of the deep, dense-opal semi-indirect units showed a smaller percentage loss. Whereas the shallow type had acquired depreciation of from 36 to 52 per cent at the end of twenty weeks, the deep type averaged in the neighborhood of 25 per cent. This difference was no doubt due to the fact that the steepness of the sides tended to cause the dry dust to slide down to the opaque cap covering the bottom opening.

An analysis of figures such as these readily shows the economics of cleaning. One can determine the cost of power per lumen or foot-candle of illumination and also the cost of labor for cleaning. With these two factors a set of curves can be plotted as follows: (a) Cost of cleaning versus elapsed time; (b) cost of energy wasted versus elapsed time. Curves A and B combined form a third curve which reaches a minimum. This value indicates the most economic period between cleanings.

At the present time a carefully supervised and regular system of maintenance is in force. This calls for the careful dry cleaning of all fixtures at least once a month and a thorough washing at greater intervals. This seems to be an economical scheme at the present time in view of the high cost of labor.

The author wishes to express his appreciation of cooperation on the part of R. E. Harrington of the illuminating engineering department, who had charge of all details of design and installation; of J. Wilson Ely, architect in charge; of A. A. Carey, who supervised the electrical installation, and of H. F. Barnes, who conducted the illumination tests.

MAKING A MARKET FOR CENTRAL-STATION POWER

Conditions in Manufacturing Centers and Possibilities for Development of Energy Sales by Encouraging Community Industries

BY L. W. ALWYN-SCHMIDT

This article, like the previous one by the same author in the issue of Feb. 1, is based on a statistical study.

OF THE population of approximately 21,000,000 living in the Middle Atlantic States, New York, New Jersey and Pennsylvania, 7,300,000 live in two cities, New York, and Philadelphia, and more than 10,000,000 in cities of more than 100,000 inhabitants each. This concentration of so large a part of the population in a comparatively small number of communities is the principal feature of power demand and supply in the Middle Atlantic States. It has created conditions which so far are not to be found in any other part of the United States. According to the latest industrial census, of the 48,203 industrial establishments of the State of New York 29,621, employing 550,962 hp., are in New York City; 2225, employing 152,338 hp., in Buffalo; 1244, employing 57,565 hp., in Rochester, and 742, employing 26,109 hp., in Syracuse. Seventy-one per cent of all the industrial establishments of the state therefore were situated in four of its largest cities. If to the four cities mentioned Schenectady is added, with its 61,584 hp., and Niagara Falls, with 139,085 hp., it appears that 42 per cent of all the power consumed in the state is consumed by six cities.

The same concentration in power demand is found in Pennsylvania. The city of Philadelphia has 8454 industrial establishments, employing 465,678 hp. Pittsburgh, with 1741 establishments, employs 308,823 hp.; South Bethlehem, 117,017 hp.; New Castle, 71,118 hp.; Reading, 47,702 hp.; Erie, 26,852 hp., and Pottsville, 25,978 hp. The total power consumption of the State of Pennsylvania is 3,549,858 hp. In New York State 48 hp. are used per industrial establishment, in Pennsylvania 128 hp. New York City uses 18 hp. per establishment, Philadelphia 55 hp.

The principal cause for the difference in the use of power by the individual establishment is the industrial composition of the two states. The industry of the State of New York is extremely varied. In fact, none

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of the other states can claim so diversified an industry.

The State of Pennsylvania leads New York in so-called heavy industries. The existence of cities like Pittsburgh, South Bethlehem and others in Pennsylvania will readily explain why this should be so. In fact, Pennsylvania produces approximately half of all the heavy iron manufactured in the United States, and its iron industry is a very heavy consumer of power. The blast furnaces of Pennsylvania in 1914 employed 477,588 hp., the steel works and rolling mills 1,270,642 hp. All in all, the iron industry accounts for more than half of the power demand of the state.

The vast iron and steel industry, with its great possibilities for the consumption of electric power, forms a special problem of the power market of Pennsylvania. Brent Wiley, in a paper before the Association of Iron and Steel Electrical Engineers, pointed out the rapid increase in the demand for electrical power coming from the steel works. In the period from 1905 to 1909 this totaled only 15,000 kw.; it rose during 1909-1913 to 30,000 kw., and it reached 50,000 kw. during 1915. Since then a rapid development has taken place. The rapid increase in the steel industry, and especially the increasing employment of electric furnaces, has led to a more extended reliance on central stations for power.

New Jersey, the third of the Middle Atlantic States, uses in her industries 793,063 hp., 94,605 hp. of which is rented from the central stations. The total consumption of electric power in the state rented and owned amounted in 1914 to 352,206 hp. New Jersey has few mines, and the mining industry therefore plays only a secondary part in its power demand. The state, however, has a large general industry. In the dyeing and finishing of textiles it takes first place among the states of the Union. New Jersey leads the states in the smelting and refining of copper.

That large mining field which exerts its influence on the power demand in Pennsylvania continues to West Virginia and Virginia. Industrially these states are not so fully developed as the more northerly states, although their industry is growing rapidly and has made big strides. The cotton industry, especially, is progressing rapidly, making use of the raw materials found in the immediate neighborhood.

The most important industry of North Carolina is the cotton industry. This is one of the cases where the raw material has attracted the industry. The state, in 1889 ranking still as tenth among the states of the Union as a cotton manufacturer, had reached in 1909 the second place and is making now 12 per cent of the total cotton goods manufactured in the United States. In this position it is followed closely by South Carolina, Georgia being fourth. In Maryland the canning industry has proved an especially good customer for the central stations. A promising consumer of power in Maryland is the large clothing industry.

There is no doubt that in future the industrial pressure will increase in the North, and that this will extend to the South more and more. The Middle and South Atlantic States will see a reorganization of industries. The industrial changes taking place in the large cities will be the deciding factor of this development in the North. The seven leading cities of New York State outside New York City added to their population 2.3 per cent in the period from 1915 to 1917, while New York City grew only 0.8 per cent. In Pennsylvania, on the other hand, conditions have favored Philadelphia. Changes have been less noticeable in the South Atlantic States, indicating a less abrupt industrial forward movement in these states as compared with the North.

With the attracting forces of such cities as New York and Philadelphia in the neighborhood, it must be the principal aim of all those interested in the extension of the power demand in the smaller communities of the North to concentrate their efforts as much as possible on retaining such labor as has gone to them. This can be done best by improving the facilities available for the existence of industries, by providing modern housing and healthful surroundings. In all these endeavors the electrical industry plays a considerable part. It provides not only cheap and sufficient power for the industries, but it also cares for the lighting of the streets and houses and makes for general comfort and labor saving in the house.

Outside this it appears that the further industrial growth of the Middle Atlantic States will proceed as a matter of course. The industries are well planted in these states, and there are hardly any industries existing which have not yet found a home there. Therefore little need be done to attract entirely new industries. The work will have to be concentrated rather on expanding those already existing. With the rapidly growing South as an immediate neighbor there is, however, the possibility that industries now established in the North may seek the Southern field for further industrial expansion. This has not been felt during the rapid increase in industrial activity in general. With less activity, however, there is a very decided possibility that industries will not only seek the convenient localities but will stretch a point in favor of cheap sites. The growth of industrial production in the Southern Atlantic States has proved that manufacturers have found many things in the South which have made it worth their while to establish plants there.

They have had a warm reception. The South has decided for itself on a policy which will be followed to attract new investors and industries by starting a fund which will be used for collective and sectional advertising. Keeping in mind the good results obtained in Baltimore, there is no doubt that further benefits should accrue by following such a policy. Certain specialized industries, such as the cotton industry, the clothing industry and others, create by their own existence a demand for auxiliary industries which so far is not filled sufficiently in the South.

The existence of the central stations in the growing cities of the North and South in itself is sufficient argument to attract industrial enterprises. With the possibility of great economic changes ahead of us the power stations should not rest content with the performance of their immediate duties but should also take an active part in any movement destined to bring new customers to their territory. No energy and money expended, of course, can change the basic industrial conditions of a neighborhood as to raw materials, transportation, etc. A full understanding, however, of these conditions will serve as a guide as to the further development of the existing tendencies so as to make progress more easy and profitable to all concerned.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

EMERGENCY METHOD OF HOISTING TRANSFORMERS

Fall Line of Hoisting Tackle Wrapped Around Hub of Truck Wheel, Which Was Raised from Ground and Driven by Automobile Engine

Arriving on a job where three 15-kw. single-phase transformers had to be raised to a platform to supply emergency service and being unable to perform the work with the equipment and help at hand, the method briefly described below was employed. Block and tackle were attached to one of the transformers and at a point above the platform to which the transformers had to be raised, and the fall line was given a couple of turns around the extended hub of one of the rear wheels of the truck which had been used to carry the transformers to the job. This wheel was then jacked up so that it could turn freely and the transformers were raised by using the wheel hub as a hoisting drum and throwing the transmission gear in the low-speed position. The transformer could be held in any position by means of the truck brake.

This scheme avoided considerable delay in giving service to the Carlsbad (N. M.) waterworks and was used by the Public Utilities Company, of which E. A. Roberts is manager.

NOTES ON EFFECT OF ASH ON BOILER EFFICIENCY

Reduces Heating Value, Increases Unit Coal Consumption, Requires Larger Boiler Capacity and Increases Freight Charges

Since many of the coals now available contain more ash than usual, some engineers may be interested in knowing its effect on the efficiency of combustion so that they may compare coals as to plant value. The accompanying tables applying to Illinois coal and anthracite culm may serve as a basis for such a comparison. The data on Illinois coal were presented several years ago by W. L. Abbott, chief operating engineer of the Commonwealth Edison Company, but still hold true as far as relative values are concerned. The remaining data were presented by George A. Orrok before the National Electric Light Association, and do not represent the results of systematic tests but the averages of many on flat grates and stokers.

TABLE I—INFLUENCE OF ASH IN ILLINOIS COAL ON CAPACITY AND EFFICIENCY OF 400-HP. B. & W. BOILER

Percentage Ash in Dry Coal	Hp.	Percentage Efficiency
9.00	690	61
16	620	57
20.5	570	54
24	515	51
30	385	44
35	227	30
40	0	0

The horsepower obtained in these cases depends on the ratio of heating surface to effective grate area, which should be as low as possible with the higher percentages of ash. When the percentage of ash is 35 or higher, considerable trouble is experienced in igniting the coal and also in keeping it ignited. The stoker arch greatly assists in this. With the increasing ash content the firing difficulties increase and the boiler output decreases until the fire goes out or the cost prohibits further attempts.

TABLE II—INFLUENCE OF ASH IN ANTHRACITE CULM ON BOILER EFFICIENCY

	Per Cent of Ash	B.t.u. in Coal	Equiv. Evap. per Lb. Dry Coal	Efficiency, per Cent	Lb. Coal per Boiler Hp.	Price per Long Ton	Fuel Cost per Kw.-hr. at 12.75 Lb. Steam per Kw.-hr., Cents
Buckwheat	16	12,200	8.14	64.5	4.24	$3.20	0.225
Rice	18	11,900	7.65	62	4.51	2.65	0.197
Barley	20	11,500	7.1	59.5	4.86	2.15	0.173
Culm	25	10,500	5.5	50.5	6.28	1.65	0.171
Culm	30	9,500	4.0	40.7	8.63	1.20	0.171
Culm	35	8,500	3.17	36	10.9	.90	0.162
Culm	40	7,500	2.2	28.3	15.7	.60	0.155
Culm	45	6,500	1.11	16.5	31	.35	0.179
Culm	50	5,000	.27	5.2	128	.25	1.430

SEVERELY DAMAGED LINE OPERATED FOR FIVE DAYS

Circuit of 33,000 Volts, Carrying 1500 Kw., Was Kept in Operation with One Phase Against Pole Until Light-Load Period Permitted Repairs

When an accident causing a "near" interruption of service happens to a heavily loaded outdoor circuit it is largely a matter of judgment based on experience whether the line should be de-energized at once to make repairs or whether it would be better to await a light-load period, taking chances that the damage will not result in an interruption to service in the meantime. As an incident that will add to the operating man's store of experience on this topic, Wiley F. Corl, general superintendent of the Southern Illinois Light & Power Company, St. Louis, Mo., has the following account to submit:

During a lightning storm on the Southern Illinois Light & Power Company's main Millsboro-Collinsville transmission line one of the poles was badly split so that the lower cross-arm carrying one conductor of the three-phase circuit swang out of line. This caused the conductor to come in contact with the pole. Although

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it was carrying energy at 33,000 volts, no interruption of service occurred in the five days that were allowed to pass before repairing the damage. It so happened that at the end of this period, which was Sunday, the load was lighter, and hence the consumers would be inconvenienced very little by interrupting the service to repair the damage done. The reason that the company considered it necessary to keep this damaged line in service so long was that 1500 kw. of power was being transmitted over it.

REMEDYING FLASHOVER AT THE ROTARY RINGS

Barriers Are Placed Between Rings, Brush Yokes Are Made Firm and a Piece of Graphite Is Dovetailed in Brushes

BY GEORGE A. ILER
Superintendent Operation, Georgia Railway & Power Company

A 2000-kw. railway rotary of a reliable design had been flashing from alternating-current rings to ground and from phase to phase, with the usual results of melted brass and iron, damaged brushes and ruined pigtails, when the writer commenced an investigation of the cause of the trouble. Every electrical test was made that could have a bearing on the case, with the hope of finding bad surges, transformer trouble, sudden overloads, etc., but nothing of this nature was found. Besides, this rotary operates from the same alternating-current source and set of high-tension cables that other rotaries in the same station are connected with and no trouble whatever is experienced from the others.

Next, transformer cores were pulled out of the oil for careful inspection; low-voltage compression chamber arresters were connected from phase to phase next to the alternating-current rings in order to drain or equalize any high-frequency current that might thereafter build up; field circuits were tested, also the air gaps; recording instruments were placed in field circuit and main circuits to see what would happen at the time of flashover. It seemed that others had made the same careful search before, including the manufacturer's representatives, with no results. The case was still more perplexing when it was known that there were two of these machines, exactly alike but in separate stations, operating at about three-quarters full load, and that one of them ran year in and year out with no trouble and as a result received less attention than the other.

At this point in the investigation a boy was placed right at the machine to observe what happened so far as his untrained eye could grasp it. Here is what developed:

With no electrical reason that was known of, one of the alternating-current metal and carbon composition brushes would start a very small spark, and in three minutes it would be shooting long streamers of sparks at a tangent to the ring, and in ten minutes the rings flashed over. Barriers were then built up between the six rings with a composition of tape and asbestos to close off the air blast and dust traps. This helped considerably. Next a slight vibration of the top ends of alternating-current yokes was stopped by tying them fast to the bearing pedestal cap with an insulated rod. It was then discovered that the bearing and all that was attached to it vibrated slightly. This was stopped by a brace made of 2½-in (6-cm.) pipe completely hidden from view.

Since then the rings have showed a slight sign of distress by blackening at spots, so one of the six large brushes on each ring was removed and a piece of very soft graphite was dovetailed into the face of it to lubricate the ring in order to allow more brush tension without cutting. This has stopped the black spots on the rings.

A note of warning must, however, be sounded here in regard to graphite. If too much graphite is used, a heavy film will build up on the rings and brushes, reduce the current-carrying capacity per square inch of brush contact and cause heating and sparking. Since the metal and graphite brushes are self-lubricating, very little, if any, added lubricant is needed, and liquid or plastic lubricants should not be used except in the hands of an experienced attendant.

OPERATING COSTS OF AN EASTERN CENTRAL STATION

Itemized and Presented in Relative Values for Conditions as They Prevailed During Latter Part of War

Some indication of the effect of war conditions on operating costs is afforded by the accompanying data, which apply to the power plant of the Elmira (N. Y.) Water, Light & Railroad Company. Of course, the effect of conditions on fixed charges is not shown nor the relation of operating expense to fixed charges, but still the figures would show, when compared with similar figures for the period preceding the war, that labor and coal expenses became very much larger per kilowatt-hour. Since modern stations such as that at Elmira are operated at the top notch of economy anyway, these increased expenses can be offset only with difficulty so far as changes in operating methods are concerned. More careful attention to the maintenance of equipment, distribution of loads so that apparatus will be worked at the best economy, education of station attendants, interconnection of plants, etc., are among the methods which give promise of the best returns.

OPERATING COSTS AS AFFECTED BY THE WAR

	Cost per Kw.-Hr.	Per Cent of Total
Coal	0.48	83.700
Superintendence	0.01048	1.825
Wages	0.0337	5.880
Repairs:		
Miscellaneous station	0.0000315	0.005
Coal and ash-handling equipment	0.003824	0.665
Boiler apparatus	0.0032	0.560
Building	0.0003825	0.065
Steam equipment	0.01143	2.000
Electrical equipment	0.00368	0.625
Furnaces and boilers	0.01838	3.175
Oils and waste	0.00485	0.847
Tools and appliances	0.0000836	0.015
Miscellaneous station expenses	0.0022	0.384
Water	0.002742	0.478
Total	0.574	100.00

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PROFITING BY ADVERTISING DEVOTED TO GOOD WILL

Louisville Company Emphasizes the Part That Is Played by Electricity in Building and Making Attractive the Home Town

The Louisville (Ky.) Gas & Electric Company has recently been doing some peace-time and good-will advertising. Gas shortages have occurred in Louisville, and naturally the company did not find that an increase in the good will felt toward it resulted. On Jan. 1 a full-page advertisement was printed in a number of papers emphasizing the service feature of the electric branch of its business. The advertisements were headed by a good-will message—"Service that makes Louisville bigger—brighter—busier." Then a picture of the generator room was shown, and beside it was this statement, again emphasizing service:

"Here is a picture of a row of giant turbo-generators located in the power plant of the Louisville Gas & Electric Company that are working day and night faithfully, patiently turning out energy which spells ease, comfort and industry to the people of the city of Louisville. They take no vacation and get no sleep, but are always ready to respond instantly to the pushing of the switch in our homes or the throwing of the lever in our factories."

The rest of the page is devoted to an argument showing the advantage of taking electric service at the present time.

EXCELLENT POWER BUSINESS IN 1918 AT PROVIDENCE, R. I.

Contracts Amounting to 19,568 Hp. Were Secured by the Central-Station Company—Motor Sales Increased by 39 per Cent

The power division of the sales department, Narragansett Electric Lighting Company, Providence, R. I., had one of the best years in the history of the organization in 1918, despite the fact that fewer salesmen were employed. In January, 1918, there were five power salesmen in the department, and by September but one was left. During the year power contracts amounting to 19,568 hp. were secured, with an estimated annual income of $285,182. There was an increase in gross motor sales of 39 per cent, those for 1918 totaling $121,769, and the 1918 profit was $25,733 compared with $20,345 for 1917. The actual income from commercial power amounted to $839,305 for 1918, against $545,688 for the year 1917, or a 53 per cent increase.

The following steam plants were discontinued during the year: Ostby & Barton, 200 hp.; Imperial Printing & Finishing Company, 270 hp.; United Lace & Braid Company, 250 hp.; Boston Wire Stitcher Company, 110 hp.; National India Rubber Company, 2000 hp.; total, 2830 hp.

The following new contracts have also been signed, thus preventing the installation of new power plants: Revere Rubber Company, plant No. 2, 10,000 hp.; Lord Construction Company, 75 hp.; Bethlehem Shipbuilding Corporation, 300 hp.; Lynn Rubber Company, 100 hp.; Providence Theater Company, 125 hp. Three contracts aggregating 925 hp. were also received from concerns now operating steam plants, and in addition the Warren Manufacturing Company signed a contract for an ultimate supply of 4000 hp.

EACH COMPLAINT SHOULD BE ENTERTAINED INDIVIDUALLY

Routine Methods of Treating Dissatisfied Customers Are Condemned by the Public Utilities Commission of Illinois

To each utility in the State the Public Utilities Commission of Illinois is sending a letter on "war quality" service and customers' complaints.

The purpose of the commission in sending this letter is to bring home in a forceful way to the operating heads of utilities the importance of giving to each complaint an individuality of its own. Individual consideration does not mean the official attention of a responsible executive officer of the company, but means that each complaint upon entering the office should acquire a "personality." The commission's whole idea is that from the consumer's standpoint his complaint, instead of being received as one of a thousand during the month, should be accepted as the only complaint against the public utility service which has been lodged. While there are many consumers who are habitual complainants, such consumers as citizens of the community do not exercise great influence. The vast majority of complainants are sincere, and to them each complaint is a matter of sufficient importance to lead them to go to the trouble of visiting the company's office, writing a letter or telephoning about it. Even though its tenor may be the same as that of other complaints which have been received that day by the company, there are certain individual circumstances which make this complaint different from any of the others.

If the company, in passing its opinion regarding the matter, gives no attention to these individual circumstances, such a lack of attention is apparent to the consumer, and he feels that his complaint has been classified in the machine routine of the office and that the details which to his mind are important have had no consideration.

The commission cannot see how this situation can be overcome unless the responsible operating officials occa-

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sionally take time and give thought to the entire situation. In the case of an individual community of 5000 population such complaints usually receive careful consideration. In the case of a company operating in a large number of such communities the problem is in no way a different one, but is simply the same problem multiplied by the number of communities which the company serves. The utility would not think of neglecting the operation of any station because of the complexity of its system, but if it neglects the handling of its complaints in a satisfactory way, this amounts to an actual decrease in the quality of service rendered by the company.

THE LETTER FROM THE COMMISSION

The letter sent out by the Public Utilities Commission follows:

As a result of the commission's experience extending over a period of five years in meeting various problems involving the relations of public utilities with the public, we have become very strongly impressed with the large influence which the quality of service rendered and the methods of handling complaints exert upon the character of this relationship with the public.

During the recent times of stress, with the attendant scarcity of labor, there has been a tendency on the part of utilities to decrease the standard of service rendered, possibly with a view to more economical operation and possibly because of inability to supervise adequately the work of strange employees necessarily employed. In so far as such a policy may have been intended, we believe that it is most unwise, and that instead of operating to relieve the utility of its burdens it will greatly increase them. We have seen this repeatedly proved during the past year.

Through the handling of complaints most utilities find their only opportunity of meeting their consumers. This is unfortunate, because the utility gains its impression of its consumers through these complaints, which are often presented at times when the consumer is vexed, and, on the other hand, the consumer gains his impression of the utility through the methods by which the complaint is handled.

With the utility the handling of complaints is a routine transaction which occurs with regularity, and the employees engaged upon this phase of the work come to regard the complaints merely as a part of the company's routine which is capable of being handled by routine methods, in much the same manner that material is passed through the stockroom. With the consumer, however, a complaint is not a routine matter, but represents to him a real grievance. In other words, utilities are apt to regard a complaint as lacking individuality, while from the consumer's standpoint each complaint has a very distinct individuality and stands out in his mind as a particular situation which merits individual attention.

We have been frequently impressed with the fact that if a utility is willing to accord to each complaint an individuality and give it a just investigation, both from the consumer's and the utility's viewpoint, the complainant is well satisfied and, as a result of his contact with the company, has an appreciation of its human characteristics and a regard for its sincerity of purpose. A routine reply to some classes of complaints may be suitable, but its routine nature will usually impress the complainant unfavorably.

The problem as to the future of public utilities is one which occupies considerable attention in the public mind to-day and is one which is of vital importance to the utility and to the public. We believe that much of the criticism directed against utilities and which, in a certain measure, reacts against the regulatory bodies charged with their supervision might be relieved by a broad-minded policy of handling complaints in which each case is treated as an opportunity for acquaintanceship with the consumer and each complaint is given an individuality and impartially investigated.

SEPARATE ORGANIZATION TO HANDLE ELECTRIC HEATING

Emphasis Placed on Necessity for Special Training in Order that Heating Salesmen May Have Sufficient Knowledge of Applications

With the same enrgy devoted to the development of the industrial heating load that was given in the development of the motor load, greater progress can be made in less time, according to a statement made by Wirt S. Scott of East Pittsburgh before a recent meeting of the new-business men of the Ohio Electric Light Association.

In part Mr. Scott said:

The industrial heating load is not a load which will necessarily come on top of the motor load. At present many of the power plants are struggling along during the day to carry the motor load, while at night the load is relatively small. In the majority of cases the heating operations in an industrial plant may be carried on entirely independent of all other operations; consequently in addition to the certainty of securing this enormous load there is also the possibility of having it regulated so as to come on the power plant at all the valleys that occur in the power curve.

The industrial heating load is so diversified that it is possible to find a load which will fit in any valley of any power curve. Even the noon-hour off-peak period can be utilized for some specific operation which can be done at that time just as well as it can at some other period of the day.

Many cases have come to our attention recently where the customer who was willing to electrify and had been turned down by the central station on account of the overload condition of the power plant during the daytime jumped at the chance to operate at night. In every case it had not occurred to the customer that the central station possibly could perform his particular heating operation at night just as well as during the day, and at much less expense, since the fixed charge for the power in many cases was taken care of by the day load, the night load being therefore obtained by the central station on a straight energy-cost basis.

In the development of the motor load it was necessary for the central station to have specially trained men who could talk intelligently to the prospective customers and who had sufficient knowledge of motor application work to be able to secure the necessary data, so that either by their own knowledge or through a source of information they knew to be available, either in their own organization or in that of an electrical manufacturing company, the salesmen could go back to the customers with the correct answer. Just as this was true of motor application work, so it is true of industrial heating.

In order to develop the industrial heating load a vast amount of missionary work must be done, and the sooner these initial stages are passed just that much sooner will the central stations begin to reap the benefit of their efforts.

But to do good missionary work one must have something definite to exploit, and in this case there must be apparatus available for applications with which the power solicitor will come in contact. Several of the larger electrical manufacturing companies have formed industrial heating departments for the development of industrial heating and are bending their efforts to the development and manufacture of new and suitable apparatus. New ideas and applications are springing up so rapidly that it is now a matter of selecting only the ones that offer the widest field.

However, those applications that appear to be of a special nature to-day may be placed in a general class to-morrow, and the apparatus developed for some specific application perhaps may be used in very large quantities in applications altogether different from that which was originally intended.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Three-Phase Transformation with Single-Phase Transformers.—E. G. REED.—The discussion relates to the vector relations of the voltages and currents and the size of transformers necessary for connection in star and delta for speed connections and interconnected star.—*Electric Journal,* December, 1918.

Diagram of Asynchronous Polyphase Motors Which Takes Account of Magnetic Saturation.—J. BETHENOD.—Previous circular diagrams for asynchronous motors have not taken notice of magnetic saturation. To accomplish this the author gives in reality two diagrams—one an approximate diagram in which he supposes that the various fluxes reduce themselves to one common flux and to two leakage fluxes proportional respectively to the stator and rotor currents, and the other an exact diagram which takes account of the real conditions of performance.—*Revue Générale de l'Electricité,* Dec. 21, 1918.

Excitation Characteristics of Alternators.—Q. GRAHAM.—The author takes up the effects of load and power factor on the excitation characteristics of small belt-driven alternators, those directly connected to moderate-speed engines, waterwheel generators and the high-speed turbo-generators.—*Electric Journal,* December, 1918.

Generator Testing.—OTTOMAR H. HENSCHEL.—The writer gives methods of caring for generator operations and gives some methods of measuring losses and governing regulation.—*Power Plant Engineering,* Jan. 1, 1919.

Generation, Transmission and Distribution

Testing of Coal.—HENRY KREISINGER.—Simple tests that may be easily made with inexpensive apparatus are described for the determination of the quality of coal supplied to a plant.—*Power Plant Engineering,* Jan. 1, 1919.

Utilization of the Tides for the Production of Motive Force.—E. MAYNARD.—Last installment of this continued article. The author concludes from his investigation of three experimental installations situated at advantageous points in the bays of Rothéneuf, de La Rochelle and the Rance Maritime that power can be obtained from the tides more advantageously than from high mountain falls. Such installations would reach points that are inaccessible to other hydroelectric stations and would result in a large saving in coal.—*Revue Générale de l'Electricité,* Dec. 28, 1918.

Design of Porcelain Insulators from the Ceramic Standpoint.—G. I. GILCHRIST and T. A. KLINEFELTER.—Suggestions are given having for their object the production of a uniform and reliable porcelain product for insulators.—*Electric Journal,* December, 1918.

A New Hydroelectric Installation at St. Gall, Switzerland.—Description of a new form of turbine and regulator. The turbine, rated at 2500 hp., is of especially compact build. The results achieved are stated.—*Revue Générale de l'Electricité,* Jan. 4, 1919.

Boiler-Room Inspection.—ROBERT H. KUSS.—The author states the objects of inspection, the points to be given attention and indications of waste during operation.—*Power Plant Engineering,* Jan. 1, 1919.

Aluminum in the Electrical Industry.—E. DUSAUGEY.—Reprint of a paper read before the French Society of Electricians containing an extended account of the properties of aluminum and of its suitability both for conductors and in other applications—*Revue Générale de l'Electricité,* Jan. 4 and 11, 1919.

Keeping Track of Boiler Performance.—H. A. WILCOX.—Under this title are discussed weighing of the coal, metering feed water, measuring draft, analyzing flue gas and working the data into useful form.—*Power Plant Engineering,* Jan. 1, 1919.

Bonuses for Coal Economy in Steam Stations.—M. GROSPAUD.—The author thinks it illusory to try to bring about economy in the production of energy by paying bonuses to the firemen according to the amount of coal used. A more rational method, and one on which a system of rewards could also be based, lies in the scientific and methodical control of the furnace to the end that the most kilowatt-hours possible for a given consumption of coal shall be had.—*Revue Générale de l'Electricité,* Jan. 11, 1919.

Steam-Turbine Progress Reviewed Historically.—FRANCIS HODKINSON.—Starting with the early types of Parsons and De Laval turbines, the author leads up to the modern plant, indicating the great improvement.—*Central Station,* November, 1918.

Steam Turbines.—A. D. BAILEY.—In this paper are given methods of determination of the water rate of steam turbines.—*Power Plant Engineering,* Jan. 1, 1919.

Saving the Waste in the Chimney.—ROBERT SIBLEY and CHARLES H. DELANY.—This is the second article of a series on this subject. In this installment it is shown how to compute mathematically the draft that will prevail in a chimney of given height, at a given altitude above sea level when the entering and exit temperature gases are known.—*Journal of Electricity,* Dec. 1, 1918.

Installations, Systems and Appliances

The Liberty Mill of the Carnegie Steel Company.—C. A. MENK and F. L. HUNT.—This mill was built in the short period of six months. In the Liberty mill not only are the main rolls and tables motor-driven, but also all auxiliaries such as pressure pumps, compressors, etc. Power for the operation of this mill is obtained from a gas-engine-driven power plant at the

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Carrie furnaces, the blast furnace connected with the Homestead plant and located on the north bank of the Monongahela River about two miles further up. Data on the building and equipment are given in this article. —*Electric Journal*, December, 1918.

Electrical Equipment for Oil Wells.—H. D. JAMES and W. L. HARTZELL.—In this article are considered the characteristics of the induction motor and various methods of control and their protection in the oil-pumping service.—*Electric Journal*, December, 1918.

Testing Reciprocating Pumps.—R. E. TURNER.—The writer discusses inspection to discover faults in erection, location, adjustments and accessories and the tests that should be made to indicate where losses occur in operation.—*Power Plant Engineering*, Jan. 1, 1919.

Review of Electric Arc Welding.—JOHN A. SEEDE.—Mr. Seede outlines the evolution of the present practice of arc welding, starting at the time when the weld material was deposited by being fed into a long arc drawn by a carbon electrode. He then traces the progression of the art to its present-day status and gives especial consideration to the subjects of carbon electrode welding, metallic electrode welding, electrodes, fluxes, holders, alternating-current arc welding, automatic welding, and the apparatus employed.—*General Electric Review*, December, 1918.

Tracing Losses in Centrifugal Pumps.—O. H. DORER. —The author points out where to look for trouble and outlines the tests that should be made and the plotting of the results.—*Power Plant Engineering*, Jan. 1, 1919.

Synchronous Condenser in Fuel Conservation.—L. N. ROBINSON.—To attain the 80,000,000 barrels of fuel oil for the propulsion of our new merchant marine vast conservation of power is necessary. In this article a constructive suggestion is given that offers a wide field of possibility in attaining a saving on a great scale.—*Journal of Electricity*, Nov. 15, 1918.

Electric Welding at Erie Works of General Electric Company.—H. LEMP and J. R. BROWN, JR.—The contents of this article indicate that the electrical manufacturers' recommendation that electric welding be applied to other lines of manufacture and construction is backed up by a record of successful development of the processes and application of them to the electrical industry.—*General Electric Review*, December, 1918.

Grading of Direct-Current Starter Resistances.—PERCY H. JACKSON.—The writer bases his calculations of resistance steps for a direct-current motor upon the following considerations: (1) The maximum value of the current peaks when switching on or from contact to contact must not exceed 150 per cent of the rated full-load current of the motor. (2) The grading must be in the form of a geometrical progression. (3) In order to reduce to a minimum the flashing between contacts, the spark volts must be limited to a predetermined value. (4) The current allowed to pass on the first contact must be such as will avoid excessive flashing when switching off.—London *Electrical Review*, Nov. 22, 1918.

Saving the Waste with an Electric Furnace.—C. B. MERRICK.—The installation of an electric furnace which has more than met expectations. Not only does it admirably serve the purpose for testing out special grades of iron, but it adapts itself readily to the utilization of waste materials and is largely fed on scrap iron from the shops. The resultant product passes a very satisfactory test.—*Journal of Electricity*, Jan. 1, 1919.

Arc Welding in Railroad Shops.—B. C. TRACY.—The author describes some of the more important applications of the electric weld in making locomotive repairs. Results shown would indicate that in the near future the subject must be given serious consideration by the railroads, not only from an economic viewpoint but also with the object of increasing our transportation facilities while new equipment is being built.—*General Electric Review*, December, 1918.

Electrically Driven High-Lift Centrifugal Pumps Supply Water for Irrigation.—B. P. FLEMING.—In this paper is discussed the supply of water for irrigation purposes in the vicinity of Lewiston, Utah. It is stated that some tests show over 81 per cent efficiency under 90-ft. (27-m.) head.—*Engineering News-Record*, Jan. 9, 1919.

Electrically Welded Freight Car.—JOSEPH A. OSBORNE.—The gondola car described in this article was constructed largely by electric spot welding seven years ago, and since its completion it has been in constant use. The results accomplished by the builders appear remarkable when we consider that there was no precedent by which to be guided. The work involved even the design and construction of a large spot welder, as no apparatus of sufficient capacity was to be found on the market at that time. The service record of this car demonstrates fully the practicability of electric spot welding for railway car construction, and in the words of the author, it is to be hoped that the adoption of the electric welding process in this field will not be delayed longer.—*General Electric Review*, December, 1918.

Electrochemistry and Batteries

Industrial Electrochemical Production.—JEAN ESCARD.—A study of the various nitrogenous products of electrochemistry, their mode of manufacture and their utilization. In the first part the author deals at length with nitric acid and its derivatives, the principle of its manufacture, the obtaining of oxides of nitrogen, their transformation into industrial products, and furnaces and processes for producing synthetic nitric acid. The second part deals with calcic cyanamide and metallic-nitrogenous compounds.—*Revue Générale de l'Electricité*, Dec. 21 and 28, 1919.

Production of Cyanamide and Nitrogenous Fertilizers in France.—It is estimated that 300,000 metric tons of cyanamide may be produced in 1919 in France, largely for agricultural use, a matter of much interest to electrochemical plants, for which the production of cyanamide serves as an outlet against excessive manufacture of carbide of calcium.—*Journal du Four Electrique*, Jan. 1, 1919.

Metallurgy of the Arc Weld.—W. E. RUDER.—The microscope has played an important part in the study of the internal structure of steels and other metals. However, the mere inspection of a few photomicrographs by the untrained eye will reveal nothing of value; it is only through an intelligent study of these magnified structures in conjunction with the test performances of the sample that any useful knowledge can be derived from microphotographs of specimens of unknown properties. It is only natural to find that the microscope has given

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us considerable information respecting the character of electric arc welds and of the factors that are responsible for successful and unsuccessful results. The considerations that have an important bearing on electric welds as revealed by the intelligent use of the microscope are given in this article.—*General Electric Review*, December, 1918.

Annual Report by the Director of Mines to Secretary of the Interior.—This report includes a discussion of the uses of gases in warfare, war investigations of minerals, organization of the Bureau of Mines, metallurgy development and investigation, and petroleum divisions. The administrative work of the bureau is also given in the report, which covers the fiscal year ended June 30, 1919.

Notes on Electrical Precipitators.—ERNEST EDGAR THUM.—The article contains a summary of observations taken from several installations showing the expanding scope of the process. It is pointed out that power consumption, voltage, velocity and temperature of gases must be experimentally determined for service of this kind.—*Chemical and Metallurgical Engineering*, Jan. 15, 1919.

Units, Measurements and Instruments

Design and Test of Standards of Mass.—The third edition, superseding the second edition, which was entitled "Verification of Standards of Mass" and issued Jan. 10, 1907, contains classification of weights, high-precision commercial standards, precise commercial standards, commercial test weights, high-precision laboratory standards, analytical and similar laboratory weights, notes on the design and construction of weights, testing of weights, buoyant force of the air and regulations governing the testing of weights. The appendix contains tables of practical use and mass conversion tables for the English and metric systems.—Publication of the Bureau of Standards.

Measurement of Stack Heat Losses.—J. H. BLAKEY.—The writer describes an electrical device for which he claims simplicity and accuracy for use in the measurement of stack losses.—*Power Plant Engineering*, Feb. 1, 1919.

Some Tests with Flow Meters.—JOSEPH A. MAGUIRE.—The author points out that in making tests of a steam generating plant the use of the flow meter made possible the elimination of wastes that were unsuspected.—*Power*, Jan. 28, 1919.

Telegraphy, Telephony and Signals

Note on the Production of Continuous Electrical Oscillations by the Three-Electrode Valve.—E. V. L. APPLETON.—The three-electrode thermionic valve, when functioning as a generator of continuous electrical oscillation, may be regarded as a tube possessing a negative resistance. Its action is thus analogous to the action of other continuous oscillation generators, such as the Poulsen arc and the dynatron. The device is used in radio-telephony.—London *Electrician*, Dec. 27, 1918.

New Vacuum Tube.—In this article is described a new vacuum tube, a recent development by Dr. Irving Langmuir, in which the filament is heated by potassium, sodium or other metal which emits electrons when illuminated.—*Wireless Age*, January, 1919.

Miscellaneous

Power-Plant Management.—ROBERT JUNE.—In this article the author discusses the use of the instruments in checking power-plant operation.—*Central Station*, November, 1918.

Annual Report of the Director of the Bureau of Standards to the Secretary of Commerce.—The functions of this report are to consider development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce. Under the heading "Electricity" the scope of electrical work accomplished by the bureau is discussed and mention is made of special military work in electrical subjects. With the exception of necessary work and routine testing, two important sections of the bureau—namely, the standards of resistance and the inductance and capacity sections—have devoted practically all of their time during the war to urgent military problems of a confidential nature. Electrical measuring instruments, the testing of electrical instruments, a new deflection potentiometer, instrument transformers, methods of testing the electrical properties of transformer oils, electric blasting machines, ignition in gasoline engines and mica for electrical purposes are outlined briefly. The measurement of magnetic properties of materials and the design and calibration of magnetic instruments and appliances, including compasses and magnetic analysis, are discussed. Photometry and illuminating engineering in its relation to military work are described in this report. A new radio building and equipment, and circulars on radio instruments and measurements, use of closed-coil antennas, insulating materials for radio apparatus, miscellaneous testing, calibration and designing of radio instruments and vacuum-tube apparatus show the work of the bureau in radio communication. Other subjects considered in the report are electrochemistry in its relation to electric batteries and miscellaneous electrochemical work, radio activity and X-ray measurements, public utility standards (relation of the bureau of municipalities and public service commissions), gas engineering, electrical service standards, electrical safety engineering, electrolysis prevention, telephone service standards, heat and thermometry, optical instruments, structural, miscellaneous and engineering materials, metallurgy and ceramics.

Second Annual Report of the Council of National Defense.—Comprehensive outline of the work of the Council of National Defense for the fiscal year ended June 30, 1918.

Books Received

STEAM ENGINES. By E. M. Shealy. New York; McGraw-Hill Book Company. 290 pages, 173 illustrations. Price, $2.50.

AMERICAN METHODS IN FOREIGN TRADE. By George C. Vedder. New York: McGraw-Hill Book Company, Inc. 204 pages. Price, $2.

ELEMENTS OF THE ELECTROMAGNETIC THEORY OF LIGHT. By Ludwik Silberstein. London, England, and New York: Longmans, Green & Company. 48 pages. Price, $1.25.

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Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

FLUX DISTRIBUTION BETWEEN SEGMENTS OF TWO ECCENTRIC CYLINDERS.

This problem finds its application in the computation of the magnetic permeance of the air gap of an electric generator or motor, and also in electrostatic design; for example, in an umbrella-type spark gap. The problem has been solved by finding the proper form of conjugate functions which satisfy the boundary conditions. A similar problem for complete cylinders is solved in Webster's "Electricity and Magnetism." —*James McMahon, Cornell University, Ithaca, N. Y.*

FUSE CUT-OUTS, OIL-IMMERSED.

One cause of the uncertainty of operation of some large inclosed fuses designed for 2000 volts or more lies in the porous filling used to suppress the arc. Under certain conditions of elevation of temperature this filling becomes a conductor, sometimes termed the "Nernst effect," and its effectiveness as an arc-suppressing material is thereby destroyed. Exhaustive investigations have shown that most of the materials suitable for use as a porous filling are affected in like manner. As a result a cut-out has been developed in which the fusible strip is placed under oil. The fuse link is under mechanical tension; on blowing, the ends are suddenly separated under the oil, and the arc is immediately extinguished without disruptive disturbance. The homogeneity of the oil permits very close rating of the fuse. An important feature is the protection of the lineman in re-fusing a circuit, since many accidents and deaths have resulted from throwing in a new fuse on a short-circuited line. These devices have been developed for use at 2200 volts to 13,000 volts and with currents of 1 amp. to 300 amp.—*L. W. Downes, Providence, R. I.*

GENERATOR FOR PULSATING CURRENTS.

A pulsating emf. may be generated by means of a radial-type homopolar machine. The disk should contain a number of slots the size of which should be equal to the cross-sectional area of the pole pieces. The collecting brushes should be mounted in the same manner as used on all homopolar machines. The writer has built such a machine and has found it to give fair results. Such a machine should be of use in medical treatment where pulsating currents are used to a great extent.—*Samuel D. Cohen, Brooklyn, N. Y.*

HEAT TRANSMISSION AND SURFACE ROUGHNESS.

The effect of surface roughening on the heat transmitted from hot bodies to fluids flowing over them has further been studied, with some unexpected results. It was observed that with the degree of roughening obtained with the aid of a screw-cutting tool in the case of 1½-in. (2.9-cm.) brass pipe the heat transmission per unit of surface per degree difference of temperature between the metal and the water could be increased in the ratio of about two and a half to one for the same mean velocity of flow. The rule of Reynolds that the heat transmitted from a hot surface to the fluid moving over it is proportional to the frictional resistance between surface and fluid was thus practically confirmed.—*Dr. Stanton and Miss D. Marshall, National Physical Laboratory, Teddington, England.*

OSCILLATIONS, LINEAR-SINUSOIDAL TYPE.

The mathematical theory has been developed of an electric circuit which can act as a source of high-frequency oscillations. A condenser is charged from a direct-current source and is discharged through a vacuum tube which contains a gas at low pressure and which allows the current to pass in one direction only. Suitable inductances are provided in the battery circuit and in the oscillating circuit. With this arrangement the voltage across the condenser varies practically as a linear function of the time during part of a complete oscillation and varies according to the sine law for another part of the oscillation. Such an oscillator is of particular advantage on ships where the source of electrical energy is a low-potential direct current. The principal difficulty to overcome is to keep the discharge frequency constant at high frequencies. An apparently practical method for accomplishing this result has been theoretically developed by the writer and will be described later. —*Henry G. Cordes, Bremerton, Wash.*

PHOTOMETER, INTEGRATING.

Satisfactory methods had to be devised for the photometry of gas-filled lamps. The ordinary step-by-step method is slow, particularly when the lamp cannot be rotated, and for most purposes a knowledge of the average candlepower is all that is wanted. This can be done with the aid of the integrating photometer box suggested by Dr. Sumpner. It is a room rather than a box and should be spherical instead of cubical. The internal walls of the room are painted dull white; the lamp under test, which may be a searchlight, is mounted or suspended in the box, and the beam passes out through a window in one of the walls, outside of which the photometer bench is mounted. In order to be able to examine the crater of an arc separately from the arc, the rays from the crater are reflected by mirrors through a second window so as to fall outside on the diaphragm disk of a second bench. This disk has a hole in the center and the light spot is, by a lens, magnified to cover the photometer disk. Light filters and standard vacuum lamps running at normal temperature are used in the measurements, but we are not satisfied with the arrangements, and these will be perfected as soon as conditions permit. Searchlight carbons are also under examination.—*C. C. Paterson, A. Kinnes, J. W. T. Walsh and Dr. Norman Campbell, National Physical Laboratory, Teddington, England.*

STANDARD CELLS.

Some Weston normal cells have been constructed and the laboratory standards of electromotive force have been compared with the standards of Japan. Dr. Yokoyama having brought three normal cells over to Teddington for this purpose. These cells, made in March, 1916, contain a 10 per cent cadmium amalgam, and the mercuric sulphate was prepared electrolytically. They agreed with the National Physical Laboratory standard cells within seven, two, four parts (average four in a million), which is very satisfactory. The agreement of four other cells with a 12.5 per cent amalgam, which were made by Dr. Shimidzu at Teddington in 1910, according to the instructions of the laboratory (mercuric sulphate prepared by a chemical process) and which have remained at Teddington since, is not now quite so satisfactory. The preparation of the mercuric sulphate and the composition of the amalgam gave rise to long-continued international researches before the war. —*F. E. Smith and H. C. Napier, National Physical Laboratory, Teddington, England.*

Suggestions for Research

AMMETER WITH MULTIPLE SHUNTS

There is a high-grade laboratory-type direct-current ammeter of foreign make in which external shunts of different range are introduced by simply turning a handle. In so far as the writer is aware, no such instrument is made in this country, and it would be a great convenience for research and testing purposes if one were developed and marketed.—*William L. DeBaufre, U. S. Naval Engineering Experiment Station, Annapolis, Md.*

INTERRUPTIONS IN SERVICE; AUTOMATIC RESTORATION.

When an accidental short circuit or an arc occurs in a power network and line switches begin to open feeders, the operator has a number of things to do quickly and in a definite succession. In order (a) to prevent confusion, (b) to restore the service in a minimum possible time, and (c) to reduce undue stresses on the equipment, it is desirable to have an automatic emergency device which would perform certain duties ahead of the human operator as soon as the conditions become abnormal. Such a device may consist of a controller or a dial with various contacts, the shaft being driven by a small motor. As soon as trouble occurs a relay starts the motor and the controller trips generator field switches, closes them again after a few seconds, introduces some resistance into the voltage regulator circuit, and performs such other operations as are necessary. A simple device of this kind has been described by F. E. Ricketts in the A. I. E. E. *Proceedings* of 1916, page 931, and a further development is very much desired, to take care of more complicated cases of interruptions.—*Editorial Suggestion.*

LIGHTNING ARRESTER.

I hope to see an arrester, of the type of the oxide film or the aluminum cell, which has no spark gap, but is permanently shunted across the circuit and is capable of taking care not only of over-voltages but equally well of steep wave fronts and high-frequency oscillations, even if of lower than the circuit voltage. Such an arrester would give universal protection.—*C. P. Steinmetz, A. I. E. E. Proceedings*, 1918, p. 560.

SOLAR ENERGY.

Dr. Steinmetz has figured out that if all the potential water powers of the country were developed and every raindrop used it would not supply even our present energy demand. On the other hand, if only a small fraction of the solar radiation could be collected and used, it would be many times all the potential energy of coal and water. Hence he concludes that solar radiation may be an important source of energy for the future (*A. I. E. E. Proceedings*, 1918, p. 597). Here is a great problem for the physicist and for the engineer, one worthy of endowed research for many years, because even a moderate success and an inefficient utilization of solar energy may be of inestimable economic value.—*Editorial Suggestion.*

TRANSMISSION LINE, EXPERIMENTAL.

Transient phenomena, disturbances due to switching, deterioration of insulators, etc., could be conveniently studied on a full-size experimental transmission line corresponding to an actual line, say, 100 miles (161 km.) long. Such an experimental line would be distinct from the usual "artificial" transmission lines used in laboratories, in that it should be of actual size, electrically speaking; that is, it must withstand service voltages up to 100 kv. and carry several hundred amperes per phase. Furthermore, the proposed line should be suitable for experiments on oscillations up to say 1,000,000 cycles per second, and therefore must have its resistance, reactance and capacity strictly distributed and not concentrated at a number of points as in the usual artificial lines. For convenience in experimentation the whole line should be housed under roof—for example, in a long factory building—so that the spans would have to be reduced to a fraction of their actual length, while preserving the electrical constants of an actual line of this size. A beginning in this direction has been made by Prof. L. Lombardi of Naples; see *Elettrotecnica* of Nov. 5, 1917.—*Editorial Suggestion.*

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

DEADLOCK OF CONFEREES ON WATER-POWER ACT

Difference Between Senate and House of Representatives Not Settled at Meeting This Week, but Probably Another Meeting Will Be Held

The water-power conferees of the Senate and House of Representatives have held another meeting, lasting for three and one-half hours, and are again deadlocked upon the same question which has prevented the passage of a water-power bill for five years, namely, the question of the charge to be made.

The Washington representative of the ELECTRICAL WORLD reports that Senators insist that no charge shall be made for the use of water, on constitutional grounds, while the House conferees are insisting that the language of the House bill shall be used, which would give to a proposed federal power commission the right to make a charge for water. The conferees adjourned subject to the call of the chairman, and will try to hold another meeting Monday.

NORMAL ELECTRIC SERVICE GIVEN IN SEATTLE STRIKE

Plants and Substations Heavily Guarded During Disturbance on Pacific Coast—Position of Utilities in the City Unrest

The general strike called on Feb. 6 at Seattle, Wash., in sympathy with shipyard and allied industrial workers, ended officially at noon on Tuesday of this week by order of the general strike committee. The backbone of the strike was broken on Feb. 9, two days before, by the return of the street railway employees of the Puget Sound Traction, Seattle & Rainier Valley and municipal street railways and by the return of the teamsters, the second largest union, on Feb. 10. The end of the general strike came without change in the status of 30,000 shipyard workers.

Before the sympathetic strike was called the general strike committee made an unsuccessful attempt to close all public utilities, including gas and electric lighting plants. Gas operators voted to stay on the job, municipal light employees stood fast, and only a few men altogether went out. These were replaced by volunteers. Employees in power plants and substations of the traction company, not being unionized, stayed on the job, only a few linemen going out.

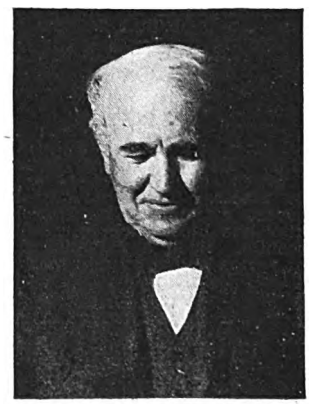
Electric lighting service furnished by both city and traction company remained normal. No electrical service was required by industrial plants. Plants and substations were guarded heavily, but no attempts at violence were made. It is believed that electrical workers would have joined the general strike except for the firm stand of Mayor Ole Hanson and Superintendent of Light Ross, who threatened to operate with non-union men, protected by federal troops, and to refuse reëmployment to all strikers.

Anticipating possible interruption of telephone service between scattered power plants and substations, Superintendent Ross installed wireless sets to connect isolated stations, insuring instant touch with local stations and federal headquarters.

EDISON, 72 YEARS YOUNG, THE GUEST OF PIONEERS

Organization Gives Luncheon to the Inventor Before His Departure for First Vacation Since Beginning of Active War Preparations

To celebrate the seventy-second birthday of Thomas A. Edison, the Edison Pioneers gave a luncheon to the great inventor on Monday of this week at the Robert Treat Hotel, Newark. The anniversary of the inventor's birth was Tuesday, but he left for the South on Monday afternoon. Edison was in fine spirits in greeting the "oldtimers" who were associated with him prior to 1886.



A SNAP SHOT OF THE EDISON SMILE

Francis R. Upton, retiring president of the Edison Pioneers, said in his tribute to Edison that the inventor has laid the foundation for many industries. Mr. Upton estimated that $1,000,000,000 is invested in the industries which Edison created or for which he laid part of the foundation and that 1,000,000 employees are in these industries.

The following officers were elected by the Edison Pioneers: President, John W. Lieb; vice-presidents, S. Z. Mitchell and T. C. Martin; historian, William H.

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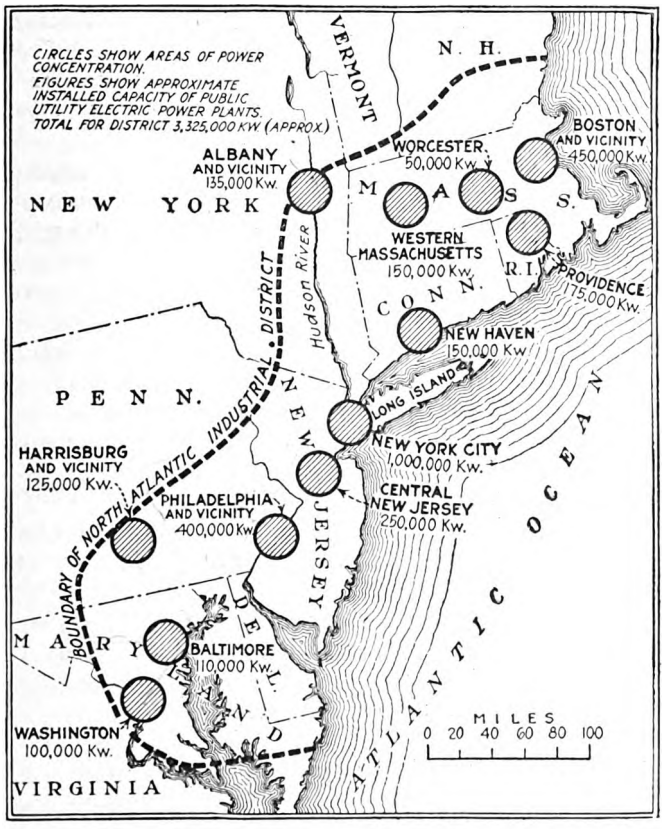
Meadowcroft; treasurer, F. A. Scheffler; secretary, Robert T. Lozier; executive committee members, F. R. Upton, Major W. J. Hammer and A. W. Kiddle.

After the luncheon Edison, with Mrs. Edison and other members of his family, left for Fort Myers, Fla., for his first vacation since this country began preparations to enter the war.

INTERCONNECTION OF EASTERN ELECTRIC GENERATING SYSTEMS

Concentration of Power in North Atlantic Seaboard Region Being Studied by the Department of the Interior

In connection with the plea of Secretary Lane of the Department of the Interior, published last week, for an appropriation with which to carry on an investigation of electric systems with a view to their interconnection, the accompanying map may be of interest.



This shows in a general way to what extent power is concentrated in the North Atlantic seaboard region. The data are intended to be general rather than exact. The figures represent the total installation on Jan. 1, 1918, of central-station plants and electric railway plants, together with such private plants as may be regarded as feeders to the public utility power supply. These total about 3,325,000 kw. or roughly 4,000,000 electrical horsepower. In addition, there are fully 4,500,000 hp., mechanical and electrical, installed in industrial plants. The total concentration in this area was, therefore, a year ago about 8,500,000 hp. It is estimated by the Department of the Interior that at the present time it is well over 9,000,000 hp. and represents about 20 per cent of the installed capacity of the country. This survey was made by the water resources branch of the United States Geological Survey.

LEWIS B. STILLWELL ON WATER POWERS OF FRANCE

Delegates to French Engineering Congress Report to Four National Societies Here on Their Visit and Conclusions

At a meeting of the American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society of Civil Engineers and American Institute of Mining Engineers on Monday evening of this week at the Engineering Societies Building, New York, reports were made by delegates to the French Engineering Congress held recently in Paris. Lewis B. Stillwell spoke on the hydroelectric conditions found by the delegates in France. Others who spoke on various phases of the engineering situation as it was disclosed by the trip were Dr. George F. Swain, George W. Tillson, E. J. Stilsbury, George W. Fuller, A. M. Hunt and Nelson C. Lewis.

The delegation of American engineers appointed the following committee to represent it on the water committee of the Paris Congress of Engineers: Lewis B. Stillwell, chairman; A. M. Hunt, Dr. George F. Swain and Charles T. Main.

Mr. Stillwell said in his remarks that meetings of the water power committee were held in Paris and Grenoble. He added that there are three important water-power districts in France, namely, the region of the Alps in southeastern France, drained by the Rhone and its tributaries, the northern slopes of the Pyrenees, and the elevated region in the south-central part of France drained for the most part by streams flowing northward into the Loire and westward into the Garonne. Of these the region of the Alps is by far the most important. It is estimated that the total hydraulic power available for commercial development in France is approximately 4,500,000 hp. Hydroelectric plants thus far installed aggregate a capacity of 1,000,000 hp. (approximately), of which about 800,000 hp. is in the watershed of the Rhone and its tributaries. The vicinity of Grenoble is the birthplace of the art of utilizing hydraulic power under high head, and hydroelectric power is there used for many purposes of special interest to the chemist and the metallurgist.

Among the establishments in the Valley of the Isère which were visited by the committee, said Mr. Stillwell, is the paper mill of Bergès at Lancey, where a turbine designed by Aristide Bergès began successful operation in 1869. At this place wheels are now in operation under a head of about 500 m., and the committee was informed that this establishment was using wheels under the head named as early as 1889. It is said also that the wood-pulp-grinding machine of the type now generally in use was invented by Bergès in 1865. The labor employed at the time of the visit of the Americans included a very few Frenchmen, a considerable number of Frenchwomen, a large number of Annamites, a few Arabs, and some German prisoners.

Mr. Stillwell reported that the establishment of Fredet at Brignoud, which began operation in 1868 as a paper mill, has been greatly expanded during the war. Recently a large addition has been made for the bleaching of cotton from rags. This has been used as a raw material in the manufacture of high explosives. Four 1500-hp. calcic-carbide furnaces are in operation, and

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several much larger furnaces are approaching completion, as is also a plant for the manufacture of cyanamide. In design and construction the newer buildings of the Fredet establishment and their equipment are in every respect admirable.

In the valley of the Romanche the Société Electrothermique Keller-Leux is installing a power plant which will utilize in one step a fall of 1100 m. The diameter of the pipe is 18 in. (45.7 cm). Another development which particularly interested the committee is the manufacture of iron pipe by electrolytic deposit of iron upon revolving cylinders.

The following figures, quoted by Mr. Stillwell in the course of his talk, are from data collected by Mr. Davis, the American Consul at Grenoble at the beginning of the war.

At the beginning of the war there were in Dauphine twenty-nine hydroelectric stations, producing an aggregate of 170,000 hp. At the end of June, 1918, forty plants were in operation, producing approximately 220,000 hp. It will be noted that, notwithstanding the extreme urgency of war conditions, the increase is only 50,000 hp., although far larger amounts of undeveloped power are available in this region and if developed would have been of the utmost value to France.

Commenting on these figures, Mr. Stillwell said:

"It is hardly necessary to remark that we had in the United States a similar condition, and it is to be hoped that the American people, like the French, will in future realize that the development of hydraulic resources and the construction of electrochemical and electrometallurgical works is not a matter of a day or a month. A nation which would be prepared for any emergency in war or in peace must develop its natural resources and should follow the lead of statesmen, scientists and engineers, and not that of the political profiteer."

Again referring to the data of Consul Davis, the speaker said that in the vicinity of Grenoble factories exist for the manufacture of sodium, chlorine, aluminum, carbide of calcium, cyanides, nitric acid, ferro alloys of many kinds, magnesium, sodium peroxide, explosives, chlorates, cyanamide and nitrogenous products. Before the war about 90,000 hp. was used in producing aluminum. In June, 1918, carbide of calcium was produced by a group of factories using 42,000 hp. and producing about 45,000 tons per annum. Nitrogenous products including cyanamide were being produced at a rate of 4000 tons per annum. Plants manufacturing shells, cartridges, military wagons and other material for the French army were employing 25,000 hands and using 20,000 hp.

In the Grenoble district, Mr. Stillwell added, the stimulus of war conditions is said to have resulted in the development of a method of enriching the flame produced by the local coal with a spray of heavy oil and solving the problem of utilizing for metallurgical purposes the coal of the region, which is far from being rich in volatile matter. It resulted also in the installation of a considerable number of electric furnaces.

The time available to the delegation did not permit a visit to the region of the Pyrenees. The impetus toward water-power development has been felt in this region, and several important plants are now in operation, including one of approximately 20,000 hp. and another of 32,000 hp. The committee was informed also that two projects are under way in that region which will employ for transmission purposes a potential of 120,000 volts. The highest hitherto used in France is 60,000 volts.

The third water-power district is that of the Massif of the south-central part of France. This region is extensive in area and there are a number of streams of high aggregate fall, but these streams are not large and the potential power possibilities of the region are by no means comparable to those of the Rhone.

In the years immediately preceding the great war the annual consumption of coal in France was something over 60,000,000 tons. Of this amount approximately one-third was imported. The average price then was from $5 to $6 per ton. It is probable that in the future the price will be materially higher, probably about $8 per ton. Mr. Stillwell pointed out that it is obvious therefore that France should develop her water power as rapidly as may be practicable.

The Engineering Congress at its session in March last adopted recommendations looking to the standardization of frequency and voltage. It was recommended that 50 cycles per second be adopted as the standard frequency and that the use of 25 cycles per second be permitted in special cases.

Although the Orleans Railway Company began in 1900 the operation of trains by electric locomotives between the Austerlitz station and the Quai d'Orsay, and while the Western company in the following year electrified its line from the Invalides station, Paris, to Versailles, comparatively little has been done toward the electrification of the railways of France. Careful studies by the engineers of several of the railway companies were in progress before the war, and it is expected that these studies will be resumed in the near future.

"As regards water-power legislation," said Mr. Stillwell, "France is in a position to-day very much like that in which we in America find ourselves. A general water-power bill is before the House of Deputies. In view of the present realization of the importance of water-power development, it is expected that a general bill governing water-power concessions will be promptly enacted, and that its provisions will be attractive to capital."

Dr. Swain described the work of the congress and stated that it included public men and business men. M. Millerand, former Minister of War for France, was chairman. It was desired to consult American engineers with reference to three problems: (1) Changing war industries to a peace basis, (2) rebuilding the devastated districts, and (3) the great engineering problems.

Dr. Swain reported the action of the congress in voting to ask for the permanent Franco-American International Commission. He stated that France had spent more than any other European country in improving inland waterways and expected a great increase of commerce through her ports to replace Hamburg and Bremen, and that great plans are being made for developing canals and navigable rivers. He commented on the lack of economic studies and comparison with railroad costs. The state assumes all the burden, but he claimed that the present emergency required more economic study to insure sound economy.

Exchange of students with America was favored.

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PROBLEMS OF AMERICAN INDUSTRIAL READJUSTMENT

National ndustrial Conference Board, Reviewing Present Conditions, Sees Industrial Peace as a First Essential

Maximum efficiency in production, closer coöperation between management and labor, reduction in the cost of living, continued saving and a clearer definition of the government's relation to industry are the points given major emphasis in a report issued by the National Industrial Conference Board on "Problems of Industrial Readjustment in the United States."

Particular stress is placed upon the importance of a prompt decision in defining the government's relation to industry. "Of all the problems involved in readjustment," says the report, "none is so difficult, so controversial or so vitally important to permanent progress." Special mention is made of the necessity of speedy decision as to the government policy toward the railroads, the telephone and telegraph and the merchant marine. The report favors a policy of individual initiative rather than direct state control.

Need of high efficiency in production is repeatedly emphasized. Continuance of liberal wages as well as a reduction in the cost of living, and the ability of the nation to meet the interest on its heavy war obligations —all important factors in the readjustment problem— depend in large measure, the report states, on efficient production. To this end industrial peace is emphasized as a first essential. "For employers and workmen to quarrel at this juncture would be comparable to two men in the water who, instead of trying to save each other, endeavor to strangle each other." Among plans frequently suggested for promoting greater harmony between management and labor are shop committees, or some other means of giving workers a voice in the determination of work conditions.

One of the most immediate problems of readjustment, according to the report, is that presented by the prevailing scale of wages. So long as wages remain at the current level a downward revision of living costs is exceedingly difficult. An increase in the efficiency of individual production to such a degree that employers will be warranted in paying relatively high wages is regarded as the most promising solution of the present wages problem. "This," says the report, "seems to be the only means of escaping the vicious circle by which an increase in the cost of living is used as a reason for demanding higher wages, which, in turn, are important factors in high prices of goods, resulting in still another rise in the cost of commodities consumed by the worker."

Notwithstanding the great expansion of credit, due largely to loans on securities (especially government bonds) to an extent which was never contemplated when the Federal Reserve banking system was organized, the report holds that there is no indication that a really dangerous inflation has taken place. It does, however, emphasize that habits of economy and saving forced by the war must be continued.

A scientific determination of just rates of taxation is mentioned as another of the urgent tasks of readjustment. While heavy taxation must be faced for a long time, the report holds that the burden should be adjusted to the ability of the nation to bear it under changed conditions. "The one fundamental principle of taxation," says the report, "is that it shall not be so heavy as to discourage the production of new wealth from which taxes can be paid."

A sharp, though possibly short, period of unemployment is indicated in the report. Although it is considered that the demobilization of the military forces now overseas—approximately 1,800,000—is likely to extend over such a period of time as not seriously to complicate the immediate situation, the rapid demobilization of the 1,700,000 men who were in military camps at the signing of the armistice and the necessity of providing work for a still larger number of civilian war workers throw a heavy strain on industry, especially in view of the present high scale of wages. This is likely to be felt most seriously in the iron and steel, textile and other major branches of industry employing common labor on a large scale. Here the report calls attention to the fact that a marked slackening in activity has already taken place.

Promise of partial relief is found in the demand for labor in shipyards and in a group of new industries such as chemicals and dyestuffs, which either sprang up or were greatly stimulated because of the shutting off of foreign competition during the war. The report also finds a reserve demand for labor of considerable proportions in the building trades and in permanent construction where the necessities of war had very sharply reduced the volume of activity.

While the immediate employment outlook is confused, the report notes that some observers maintain the opinion that in the not distant future there may be a shortage of labor rather than a lack of work. So far as agriculture is concerned, the problem seems to be to find a sufficient number of workers rather than to provide employment.

The report takes a generally optimistic attitude toward the outlook for foreign trade. It points out that other great wars have almost universally been followed, not only by an early resumption of trade relations between the belligerents, but by an increase in their trade exchanges. Thus, whereas French imports from Germany in 1869 were $50,000,000, in 1872, the year after the close of the Franco-Prussian War, they were almost $70,000,000. German imports from France, in turn, rose from $60,000,000 in 1869 to an average of about $83,000,000 in the five years following that war. A similar expansion in trade between the United States and Spain occurred soon after the Spanish-American War and between Russia and Japan following the Russo-Japanese War.

Among other readjustment problems mentioned are:

The necessity of a careful analysis of the relation of hours of work to efficiency of production and to the health and social needs of workers.

The advisability of establishing an industrial court, or some other form of tribunal, for the settlement of labor controversies, to succeed the National War Labor Board.

The retention of women workers in new fields of employment.

The advisability of amending immigration laws, on the one hand to attract a larger number of workers from abroad, or, on the other hand, to provide still more rigid restrictions against immigration of an undesirable sort.

The development of a market for foreign government securities, which the report holds must largely be accepted in payment for goods sold to nations whose resources have been heavily drained by the war.

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CALIFORNIA RATE INCREASE WILL FURTHER BOND ISSUE

Commission Approves Second Surcharge for San Joaquin Light & Power Corporation, Which Plans Expenditure of $3,000,000 for Betterments

To avert a serious power shortage and threatened curtailment of development in the San Joaquin Valley, the San Joaquin Light & Power Corporation, which plans in the next eighteen months to spend $3,000,000 in betterments, and which applied to the California Railroad Commission for authority to make a 20 per cent increase in its base rates for electric energy, has been granted permission by the commission to add a 15 per cent surcharge to all bills, effective for all meter readings on and after Feb. 15, 1919, and for all flat-rate service after Feb. 1, 1919. The surcharge period, however, is limited to Jan. 15, 1920.

This proceeding is kept open and the commission retains jurisdiction to issue a supplemental order terminating such surcharge whenever the revenues of the corporation shall be sufficient for the purposes specified.

Last May the commission granted the company authority to add a surcharge of 10 per cent to its bills, estimating that the business of 1918, with the increased charge, would give an 8 per cent return after covering the increased cost of operation due to abnormal conditions. The returns, however, according to records of operation, fell $195,000 below an 8 per cent return, due to unforeseen conditions such as shortage of output by the company's hydroelectric power plant and the consequent expenditure of large sums for oil for power development. The decision says:

> At the price of oil in 1918 this represents a cost above the average of approximately $250,000 per annum and approximately $400,000 more than would have occurred had 1918 been a year of normal rainfall. Applicant is faced with the urgent necessity of further developments of hydroelectric power. Developments must be made in order that a serious shortage of power be averted and also that the development of the San Joaquin Valley be not interfered with because of lack of available power for agriculture and for industrial growth.

To meet this demand for betterments, the company has planned the development of a 15,000-kw. plant on the San Joaquin River, requiring an investment of $1,750,000. Extension and improvements of its existing transmission and distributing system will cost $1,250,000, or a total of $3,000,000 to be expended in the next year and a half. The company expects to get most of this money through the sale of bonds. In its petition for rate increase it claimed that because of its failure to earn a full 8 per cent return it could not meet its trust deed requirements as to issuance of bonds and therefore cannot obtain the necessary money to make extensions. On this point Commissioner Devlin writes:

> I do not consider the requirements of the company's trust deed, which stipulates that its net earnings for the preceding twelve months must be twice the interest on bonds outstanding and bonds to be issued before bonds can be issued, as a compelling reason for an increase of rates. Rates previously fixed by this commission as fair and reasonable rates failed to earn what the commission deemed to be a reasonable return. The existing customers must be given consideration and not burdened with an excessive increase for a short period of time in order that special financing might be carried out to meet new developments. New developments, however, are necessary, and the sooner they are made the sooner will reduced rates be possible.

RATE EQUALIZATION PLAN TO OFFSET HIGH COAL PRICES

Narragansett Electric Company Arrangement to Continue Rates Based on Stabilized Figure Until Excess War Cost Is Averaged

The Narragansett Electric Lighting Company, Providence, R. I., established a plan of rate equalization Feb. 1 to offset the increased cost of coal accumulated last year under conditions requiring unexpected storage.

The plan is designed to make it unnecessary for customers to pay for energy at a rate based upon the excessively high cost of coal which has existed for the past few months, and yet to insure full compensation to the company for this extra cost by prolonging the period during which energy will be paid for at a certain basic coal price, as explained below. In the early part of 1918 it seemed advantageous to contract for and arrange for the delivery of a sufficient amount of coal to carry the company through the coming winter. The company had previously contracted for coal-handling apparatus which was to be installed on its property north of its waterside generating station in sufficient time to receive coal upon its arrival. Owing to war conditions this apparatus was not installed in time, and it became necessary to store a large part of the coal elsewhere. Because of double handling, charges on this coal as well as the excessive water freights, demurrage, insurance, etc., the cost of coal in the bunkers had increased for the three months prior to Jan. 1, 1919, to $11.50 per ton.

Instead of using this figure as a basis for lighting and power rates for the first three months of 1919, it appeared preferable to the company to establish a price of $9.95 per ton for coal and to continue this price until such time as the actual cost of coal in the bunkers, as determined in accord with the coal clause in the rate schedules, shall equal $9.95 per ton, and to continue this price of $9.95 per ton in the bunkers until the cost of coal has decreased below this figure and a sufficient number of tons of coal have been burned so that the gain in this latter period will have equaled the loss in the former period.

This method of handling the coal cost will mean neither an increase or a decrease in revenue nor increased or decreased payment by the customers, but simply an equalization of prices for a certain period instead of a higher price for a part of this period and a lower price for the remaining time. The equalization having been accomplished, the contract rider supplement expressing the foregoing $9.95 price establishment will be automatically discontinued. The coal clauses or riders in the Providence contracts are based on a cost of $8 per long ton for coal of 14,500 B.t.u. in the bunkers, and provide that for each increase or decrease of $5 or fractional part thereof greater than $2.50 in the cost of coal above or below $8 there is a differential of 5 mills per kilowatt-hour for a period of six months only.

In 1918 the company burned 128,931 tons of coal. On Dec. 1 it had in storage 46,250 tons and received during the month 7125 tons. The coal consumption during December was 10,280 tons, and it had on hand Jan. 1, 1919, 43,094 tons. For December the carrying charges amounted to $11,219.

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COMPETING PLANT IN CITY OF SPOKANE IS PURCHASED

Washington Water Power Company Acquires the Plant and Franchises of Spokane Heat, Light & Power Company

The Washington Water Power Company has purchased the system and franchises of the Spokane Heat, Light & Power Company, a competing property in Spokane. Holders of the mortgage notes of the Spokane Heat, Light & Power Company are to receive $1,400,000 twenty-year unsecured debentures of the Washington Water Power Company bearing 3 per cent annual interest for the first six years, 4 per cent annually for the next seven years and 5 per cent annually for the final seven years. In addition to the transfer of securities a cash payment was made. Recently receivers were appointed for the Spokane Heat, Light & Power Company.

PUBLIC OWNERSHIP OPPOSED BY NEW YORK ASSOCIATION

Merchants' Association Reaffirms Its Attitude—Fields of Politics and Economics Dissimilar, and the War Has Not Changed Position

The Merchants' Association of New York has reaffirmed its opposition to government ownership and operation of utilities. Its action is based on the recommendation of a special committee consisting of Frank R. Chambers, chairman; James G. White, Otto H. Kahn, Francis H. Sisson, H. H. Porter and Prof. Joseph French Johnson. The committee was appointed by President William Fellowes Morgan in pursuance of action taken by the board of directors for a re-examination of the question of government ownership and operation in view of the prominence that the matter has assumed since the beginning of American participation in the war.

In its report the committee says in part:

Except under war conditions the sole plea that can be advanced to justify the operation by governments of public utilities is that governments can provide better service at less cost to the public than can private operators—that is to say, the assumption that government operation is more efficient and less costly than private operation.

We do not believe that this contention can be sustained. On the contrary, we contend that the operations of governments in the economic field—and particularly under American conditions—are generally characterized by inefficient management and excessive cost, so that under government operation the public would get poorer service and pay more for it than under private operation suitably regulated by public authority.

The cause of inefficient management and excessive cost when governments undertake economic activities is simple. All the activities of any government are necessarily carried on by political machinery and that machinery is wholly unsuited to the economic field.

The fields of politics and economics are dissimilar and separate. The field of politics (meaning thereby the art of government) is mainly the regulation of conduct and the protection of rights. The field of economics is the production and utilization of material things. The principles, the methods and the machinery of political administration are wholly different from those of economic activities and not adapted nor adaptable to the latter. The differences are fundamental and cannot be reconciled. When, therefore, the machinery of political action is applied to economic undertakings it works badly and makes impossible the perfect coördination which can alone, in the economic field, produce efficiency and economy of operation.

We believe that the public can best be served by utilizing the efficiency, enterprise and energy of private corporations for the continued operation of public utilities, under such public control as shall protect the public in its right to efficient service and fair rates, and at the same time assure to private capital invested in public utilities a fair return upon such capital.

We do not find any change of conditions resulting from the war which warrants or requires the previous position of the association in opposition to government ownership and operation to be modified.

HIGH COST IN NEW YORK RESULTS OF OPERATION

Conditions in Manhattan Are Affected by Expense of Operation—Increase in Kilowatt-Hour Output Over 1917 Is 0.91 per Cent

The report of George B. Cortelyou, president Consolidated Gas Company, presented at the annual meeting of stockholders on Jan. 27, gives some information about the operations of the subsidiary New York Edison Company. It says in part:

As was predicted in the last annual report, the disastrous effect of the war upon the cost of producing and distributing gas and electrical energy was much greater during the year 1918 than it was in 1917.

The purchase price of twenty-seven materials, such as coal, wrought-iron pipe, cast-iron pipe, steel bars, sheet iron, malleable iron fittings, red and white lead, pig lead, copper, fireclay and building materials, used in quantities by the companies, increased 61 per cent in 1918 as compared with 1917 and 123 per cent in the year 1913.

The total increase in the combined operating expenses of the gas and electric companies during 1918 amounted to $6,840,970, including an increase of $1,590,949 in taxes and an increase of $1,488,529 due to the greater quantity of gas and electricity sold.

The total increase in the combined operating expenses, as stated in the last annual report, amounted to $9,336,003. The total increase in the operating expenses for 1918 over 1916 amounted therefore to $16,176,973, about 75 per cent of which may be attributed to increased expenses and taxes due to the war, the balance being attributable to the greater quantity of gas and electricity sold.

The business of the affiliated electric companies was much more seriously affected by restrictions put upon the use of electric energy as a means of fuel conservation than were the gas companies by restrictions affecting their product. The reduction in street lighting and restrictions on sign lighting and in exterior illumination did not affect the gas companies noticeably, since the Consolidated and its affiliated companies supply very little gas for these purposes, while it represents a very substantial percentage of the business of the electric companies. The result was that the normal growth of the commercial and street-lighting business of the electric companies was arrested and the output of electric energy remained about the same as it was in 1917.

As a result of the difficulties experienced by private plant operators in procuring coal, labor and supplies in sufficient quantities and of proper quality to meet their requirements, seventy-two private plants were displaced by central-station service during the year, including those in the Waldorf-Astoria, Sherry and McAlpin Hotels, the Metropolitan Museum of Art, the Hallenbeck-Hungerford, Fifth Avenue and Aeolian Buildings and the Cunard and Southern Pacific Piers.

The sales of electric energy during the year, including sales to the Third Avenue Railroad Company, the Brooklyn Rapid Transit Company and the New York, New Haven & Hartford Railroad Company, amounted to 756,649,203 kw.-hr., an increase over the previous year of 0.91 per cent.

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ASKS SPEED IN LAWS TO LEGALIZE WAR CONTRACTS

Delay in Congress in Enacting Legislation to Validate Informal War Contracts Calls Forth Protest on Behalf of War Service Committees

The urgent necessity for speed in enacting legislation to validate so-called informal war contracts is emphasized in a statement issued by Joseph H. Defrees, chairman of the War Service Executive Committee of American Industries. This committee is the central committee of the four hundred war service committees of industry organized during the war under the direction of the Chamber of Commerce of the United States.

The statement was called forth by the delay in Congress in getting the proposed legislation through, and more especially by the insertion by the Senate military affairs committee of a provision giving the government the right of appeal through the Department of Justice from the War Department's decisions respecting the contracts. This clause, in the opinion of Mr. Defrees and others, would make for interminable delays in settlement, while at the same time it would not serve any necessary purpose of protection for the government. Mr. Defrees' statement says in part:

The Senate committee on military affairs has reported out as an amendment and substitute for the Dent bill (H. R. 13,274) the War Industries Board bill, to which was added a section giving the right of appeal from the decisions of the War Department to both the contractor interested and the Deparement of Justice to a commission to be composed of one representative of the War Department, one representative of the Department of Justice and one representative of the business interests of the country.

There is also included in the substitute bill a section providing that in all instances where no affidavit is obtained from the officers of the War Department who had to do with the making of the contract stating that they were not interested directly or indirectly on the side of the contractor in respect to the contract, such contracts cannot be settled by the Secretary of War, but that they shall go at once to be settled by the Appeals Commission.

This substitute bill would be of all the bills proposed the best bill, from the standpoint of both the public and the industrial interests whose patriotism caused them to proceed with necessary war work without awaiting formal contracts, if the provision giving appeal by the Department of Justice from the War Department's decisions were eliminated. It affords to the War Department the necessary powers to enable it to carry out its engagements with industry and would permit it to do that speedily except for the right of appeal of the Department of Justice.

Speed in payment of the industries which did war work is absolutely vital in order that the industries may have use of their capital and thus employ the labor of the country and assist in preventing a bread line. Already the newspapers are carrying stories of non-employment, and it is clear that situation will grow worse unless the industries that have been doing war work can receive payment from the government so that they can go immediately back to peace production.

The appeals clause referred to opens the way not only to delay in payment on informal contracts, but on formal contracts as well, of which the War Department now has full jurisdiction and which are being settled.

The right of one department of the government to appeal from the decisions of another is an anomaly in the history of legislation. Such a provision if it were incorporated in the legislation as finally passed would prevent the expeditious relief essential. The Department of Justice would feel that the right cast upon it would be a duty, and it would have to organizze forces to enable it to become advised and pass judgment upon all the details in respect to each contract up for settlement that it might be able to ascertain which decisions of the War Department it should appeal. This could mean nothing other than intolerable and endless delay and disaster, because in few cases could it make such investigation in the thirty days allotted for appeal, and it would feel constrained to appeal every case in order that sufficient time could be allowed for it to make its investigation.

There can be no reason for retaining the right of appeal in the bill except the feeling that there might be some cases in which some of the civilians who have been operating as officers of the War Department may, at the time of letting the contract or at the time of settlement, have been interested in some manner with the contractor.

The committee which I represent represents in turn, through the war service committees of the industries, substantially 90 per cent of the industries of the United States.

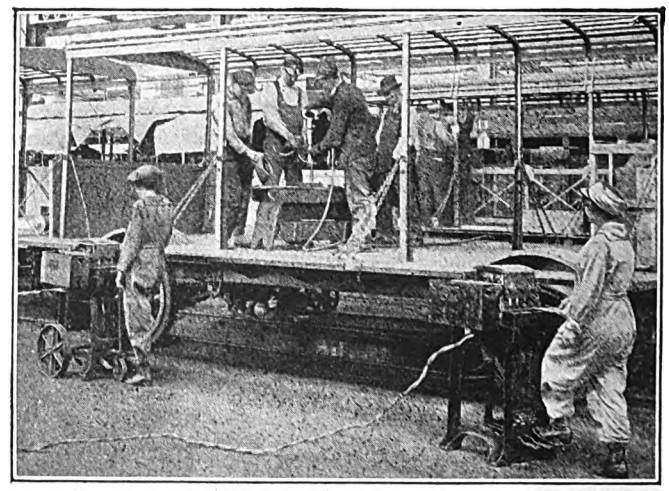
MAKES RECOMMENDATIONS UPON TRADE LEGISLATION

Chamber of Commerce Committee Urges that Congress Shall Give Especial Attention to the Sherman and Clayton Acts

A recommendation that Congress give especial attention to the Sherman and Clayton acts with a view to their immediate revision has been put by the Chamber of Commerce of the United States to a referendum vote of its membership. The proposals to be voted on embody the results of a special study of the situation made by the chamber's federal trade committee. They follow:

The committee recommends that Congress should at once consider the situation of all statutes constituting our anti-trust legislation, that there should be formulated standards of general business conduct to be administered by a supervisory body, that an enlarged Federal Trade Commission should be made the supervisory body, and that the membership of the Federal Trade Commission should be increased from five to nine.

The Up-to-Date Rivet Heater



Electricity's characteristic of convenience and the war-made labor shortage have combined to add new romance to the village smithy's job. Instead of sooty portable forges operated by husky men to heat rivets, industrial plants are now adopting a new type of portable electric rivet heater that will heat a rivet in thirty seconds and can be handled by a fairly capable and intelligent girl.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New Mexico Electrical Association.—The annual meeting of the New Mexico Electrical Association is to be held on Feb. 17 to 19 in Albuquerque, N. M.

I. E. S., Philadelphia Section.—On Feb. 6 Prof. C. E. Clewell of the University of Pennsylvania addressed the joint meeting of the Philadelphia Section of the Illuminating Engineering Society and the Franklin Institute, his subject being "Industrial Lighting."

Percy H. Thomas Delivers First of Aldred Lectures.—"The Public Service Electric Power System" was the subject of Percy H. Thomas, who delivered the first of the 1918-1919 series of J. E. Aldred lectures on engineering practice at Johns Hopkins University on the afternoon of Feb. 5.

Electrical Club of New York.—At the annual meeting of the Electrical Club of New York held on Feb. 4 J. E. McClernon, Northwestern Electrical Equipment Company, was reëlected president and W. J. Kreger was elected secretary-treasurer. The secretary's offices are at 47 West Thirty-fourth Street, New York City.

Association of Iron and Steel Electrical Engineers.—The next meeting of the Association of Iron and Steel Electrical Engineers is to be held in Pittsburgh, Pa., on Feb. 15, at which time Alfred Alsaker, chief engineer of the Delta-Star Electric Company, will give an illustrated lecture on "Outdoor Substation Practices and Use of Carbon Tetrachloride Fuses."

Officers Underwriters' Laboratories, Inc.—The following officers have been elected for the Underwriters' Laboratories, Inc., for the ensuing year: Chairman of the board, H. C. Eddy, Commercial Union; president, William H. Merrill, Jr.; vice-presidents, W. C. Robinson, Dana Pierce and A. R. Small; secretary, D. B. Anderson; treasurer, L. H. Headen.

Ohio Electric Light Association.—The transmission and distribution committee of the Ohio Electric Light Association will meet at Cleveland in the rooms of the Electrical League, Statler Hotel, on Feb. 20. "Industrial Power Substations," by G. B. Schneeberger, electrical engineer for the Cleveland Electric Illuminating Company, and "Automatic Voltage Regulation of Distributing Circuits," by Frank Hershey, General Electric Company, will be the principal papers. The station operating committee of the Ohio Association met at Detroit on Feb. 14 to inspect plants of the Detroit (Mich.) Edison Company.

American Institute of Electrical Engineers

St. Louis Section.—E. E. Huffman recently gave an address on "United States Patent Law and Procedure."

Toronto Section.—An illustrated lecture was recently given by Dr. Sam Dushman on "Modern Applications of the Electron Theory."

Pittsburgh Section.—"Some Problems in Parallel Operation of Power Plants" was the title of an illustrated paper by E. C. Stone, system operator Duquesne Light Company, on Feb. 11.

Lynn Section.—"Motion Picture Projection" was the subject of a lecture by Robert P. Burrows, projection engineer of the National Lamp Works, before a recent meeting.

Fort Wayne Section.—"The Fixation of Atmospheric Nitrogen by the Silent Discharge Method" is to be the subject of Prof. C. Francis Harding, Purdue University, on Feb. 20.

Detroit-Ann Arbor Section.—Another "round table" will be held on Feb. 28, when Prof. F. C. Parker will speak on "Alternating-Current Generators." At the Feb. 14 meeting "Automatic Substations" were discussed by Cassius Davis, Schenectady, N. Y.

Chicago Section.—John B. Taylor, consulting engineer of the lighting department of the General Electric Company, will address the electrophysics meeting of this section on Feb. 24 on "Phenomena of Sound Waves." The Jan. 27 meeting was on industrial power. Members of other engineering societies were invited to be present. Martin J. Kermer spoke on the beet-sugar industry, and Prof. H. H. Stoek of the University of Illinois on the mineral resources of Europe.

Pittsfield Section.—Colonel R. H. C. Kelton of the General Staff, operations branch, at Washington, gave a lecture on "The Situation at Château Thierry" at the Jan. 9 meeting. Stereopticon slides and motion pictures were shown. "The First Peary Expedition of 1891" was the title of an illustrated lecture on Jan. 23 by Langdon Gibson, Schenectady, N. Y. Dr. Elwood B. Spear, professor of chemistry at the Massachusetts Institute of Technology, lectured on "Problems of Gas Warfare" on Feb. 14.

Indianapolis-Lafayette Section.—The January meeting of this section was held in conjunction with the annual meeting of the Indiana Engineering Society in Indianapolis on Jan. 23, 24 and 25. Among the papers were "Public Utilities in the War Period," by H. O. Gorman; "Psychological Methods of Selecting Soldiers, Officers and Employees," by Prof. C. F. Harding; "Efficiency Engineering in Industrial Plants," by J. E. Hannum; "Some Recent Technical Developments in Telephony," by Prof. R. V. Achatz; "Electrical Pumps in Municipal Waterworks," by Prof. D. D. Ewing, and "The Decimal Versus the Dozen System of Writing Numbers," by John R. Riggs.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rectification of Schedules.—The Public Service Commission of Oregon, in authorizing new rates for the Stayton Electric Light Company, says in part: "Evidence was presented by witnesses on behalf of the consumers that the service rendered by this utility has been very irregular and unsatisfactory, accompanied by wide variations in voltage. This condition was generally admitted by the manager of the utility and was attributed to his inability to finance the installation of adequate governing apparatus under past and present revenues. In line with its regulatory powers, the commission will hereinafter require such measures to be taken by applicant as will provide the quality of service that the patrons of this utility are justified in expecting, concurrently with such rectification of the rate schedules as is found requisite to provide funds for placing this service on a satisfactory basis. . . . Certain of these rate structures are obsolete in form and should be revised to be readily applicable to present lamp ratings. For general service the flat rates are unscientific and uneconomical and not favored by this commission."

Ohio Commission Rebukes Alliance City Council.—For several years the Alliance (Ohio) Gas & Power Company had been serving residence customers at a rate of 12½ cents per kilowatt-hour for the first thirty hours' use of the maximum demand figured on a basis of 40 per cent of the connected load and 5 cents per kilowatt-hour for all additional energy. As of Aug. 1, 1916, the City Council passed an ordinance fixing the price of energy at 6 cents per kilowatt-hour for the first thirty hours' use and 3 cents for all additional. The company attempted to compromise with the city on a rate of 9 cents for the first thirty hours' use and 5 cents for all additional, but without avail. The Public Utilities Commission of Ohio, when it was brought into the case, valued the property of the company at $621,077 as of May 1, 1918, and allowed the company an earning of 8 per cent and depreciation of 5 per cent. The rates were also fixed for a period of ten years at 12½ cents and 5 cents for the first two and one-half years and 10½ cents and 5 cents for the last seven and one-half years of the time. The commission further informed the City Council that it had no right to fix power rates and advised it to reopen dealings with the company concerning a fair street-lighting contract.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Effect of Daylight Saving on Boston Earnings.—Daylight saving in September, 1918, resulted in a reduction of from 10 to 15 per cent in income compared with the corresponding month of 1917 on the system of the Edison Electric Illuminating Company of Boston, according to President C. L. Edgar. Dr. Edgar said that he anticipated the repeal of the daylight-saving act in the near future.

Sale of Municipal Energy Outside Seattle Limits.—The Skagit River power bill now before the Legislature at Olympia, Wash., seeks to grant municipalities the right to sell surplus energy outside of their corporate limits. The purpose is said to be to permit the city of Seattle to sell light and power to cities and towns in Skagit County when the Skagit River plant is completed. The delegations from Skagit County and from Snohomish County are both enthusiastically in favor of the bill, which was drawn by Corporation Counsel Walter F. Meier of Seattle and introduced by the Skagit County delegation. The last Legislature enacted a law authorizing the operation of waterworks beyond city limits, including power to make extensions of such municipal utility plants and to sell the surplus product. A bill seeking to extend the privileges to cities or towns operating gas, water or electric plants was indefinitely postponed.

New Insull Utility Company.—The North West Utilities Company, a Delaware corporation, organized in December 1918, for the primary purpose of acquiring and holding securities of companies operating public utility properties, has, as its three initial subsidiaries, the Wisconsin River Power Company, the Southern Wisconsin Power Company and the Wisconsin Power, Light & Heat Company. The properties of these subsidiary companies are in south central Wisconsin and are interconnected with high-tension transmission lines. Included in the system are the hydroelectric plant of the Wisconsin River Power Company at Prairie du Sac and the hydroelectric station of the Southern Wisconsin Power Company at Kilbourn. These stations have a combined rating of 30,000 hp. The three subsidiary companies now serve twenty-two communities with electrical energy and also sell power in bulk to a number of granite quarries, iron mines and other public utilities. All of the common stock of the North West Utilities Company is owned by the Middle West Utilities Company of Chicago. Samuel Insull is president of both of these companies.

Metric System in the War.—In the annual report of Secretary of Commerce W. C. Redfield the section referring to the Bureau of Standards says regarding the metric system: "The War Department early in the war decided to adopt the metric system for use in connection with maps and gun-firing data. The Ordnance Department has also adopted standard metric-dimensioned guns, such as the 37-mm., 75-mm. and 155-mm. models, and this involves corresponding changes in shell sizes. These uses of the metric system made it desirable that the Bureau of Standards issue for the information of the soldier a small manual. This has been prepared for publication early in the coming fiscal year. Furthermore, there is a demand for metric literature for the various officers' training camps, cantonments, radio schools, aviation schools and other military organizations. The bureau has supplied for these purposes the graphic chart of the international metric system, together with a descriptive pamplet and table of equivalents. The latter has proved of great value in connection with the manufacture of war supplies by various war industries. Publications which have proved of great assistance in developing export trade are in demand for military purposes and will be of increasing value for trade purposes upon the conclusion of peace."

Brooklyn Edison Company, Inc., Authorized.—The Public Service Commission for the First District has approved the merger of the Edison Electric Illuminating Company of Brooklyn into the Kings County Electric Light & Power Company, the new corporation to have the name Brooklyn Edison Company, Inc. The commission has approved the issuance by the merged company of a blanket mortgage covering all of its plant and property. Another order was adopted permitting the company to issue $5,500,000 principal amount of gold bonds, Series A, under this mortgage. The general mortgage will permit the issuance all told of $100,000,000 in series bonds, but only such bonds may be issued as have the approval of the commission from time to time as their issuance is desired, and only in such amounts as the commission may allow. The action of the commission was taken on motion of Commissioner F. J. H. Kracke, who has filed an opinion covering the various questions involved in the merger, mortgage approval and bond issue. During the hearings in reference to this matter a question was raised by the city of New York as to whether the approval of the merger, which is desired for simplification of accounting and financial matters, would not tend to complicate legal actions begun by the city of New York in reference to the franchises of the Kings County company, and as to whether approval by the commission of the merger might not enlarge the powers and privileges of the company or, in other words, militate against the interests of the city. The commission took this objection into consideration and so drafted its order of approval as to protect the interests of the city to the fullest degree, specifically reserving that no rights in doubt at the time of the merger would be validated thereby, nor any new rights granted to which the city might have just objection.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Impairment of Contract.—A franchise from a town to furnish its inhabitants with electric light for public or private use as soon as it is accepted by the party to whom it is granted becomes a "contract" between the town and himself entitled to protection under the constitutional clause, the Supreme Court of Louisiana held (80 S. 224).

Exclusion of Evidence.—A judgment will not necessarily be reversed for the exclusion of opinion evidence sought to be introduced to show that a fire in a building had started at a certain place and had been caused by an electric meter, the admission or exclusion of such evidence being largely within the discretion of the trial court, according to the Supreme Court of Kansas in Kirkham vs. Leavenworth Light, Heat & Power Company (176 P. 979).

"Wilful Misconduct" in Compensation Case.—That a lineman killed by coming in contact with a live wire was guilty of contributory negligence, or of an infraction of certain rules of the employer which were enforced with little or no diligence, would not constitute "wilful misconduct" within the meaning of the workmen's compensation act, it being necessary to show an intentional disobedience to strictly enforced rule, according to the Appellate Court of Indiana in Indianapolis Light & Heat Company versus Fitzwater (121 N. E. 126).

Illegality of Sale of Properties of Public Utility.—A contract between two electric companies for the sale of the properties of one to the other, not approved by the Railroad Commission as required by the public utilities act, was void and unenforceable, as in violation of statutes for the protection of the public, it was held by the Supreme Court of California in Napa Valley Electric Company versus Calistoga Electric Company (176 P. 699). In view of the public utilities act one electric company could not have the equitable remedy of specific performance to compel another electric company to convey its properties, on which it had given an option, where neither of the companies had obtained from the Railroad Commission an order authorizing the sale.

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Charles L. Kurtz has been elected president of the Columbus (Ohio) Railway, Power & Light Company, succeeding Samuel G. McMeen, who has resigned.

W. E. Coman, vice-president and general manager of the Northwestern Electric Company, Portland, Ore., has been elected vice-president and general manager of the Washington Water Power Company, Spokane, Wash., to succeed Harry L. Bleecker, deceased. He will assume his duties at Spokane about March 1. Mr. Coman is one of the best known electric lighting and power men in the Northwest. He began his career as a clerk with the Oregon-Washington Railroad & Navigation Company, and rose quickly in the freight department. In 1910 the new Spokane, Portland & Seattle Railway opened with Mr. Coman as its general freight and passenger agent. In 1912 he accepted the position of vice-president and general manager of the new Portland power company, the Northwestern Electric Company.

Major John C. Damon, Engineers, U. S. A., who was taken from the 114th Regiment of Engineers for special duty in the power section of the War Industries Board, has now finished this work, returned to civil life and entered the organization of the West Penn Power Company. Major Damon was born in 1882 in Concord, Mass., and was graduated from the Massachusetts Institute of Technology in 1905, remaining there the following year as assistant in the electrical engineering laboratory. His professional experience began in the construction department of the Chicago Telephone Company, but he soon left to engage in construction work on large hydroelectric developments and transmission lines in the West. In 1909 he became superintendent of operation of the Colorado division of the Telluride Power Company. Two years later he entered the organization of the Trinidad (Col.) Electric Transmission Railway & Gas Company and was active in the design and construction of its steam plant at Walsenburg, Col. He entered in July, 1912, the engineering department of the Electric Bond & Share Company, which took up at this time the development of the Utah Power & Light Company. Later he became assistant chief engineer of the Utah Power & Light Company. Early in January, 1918, he was relieved from duty with the 114th Engineers and detailed to the power section of the War Industries Board. In this capacity he was assigned to make studies of and recommendations for the power supply in several of the heaviest industrial districts of the East, including Philadelphia, Baltimore, Lancaster, Pittsburgh and eastern Ohio, and the New England States. In September, 1918, while a captain, he was placed in charge of the development and control of the power supply in the Pittsburgh and eastern Ohio district and in the following month was promoted to the rank of major.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

John S. Bleecker, manager operating companies for Stone & Webster at Columbus, Ga., which include the Columbus Railroad, has been appointed general manager of the New Orleans Railway & Light Company by J. D. O'Keefe, receiver of that company. This is a new office with the company at New Orleans. All of the present departmental heads of the corporation will, it is announced, continue with the company, Mr. Bleecker assuming general charge of operation under Mr. O'Keefe. As at present organized, the company has separate managers for its railway and light departments. Mr. Bleecker has long been connected with Stone & Webster. He was born in Washington, D. C., on April 8, 1878, and was graduated from the Massachusetts Institute of Technology in 1898. He was employed in the mechanical department of the American Bell Telephone Company at Boston immediately after graduation and remained with that company until 1900, when he entered the service of the Stone & Webster Engineering Corporation. In the interests of this large holding system he has filled various positions at Boston, Seattle, Houghton, Blue Hill, Paducah and Columbus, the duties covering a very wide range of activity.

J. S. BLEECKER

B. F. Tucker, who until recently was general superintendent of the Central Illinois Public Service Company, has been made manager of operation for the same company.

G. W. Hamilton, who was vice-president of the Central Illinois Public Service Company, has been transferred to Chicago to become associated with the Middle West Utilities Company.

G. H. Knutson, who has for the past eight years been a partner in the Fargo Engineering Company, consulting engineer, Jackson, Mich., is now associated permanently with the corporation department of the Harris Trust & Savings Bank of Chicago.

Clifton W. Wilder, electrical engineer of the Public Service Commission for the First District of New York, and connected with that organization practically since its establishment in 1907, has resigned to join the staff of the New York Edison Company. Mr. Wilder was graduated from the Massachusetts Institute of Technology in 1896. He engaged in general engineering work pertaining to lighting, industrial and railroad properties in Boston and New York until 1907, when he entered the service of the commission as an assistant electrical engineer. In 1909 he was appointed electrical engineer and placed in charge of the equipment inspection bureau. Just previous to the signing of the dual subway contracts in 1913 Mr. Wilder's duties were extended so as to include the engineering matters coming before the commission pertaining to the equipment of the rapid-transit lines constructed under the dual contracts and the related elevated railroad certificates. He has also had charge of appraisals of the property of several of the large public utility corporations under the jurisdiction of the commission.

Obituary

E. H. Jacobs, construction engineer and superintendent of all distribution lines of the Western States Gas & Electric Company at Stockton, Cal., died of pneumonia on Jan. 16, after an illness of about ten days. Mr. Jacobs had been connected with the Western States company for ten years and for the last seven years had been stationed at Stockton.

Prof. Edward C. Pickering, director of the Harvard College Observatory at Cambridge, Mass., since 1876, died at Cambridge Feb. 3 at the age of seventy-two. He was graduated in 1865 from the Lawrence Scientific School and from 1868 to 1876 occupied the Thayer chair in physics at the Massachusetts Institute of Technology. Here he established one of the first laboratories used in student work and wrote a textbook on "Physical Manipulation" which has long been regarded as a standard. He was the recipient of many degrees and medals from universities, scientific institutions and societies and attained an international reputation in the astronomical field. In the varied and exhaustive investigations carried out under his direction electrical methods were brought to a high stage of development. These methods have been described at various times in the ELECTRICAL WORLD, notably in connection with the Harvard Observatory's equipment and that of other astronomical plants which have interchanged ideas with the Massachusetts Institute of Technology.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

OUTLOOK FOR ELECTRIC ROAD TRUCK IS BRIGHT

Expansion to Such a Degree Expected that Fear Is Expressed that Producers May Be Unable to Handle Entire Volume

Inquiries regarding electric road trucks received by manufacturers' agents indicate that considerable expansion in this business is to be expected before long. The fear has been expressed to the ELECTRICAL WORLD recently that manufacturers may be unable to care for the volume of road-truck business expected in the near future, and it is said that in some districts only the lack of adequate garaging facilities holds back a remarkable development. Recent attempts in one city to secure bids from building contractors on a high-class modern electric garage were unsuccessful on account of the extreme conservatism of the banking interests when it comes to according credit to bidders on building construction work.

There is no gainsaying the fact that electric road trucks, always within their economic field be it said, were kept on the job throughout the war period in localities where drivers could be secured below a college professor's salary, and it is a fact that there are still unfilled orders being handled in territories where road trucks of the electric type have always had to earn their way. Nor would it seem to be necessary at this late day to stress the value of the storage-battery road truck as an off-peak central-station load. High prices of line material and generating equipment have little in common with the development of the truck industry and the handling of the extremely profitable class of load it provides the central station. It is significant that trucks of the electric type will be a feature of the forthcoming automobile show at Hartford, Conn., always an area of advanced central-station practice.

ELECTRICAL EXPORTS EXCEED SIX-MILLION-DOLLAR MARK

November's Record Figures Bring Total for First Eleven Months of 1918 Up to Almost $55,000,000

A new record in exports of electrical merchandise was hung up during November last, when a total of $6,177,252 worth of goods was exported, an increase over November, 1917, of a little more than $700,000. This was done in spite of the fact that exports in a number of items fell below those of November of 1917. For instance, the exports of batteries were less by $50,000, insulator wiring cable less by over $300,000, interior wiring supplies less by roughly $90,000, magnetos, spark plugs, etc., less by about $175,000, switches and accessories less by $12,000, and telephones less by $40,000. However, some items went particularly high. For instance, carbons showed a gain of over $100,000, and generators did almost the same; metal-filament lamps showed a gain of $140,000; meters, $90,000; motors, $300,000; rheostats, $50,000; telegraph material, $25,000; transformers, $280,000, and miscellaneous items, more than $300,000.

The November figures brought the total for the first eleven months of last year up to $54,794,545, which is more than $5.000 greater than the total for the first eleven months of 1917, a record year. Figures for December are not yet available, but there seems every reason to believe that 1918 exports at least reached, if they did not exceed, the sixty-million-dollar mark.

The figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce.

Articles	November		Eleven Months Ended November	
	1917	1918	1917	1918
Batteries	$409,968	$350,162	$3,253,738	$2,945,116
Carbons	94,699	211,191	558,150*	1,461,573
Dynamos or generators	202,046	300,230	2,256,197	3,019,315
Fans	33,361	35,307	536,875	758,649
Heating and cooking apparatus	48,596	54,617	197,832*	611,545
Insulated wire and cables	713,533	398,956	6,512,529	5,138,426
Interior wiring supplies, including fixtures	241,265	153,310	1,271,410	1,328,345
Arc lamps	732	274	14,884	14,011
Carbon-filament lamps	7,541	14,845	159,928	89,063
Metal-filament lamps	285,814	423,533	2,543,389	3,139,289
Magnetos, spark plugs, etc	433,704	206,796	1,429,321*	2,431,700
Meters and measuring instruments	128,869	219,620	1,021,739	1,765,614
Motors	621,845	925,171	5,767,137	7,561,981
Rheostats and controllers	10,783	63,048	71,971*	260,907
Switches and accessories	219,302	206,828	803,981*	2,043,514
Telegraph apparatus, including wireless	24,099	51,767	511,059	310,716
Telephones	228,554	188,429	1,934,075	2,565,548
Transformers	271,016	554,116	1,534,641	3,333,493
All other	1,436,257	1,765,052	19,163,743	16,015,740
Total	$5,411,984	$6,177,252	$49,542,599	$54,794,545

* Figures cover period beginning July 1.

UNEMPLOYMENT DUE PRIMARILY TO INDUSTRIAL UNCERTAINTY

Immediate Problem Is to Reach a Price Basis That Will Restore the Normal Civilian Demand

Magnus W. Alexander, of the General Electric Company and managing director of the National Industrial Conference Board, in discussing the labor outlook a few days ago in a press interview, pointed out that non-employment in the United States is not due at this time to demobilization and a consequent surplus of labor, but primarily to the uncertainty of the industrial outlook both as to the cost of production and the quantities of goods that will be required. There are not and there will not be, he stated, too many hands for the work needing to be done for home consumption as well as for foreign trade. During the war there was a very large demand for goods at high prices, due to the imperative needs of the government. Demand in all lines is now rapidly falling off because the government is no longer a heavy purchaser, while civilian orders are being deferred on account of the present uncertainties. There is still a great potential demand for goods, but only at more normal prices. The immediate problem is to reach a price basis that will restore the normal civilian demand for goods. Until such a basis is reached non-employment must continue and may increase.

Mr. Alexander pointed out that there is a great fallacy in the attempt to stimulate employment by reducing the hours of labor unless at the same time the productive output per hour is correspondingly increased. Statements of certain leaders of organized labor that the employment problem can

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be met by a restriction of production by each individual worker arises from a complete misconception of economic laws. Production offers the only possible means of paying both wages and profits. To grant the demand of textile or other workers for fifty-four hours' pay for forty-eight hours' work without increase of output would raise the cost of production because the same total overhead expenses for equipment in buildings, machinery and tools, for insurance, taxes and general supervision, would fall on an output reduced by about 11 per cent on account of the lessened hours of work.

In addition to this, the unit cost of the product would be materially increased by the higher cost of labor. Under these circumstances the public could not afford to buy as many goods at the increased price, and foreign markets could not be largely developed or held in competition with other trading nations

METAL MARKET SITUATION

Break Comes, Bringing 18½-Cent Copper and 5-Cent Lead—Tin Lower in London

Copper broke last week. The big producers, who have been on 23 cents for many weeks in spite of sales by small producers at 20 cents and lower, came down to 18⅛ cents for spot electrolytic. This brought orders for approximately 7,000,000 lb.—the first real buying since the armistice—and it opened up the way for a very fair business which followed. Since that first drop some of the smaller producers have sold copper as low as 17⅝ cents per pound. It seems probable that the producers are feeling out the market. Large stocks are known to be held in the United States and Europe, and consequently very low prices must be made to tempt buying on a scale commensurate with that of normal times.

The Butte district dropped wages from a 26-cent basis to an 18-cent basis. Further reductions would not be made for a decline of copper below 18 cents, it was stated, but the sliding scale of wages would apply on an advance in copper. The 50-cents-per-day bonus, however, remains in the scale.

Tin dropped £10 per ton in London, due evidently to the attempt of the Malay government to stabilize the market at Singapore and Penang.

The American Smelting & Refining Company reduced the price of lead from 5.25 cents to 5 cents. This gives a drop of more than 3 cents since the end of hositilities.

Sheet zinc shows a decline of 2 cents, while spelter holds about the same.

The old metals have as a rule dropped, although old scrap zinc shows an increase

NEW YORK METAL MARKET PRICES

	Feb. 4			Feb. 10		
Copper:	£	s	d	£	s	d
London, standard spot	88	0	0	80	0	0
	Cents per Pound			Cents per Pound		
Prime Lake	19.50			18.50		
Electrolytic	18.50			18.00		
Casting	17.75			17.25		
Wire base	22.75*			21.75*		
Lead, trust price	5.25			5.00		
Antimony	7.37½			7.37½		
Nickel, ingot	40.00			40.00		
Sheet zinc, f.o.b. smelter	13.00			11.00		
Spelter, spot	6.75			6.85		
Tin	Govt. price 72.50			Govt. price 72.50		
Aluminum, 98 to 99 per cent	Govt. price 33.10			Govt. price 33.10		

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.50 to 15.00	14.50 to 15.00
Brass, heavy	8.50 to 9.00	8.00 to 8.25
Brass, light	7.00 to 7.50	6.50 to 6.75
Lead, heavy	4.25 to 4.50	4.00 to 4.25
Zinc, old scrap	5.00 to 5.25	5.25 to 5.50

* Normal.

THE WEEK
IN TRADE

LABOR disturbances were a very disquieting factor last week, particularly in the Pacific Northwest. The radical element in organized labor is apparently making an effort to impose labor control upon industry.

Signs pointing to a very appreciable amount of new construction in the spring are becoming more numerous. A number of sizable projects are awaiting warmer weather.

The copper drop of last week brought lower wire prices. Other electrical goods kept rather steady in price.

It is now rather certain that January of this year surpassed January of 1918 in value of jobbers' sales. For a number of reasons February will probably not show so good a record. March, however, is expected to show up well, particularly in the Southern States.

NEW YORK

New building projects continue to sift in, including three apartment houses contemplated for Manhattan, a candy factory for Newark and two new refrigerating jobs in Queens and Brooklyn. Alterations and remodeling continue. Further work, however, may be delayed or curtailed by labor agitations among the building trade, which appear to be increasing this week.

The oversupply of labor still holds in this section, especially in New York City, where many discharged soldiers from other parts of the country are seeking work rather than return to their homes.

Following the drop in copper in the previous week, wire softened considerably, decreases of from 1 cent to 3 cents being reported. Galvanized wire hardware is down 10 per cent. Other prices continued to hold firm.

USED MOTORS.—Although one dealer reported no startling return to normal business, two other dealers reported that February was already showing better than January, and that, while their stocks were rather large, they would not refuse an opportunity to add thereto reliable motors, as they felt there would soon be an opening for them.

GONGS, BELLS AND ALARMS.—There was no special activity in fire alarms. Their price, with that of gongs, showed no tendency to drop. It is different, however, with the smaller type of bells for call-bell use. In certain prominent lines of iron and wood box-type bells and buzzers, the price has dropped 5 cents on all quantities listed, to take effect Feb. 10. This reduction was occasioned by the fact that the parts of these bells are not in stock but are being manufactured from materials bought in the open market at the present time and under lower prices. Deliveries run about three weeks.

FANS.—Some manufacturers have progressed further than others in their distribution. One manufacturer has not yet set his campaign before his distributers, another has just recently outlined his plans to his representatives and has had time to receive only a few orders from them, while still another manufacturer has not only received orders but some of the distributers already have received their stocks of fans. Dealers in used fans have few left from last summer.

CONDUIT.—There have been no new developments in the conduit market. The general hand-to-mouth buying has not given way to the carload-lot shipments.

FLEXIBLE ARMORED CABLE.—The trade continues along very quiet lines, deliveries running approximately three weeks.

TAPE.—White cotton tape has been reported by one jobber as off 10 to 15 per cent. Friction tape has been reported as lower in only one instance, and that was about

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8 per cent. The drop in cotton brings that commodity to a level which some believe is close to bottom.

WIRE.—Rubber-covered wire-base averages 25 cents, a drop of about 3½ cents from last week. One manufacturer quotes on a 28-cent base, one on 27 cents, six on 25 cents, two on 24 cents, one on 22-cent base and two on cost. Those quoting on the high bases apparently figured that business could not be stimulated merely by a change in prices and therefore saw no reason to reduce. Bare wire was reported on a 21-cent base, weatherproof on 22½ to 24-cent base and annunciator on 30-cent and 37-cent bases.

CABLE.—One large manufacturer reports a very satisfactory business in cable at this time.

LINE HARDWARE.—Galvanized line hardware has declined in price approximately 10 per cent.

CHICAGO

Opinions are generally that for the six months to come business will remain at about its present level. Only in central-station commercial circles does real optimism prevail. Even here the bright outlook may be only comparative. Nevertheless, it is a hopeful sign to see central-station selling crews again at work intensively, even though it is well known that structures already built present their only prospects.

In the building field plans for a million-dollar apartment hotel are reported. The Chicago school trustees have about $3,900,000 for new school buildings, additions and betterments in 1919. Other projects are awaiting favorable conditions.

Wire manufacturers have been indulging in some rather wild competition and have taken orders at low prices, ostensibly to keep their factories running. The America Sheet & Tinplate Company has sold to the French government its entire output of electrical sheets for two months.

TRANSFORMERS.—Some of the smaller manufacturers were unable to buy so heavily in copper and steel at the high prices as were some of the larger producers, and had therefore less high-priced stock to use up. The smaller producers as a result are now or should soon be in a position to buy in the open market to advantage. The volume of transformer business is fair.

POLES.—Wooden poles may be higher before they are lower because the amount of cutting done in the open season was not nearly so great as usual. The sudden cessation of war left no time to get the producers' gangs together.

LINE MATERIAL.—Prices of these goods are all holding steadily, regardless of whether they are wood products, porcelain or steel.

MOTORS.—The motor market at Chicago is in a rather peculiar state. The stocks of some distributers are known to unbalanced. While there are plenty of alternating-current motors on hand, there is very little demand for these. On the other hand, there is a demand for the smaller sizes of direct-current motors, but none of these are available. It has been many mbnths since some concerns have had a 1-hp., 2-hp. or 3-hp. direct-current motor in stock. At present on these sizes about six weeks' delivery is being quoted.

SECOND-HAND MACHINERY.—Reductions in price of both new and second-hand equipment were announced by the Gregory Electric Company early in February as a pre-inventory expedient.

FLASHLAMPS.—The Manhattan Electrical Supply Company has agreed to protect its trade against decrease in prices of Ever Ready products and tungsten batteries.

SEWING-MACHINE MOTORS.—Hamilton-Beach specialties, including sewing-machine motors, have been guaranteed against decrease in price until June 1.

ELECTRIC APPLIANCES.—The Edison Electric Appliance Company will maintain its present list prices at least until April 1, 1919, and does not contemplate any reduction at the end of that period, according to an announcement issued by George A. Hughes on Feb. 7. Continued high prices of labor and raw material are given as the cause. Reductions when they are made, it is stated, will be gradual, in short steps, so as not to interfere with distributers' plans.

BOSTON

Business continues quiet, although inquiries are increasing, notably in street-lighting equipment and fire-alarm telegraph apparatus. Jobbers are carrying very substantial stocks, and there is little incentive to order more material at this time, broadly speaking. Appliances are moving well. Collections, while a little slow, are not causing much trouble. Conditions in the trade are believed to be sound, barring he risk of a too sudden drop in prices. General price levels remain high, though wire is weak. Schedule material is being held in quantity for prompt delivery by jobbers, but contractors find few wiring contracts, and as yet there is no perceptible boom in building. The shipyards continue to absorb electrical material, but rush orders are not now much in evidence. At present labor is in oversupply except in some highly skilled classifications. Electrical circles are just now unusually free from labor disturbances. The central stations are beginning to make plans for expansion, and jobbers report increasing inquiries from this source. Some January reports indicate that the monetary value of jobbing business transacted equaled or exceeded that of January, 1918. The total volume of material handled apparently fell off somewhat.

STREET-LIGHTING REFLECTORS.—Inquiries are increasing from municipalities and central stations. Plans are being made to pick up a good deal of outside work held up by the war, and in Boston, Quincy, Laconia, N. H., and New York State early developments are expected. Manufacturers will now be able to dispose of material completed before the war ban was placd on general construction work. It is not expected that prices will go down much at present. Deliveries are on a favorable basis, barring minor delays due to pipe shortage.

FIRE-ALARM TELEGRAPH APPARATUS.—Municipalities are showing new signs of life, and increased fire protection is likely to be an issue at many town meetings this spring. Beyond price increases in some spare parts some weeks ago, little change is to be seen in the cost of such equipment to the buyer. As previously stated, prices in fire-alarm boxes did not advance in proportion to many other electrical products, and therefore prices seem likely to remain steady for some time.

WASHING MACHINES.—Business is in good volume, and deliveries are much improved.

VACUUM CLEANERS.—With one or two exceptions, no shortages are reported. A good spring business is expected, and the winter trade holds up well.

WIRE.—Rubber-covered wire holds around a 25-cent. base. Little new business is being handled. Bare copper is selling off. Jobbers are trying to get rid of accumulated wire stocks, but it is a slow process.

SEWING MACHINES.—Trade is very fair. A large amount of relief work for Belgium, northern France and other countries is under way, and this, with growing popularity of extensively advertised machines, is resulting in a good many sales.

CONDUIT.—Few cases are in hand where jobbers are now short. There is not much buying at present, although the merchant marine program is absorbing not a little material.

MOTORS.—Trade is spotty, and stocks are tending to increase. At present prices the jobbers are not spending much money on motors.

FLASHLIGHTS AND DRY BATTERIES.—Deliveries are much improved over those of last fall, and a fair trade is being handled.

SPRAY-COOLING APPARATUS.—Inquiries are very good and some sales are being made for power-plant betterment work.

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ATLANTA

Electrical wiring and construction at Atlanta this week are very unsettled on account of the electrical workers' strike for an increase from 65 cents to 87 cents per hour for first-class journeymen. While work in this line is not so plentiful as in the latter months of 1918, nevertheless some inconvenience is being experienced. The situation has reached a deadlock, with no indications of early relief. A few jobbers with retail connections report that combined wholesale and retail sales for January were well above those for January, 1918. Retail sales, including socket appliances and labor-saving devices, are very satisfactory. Although the general line of transactions through manufacturers sagged during January, the volume of business was well above expectations. Residential-type meters and distributing-type 2300-volt transformers are moving freely, and as the call for these standard items remains comparatively steady, it tends to reflect a feeling of optimism among the manufacturers. One manufacturer reports that in the aggregate the number of orders remains about the same but that a decrease is shown in average value. Outside of a few plans for apartment houses the building situation shows little change, and it is not expected that any great activity will take place until early spring.

CREDITS AND COLLECTIONS.—January collections in a number of instances were slightly better than December. This is accounted for by the fact that the credit rein is being gradually tightened, especially by the larger manufacturers. Collection reports, even from reliable sources, indicate spotty conditions, because a number of large utility accounts may be running behind normal collections. There is very little complaint about the smaller central stations, and their accounts are kept well up to date. The amount of jobbers' paper held by the manufacturers shows no increase, and the present condition is said to be healthy. Indications point to less expansion and closer margins of credit.

CONDUIT.—The demand for rigid products is comparatively light. Southeastern stocks are again reaching a normal state. Prices are off about five points. Factories are still short on 1-in., 1¼-in. and 1½-in. sizes. Immediate shipment is being made on small lots of 4-in. and three weeks on other sizes.

WIRE.—There has been no change from 23-cent base this week. Stocks are in very good shape and shipments from Eastern points show improvement each week. The call for the larger cables has dwindled to a low level.

STEEL-ARMORED CABLE.—Stocks are in fair shape, but trade is quiet. Factory shipments on Nos. 10 and 12 two-wire and single and double strip are very satisfactory. Prices are holding up remarkably well.

HOISTS.—Manufacturers report an increasing number of inquiries and a substantial number of orders. A latent market exists in the Southeast, and manufacturers are especially active in going out after it. The smaller standard equipments are coming through in six weeks, but the delivery on the larger and semi-special units now range from three months up. No change in price is noted.

PANELBOARDS.—A few good orders were recorded this week, but there is little activity and the volume of sales has slumped off. Factory shipments are promised in two to three weeks. Prices are firm.

CONDUIT FITTINGS.—Following the trend of conduit, the market has quieted down. Ample stocks are available and factory fill-in shipments are satisfactory.

SEATTLE—PORTLAND

By a vote of 76 to 45 the general strike committee of the Seattle labor unions on Feb. 8 defeated the resolution to declare off the general strike called Feb. 6 in sympathy with the shipyard workers who struck on Jan. 21. One-hundred and thirty locals, covering practically every trade, walked out, throwing out of employment between 60,000 and 70,000 employees. Wholesale and jobbing houses which have been seriously hindered in conduct of business state that if union teamsters do not return to work non-union men will be employed, following assurances of the civic authorities that business interests will be protected.

While downtown business has been completely suspended, none of the expected hardships in homes has materialized. Owing to a split in the ranks of electrical workers, the electric lighting plants of Seattle and the Puget Sound Traction Company were operated continuously, as were the gas plants of the traction company.

Street-car service in Tacoma was resumed Feb. 8 and the reported status of strike is virtually the same as prior to the general strike. Shipyard workers are still holding out. Electrical jobbers and dealers reported the past week as practically barren of sales locally. Business to out-of-town points was conducted by express and parcel post. No jobbers reported sales to shipyards and industrials. Houses have arranged to bring employees to and from work in company automobiles. As a whole local firms believe that the sympathetic strike will be broken by reopening of business on a gradual scale.

The Portland district reports that general conditions during the week show no particular change over last week. Many plans are being made and organizations formed for handling business certain to come to that section in the near future. Retail electrical trade in Portland for January was excellent, exceeding that for January, 1918. The sales were most marked in percolators, vacuum cleaners and washing machines, demand for two latter items being very unusual for this time of year. Developments in the Seattle strike situation are said not to have influenced members of Portland labor organizations as yet. The opinion expressed among business men is that there will not be a sympathetic strike in Portland. With reference to the scale paid in the Portland shipyards there is a disposition to abide by the existing schedule until date of its expiration, March 31.

The demand for living accommodations in Seattle is said to be more pressing than ever, and it is expected that building operators will set a new record during the summer.

SAN FRANCISCO

This week has been a little quieter. The labor situation in San Francisco is more reassuring, but some apprehensions are felt as to the future action of the Oakland and Los Angeles shipbuilding unions. Rains are plentiful throughout the state. Collections are good.

WIRE.—Pacific Coast prices on rubber-covered have decreased about 10 per cent, No. 14 in coil lots selling for around $14.50 per 1000 ft. The demand is steady, although nowhere near what it was at this time in 1918. There will be a wonderful demand for house-wiring sizes about six months from now. There is practically no call at present for weatherproof wire and no immediate prospect for large ordering.

FIXTURES.—Manufacturers are doing very little at present except preparing to figure when the time to do business arrives. It is significant that these fixture manufacturers almost without exception are carrying stocks of electrical appliances.

BELLS.—Dealers report an increased demand for special bells for use on lighting circuits. There is an increasing tendency to standardize on bell-ringing transformers to handle bell systems, and as no gong longer than 4 in. can be rung with these transformers, unless specially wound, a stock of such bells up to and including 12 in. is now being generally carried on the coast.

HORNS.—Calls for 110-volt alternating-current horns are now regular. Recently a section of the Stockton levee districts was so protected.

ELECTRIC RANGES.—The expected demand is rather slow in materializing, principally because there are no campaigns on foot. There is a tendency to await lower prices.

ANNUNCIATORS.—Excepting small office annunciators, there has been little activity in the line, but there have been some recent requests for large return-call annunciators and electrical or automatic resetting annunciators, forecasting the long-expected building of new apartment houses and hotels.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61 00
No. 12 solid	71 00
No. 10 solid	90 00
No. 8 solid	106.00
No. 6 solid	145 00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160 00
No. 4 stranded	205 00
No. 2 stranded	266 00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
⅝	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
⅝	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
½-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–26.50
½-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4¾-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.00—$36.00
Coil to 1000 ft.	25.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$26.00
1/5 to std. pkg.	13.60	21.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.48–$0.66
No. 18, full spools	.46– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.60 to $0.90
No. 18, full spools	.53 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$17.50–$25.00	$12.00–$17.00	$12.00–$15.00
12	22.20– 27.09	19.98– 23.22	16.65– 23.22
10	30.20– 32.40	27.18– 32.40	21.75– 27.45
8	37.62– 45.72	34.49– 45.72	30.10– 38.10
6	59.58– 72.36	54.62– 60.30	47.66– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$19.50–$20.00	$14.50–$15.00	$13.00–$14.50
12	17.50– 24.57	17.55– 24.57	17.55– 21.06
10	24.05– 32.97	24.05– 32.97	21.16– 28.26
8	33.35– 46.69	33.35– 46.69	29.35– 40.02
6	52.95– 73.71	46.60– 63.18	46.60– 52.65

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$32.25 to $34.75
25 to 50 lb.	32.25 to 34.75
50 to 100 lb.	31.25 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$32.75 to $35.75
25 to 50 lb.	31.75 to 34.75
50 to 100 lb.	30.75 to 3.735

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NEW APPARATUS & APPLIANCES

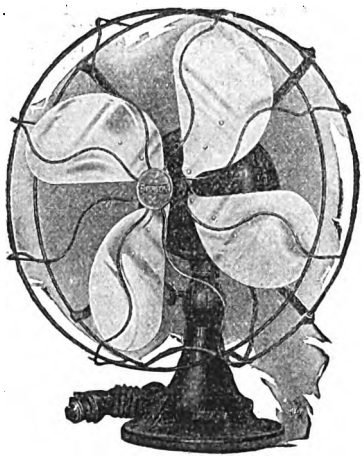
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

The New Features of 1919 Fan Designs

THE 1919 season sees few radical or important changes in design of electric fans, and at no time have changes for changes' sake been less apparent. The war has been the predominating factor in this. Confronted last year with the uncertainty of a sufficient supply of raw materials and an adequate labor force, manufacturers necessarily hesitated to make any great changes in their products for the coming season. And now, with energy and materials only recently diverted back into their normal channels by the removal of War Board restrictions, fan manufacturers have had little opportunity for development. Economy and efficiency have been given greater attention than ever before and changes tending toward conservation of material and production operations have been made. The discontinuance of less profitable and less called-for models has also taken place, and in some cases better types have replaced them.

Below are brief summaries offered by various fan manufacturers concerning the changes in the construction of their fans as well as any new models or discontinued styles. In a later issue information regarding the products of other manufacturers will, it is expected, be published.

Bodine Electric Company, Chicago.—A new three-speed 8-in. (20-cm.) desk and wall fan which can be used for both alternating and direct current of 100 volts to 125 volts has been developed by this company. Changing one cord connection from one binding post in the base to another makes this fan suitable for a different current supply.



EMERSON 12-IN. AND 16-IN. A.-C. FAN; TRUNNIONS HAVE BEEN ELIMINATED

Century Electric Company, St. Louis, Mo.—No important changes in its 1919 line of alternating-current fans from those of last year are reported.

Crocker-Wheeler Company, Ampere, N. J.—Fan manufacturing has been temporarily suspended by this company owing to the pressure of government orders.

Diehl Manufacturing Company, Elizabeth, N. J.—No decided changes have been made in the Diehl fans as compared with last year's products. A limited quantity of 6-in. and 9-in. (15-cm. and 23-cm.) fans will be available, together with the standard line of 12-in. and 16-in. (30-cm. and 41-cm.) desk and oscillating types as well as ceiling, bucket exhaust and ventilating fans.

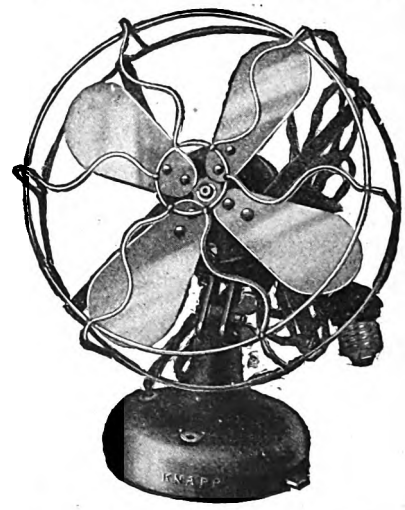
Dilg Manufacturing & Trading Company, New York City.—The fans sold

EMERSON THREE-SPEED INDUCTION CEILING FAN; LAMPS MAY BE ATTACHED

by this company this year will be identical in design with last year's.

Eck Dynamo & Motor Company, Belleville, N. J.—The only new feature in the Eck "Hurricane" line for the coming season will be a new-style blade which is designed to reduce materially the undesirable humming noise where the peripheral speed of the blades is high. The new blade, which is to be used on the 16-in. (41-cm.) direct-current fans, will have two pairs of symmetrical blades so placed on the hub that none of them travel through the same plane.

Emerson Electric Manufacturing Company, St. Louis, Mo.—The chief change made in the 1919 Emerson fans is in the 12-in. and 16-in. (30-cm. and 41-cm.) non-oscillating alternating-current fans, where the trunnions have been eliminated and the new models are equipped with a swivel-hinged base of conical design similar to that employed for several years on Emerson oscillators. These new fans may be turned laterally on the swivel as in the past and may be tilted up or deflected with the same effect as on the swivel trun-



8-IN. FAN MADE BY THE KNAPP ELECTRIC & NOVELTY COMPANY

nion models they replace. Another new feature is that these fans and also the 1919 oscillators will have bases equipped with pressed-steel bottom plates which are felt-covered. The felt coverings are not pasted on but are stretched tight and secured by an expanding ring of steel inside the steel plate so that the coverings can be replaced when worn. A new-model induction ceiling fan is being offered which has three speeds and a 56-in. (142-cm.) sweep. It is finished in dark oxidized copper, unmottled and unspotted, and is equipped with a complete adjustable hanger with ceiling hook, ceiling canopy, hanger eye and shells. The blades have a hand-rubbed mahogany finish. Lights may be attached in the usual manner, and the oil-cup covering is of a new design, protecting the switch from damage in handling or installing the fan. New types of four-blade, 12-in. and 16-in. (30-cm. and 41-cm.) oscillators for 60 cycles and a new 12-in. (30-cm.) six-blade oscillator are listed. These new types have felt-bottom bases but are otherwise identical with the 1918 line. Emerson fans for direct current are offered in the same styles as last year except the 12-in. (30-cm.) non-oscillating fans for 32 volts and 220 volts, which have swivel-hinged bases of the style described above. Six-blade fans are not listed for direct current but are sup-

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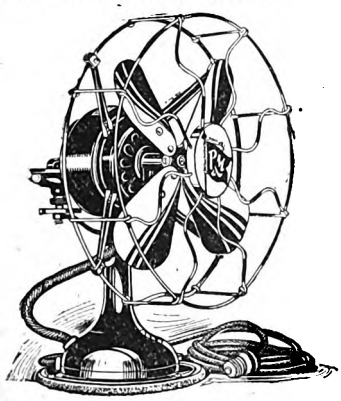
plied in 12-in. and 16-in. (30-cm. and 41-cm.) sizes for 60 cycles only. For the 1919 season the Emerson company offers the same sizes and styles of "Northwind" fans as were marketed last year.

Fidelity Electric Company, Lancaster, Pa.—No important changes have been made in this company's 8-in. and 12-in. (20-cm. and 30-cm.) table and bracket fans, which operate on either



ROBBINS & MYERS' NEW 9-IN. NON-OSCILLATING MODEL

alternating current of 110 volts, 60 or 25 cycles, or 110 volts direct current.

A. C. Gilbert Company, New Haven, Conn.—"Polar Cub" 6-in. and 9-in. (15-cm. and 23-cm.) fans which operate on either alternating current or direct current of 105 volts to 120 volts will be supplied this season with but little changes.

Hamilton-Beach Manufacturing Company, Racine, Wis.—There will be no changes in the design of this company's regular 8-in. (20-cm.) fan.

Hunter Fan & Motor Company, New York City.—The line of fans now made by this company is practically the same as last year's with the exception of type C-18 adjustable-blade ceiling fan, which is said to have been greatly improved. It is equipped with two or four blades, as may be desired, and the blades are so arranged that they can be adjusted to blow the air upward or downward. This company believes from laboratory tests that the best way to operate a ceiling fan is to have the blades tilted to blow the air toward the ceiling. This gives a better circulation of air and prevents the blowing of papers from desks and the stirring up of dust upon the floor.

Knapp Electric & Novelty Company, New York City.—A new 8-in. (20-cm.) fan of the desk and wall type is about to be placed on the market by this company in three styles. One has four speeds and is intended for 110 volts alternating or direct-current operation; another has two speeds and is suitable for 32 volts direct current such as is generated by low-voltage farm-lighting plants, while the third is a two-speed 6-volt direct-current model whic. may be run on a storage battery. As the stock of other fans made by this company has been sold out, these three new models will be the only fans marketed this year.

Manhattan Electrical Supply Company, New York City.—The 8-in., 12-in. and 16-in. (20-cm., 30-cm. and 41-cm.) desk and wall bracket fans marketed by this company will be the same in design as last year.

Peerless Electric Company, Warren, Ohio.—This company has improved its oscillating models by equipping the gimbals with two sets of ball bearings, in this way eliminating friction and making the fans operable in any position. The 9-in. (23-cm.) models are now made only with universal motors and in both oscillating and non-oscillating types. Black enamel guards are furnished with all the desk and bracket fans made by this company. Ceiling fans are supplied only in the three-speed plain style.

Pittsburgh Electric Specialties Company, New York City.—This company will market fans this season which will be the same in design as last year.

Robbins & Myers Company, Springfield, Ohio.—The 1918 designs of this company's fans will be used for the present season's models with but few changes. An addition to its line is a new 9-in. (23-cm.) non-oscillating fan which is of the four-blade, three-speed series type and has a universal motor for 100-120-volt direct-current circuits and for alternating currents with a frequency of 25 to 60 cycles. This style fan, which has a drawn-steel frame and may be used on either desk or wall, may be also obtained for operation on direct current of 32 and 220 volts and for alternating current of 60 cycles.

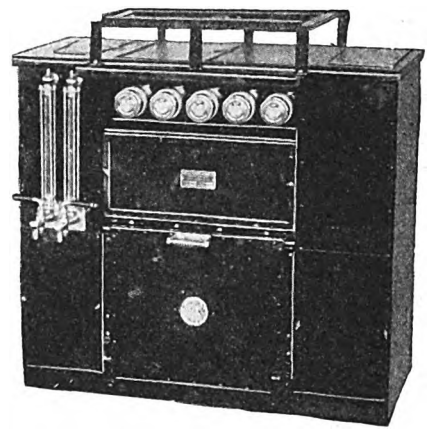
Sprague Electric Works of the General Electric Company, New York City.—The changes in the Sprague 12-in. and 16-in. (30-cm. and 41-cm.) fans consist of an improved box, fan guard and worm on the armature shaft. The new oscillating box is die-cast, is oil-tight, and the arrangement for engaging the oscillating mechanism is simple, rugged and effective, while the exterior of the box is smooth and symmetrical in appearance. The fields have been altered to suit the new form of swivel and oscillating link. The worm on the armature shaft has been changed to the left hand so that the grease in the box will be worked away from the commutator. Motor bodies, bases and guards will be finished this year in green enamel, the blades in bronze lacquer.

Tideman Electric Manufacturing Company, Menominee, Mich.—The "Menominee" fans made by this company have not been supplemented by any new models for the 1919 season, but some changes have been made in designs. One model has been discontinued, the 16-in. (41-cm.) universal fan. Oscillating 8-in. (20-cm.) universal types 129 and 155 have been slightly altered, a die casting for the housing and gear case being used. The oscillating mechanism on all types has been improved. Gears with extra large and heavy teeth are being used so that it is said to be impossible for them to skip. A clutch in the oscillating mechanism has also been devised whereby the gears will not be injured should the fan be held or prevented from oscillating while in swinging motion. Curved or dished blades, an improvement made this season, will tend to reduce noise in these fans. All this company's models will be finished this year in black enamel with black die and brass blades.

Western Electric Company, New York City.—This company reports that it will market the same line of fans as last year without any additions or changes.

Compact and Separable Range of Large Capacity

An electric range has recently been developed by the Simplex Electric Heating Company, Cambridge, Mass., primarily for submarine service in the United States Navy, but its many features should make it suitable for other installations. It occupies a space only 42 in. (106 cm.) long, 28 in. (71 cm.) deep and 35 in. (89 cm.) high and can be carried in four sections through a door, hatchway or opening only 27 in. (68 cm.) across. These four sections are separated by screws and consist of a coffee compartment with a 3-gal. (11-l.) water-jacketed tank, a hot-water compartment of 10-gal. (38-l.) capacity, an oven compartment comprising a working space 12 in. (30 cm.) high,



HAS FLUSH HOT PLATES, AN OVEN, A WATER TANK AND A COFFEE TANK

18 in. (46 cm.) wide and 17 in. (43 cm.) deep, and a switch and fuse cut-out compartment in which the wiring is centralized. A steel top with two 9-in. by 18-in. (23-cm. by 46-cm.) flush hot plates and with racks for holding utensils is placed at the top of the assembled compartments.

The heating equipment has an aggregate connected load of 9.5 kw., which is divided as follows: two hot plates, 2000 watts each; one oven heater, 1500 watts, and the coffee-tank and water-tank heater, 2000 watts each. The heating elements are designed to operate on any current pressure from 80 volts to 140 volts, giving a 75 per cent voltage range which is a distinct advance in design. On this range, which weighs about 570 lb. (258 kg.), all the usual cooking operations can be performed. It is said that the food for

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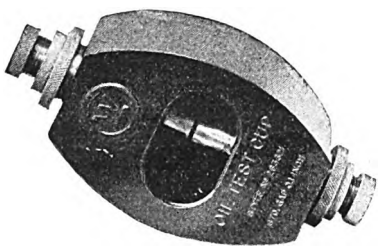
thirty men, the crew of a submarine, was easily prepared on this range in an atmosphere of explosive gas and in the extremely contracted quarters of such a craft. A removable scavenger pan under the hot plates catches any drip, while the wiring is contained in steel conduit. The hot-water tank is filled with a top draw-off, and the water is automatically pumped into the tank under pressure.

Compact Oil-Testing Cup

For determining the insulating value of oil through measuring its dielectric strength by a spark gap immersed in the oil, an oil-testing cup that gives reliable indications with a small sample of il and with a relatively low testing voltage has been developed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa. The new design has a molded construction, so that the cup proper is all in one piece and therefore is simple, rugged and compact. The molded part contains two brass electrode bushings threaded to receive the packing gland. Back of each packing gland is a small amount of packing, such as cotton waste, which prevents oil leakage around the electrodes. The bearing surfaces are reamed to receive the electrodes, which it is claimed guarantees perfect fit and exact alignment. The electrodes are made from a cylinder 1 in. (2.5 cm.) in diameter, threaded at one end to receive the lock nut. Binding posts are placed on the outside end of the electrodes to attach the leads from the testing transformer. A steel feeler gage for setting the gap at exactly 0.1 in. (0.25 cm.) is attached to one of the binding posts.

Weighing only 6½ lb. (2.9 kg.) with dimensions of 8½ in. by 4 in. by 4¾ in.



SMALL QUANTITY OF OIL OF MODERATE DIELECTRIC STRENGTH MAY BE USED

(21.6 cm. by 10 cm. by 12 cm.) and requiring only a 4-oz. (0.11-kg.) sample of oil, the whole testing cup is light, compact and convenient. The maximum voltage necessary for reliable testing is said to be 25,000. Higher voltages may be used if available, but more than 30,000 volts, it is said, will seldom be required to discharge across the gap through any insulating oil.

Non-Twisting Canopy Ring

A number of advantages are claimed for the "Non-twist" canopy made by the Non-Twist Canopy Ring Company, Toronto, Canada. Chief among these is that the wires within the canopy are not twisted, are thus in much less danger of being cut and may be pulled out for inspection of the insulation or joints. The canopy consists of three parts—a nipple crowfoot for attachment to the wall or ceiling, the canopy proper and an "N-T ring" which secures the canopy in place by attachment to the nipple and at the same time provides an outlet for the wires. The N-T ring is also threaded at its outer end to receive the fixture or bracket. It is made in two parts, and the outer piece may be rotated to accommodate the desired position of th fixture. This position is locked b means of a set screw.

Vegetable-Peeling Machines

Three sizes of electrically driven "Sim-Peel-O" vegetable-peeling machines, with capacities of 15, 25 and 40 lb. (6.8, 11 and 18 kg.) are being made by the Maxim Manufacturing Company of 700 West Twenty-second Street, Chicago. These peelers operate on the cylinder and disk principle, both of these parts being concrete-lined by a special process. All parts of the machines are interchangeable and are readily accessible for cleaning, in this way insuring proper sanitary conditions. A small stream of running water washes the vegetables clean during the peeling operation, thus facilitating the work. Among the advantages of these peeling machines indicated by the maker are simplicity and efficiency of operation, the small amount of floor space occupied, and that they are equipped with the "timeograph," an electrically operated controlling instrument which may be set so that the peeler will be operated only so long as is necessary to peel the vegetables it contains. It is also pointed out that the load can be applied and discharged while the peeler is in operation.

The motors are said to be specially wound in a small frame and will develop excess power to offset overloads

MACHINERY IS INCLOSED AND SHIELDED

and misuse. Connection of the motor to the peeling mechanism is made through one set of gears, rawhide pinions making the machine noiseless. Full ball bearings relieve the friction load on the motors, which are usually furnished for 110 volts to 220 volts, alternating or direct current. All the lubricating devices are centered at one point for convenience, and the entire mechanism is inclosed and shielded to eliminate any possibility of accident to the operator. The electrical, water supply and drainage connections are stated to be very simple.

Notes on Recent Appliances

Flexible Varnished Tubing for Internal Leads

A recent addition to the products of the Irvington Varnish & Insulator Company of Irvington, N. J., is a flexible varnished tubing for protecting and insulating bare, enameled, single-cotton, double-cotton and single-silk wires used as internal leads.

Quick-Make-and-Break Starting Switches

The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is marketing quick-make-and-break switches, known as type 816, for use with squirrel-cage motors.

Motor-Operated Filing Machine

For use by tool, die and model makers and in shops where considerable filing is done the William F. Davis Machine Tool Company, 149 Broadway, New York City, is making an electrically operated filing device.

Laboratory Gas-Blower Outfit

An electrically driven blower for use in the laboratories of manufacturers as well as in dental and surgical operations has been put on the market by the Anderson Electric Specialty Company of 118 South Clinton Street, Chicago, Ill.

Motor-Starting Safety Switches

The Trumbull Electrical Manufacturing Company of Plainville, Conn., has placed on the market motor-starting switches of the straight-through type with no-voltage-release coil.

Fittings for Marine Service

A line of marine electrical fittings is being marketed by the Factory Products, Ltd., Toronto, Canada, and includes a watertight junction-box lighting fixture, a watertight combined switch and receptacle and two designs of Morse signaling lamps.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Norway (No. 28,262) desires to purchase electrical apparatus and supplies of good quality. Correspondence may be in English.

An electrical supply house in Norway (No. 28,268) desires to purchase electric foot warmers, heating devices, supplies, electrometers, motors, generators, household appliances and lamps. Terms, cash against documents at destination. An agency for these goods is also desired. Correspondence may be in English.

A commercial man in Italy (No. 28,270) desires to secure agencies for the sale of machinery, electrical materials, etc. Correspondence should be in Italian.

A man in France (No. 28,283) desires to secure an agency for the sale in Tunis and the north of Africa of lighting devices. Correspondence should be in French.

Dr. Chester Lloyd Jones has been appointed commercial attaché to Spain. He will be the first trade ambassador for the United States to Spain, which offers an unusually attractive field for American enterprise. During the war he has been director of the Bureau of Foreign Agents of the War Trade Board. At the present time Spain is in the midst of a period of revived industrial and commercial activity, and the time is unusually favorable, the Bureau of Foreign and Domestic Commerce states, for making secure the expansion of her trade with the United States which has taken place during the war and for a further development of the demand for American merchandise. Dr. Jones will be accompanied by a staff of experts who will investigate different phases of the situation.

Western Electric Changes in Sales Forces

The Western Electric Company has announced the following changes in its district sales forces:

D. J. BUTTS, who has been manager of the Los Angeles house since March, 1917, has been appointed district sales specialist at San Francisco. Mr. Butts began his career with the company at Chicago in 1903, his first work being armature winding. He went to Hawthorne in 1905 and did engineering work there for a year. In 1906 he was sent to New York and in December of that year was transferred to the sales department. He remained in New York until 1910, when he went to Boston, and in 1916 he was transferred to Salt Lake City as manager. He remained there until he became manager at Los Angeles.

H. L. HARPER has been appointed manager of the Los Angeles house, going there from Kansas City, where he has been throughout most of his career with the company, extending over a period of fifteen years. He joined the Dallas house as a telephone salesman in January, 1913, and stayed there four years, during most of which time he was telephone specialist. He returned to Kansas City in February, 1917, as sales manager.

W. B. DE FOREST, who has been a farm-light specialist for the Kansas City house, stationed at Oklahoma City, has returned to Kansas City to take Mr. Harper's place as sales manager. Mr. De Forest has been employed by the company for a little less than ten years, coming to the Kansas City house as a salesman in April, 1909.

W. E. LOTSPEICH, formerly lamp specialist at Atlanta, has been transferred to New Orleans as the company's sales representative in that territory.

PANAMA CANAL PURCHASES. — Orders placed by the Panama Canal for electrical goods from Jan. 22 to 28 were as follows: General Electric Company, twenty-four armature coils, $1,152; thirty-six boxes of rheostats, $504; two indicators, $109; Locke Insulator Manufacturing Company, 1500 insulators, $3,750; National Electric Supply Company, 500 carbons, $20; Western Electric Company, one annunciator, $16; H. W. McCandless Company, 5000 lamps, $333; Westinghouse Electric & Manufacturing Company, 50 bricks, $62.50; Bryant Electric Company, 50 receptacles and 50 plugs, $170.62.

HOOVER NATIONAL ADVERTISING CAMPAIGN.—Despite calls for more electric sweepers than their greatly enlarged factory can produce, the Hoover Suction Sweeper Company has launched a large national advertising campaign. Nearly 30,000,000 full pages, in colors and black and white, are promised for the remaining months of 1919 in a list of prominent periodicals. The Hoover company is also running an extensive campaign in periodicals read by the trade, that dealers may be kept informed of the work being done to make the sale of Hoovers more attractive. Dealer helps, providing the dealers with different forms of local publicity, are also being distributed.

THE EDISON STORAGE BATTERY COMPANY announces the removal of its New York sales office from 209 West Seventy-sixth Street to 247-251 West Thirty-fifth Street, New York City.

C. C. MINER has resigned as auditor of the Robbins & Myers Company to join the Dayton Fan & Motor Company of Dayton, in which he has purchased a controlling interest. Mr. Miner, who has been in the Robbins & Myers service for twenty years, leaves on or before March 1.

GORDON E. VARNEY, founder and president of the Varney Electrical Supply Company of Indianapolis, Ind., has sold his interest in the company to the other stockholders and has retired from business. C. S. Walker has been elected president. Mr. Walker has recently been serving as secretary and treasurer of the company. Mr. Varney is a graduate of the School of Mines, Lafayette, Pa. Upon graduation he was employed by the General Electric Company. After handling electrical supplies for several years he organized in 1910 the Varney Electrical Supply Company, Mr. Walker then being bookkeeper and clerk. The company was first established at 235 South Meridian Street, where in the beginning it occupied one floor. Two years later the company outgrew this building and removed to its present site, where it uses an entire four-story building. A branch house is also maintained at Evansville, Ind. Mr. Varney has not announced his future plans but expects to take a complete rest for some time.

THE AMERICAN BOSCH MAGNETO CORPORATION has taken over the entire holdings and organization of the old company, which was German-owned. This included the works at Springfield, Mass., which comprise 250,000 sq.ft. in buildings and employ 1500 operatives; also the national service and sales system and the entire ownership of all the United States and foreign patents and trademarks under which the old company operated. Ever since the Alien Property Custodian seized the company in May, 1918, the plant has been operated to supply, up to virtually 100 per cent of its capacity, government war demands. The output will now be devoted without interruption to commercial requirements. In addition, the new corporation plans to extend greatly its scope of manufacture in the field of automotive industry. From an early date the Bosch Magneto Company manufactured electrical products for the automobile and allied fields, including magnetos and battery systems, lighting generators, etc. The first Bosch magneto dates back to 1886, although this form of ignition was not adopted by American manufacturers of automobiles until 1905. In the following year Robert Bosch opened a New York office, and in 1908 a four-story building was acquired to meet the demands of the products then made. It is said that about 350 workmen produced from 8000 to 10,000 magnetos a month at that time. The next important step in the growth of the company was taken in 1911, when ground for the new large plant was broken in Springfield. In January, 1912, the works were completed, only to be found too small in 1914, when more than 250,000 magnetos were turned out. Accordingly, the Rushmore Dynamo Works were purchased to increase the production of starting and lighting apparatus. Expansion still continued. Early in the fall of 1915 construction was started on an addition of more than 60,000 sq.ft. to the main works. It is understood that the new organization hopes to establish itself in a position of even greater prominence in the production of electrical apparatus for American automotive fields than the old company enjoyed before the war.

Trade Publications

VALVE GRINDER.—A leaflet about the Stenman electric valve grinder has been prepared by the Stenman Electric Valve Grinder Company, Worcester, Mass.

REFLECTORS.—The Reynolds Electric Company, 422 South Talman Avenue, Chicago, has prepared bulletin No. 35, which is devoted to "Reco" reflectors for illuminating signs, poster boards and walls.

CLAMP.—The Universal hose clamp, which may also be used for holding other cylindrical objects, is described in a small circular issued by the Universal Industrial Corporation, Hackensack, N. J.

INDIRECT-LIGHTING FIXTURES.—J. Livingston & Company, Grand Central Terminal, New York City, have issued section 1 of their catalog No. 100, which illustrates, describes and gives prices of lighting fixtures for industrial installation.

ARMATURE TESTER.—"How to Use the Ambur Armature" is the title of a twenty-two-page booklet issued by the American Bureau of Engineering, 1018 Wabash Avenue, Chicago. Other literature about its trouble locater has also been prepared by this concern.

GEARS.—Bevel, spiral and generated spur gears, rawhide and micarta pinions, worms and worm gears, racks, lead screws, sprockets and chains are fully described in the eighty-four-page 1919 illustrated catalog of the Philadelphia Gear Works, 1120 Vine Street, Philadelphia.

New Incorporations

THE CARLOCK (ILL.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $15,000 by W. L. Carlock, J. K. Esh, J. E. O'Hara and S. E. Maurer.

THE SULLIVAN ELECTRIC COMPANY of Callicoon, N. Y., has been incorporated by M. Herrmann, F. M. Starck and L. G. Gerhardt of Callicoon. The company is capitalized at $25,000.

THE SAVE ELECTRIC COPORATION of New York, N. Y., has been chartered by M. Ettinger, M. L. Newman and B. P. Price. The company is capitalized at $200,000 and proposes to manufacture electrical appliances, etc.

THE UNION ELECTRIC COMPANY of Richmond, Va., has been incorporated with a capital stock of $25,000 to do a general electric business. The officers are L. R. Warriner, president, and G. M. Miller, secretary, both of Richmond.

THE METALS DEVELOPMENT COMPANY of Newark, N. J., has been incorporated by Blasius Hart of Newark, Henry Escher, Jr., of Summit, and Lawson R. Jones of Brooklyn, N. Y. The company is capitalized at $25,000 and proposes to manufacture electric castings.

THE ELECTRO-CHEMICAL ENGINEERING CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $1,000,000. The incorporators are Samuel B. Howard, A. W. Britton and Paul S. Smith, all of New York, N. Y.

O. M. MATZEN & COMPANY of New York, N. Y., have been incorporated with a capital stock of $5,000 by R. C. Medl, J. F. Smith and O. M. Matzen, 176 West Broadway, New York City. The company proposes to do a general electrical engineering and contracting business.

THE CASSIDY COMPANY of Queens, N. Y., has been incorporated by G. W. Cassidy, 182 State Street, Flushing; A. Wahle, 1493 Bushwick Avenue, Brooklyn, and W. N. Bayliss, Huntington. The company is capitalized at $250,000 and proposes to manufacture gas, electric lighting and other fixtures, etc.

THE FERRO ELECTRIC WELDING COMPANY of Brooklyn, N. Y., has been chartered with a capital stock of $150,000 for the purpose of doing a general welding and electrical business. The incorporators are: K. Furuboth, 128 West Sixty-first Street; I. Meyer, 90 Broad Street, and O. Johannessen, 95 East Eighteenth Street, New York City.

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New England States

ST. ALBANS, VT.—The Public Electric Light Company has awarded the contract for the erection of a transmission line to Burlington and substations to P. E. Sullivan. The work includes 14 miles of transmission line and the construction of a step-up transformer station at Fairfax Falls from 2300 volts to 3300 volts, and at the city of Burlington a step-up transformer station. The contract also includes the construction of a forebay, penstock, raceway and power house at Fairfax Falls to accommodate two 100-hp. horizontal water turbines each directly connected to a 750-kva., 2300-volt, three-phase, 60-cycle generator and switchboard.

BOSTON, MASS.—Plans are being prepared for a ship-repairing plant for the Boston Dry Dock & Shipbuilding Company at Jeffries Point, East Boston, to cost about $6,000,000.

BROCKTON, MASS.—Contract is still to be awarded for three vertical water-tube boilers of 1000 hp. for a power plant for the Walk-Over Shoe Company.

IPSWICH, MASS.—The question of establishing a municipal electric light plant in Ipswich is under consideration.

LOWELL, MASS.—Work has begun on the reconstruction of the hydroelectric plant of the Hamilton Manufacturing Company.

NEW BEDFORD, MASS.—Bids will be received in the spring by the city of New Bedford for construction of hospital group on Mount Pleasant, Myrtle, Van Buren and Jefferson Strets, to include ward and operating buildings, laundry and power house, to cost about $100,000. J. S. Mcintyre, 22 Clifford Building, is architect. H. T. Bordan, 154 Fair Street, is chairman of committee.

RUTLAND, MASS.—Bids, it is reported, will be received about March 1 by the Central New England Sanatorium for construction of administration building and two ward buildings, to cost about $200,000. E. F. Stercus, 9 Park Street, Boston, is architect.

PROVIDENCE, R. I.—Bids will be received by Brown University in the spring for construction of dormitory building on Cushing Street for Pembroke College, to cost about $130,000.

PROVIDENCE, R. I.—Bids will be received by the board of education in the spring for the construction of a high school building on Pond, Winter and Spring Streets and Montcalm Court, to cost about $400,000.

THOMASTON, CONN.—The Connecticut Power Company is contemplating extending its lighting system to Reynolds Bridge. T. J. McEnroe is local manager.

WINDSOR, CONN.—The Farmington Power Company, which recently took over paper mills at Rainbow, is installing a generator at the Rainbow paper mill and is erecting a transmission line to Oil City to connect the two plants.

Middle Atlantic States

BROOKLYN, N. Y.—Plans are being prepared by Helme & Corbett, architects, 190 Montague Street, for the erection of a hospital building at South Ninth Street and Driggs Avenue, to cost about $350,000.

BROOKLYN, N. Y.—The Brooklyn Edison Company has been granted permission by the Public Service Company to issue $5,500,000 in bonds. Part of the proceeds, it is understood, will be used for extensions and improvements to the electric plant and system. The company is a consolidation of the Edison Electric Illuminating Company of Brooklyn and the Kings County Light & Power Company.

BUFFALO, N. Y.—Arrangements have been made by the Niagara, Lockport & Ontario Power Company for an issue of $1,980,000 in bonds, the proceeds to be used for proposed extensions and improvements to its system.

CALLICOON, N. Y.—Application has been made by the Sullivan Electric Company of Sullivan County to the Public Service Commission for permission to erect an electric light and power plant in Delaware.

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 17, under Specification 3731, for elevator for light machine and electric shop at the New York Navy Yard, to cost about $30,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 24, under Specification 3759, for power plant, piping and equipment at the New York Navy Yard. The cost is estimated at $70,000.

RENSSELAER, N Y.—The installation of an ornamental lighting system on Broadway from Columbia Street to John Street is under consideration. The street-lighting service is furnished by the Albany Southern Railroad Company of Hudson.

WATERTOWN, N. Y.—Plans have been prepared by T. T. Tomlines, City Bank Building, Syracuse, for a water-power development at the Diamond Island site on the Black River for the city of Watertown. The proposed work includes construction of dam, power house and tailrace, to cost about $600,000. About $170,000 is available.

KEARNEY, N. J.—Preparations are being made for rebuilding the fertilizer plant of Swift & Company, recently destroyed by fire. The loss is estimated at about $150,000.

ERIE, PA.—Notice has been filed with the Public Service Commission by the Erie Electric Motor Company of a bond issue for $250,000.

PARKVIEW STATION, PA.—The Construction Division, War Department, Washington, D. C., is planning to alter the attic of General Hospital No. 24 and install heating and lighting systems in attic of middle building, to cost about $10,250.

STATE COLLEGE, PA.—The board of trustees of Pennsylvania State College is considering the construction of a new power plant at the college to cost about $150,000.

SPARROWS POINT, MD.—The Bethlehem Steel Corporation of Bethlehem contemplates an expenditure of about $20,000,000 during 1919 to complete its commercial steel plant. J. N. Stringley is in charge of construction.

NORFOLK, VA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is considering building a new galvanizing plant at Norfolk, Va., to cost about $100,000 for which plans have been prepared.

RICHMOND, VA.—The Brinser Handle Works is contemplating building an extension to its plant, to cost aboot $19,000. The plans include a boiler and engine plant.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing supplies at the various navy yards and naval stations as follows: Until March 11 at Charleston, S. C., Schedule 3734—one charging machine. Norfolk, Va., Schedule 3737—20,000 ft. chain cable. Brooklyn, N. Y., and Norfolk, Va., Schedule 3738—common-type and resistance wire. Until March 18, Puget Sound, Wash., Schedule 3746—two switchboards complete. Washington, D. C., Schedule 3748—miscellaneous electrical equipment. Puget Sound, Wash., Schedule 3752—90 storage batteries.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until Feb. 18 at various stations, Schedule 3646—miscellaneous fuses and fuse elements and inclosed fuses. Until Feb. 25, Alexandria, Va., Schedule 3667—two switchboards (high and low tension), six disconnecting switches and eight panels. Brooklyn, N. Y., Schedule 3677—27,000 ft. three-conductor cable. Bids will also be received in the near future as follows: Puget Sound, Wash., Schedule 3724—28 watertight annunciators; Schedule 3683—2000 ft. three-conductor cable, 36,000 ft. bridle telephone wire. Mare Island, Cal., Schedule 3683—miscellaneous lighting and power cable, 250 lb. annunciator wire. Boston and Mare Island, Schedule 3683—90,000 ft. ship-lighting cable, miscellaneous telephone wire. Brooklyn, N. Y., Schedule 3683—10,000 ft. lead-sheathed cable, miscellaneous rubber-covered wire. Boston, Mass., Schedule 3683—miscellaneous telephone cable. Mare Island and Puget Sound, Schedule 3683—miscellaneous weatherproof wire. Various, Schedule 3681—miscellaneous charging stations. Schedule 3683—miscellaneous lighting and power wire. South Charleston, Schedule 3734—one charging machine. Washington, D. C., Schedule 3729—six crane battery trucks. Philadelphia, Pa., Schedule 3709—six portable ventilating sets. Applications for proposal blanks should designate the schedule desired by number.

North Central States

BATTLE CREEK, MICH.—Plans have been prepared by M. J. Nirehouse, 343 South Dearborn Street, Chicago, Ill., for enlarging the power house at the works of the Michigan Carton Company. W. J. Fell is manager.

DETROIT, MICH.—Morgan & Wright, foot of Bellevue Street, are contemplating the erection of an addition, 140 ft. by 170 ft., seven stories, to cost about $500,000. The company manufactures rubber goods.

MUSKEGON, MICH.—The Brunswick-Balke-Collender Company is planning to build an addition to its plant, to cost about $200,000. The new department will be used for the production of rubber goods manufactured from left-over materials in tire making.

CLEVELAND, OHIO.—The Electric Steel & Forge Company, East Sixty-first Street, is contemplating the construction of a machine shop and warehouse on Grant Avenue, to cost about $200,000. The A. M. Allen Company, 1900 Euclid Avenue, is architect.

HAMILTON, OHIO.—J. J. Sloat, service director and manager of the municipal electric light plant, has petitioned the City Council for $15,000 to replace the present arc lamps with Novalux incandescent lamps. It is proposed to install 440 lamps of 400 cp., 71 of 60 cp. and 46 of 1000 cp. Mr. Sloat also asked that the electric department be permitted to purchase a one-ton auto truck.

WELLINGTON, OHIO.—Plans are under consideration to increase the output of the municipal electric plant by 200 hp. It is proposed to install either gas producers and gas engines or new boilers and a steam engine. C. E. Gadfield is superintendent.

ANDERSON, IND.—The Public Service Commission has granted the city of Anderson permission to issue $90,000 in bonds for improvements to the municipal electric light plant.

CRAWFORDSVILLE, IND.—Plans have been adopted by the City Council for extensions to the system of the Crawfordsville Electric Light & Power Company (municipal). Bids for equipment, it is understood, will soon be asked for.

HAMMOND, IND.—The Standard Oil Company, it is reported, will increase the output of its power plant at its Whiting refinery from 21,000 hp. to 40,000 hp. The company is also erecting a new coal bunker with a capacity of 125,000 tons and will also install a new refrigerating plant of 400 tons daily capacity. Other improvements, including a large warehouse, a deep sewer to the canal, etc., are contemplated.

SHELBYVILLE, IND.—The Interstate Public Service Company has petitioned the Commissioners of Shelby County for permission to erect electric transmission lines from Franklin to Shelbyville. The company intends to connect the two plants so that power may be supplied in either city from either plant.

BUSHNELL, ILL.—The Illinois Public Utilities Commission has granted the North McDonough Light & Power Company permission to erect and operate a 11,000-volt transmission line from Blandinsville to Good Hope, and to construct and operate a distributing system in the village of Good Hope, and also to supply electricity to residents along the line between the two villages. Energy to operate the proposed system will be purchased from the Western Illinois Utilities Company. The company is also authorized to issue $10,000 in capital stock.

JOLIET, ILL.—The Joliet Forge Company is contemplating building an addition to its plant, to cost about $150,000.

MATTOON, ILL.—The installation of new ornamental street lamps on Broadway from Fourteenth Street to Twenty-first Street, and also on Sixteenth and Seventeenth Streets, has been decided upon by the Board of Water and Light Commissioners.

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SOUTH ELGIN, ILL.—The Illinois Public Utilities Commission has authorized the South Elgin Electric Light Company to discontinue the operation of its plant. The plant was established sixteen years ago and suspended Nov. 7, 1918. Since then the town has been without electrical service until recently, when twelve street lamps were installed by the Aurora, Elgin & Chicago Railroad Company.

APPLETON, WIS.—The Graef Wire Manufacturing Company, it is reported, contemplates the construction of four two-story buildings in Appleton, to cost about $350,000. E. Wettengel, 901 Washington Street, is architect.

CHETEK, WIS.—The Council is considering the purchase of the electric plant of the Chetek Light & Power Company.

CLINTONVILLE, WIS.—The hydroelectric plant of the Clintonville Power Company on the Embarrass River has been acquired by interests said to be identified with the Kelsey-Brewer syndicate of Grand Rapids, Mich. The new owners are contemplating extensions to the plant and improvements to other water-power sites on the Embarrass River, involving an expenditure of from $1,000,000 to $2,000,000. The name of the company has been changed to the Central Wisconsin Power Company. F. H. Josslyn of Oshkosh is president and C. A. Runyan of South Haven, Mich., is secretary and treasurer.

RHINELANDER, WIS.—A proposal has been submitted to residents of Woodruff and Minocqua by E. A. Forbes, president of the Rhinelander Light & Power Company, offering to erect a high-tension transmission line from Rhinelander to those villages to supply electricity for lighting purposes.

WEST ALLIS, WIS.—Arthur J. Sweet, consulting engineer, 521 Grand Avenue, Milwaukee, has been engaged by the City Council to prepare tentative plans and estimates of a proposed municipal electric light and power plant for West Allis.

GARY, MINN.—The Gary Telephone Company is planning to erect a telephone line into Fleming this spring and will improve the line to Ada.

MOOSE LAKE, MINN.—The General Light & Power Company of Cloquet is reported to be considering rebuilding its local system, recently destroyed by fire.

ORTONVILLE, MINN.—The Tri-State Flood Central Association has been organized to eliminate the flood wash of the Red River Valley and for industrial developments and harnessing of flood water for power. For further information address A. B. Kaeches of Ortonville.

ST. PAUL, MINN.—The Northern Pacific Mutual Benefit Association, 203 Railroad Building, it is reported, will receive bids in March for the construction of hospital building and power plant at Simpson and Edmund Streets, to cost about $300,000. L. Bassindale, Capital Bank Building, is architect.

MAQUOKETA, IOWA.—The Iowa Electric Company contemplates the erection of a high-tension transmission line connecting the hydroelectric plant at Anamosa with the steam generating plant at Maquoketa. John I. Reed of Cedar Rapids is general manager.

MONTICELLO, IOWA.—The Monticello Electric Company is contemplating extending its service to Sand Creek and other surrounding towns.

BUTLER, MO.—Preparations, it is reported, are being made by J. F. Butler for the installation of an electric light and power plant in Butler.

GUILFORD, MO.—The Maryville (Mo.) Electric Light & Power Company has submitted a proposal to the town of Guilford offering to extend its lighting system here. The company asks for a twenty-year franchise and a cash bonus of about $5,000. C. C. Hellmers of Maryville is superintendent.

KANSAS CITY, MO.—The Kansas City Light & Power Company is contemplating the erection of a substation at Thirty-first Street and Robert Gillham Road.

KANSAS CITY, MO.—Contracts have been awarded by the Kansas City Light & Power Company to the E. L. Winn Construction Company, Railway Exchange Building, for the construction of two substations, one to be erected at 3037 Cherry Street and the other at 7111 East Twelfth Street, Kansas City, at $16,000 each.

MARSHFIELD, MO.—Plans for the construction of a hydroelectric plant on the Niangua River to supply electricity for lamps and motors for the city have been announced.

WATERTOWN, S. D.—An election will be called to vote on the proposal to issue $150,000 in bonds for the installation of a municipal electric lighting plant and waterworks system. D. N. Hagan is chairman of board.

NORFOLK, NEB.—Application has been made to the State Legislature for an appropriation of $75,000 to construct and equip kitchen and dining room and dormitory, $35,000 for addition to power house and smokestack, and $80,000 for chapel and assembly hall.

O'NEILL, NEB.—The McGinnis Creamery Company is considering plans for rebuilding the creamery and lighting plant destroyed by fire some time ago.

VERDIGRE, NEB.—Plans are being prepared by the Verdigre Creamery Company for rebuilding creamery and installing a large electric power plant.

KANSAS CITY, KAN.—Two-thirds of the property owners on Central Avenue have petitioned the City Council to erect ornamental lamps (cluster) along Central Avenue from Seventh Street to Twenty-third Street. L. H. Chapman is commissioner of water and light plant.

OSWEGO, KAN.—The installation of a new electric light and power plant in Oswego is reported to be under consideration.

Southern States

SHELBY, N. C.—The Double Shoals Cotton Mills is planning to install an electric lighting system for the mill village.

ATHENS, GA.—The Athens Railway & Electric Company is considering the installation of an additional boiler. Nothing definite as yet has been decided upon. C. D. Flanigen is president.

LYERLY, GA.—J. S. Owings, who has recently purchased the Sarling Mill property, proposes to establish an electric light and power plant and flour and grist mills.

BUNNELL, FLA.—Bonds to the amount of $15,000 have been voted for improvements to the electric light plant and waterworks system. Contract was recently awarded for the installation of an alternating-current lighting system.

PENSACOLA, FLA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to install electrical equipment at the local navy yard, to cost about $30,000. Specification 3785.

STARKE, FLA.—The City Council is considering a bond issue to provide funds for improvements to the municipal electric plant and also to install ice-manufacturing machinery.

ZEPHYRHILLS, FLA.—The Zephyrhills Electric Company has purchased machinery for a new ice plant to be operated in connection with its electric plant. L. N. Gilbert is proprietor.

BIRMINGHAM, ALA.—The Chickasaw Utilities Company after July 1 will take over and operate its own car line between Prichard and Chickasaw. Electricity will be generated at its own plant now under construction.

SELMA, ALA.—The establishment of a municipal electric light plant is under consideration by the City Council.

UNION SPRINGS, ALA.—Bonds to the amount of $15,000 have been voted for improvements to the municipal electric light plant and waterworks system.

PASCAGOULA, MISS.—The city of Pascagoula is planning to equip loading docks and will purchase cosiderable mechanical loading and unloading machinery.

NEW ORLEANS, LA.—A conference will be held on Feb. 27 and 28 to arrange for the construction of a proposed municipally owned electric interurban railway to connect New Orleans, La., and Mobile, Ala., with all of the Mississippi coast towns. The plans include the construction of hydroelectric plants on streams near the coast to supply electricity to operate the proposed railway.

FREDERICK, OKLA.—Plans are being prepared for extensions and improvements to the municipal electric light plant. The installation of an ornamental lighting system on Grand Avenue is also under consideration.

HOUSTON, TEX.—The Industrial Transportation Company is planning to erect a packing plant and warehouse in Houston, to cost from $1,000,000 to $1,500,000. The installation of a refrigerating plant in the basement is included in the plans.

MINERAL WELLS, TEX.—The construction of an interurban electric railway between Fort Worth and Mineral Wells, a distance of about 65 miles, is being promoted by W. J. Walder of Mineral Wells and associates. The plans provide for the installation of an electric power plant.

SAN BENITO, TEX.—The San Benito Water & Electric Company is contemplating improvements to its system.

Pacific and Mountain States

EVERETT, WASH.—At the spring election the proposal to establish a municipal electric light plant will be submitted to the voters. The city has acquired considerable undeveloped power on the Sultan River, the first unit of which would develop about 6000 hp., which would meet the present needs of the city. The present plan is to harness power in the river from the Sultan dam to the horseshoe bends in the river.

SEATTLE, WASH.—A. H. Dimock, city engineer, has asked the City Council for a small appropriation for a survey and drilling work at Ruby Creek, on the Skagit River, to determine the feasibility of upper dam sites on the river, before the construction of the first unit of the large hydroelectric project at Gorge Creek. The cost of the entire project is placed at $30,000,000, based on the development of 300,000 hp. The first unit will develop 50,000 hp., and the cost will be covered by the $5,500,000 bond issue.

PORTLAND, ORE.—The Commissioners of Multnomah County are considering the construction of a county hospital on the grounds of the Oregon Medical College, to cost about $200,000.

LA JOLLA, CAL.—The La Jolla Electric Line, recently incorporated with a capital stock of $250,000 to construct an electric railway from San Diego to La Jolla, plans to purchase part of abandoned right-of-way of the La Jolla Railway between Bird Rock and La Jolla and will build an electric railway to connect with the Mission Beach electric car line. The cost is estimated at about $108,000, of which $54,000 will be paid to the old La Jolla line for track. E. F. Stahle of La Jolla is treasurer.

BOISE, IDAHO.—The Keystone Dredging Company of San Francisco, Cal., has purchased 800 acres of placer ground on Boise and Feather Rivers for which three gold dredges are to be built. They will be equipped with electrically operated machinery. Captain Rupert Winters is interested in the project.

MANVILLE, WYO.—E. P. Bacon of Casper has been granted a franchise by the Town Council to construct and operate an electric light, heat and power plant in Manville.

THERMOPOLIS, WYO.—The Town Council has adopted a resolution to make application to the Wyoming Public Service Commission for transferable franchise for construction of a municipal light and power system. This action was taken in connection with application to the Public Service Commission by the Hot Springs Light & Power Company for increased rates which was opposed by the town on the ground of poor service.

MOUNTAIN, N. M.—The Council has granted a franchise to Bob Evans to install and operate a water and light system in Mountain.

Canada

PORTAGE LA PRAIRIE, MAN.—The Portage Milling & Transfer Company is contemplating rebuilding its elevator recently destroyed by fire. The loss is estimated at about $110,000. C. G. Earhart is manager.

WINNIPEG, MAN.—The construction of a provincial hydroelectric line from Winnipeg to Portage la Prairie is under consideration by the provincial government.

MONTREAL, QUE.—The workshops of the Cadillac Motors, Ltd., at Park Avenue and Sherbrooke Street, were destroyed by fire recently, causing a loss of about $500,000.

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Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 31, 1918)

1,289,068. ELECTRICAL MEASURING INSTRUMENT; Chester T. Allcutt, Wilkinsburg, Pa. App. filed Dec. 20, 1916. For indicating the position of the corona discharge on a tapered conductor and, consequently, the value of the voltage impressed thereon.

1,289,073. CONDUIT FITTING; Albert I. Appleton, Chicago, Ill. App. filed April 14, 1915. The box is formed from a single piece of sheet steel or other suitable ductile sheet metal.

1,289,099. VAPOR RECTIFIER; Quincy A. Brackett, Pittsburgh, Pa. App. filed May 14, 1915. Harmful arcing is eliminated, and accordingly rectifiers may be operated at higher voltages and at higher current densities by the use of auxiliary wire-gauze electrodes.

1,289,112. ELECTRICAL MEASURING INSTRUMENT; William M. Bradshaw, Wilkinsburg, Pa. App. filed Jan. 26, 1917. Patent particularly relates to wattmeters and other similar meters, giving simple and compact construction.

1,289,113. LAMP; Colin Campbell, New York, N. Y. App. filed Feb. 1, 1917. Pocket lamp has focusing lens to enable the light to be concentrated or disseminated.

1,289,116. THERMOCOUPLE AND METHOD OF CONSTRUCTING THE SAME; Lewis W. Chubb, Pittsburgh, Pa. App. filed Feb. 19, 1914. Will respond quickly, by a change in its thermo-electromotive force, to any change in the temperature to which it is subjected.

1,289,128. DISTRIBUTER HEAD FOR MAGNETOS; George T. Dochtermann, Passaic, N. J. App. filed April 10, 1918. The parts are of simple and long-wearing construction.

1,289,135. IGNITION DEVICE; James M. Edwards, Waterloo, Iowa. App. filed Jan. 29, 1917. Is capable of being quickly and easily adjusted into and out of operative position on the internal-combustion engine as a single unit.

1,289,146. VENTILATION OF STORAGE-BATTERY CELLS; Bruce Ford, Philadelphia, Pa. App. filed Feb. 8, 1918. More particularly for submarine cells.

1,289,161. CONTROL SYSTEM; Arthur J. Hall, Wilkinsburg, Pa. App. filed Sept. 10, 1915. For electric locomotives or other similar vehicles that are propelled by means of polyphase induction motors receiving their energy from a single-phase source or distributing system through the agency of a so-called phase converter.

1,289,162. CONTROL SYSTEM; Arthur J. Hall, Wilkinsburg, Pa. App. filed Jan. 5, 1916. To govern the operation of polyphase induction motors and the like through the agency of adjustable liquid rheostats.

1,289,210. ELECTRIC IRON; Purdy J. Lincoln, Birmingham, Ala. App. filed Jan. 16, 1918. The temperature of the iron may be easily controlled.

1,289,230. ELECTRIC LAMP-SOCKET CASING; Harry J. Morey, Syracuse, N. Y. App. nled Jan. 8, 1916. Novel means are provided for detachably connecting the cap and shell together.

1,289,255. ELECTRIC CIRCUIT-BREAKING DEVICE; Frederic S. Perrin, Brooklyn, N. Y. App. filed May 2, 1916. Motor-controlled means cause breaking of the circuit when the apparatus is at rest.

1,289,272. CAR-LIGHTING SYSTEM; Harry D. Rohman, New York, N. Y. App. filed Sept. 18, 1916. Battery-overcharge-preventing device which dispenses with electromagnetic and other complicated forms of operating means is provided.

1,289,274. PORTABLE ELECTRIC LIGHT; Harry Rothenberg, Ridgewood, N. Y. App. filed May 29, 1916. Novel switch utilized for making and breaking the circuit.

1,289,284. CONTROL SYSTEM; Karl A. Simmon, Edgewood Park, and Hurd T. Morris, Wilkinsburg, Pa. App. filed Nov. 5, 1915. For motors used in electric railway and similar vehicles.

1,289,288. ELECTRICAL PROTECTIVE DEVICE; Benjamin H. Smith, Turtle Creek, and Almon W. Copley, Pittsburgh, Pa. App. filed Oct. 3, 1918. Means for insuring the proper sequence in the interruption of the various circuits of multi-circuit electrical systems.

1,289,294. CONTINUOUS FEED FOR ARC LAMPS; Archie D. Standeford, Kansas City, Mo. App. filed July 23, 1915. Constant and automatic feeding of the lamp carbons is accomplished by a rotary motor, which is connected in parallel with the lamp and consequently maintains a uniform arc gap between the carbons.

1,289,295. BRUSH-HOLDER-SUPPORTING DEVICE; Charles W. Starker, Pittsburgh, Pa. App. filed Nov. 6, 1914. May be easily detached from the sustaining end bracket without first removing this from the frame of a dynamo-electric machine.

1,289,301. SYSTEM OF CONTROL; Norman W. Storer, Pittsburgh, Pa. App. filed Sept. 9, 1915. Invention has special reference to the regenerative control of motors in electric railway vehicles and the like.

1,289,309. REGULATOR; Allen A. Tirrill, Pittsburgh, Pa. App. filed Sept. 9, 1916. Of the vibratory-contact type, devoid of inherent mechanical vibrations which may prevent the main contact members from making firm and positive electrical contact with each other.

1,289,315. INTERLOCK FOR AUTOMOBILE STARTER; Samuel Trood Edgewood Park, Pa. App. filed March 1, 1913. Automatically disconnects the starting motor from the engine shaft of an automobile when a predetermined speed is reached.

1,289,318. ARMATURE-WINDING MACHINE; William A. Van Deven, Wilkinsburg, Pa. App. filed March 17, 1916. For winding continuous wire upon a slotted armature core to form the coils composing the armature winding directly in their proper slots.

1,289,332. CIRCUIT CLOSER FOR ELECTRIC HEATING DEVICE; Herbert E. Welchel and Aaron A. McCray, Indianapolis, Ind. App. filed March 5, 1915. Primarily designed for use in connection with heating devices for incubators.

1,289,338. CUT-OUT; Charles E. Wilson, Wilkinsburg, Pa. App. filed March 3, 1914. For controlling the electrical connections of dynamo-electric machines.

1,289,344. COMMUTATOR CYLINDER; Harry M. Wood, Edgewood Park, Pa. App. filed Jan. 26, 1917. Particularly adapted for use with dynamo-electric machines of the high-voltage type.

1,289,346. SYSTEM OF CONTROL; Francis E. Wynne, Wilkinsburg, Pa. App. filed Jan. 4, 1916. For motors of the "field-control" type in electric railway vehicles and the like.

1,289,430. LOAD-BALANCING SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Oct. 6, 1916. Booster means, either alternating-current or direct-current, are associated with the other elements of the system so that a substantially uniform load distribution is obtained throughout wide load variations.

1,289,433. ELECTRIC BATTERY; Harry F. French, Fremont, Ohio. App. filed July 27, 1915. Can be kept without deteriorating and is made active in a simple manner.

1,289,437. SIGNALING SYSTEM; John S. Garvin, New York, N. Y. App. filed March 18, 1918. Particularly applicable to composite telegraph and telephone circuits.

1,289,459. BATTERY HAND LAMP; Carl Hambuechen, Belleville, Ill. App. filed Oct. 18, 1917. Push-button type of switch may be used for controlling the lamp circuit.

1,289,464. SEMAPHORE SIGNAL FOR VEHICLES; Samuel D. Hope, Sr., Martin's Ferry, Ohio. App. filed May 21, 1918. To indicate intended direction of travel in day or night.

1,289,467. TELEPHONE-EXCHANGE SYSTEM; Edward E. Hinrichsen, New York, N. Y. App. filed May 22, 1917. Equipment provided for connecting a calling subscriber with either a manual or an automatic substation or trunk line.

1,289,503. ELECTRICAL MEASURING INSTRUMENT; Paul MacGahan, Pittsburgh, Pa. App. filed July 11, 1914. Employed to record the total value of the indications of a plurality of electrical meters.

1,289,504. AUTOMATIC TELEPHONE TRUNKING SYSTEM; Anders M. Makmberg, Chicago, Ill. App. filed Nov. 8, 1915. Invention relates to systems in which numerical and non-numerical switches are employed.

1,289,510. ELECTRIC INCUBATOR; Max K. Miller, Detroit, Mich. App. filed March 27, 1915. Even temperature insured for each egg.

1,289,514. ARC-LAMP ELECTRODE; William R. Mott, Lakewood, Ohio. App. filed Jan. 28, 1916. Containing carbon, calcium fluoride and yttrium fluoride.

1,289,521. LIGHTNING ARRESTER; Harold A. Newcomb, Wilkinsburg, Pa. App. filed May 3, 1915. An excess of ions is produced during the discharge excess voltage, whereby the subsequent flow of line current is retarded.

1,289,549. ELECTRIC BELL; John F. Rodgers, Brooklyn, N. Y. App. filed March 23, 1918. The movable core of a solenoid is used as a striker for sounding the bell.

1,289,567. FLAMING ARC LAMP; Thomas Spencer, Philadelphia, Pa. App. filed Sept. 20, 1913. During the operation of the lamp the inner globe is maintained at a temperature sufficiently high to minimize and substantially prevent the obscuration of the inner globe by the deposit of the product of internal combustion thereon.

1,289,569. ATTACHMENT FOR TELEPHONE AND THE LIKE; William F. Stearns, Exeter, N. H. App. filed Feb. 12, 1917. To prevent the spread of disease by the transmission of germs to user.

1,289,572. TROLLEY-POLE CONSTRUCTION; Ignac Szafranski, Schenectady, N. Y. App. filed Sept. 7, 1917. The pole has a swinging movement substantially limited to an arc of 90 deg.

1,289,574. ELECTRICAL RELAY; Vittorio Tedeschi and Andrea G. Rossi, Turin, Italy. App. filed July 29, 1915. Is characterized by the absence of friction brushes or any kind of commutator and does not generate any current having a frequency different from that of the current which it is desired to reproduce in amplified manner.

1,289,592. MOTOR EXCITATION; Ernst F. W. Alexander, Schenectady, N. Y. App. filed Dec. 18, 1913. Arrangement enables the use of a series motor with a pulsating current supply and at the same time prevents heating of the field core and transformer action in the armature.

1,289,593. SYSTEM OF ELECTRIC SHIP PROPULSION; Ernst F. Alexander, Schenectady, N. Y. To provide an electric generator with connections arranged to give satisfactory operating characteristics when connected to two different numbers of propeller-driving electric motors.

1,289,595. IGNITION APPARATUS; Samuel Alsop, New York, N. Y. App. filed April 13, 1918. By increasing the intensity of the spark in gas engines failures due to carbonizing or other causes are overcome and greater power developed.

1,289,609. ELECTRIC BATTERY; William C. Bauer, Evanston, Ill. App. filed April 3, 1914. A fixed alkali as the electrolyte and red lead or minium as the depolarizing agent immersed in the alkali electrolyte are simultaneously employed.

1,289,617. HEATING SYSTEM; Arthur F. Berry, Ealing, England. App. filed March 28, 1917. Means are associated with a luminous radiator for varying its luminosity to stimulate movement.

1,289,623. QUICK-BREAK SWITCH; Bornett L. Borroff, Milwaukee, Wis. App. filed June 18, 1917. Adapted for use with high-tension currents.

1,289,637. TELEGRAPH APPARATUS; William M. Bruce, Jr., Springfield, Ohio. App. filed March 29, 1915. For more effectively translating the currents received over lines of high capacity to operate local apparatus therefrom.

1,289,649. RELAY; Ray E. De Camp, Wilkinsburg, Pa. App. filed March 8, 1917. Invention relates to time-element relays of the electromagnetic type.

1,289,654. SWITCH; John F. Cavanagh, Meriden, Conn. App. filed Aug. 9, 1917. For controlling the circuits of an automobile and can be locked in position to prevent theft of or tampering with the machine.

1,289,656. TIME-ELEMENT CIRCUIT BREAKER; Herbert W. Cheney, Milwaukee, Wis. App. filed Oct. 6, 1909. The reluctance of the magnet tripping device is diminished upon sufficient energization.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Work for Willing Hands

THE Department of Labor is engaged in a campaign for encouraging building of all kinds in order to counteract the tendency toward industrial unrest because of non-employment. The idea is a good one and should be encouraged both by the government and by private individuals. We know of one way in which the government can help. The passage of the water-power bill will give work to hundreds of thousands of men erecting dams, power houses, etc., and will also give added impetus to the development of industries seeking cheap power. To cite a concrete case, the largest manufacturer of automobiles is anxious to erect a factory in a certain community and to develop a few thousand horsepower in a navigable stream. Aside from the work which the erection of the dam and the factory would start, the establishment of the factory in that particular locality would mean an increase in the population of 25,000 people. This in turn would involve the erection of dwellings to house these workers and would contribute to the general prosperity of the community. All of this work is contingent on the development of water power, however, and this must await the pleasure of Congress. Certainly one cannot believe that Congress would deliberately stand in the way of progress or the advancement of American industries, and yet that is what inaction on the water-power bill really amounts to. Is it asking too much for the government to practice what it preaches?

By lifting the censorship now prevailing on operating troubles in many utilities, engineering practice can be revitalized and an enormous amount of lost motion prevented in future developments. The frank discussion of equipment difficulties among engineers is needed at all times, and if personalities are kept out by an honest desire to learn the best ways of doing things electrically, a new era of technical progress will be entered.

The Responsibility of Commissions

WITH the public utilities commissions of the various states rests in a measure the responsibility of determining the speed with which new power-plant work will get under way. The necessity of doing the work is apparent to all, but there are two determining factors. These are, first, getting the capital with which to do the work and, second, getting the approval of the commission of the issuance of securities for the purpose. It is folly to say or to believe that the money is not available. It is available, but the price that must be paid for it is in excess of that which commissions are accustomed to concede as fair. That is about the present situation. Capital is demanding an increased wage, commissions are debating on the advisability of granting it, because it will for a long time be reflected in rates, and meanwhile the excellent labor that is returning from Europe on our transports is anxiously waiting for the much-talked-of construction work to open up. Nobody envies the commissions their position of responsibility in making the decision that will start this construction or retard it. It is only to be hoped that they will, after adequate deliberation but without unnecessary delay, take some action so that the people who are to furnish the money, the interested labor and those who require the power may all know what to expect.

The time has come to encourage traversing the branch lines of inviting research denied the investigator during the period of hostilities. It would be a calamity if many promising "leads" should be lost to mankind through the failure of erstwhile war industries to preserve adequate records of their investigations.

Government Initiative Lacking

THERE are three phases of the general subject of interconnection of electric generating systems now up for attention—(1) the present practice of electric companies in interconnecting contiguous generating systems, the advantages of which are so obvious as to require no comment; (2) the proposal of Secretary Lane to ascertain if it is practicable to apply the principle in a wider way so as to involve more power producers, and (3) the extreme suggestion of the Smithsonian Institution of the United States National Museum that transmission systems be made common carriers. The fundamental principle underlying the plan is sound. The proponents recognize that the electric circuit provides a most practical and economic means of transporting energy and of distributing it easily to consuming centers. From an engineering standpoint the plan presents no insuperable difficulties; in fact, it has become more of a financial than an engineering problem and as such will take care of itself. Hence the objection to governmental duplication of effort. The idea of interconnection of transmission systems emanated from within the electrical industry itself and represents an evolution in the art. Moreover, the industry is capable of applying the scheme wheresoever and whensoever conditions indicate that in-

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terconnections should be made. But if the government must busy itself in power matters, let it take up original problems of greater national importance. Our coal supply, for instance, is limited and the whole nation is interested in its conservation. The government might, therefore, profitably turn its attention to the destructive distillation of coal, and if it displays the same degree of skill in the solution of this problem that the meat packers manifest in their particular field or the oil refiners in theirs, the art of producing gas, electricity, heat and refrigeration may be entirely revolutionized and the products cheapened to the advantage of the nation. Research of this kind is performed by the government for the farmer and ought to be extended to the industries of the country in general. The tendency of the government is to follow after and appropriate the work of others, whereas it would not be a bad idea for it to exercise some initiative itself.

Electric heating design commends itself to the engineer who feels that standardization has eliminated many of the opportunities of the art of illumination and power supply. Who can predict the size of the heating loads of a decade hence? The combinations of material required to yield efficient service under severe conditions of space, surroundings and time element challenge the ingenuity of the highest inventive talent.

War-Time Development of Vacuum Tubes

THE article by Capt. Ralph Bown appearing in this number is a very interesting description of that phase of the United States Army Signal Corps' work dealing with the development of the vacuum tube since America's entry into the world war.

At that epoch, when the Signal Corps took the matter up, the three-electrode vacuum tube, although standardized to some extent for the purposes of wire telephony, was a flimsy, delicate and uncertain device in radio communication, requiring careful adjustment and expert attention. In other words, it was a laboratory device rather than an army instrument. It has been said that an instrument really adapted to army service must be capable of being dropped from the back of an army mule, either into deep water or onto a hard road, without detriment to its serviceability and must work equally well in tropical sunshine or in pouring rain. Even allowing for exuberance of professional pride, it must be admitted that many of the engineering instruments which the army has adopted in the past meet these conditions in a surprisingly high degree.

After about a year of effort in the directions described by the article, and with the aid of the electrical engineering companies mentioned, the Signal Corps did wonders in transforming the delicate vacuum tube into a standardized army instrument; so that a vacuum-tube amplifier or oscillator could be manufactured, shipped and operated under war conditions in large numbers, and without much dependence upon highly specialized skill. It is common parlance to say "as like as two peas" when attempting to suggest a high degree of uniformity, but to the initiated the phrase "as like as two vacuum tubes manufactured for and accepted by the Signal Corps" would convey the idea of a degree of uniformity far higher than the humble and esculent pea could ever hope to attain.

Captain Bown's article is of great technical value at the present time because it records the stage in mechanical, electrical and manufacturing development which the Signal Corps was able to secure, in the brief time at its disposal, toward filling the requirements of military radio communication. In future vacuum tubes at least as good as those specified should become available for the industry in times of peace. A landmark is thus established for the electrical industry that will help the whole world for all time. It is no exaggeration to say that this landmark is probably as far ahead of the ante-war stage as twenty years of peace development could have hoped for. This does not mean that we should wait for a war to develop our implements of electrical communication. The cost of the gain in human life and commodities would be too overwhelming. It does mean, however, that against the colossal losses of the war, there may be set some countervailing achievements of the world, from the contemplation of which we may draw such solace and relief as the darkness of the entire picture may afford.

Captain Bown, in giving us this pen picture of what his corps was able to accomplish, unconsciously also throws credit upon his own share.

Let no reader of the journal fail to commit his experiences and impressions as to achievements and possibilities to paper where such information might be helpful now or later in the conquest of matter for the good of civilization.

Safe and Sound

IT CONCERNS each one of us to see that every part of the electrical industry is squarely on its feet, to make it realize that it has come safely through one of the greatest crises in history, to give it confidence that everything is not going to the "demnition bowwows." We are not very strong for the proposition of denying the truth about business conditions. We believe in facing the facts, but, once having accepted them, we have sublime faith in the virtue of developing the constructive features. The small boy who thought that by digging a hole in his back yard he would make it possible for a Chinaman to pop up his head in this country had a more productive imagination than his playmate who could see nothing but the disarranged yard. We are not for digging a tunnel to help Chinamen get into the country, but we have sympathy with the idea of working for what we do want rather than sighing over what we don't want.

The electrical industry, like the rest of the country, looks back on a record that is full of accomplished deeds. Every department of the industry has good reason to be thankful. Most of the people are alive; most of them are uncrippled; most of the companies have a splendid total of gross business on the books of the last four years which left some profit behind as it was turned out. The decks are being swept clean for another try. While the President is fixing up the League of Nations, Congress is floundering to be sure, but when we look around it doesn't take a telescope to see that

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big policies are in the process of making. Copper and steel are sliding off in price, and until they are where they ought to be from an economic standpoint they will be more or less unsteady. Labor is not any too happy, and we all hope that there will be a fair adjustment of its relations to capital. Neither one of these foes who ought to be friends and partners will get too much. Capital will still have to foot big tax bills and labor be more efficient in order to make its job yield the necessary flow of weekly dollars.

It is certainly a time to try the mettle of the industry, but the mettle is sound. With it all we believe that there is a strong disposition to get the utmost benefit out of conditions. The manufacturers understand the situation thoroughly and are prepared to do what they can to align themselves with the tendencies of the times. Central stations in several instances have already sold large blocks of securities and are catching up with their facilities and getting ready for the demand that is inevitably ahead of us. More companies will do what the few have done. Uncle Sam will not always ask all the investment funds; the way will be open sooner or later for easier borrowing. Let all who have sound capital and earning position get ready for it. If everybody in the electrical industry should decide at the same moment that the time to do business had come, there would be plenty of work for idle hands.

We shall get in time a domestic business that will put all other totals into dim insignificance. There will be a foreign trade in electrical apparatus and supplies which will put United States products into large world markets. The day may arrive when we shall look back upon the words of L. K. Comstock (printed in the ELECTRICAL WORLD of Feb. 8, 1919) with regret if we did not forge ahead in the spirit they expressed: "The electrical industry, American business, must grapple with the problem and move forward with a bold stride. It must not turn back and yearn for pre-war prices, but confidently forge ahead with the conviction that success will attend its efforts. . . . There are fifty persons who can figure out sure failure to one who pushes on without thinking of the possibility of failure."

Only a fraction of what the electrical industry did to help win the war has as yet been made public. Let every engineering school curriculum include lectures by industrial and technical experts giving concrete examples of how the armies and tools of production were mobilized and concentrated to meet the call of the men at the front.

Good Lighting and Efficiency

THE advantage of good lighting in industrial operations is now a commonplace. Every factory manager recognizes the broad significance of the facts, but, ground between the unions and the board of directors, he is too apt even now to look askance at the additional costs. Although assured that improved lighting means more and better product with all that that implies, he still may remain uncertain as to whether the improvement is worth the money it costs to install and maintain. Such, indeed, has been the difficulty in introducing improvements of any kind tending to better or increase the output. In the case of simple machinery the problem is easily solved, but lighting partakes of the nature of improvement in general efficiency, of which the immediate results cannot be accurately foreseen. Professor Clewell's article in the current issue will tend to clear up some of the difficulties which exist in this particular.

Perhaps the simplest basis for dealing with the benefits of good illumination is that suggested by Professor Scott of looking at the cost of lighting in terms of workmen's wages for a given period. If a thousand workmen by good lighting of the shop can save five minutes a day of active work, the total gain amounts to five thousand man-minutes per day, and if the average wage be reckoned as a cent a minute, not far from a machine-shop figure, expenditure for good lighting would yield a profit to the management at anything less than the total expense of fifty dollars a day, a sum which would pay for a great deal of thoroughly efficient lighting. Aside from this, there are gains not only in the saving of time, but in better workmanship, reduced accidents, and better shop conditions generally, which result in decreased friction with the employees. There has been, however, a lack of sufficient data on which to base judgment of even this simple consideration. Therefore tests like those conducted recently by the Commonwealth Edison Company are of high importance as furnishing for the first time something like quantitative data as to the results of good lighting, thus confirming what one may call the clinical data due to general observation.

These facts are of special importance in relation to the question of night shifts, although in every shop they are of much moment during part of the year. With the general coming of the eight-hour day the double shift assumes unwonted importance to a large number of men who on a universal eight-hour basis might join the throng of the jobless. Even were this expedient not adopted and an industrial change working toward more uniform activity throughout the year should come about, good lighting will still remain an important factor in production. One of the serious industrial questions in this country is a tendency toward seasonal working in many occupations, brought about by comparatively recent selling methods. This may make gains at one point in the capital charges, but loses in lowering the utilization factor of the plant and in compelling an increase in the wage scale.

Another interesting matter touched upon by Professor Clewell deals directly with the double-shift question in raising the question of the relative cost of double shifts with proper artificial light in existing plants as against the increase in plant needed if the output is to be secured on a single eight-hour shift. He shows that the cost of thoroughly good artificial lighting for night work is likely to be very much less than the space rental, to say nothing of the overhead, involved in increasing the plant to a point at which its output can be secured on a single shift. With the present tendency toward intensive working of every kind, the arguments in favor of the use of first-class artificial lighting are greatly strengthened, and we believe that further investigation along the lines pursued by the Commonwealth Edison Company will make an incontrovertible case for great improvements in workshop and factory illumination.

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Transmission-Line Computations

Use of Hyperbolic Functions Favored in Comparison with Alternative Methods for the Calculation of Voltage, Current and Power on Long Uniform Transmission Lines

BY A. E. KENNELLY
Professor of Electrical Engineering, Harvard, and Director of Electrical Research, Massachusetts Institute of Technology

IT IS well known that long alternating-current lines of the ordinary three-phase system, operated under a known steady load at the motor end and under a known impressed emf. at the generator end, develop distributions of voltage, current and power which can only be computed to a first approximation if all of the capacitance distributed along the line is assumed to be applied in one lump at the middle of its length. In other words, a strict computation of the electric behavior of the line must take the uniform distribution of capacitance into account. If the total line capacitance, instead of being taken as applied as a single lump in the middle of the line, is divided into halves and each half is applied at one end of the line, we obtain what is sometimes called the "split-condenser" diagram and method of computation[1]. In this method the error of computation is less than when all of the capacitance is applied in one lump. For many practical purposes it suffices to use the split-condenser method, especially with transmission lines not exceeding 200 km. in length, at frequencies not exceeding 60 cycles. If, however, precision is aimed at, and especially in cases of long lines operated at high frequencies, the error of lumped capacitance cannot be ignored, and a more nearly accurate method of computation must be adopted.

Various methods for computing the voltage and current at any point of a long uniform alternating-current line have been proposed[2] by Heaviside, Leblanc, Thomas, Franklin and others. In the opinion of the writer, however, the use of hyperbolic functions[3] is by far the shortest and simplest method. In two articles appearing in the ELECTRICAL WORLD early in 1918 T. A. Wilkinson[4] presented modifications of the hyperbolic-function method and formulas and worked out some interesting graphic charts in connection with them.

It is no doubt advantageous for electrical engineers to have in their possession alternative methods of attacking their problems, and there is no intention of criticising the Wilkinson methods adversely. However, it is proposed here to show, by means of the example offered and worked out in the Wilkinson article, that the direct hyperbolic method is, in the writer's opinion, at least as short as any that has yet been proposed for such general problems. It is contended that it is better to follow the fundamental method in all such cases, rather than change to a special method within a restricted field.

One wire of the three-phase system considered in Mr. Wilkinson's problem is represented in Fig. 1, with one-third of the total three-phase load applied to it. Since the voltage between wires at the receiving end is supposed to be 110,000 volts r.m.s., the star voltage to neutral at the receiving end b is $110{,}000/\sqrt{3} = 63{,}508$ volts, leading the received current of 110.498 amp. r.m.s. by 18° 11′ 41.5″ in phase. The impedance of the branch load is therefore $\sigma = 574.75 \angle 18° 11' 41.5''$ ohms, or $546.01 + j179.467$ ohms.

The angle θ subtended by the line wire ab, at 60 cycles, is $0.52521 \angle 83° 26' 27''$ hyperbolic radians, or $0.059994 + j0.52177$, as shown in equations (1) and (2). The real part of this angle is expressible in hyperbolic radians, and the imaginary or j part in circular radians. If the imaginary part be expressed in quadrants instead of in radians, $\theta = 0.059994 + j0.33217$ hyp. as given in (3). This quadrantal form of the imaginary is useful in using the charts that have been worked out for such computations.

The surge impedance z_0 of the line wire is likewise expressed as $396.383 \angle -6° 33' 33''$ ohms, as shown in (4).

The position angle δ_b, at the receiving end b of the line, is such that its tangent is equal to $\sigma/z_0 = 1.450 \angle 24° 45' 14.5''$. By reference to a chart atlas[5] of hyperbolic tangents this angle $\delta_b = 0.6260 + j0.73465$ hyps. As a matter of fact, the charts published do not admit of graphical interpolation to four or five significant digits; only two or three significant digits can be determined. However, the published tables[6] permit of interpolation to four or five digits, when it is worth while taking the time necessary for effecting such interpolation. In order to arrive at a precise solution in this case, the numerical work has been carried to four or five digits, whereas in practice three would probably be sufficient.

The position angle δ_a at the generating end a is then found by adding θ to δ_b, as in (6).

The general law of currents along a line is that at any point the current is proportional to the cosine of the position angle, while the potential is proportional to its sine. Knowing E_b, the star potential at b to the neutral, the star potential E_a is found by direct proportion, as in (7) and (8), to be $69{,}569 \angle 35° 35' 47.5''$ r.m.s. volts. Two references to the charts or tables are needed for this step; namely, one for each sine.

[1] "Calculation of the High-Tension Line," by P. B. Thomas, *Transactions A. I. E. E.*, June, 1909, Part I, Vol. 28, pp. 641-686.

[2] O. Heaviside, "Reprinted Electrical Papers," London, 1892, Vol. 2, p. 247. M. Leblanc, "Formula for Calculating the Electromotive Force at Any Point of a Transmission Line for Alternating Current," *Transactions A. I. E. E.*, Vol. 19, pp. 759-768, June, 1901. P. H. Thomas, "Calculation of the High-Tension Line," *loc. cit.*, 1909. W. S. Franklin, "Electric Waves," pp. 144-153 (Macmillan, 1909).

[3] A. E. Kennelly, "The Application of Hyperbolic Functions to Electrical Engineering Problems," 1911, Chapter VII; also "Artificial Electric Lines," 1917, Tables VIII and IX.

[4] T. A. Wilkinson, "Graphical Determination of Line Constants," ELECTRICAL WORLD, Feb. 2, 1918, p. 244, Vol. 71, and also March 16, 1918, p. 558, No. 11, Vol. 71, p. 558.

[5] "Chart Atlas of Hyperbolic Functions," Harvard University Press, 1914.

[6] "Tables of Complex Hyperbolic and Circular Functions," Harvard University Press, 1914.

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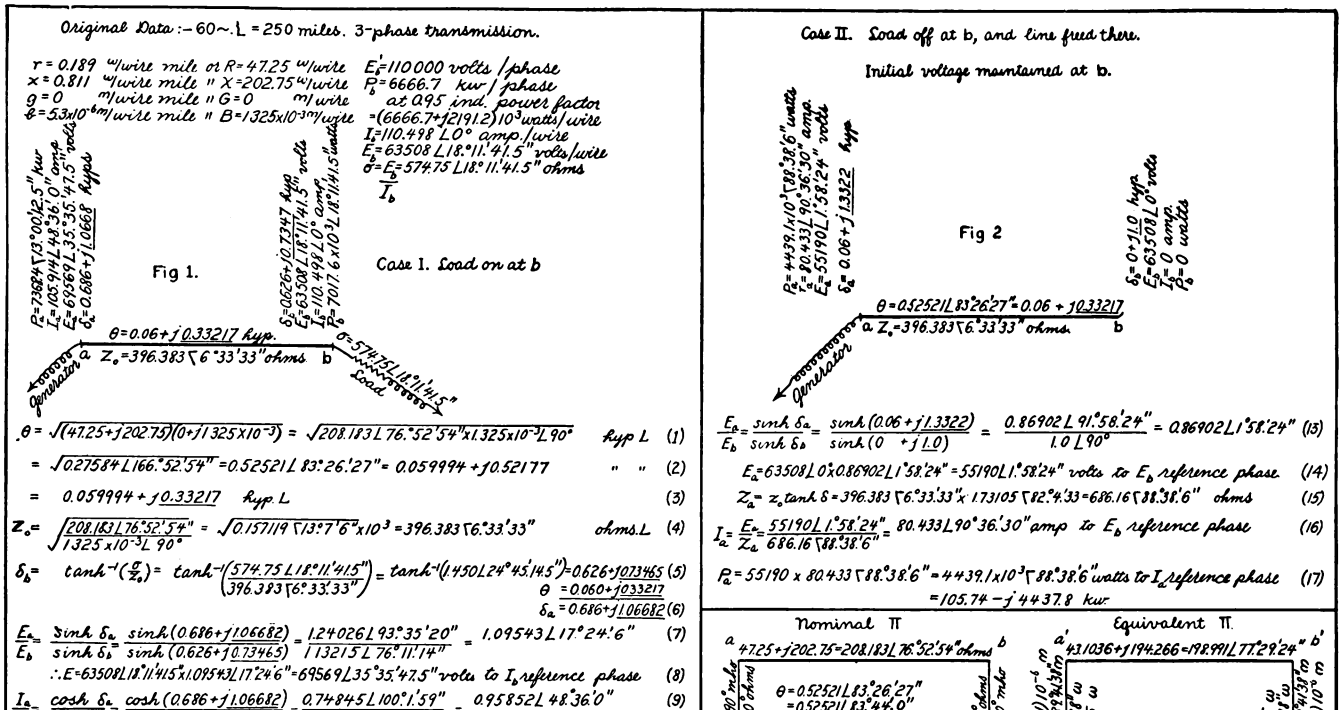
Similarly, the current I_a entering the line at a is found by direct proportion from the known current I_b at b, through (9) and (10), to be $105.914 \angle 48° 36'$ r.m.s. amp. Two references to the charts are needed for this step: namely, one for each cosine.

Finally, the power at a is found immediately, from the voltage and current thereat, to be $7368.4 \angle -13° 0' 12.5''$ kw., or 7179.4 active kilowatts and 1658 condensively reactive kilowatts.

The complete solution of voltage, current and power is thus effected with the aid of five references in all to hyperbolic charts or tables.

In Fig. 2 the line is indicated as having the load thrown off at b, but the same voltage maintained there as before. The voltage, current and power at a are or $43.1036 + j194.266$. The line conductor, therefore, behaves, through distributed capacitance, as though it had 4.2464 ohms less than the actual conductor at this frequency. Similarly, from tables or charts, we find the correcting factor $\left\{ \tanh \frac{\theta}{2} \right\} \Big/ \left(\frac{\theta}{2}\right) = 1.02297 \angle -0° 18' 22''$, which, applied to the admittance of each terminal leak at a' and b', gives $3.6221 + j677.71$ micromho. The equivalent π, ($a'b'$, consisting of three impedances, two of which are equal) may then be substituted for the actual line without any disturbance in existing electrical conditions either at the terminals ab or external to them, assuming that the frequency of 60 cycles is the only frequency present. The process of determining the voltage and current at a', having given the values at b',



$$\theta = \sqrt{(47.25 + j202.75)(0 + j1325 \times 10^{-3})} = \sqrt{208.183 \angle 76.°52'.54" \times 1.325 \times 10^{-3} \angle 90°} \quad \text{Rep. L} \quad (1)$$

$$= \sqrt{0.27584 \angle 166.°52'.54"} = 0.52521 \angle 83.°26'.27" = 0.059994 + j0.52177 \quad " \quad " \quad (2)$$

$$= 0.059994 + j0.33217 \quad \text{Rep. L} \quad (3)$$

$$Z_c = \sqrt{\frac{208.183 \angle 76.°52'.54"}{1325 \times 10^{-3} \angle 90°}} = \sqrt{0.157119 \angle 13.°7'.6"} \times 10^3 = 396.383 \angle 6.°33'.33" \quad \text{ohms. L} \quad (4)$$

$$\theta_b = \tanh^{-1}\left(\frac{\gamma}{\gamma_0}\right) = \tanh^{-1}\left(\frac{574.75 \angle 18.°11'.41.5"}{396.383 \angle 6.°33'.33"}\right) = \tanh^{-1}(1.4502 \angle 24.°45'.14.5") = 0.626 + j0.73465 \quad (5)$$

$$\theta = 0.060 + j0.33217$$

$$\theta_a = 0.686 + j1.06682 \quad (6)$$

$$\frac{E_a}{E_b} = \frac{\sinh \theta_a}{\sinh \theta_b} = \frac{\sinh(0.686 + j1.06682)}{\sinh(0.626 + j0.73465)} = \frac{1.24026 \angle 93.°35'.20"}{1.13215 \angle 76.°11'.14"} = 1.09543 \angle 17.°24'.6" \quad (7)$$

$$\therefore E = 63508 \angle 18.°11'.41.5" \times 1.09543 \angle 17.°24'.6" = 69569 \angle 35.°35'.47.5" \text{ volts to } I_b \text{ reference phase} \quad (8)$$

$$\frac{I_a}{I_b} = \frac{\cosh \theta_a}{\cosh \theta_b} = \frac{\cosh(0.686 + j1.06682)}{\cosh(0.626 + j0.73465)} = \frac{0.74845 \angle 100.°1'.59"}{0.78085 \angle 51.°25'.59"} = 0.95852 \angle 48.°36'.0" \quad (9)$$

$$\therefore I_a = 110.498 \angle 0° \times 0.95852 \angle 48.°36'.0" = 105.914 \angle 48.°36'.0" \text{ amp. to } I_b \text{ reference phase} \quad (10)$$

$$P_a = 69569 \angle (35.°35'.47.5" - 48.°36'.0") \times 105.914 \angle 0° = 7368.4 \times 10^3 \angle 13.°0'.12.5" \text{ watts to } E_a \text{ reference phase} \quad (11)$$

$$= 7179.4 - j1658 \text{ kw} \quad (12)$$

$$\frac{E_b}{E_b} = \frac{\sinh \theta_a}{\sinh \theta_b} = \frac{\sinh(0.06 + j1.3322)}{\sinh(0 + j1.0)} = \frac{0.86902 \angle 91.°58'.24"}{1.0 \angle 90°} = 0.86902 \angle 1.°58'.24" \quad (13)$$

$$E_a = 63508 \angle 0° \times 0.86902 \angle 1.°58'.24" = 55190 \angle 1.°58'.24" \text{ volts to } E_b \text{ reference phase} \quad (14)$$

$$Z_a = z_c \tanh \delta = 396.383 \angle 6.°33'.33" \times 1.73105 \angle 82.°4'.33" = 686.16 \angle 88.°38'.6" \text{ ohms} \quad (15)$$

$$I_a = \frac{E_a}{Z_a} = \frac{55190 \angle 1.°58'.24"}{686.16 \angle 88.°38'.6"} = 80.433 \angle 90° 36'.30" \text{ amp to } E_b \text{ reference phase} \quad (16)$$

$$P_a = 55190 \times 80.433 \angle 88.°38'.6" = 4439.1 \times 10^3 \angle 88.°38'.6" \text{ watts to } I_a \text{ reference phase} \quad (17)$$

$$= 105.74 - j4437.8 \text{ kw}$$

COMPUTATIONS MADE TO COMPARE RELATIVE EASE OF USING HYPERBOLIC FUNCTIONS AND SIMPLIFIED MODIFICATIONS OF THEM. (SEE T. A. WILKINSON'S ARTICLE, "ELECTRICAL WORLD," MARCH 16, 1918, PAGE 558

then determined in (14), (16) and (17), with the aid of three references in all to charts or tables. The current I_a at a falls off from 105.914 amp. in Fig. 1 to 80.433 amp. in Fig. 2. The active power P_a in Fig. 2 falls off to 105.74 kw.

Finally, in Figs. 3 and 4, an alternative method of solving the problem is presented through the use of the "equivalent π" of the line wire. In Fig. 3 is the nominal π, which corresponds to the split-condenser diagram already referred to. The line ab has the full conductor impedance $47.25 + j202.75$ ohms of the actual line, and each of the two terminal leaks has $j0.6625$ millimho. Knowing the angle θ subtended by the line, for the frequency of 60 cycles, as in (1) and (2), we find from tables or charts the correcting factor $(\sinh \theta)/\theta = 0.95584 \angle 0° 36' 30''$. This applied to the line impedance ab gives $198.991 \angle 77° 29' 24''$ ohms, then follows by Ohm's law. The equivalent π thus uses the split-condenser method, but eliminates the errors due to its two terminal lumped capacitances.

The computation of the equivalent π is evidently brief and direct, but the subsequent computation of the voltage and current drops over it by Ohm's law takes longer. The method of position angles contained in (1) to (2) is therefore, as a rule, shorter and swifter than the method of the equivalent π. They offer mutual numerical checks, however, when great precision is aimed at.

For practical purposes, and to ordinary slide-rule precision, the published charts enable any similar problem to be worked out in a few minutes' time. When, however, five-digit accuracy is sought, interpolation has to be resorted to in the use of the tables, and this takes considerable time.

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War-Time Development of Vacuum Tubes

Most Important Advance in Radio Engineering—Three Stages—Determining Desirable Characteristics—Designing Tubes Having These Requirements and Capable of Being Produced in Quantities—Specifications and Test Methods

BY RALPH BOWN
Captain Signal Corps, United States Army

THE first important technical problem which the Signal Corps of the United States Army faced in expanding its radio development work at the entrance of this country into the war was that of obtaining suitable vacuum tubes.* It was apparent that these tubes would be a necessary and vital component of practically every piece of equipment to be developed, and that there must be available perfected and standardized tubes in quantities far greater than had ever before been attempted. The success with which this need has been met may be judged from the fact that within less than six months after the initiation of the work such standardized tubes were in production and that at the cessation of hostilities in Europe the production rate was in excess of 1,000,000 per year and large reserve stocks had been accumulated. The object of this article is to recite briefly the story of this remarkable war-time development.

In July, 1917, when the Signal Corps took up its war-time radio development work, the vacuum tube was probably represented in the mind of the average engineer by the "audion" detector, which had been on sale for several years in a variety of forms and had been rather widely employed, particularly by amateur radio enthusiasts. The tubes thus marketed were too unstable, critical and non-uniform for military use and required careful handling and expert adjustments of the filament and plate voltages for their successful operation. A common form of the audion detector is illustrated in Fig. 1a. Certain high-vacuum tubes had been constructed on a laboratory basis by the Western Electric and General Electric companies which were more stable and of wider application than the audions, and the American Telephone & Telegraph Company was using in comparatively small quantities a telephone repeater vacuum tube which had been partly standardized. In Europe the French had developed and were making and using in considerable quantities a tube which was fairly uniform and of fairly good performance. There were, however, no tubes in existence which had the properties which would insure the successful operation of future radio apparatus needed in military service and which would eliminate complications which are so undesirable in military equipment. In the United States the basic principles of vacuum-tube design were undoubtedly better understood than in any other country, but this information was confined almost entirely to the engineering staffs of the Western Electric Company, the General Electric Company and the DeForest Radio Telephone & Telegraph Company. The Western

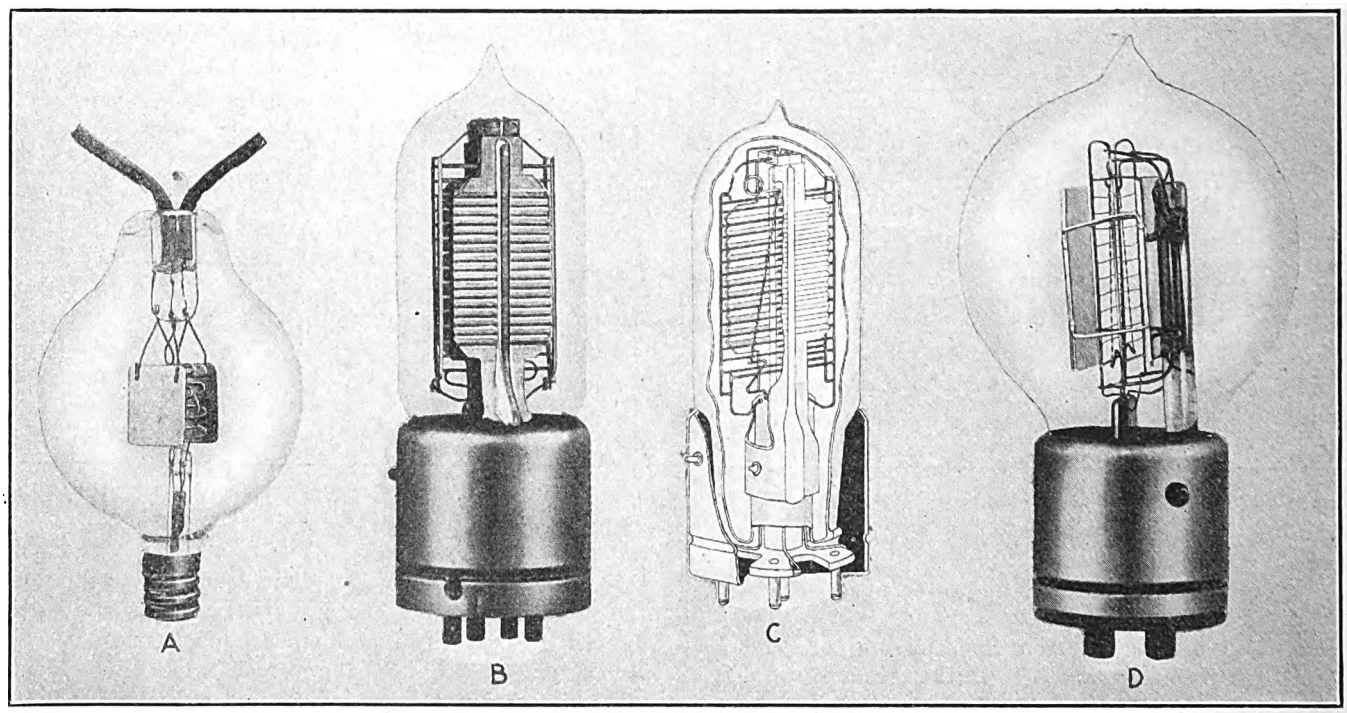

FIG. 1A—PRE-WAR AUDION DETECTOR; B—SIGNAL CORPS TYPE VT-1 VACUUM-TUBE DETECTOR AND AMPLIFIER; C—PHANTOM VIEW DRAWING OF TYPE VT-1, SHOWING STRUCTURAL DETAILS; D—SIGNAL CORPS TYPE VT-2 VACUUM TUBE FOR PRODUCTION AND MODULATION OF RADIO-FREQUENCY POWER

*The term "vacuum tube," while possibly unfamiliar to some engineers, has come to be generally accepted as a collective designation covering the various types of the three-electrode thermionic device which had its origin in the "audion" invented by Dr. Lee De Forest.

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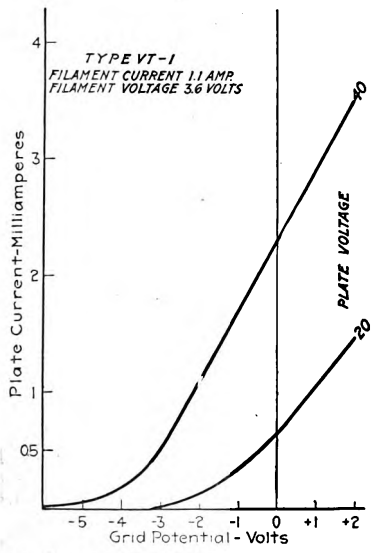
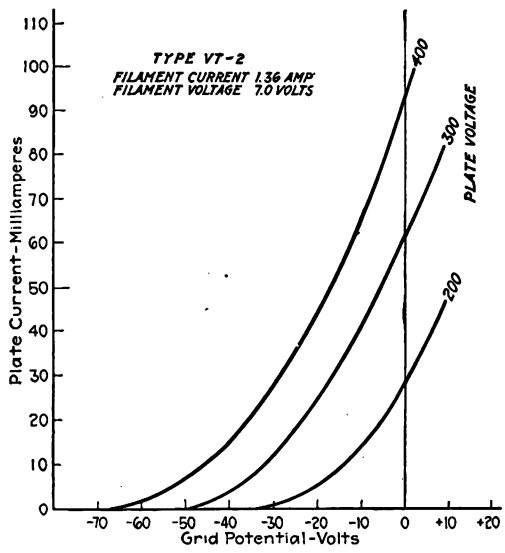
Electric Company in particular had accumulated a valuable fund of knowledge and experience from its development of the vacuum-tube telephone repeater. The Signal Corps, therefore, at once enlisted the services of these companies and worked in close coöperation with them, directing their efforts along the necessary lines.

From the Signal Corps' standpoint the undertaking resolved itself into three parts or stages. It was first necessary to decide what kinds of tubes were needed and exactly what characteristics they must possess. Secondly, satisfactory sample tubes must be designed which would possess the required characteristics and would be capable of being duplicated in large quantities. The third and most novel problem was to write exact specifications and develop testing methods for an inspection which would insure that the product passing the inspection was in every way up to the required standard and maintained the necessary uniformity. For a device which has as many aspects and governing characteristics as a vacuum tube this is no small task to be accomplished in the short space of a few months. The first and third portions of the undertaking were brought to successful solution by Signal Corps engineers, while the second portion was solved by the commercial companies who were in coöperation with the Signal Corps on the work. The three stages of the problem will be discussed in numerical order.





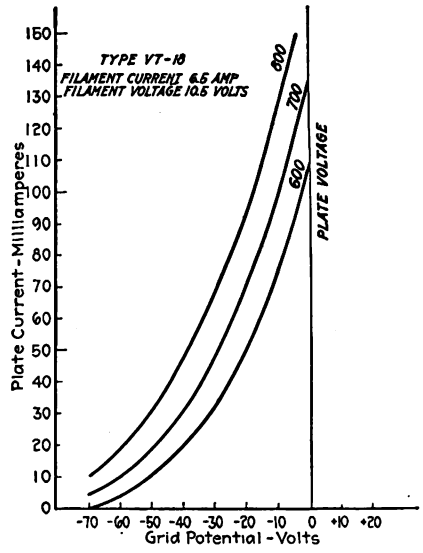


FIG. 2—CHARACTERISTIC CURVES OF THE TYPE VT-1; FIG. 3—CHARACTERISTIC CURVES OF THE TYPE VT-2; FIG. 4—CHARACTERISTIC CURVES OF THE TYPE VT-18

Vacuum Tube Requirements.—It was at once decided to develop two types of tube, one suited to receiving functions and one suited to transmitting functions. These were to be so balanced in their adaptabilities that they would serve successfully, either separately or in combination, for any uses contemplated. All apparatus was to be designed to employ one or both of the standard types according to its needs. These requirements necessitated that the receiving tube be suited to operation as a detector of damped oscillations, as an oscillating detector of continuous oscillations by the heterodyne method, and as an amplifier of audio and radio-frequency alternating currents. On the other hand, the power tube must be an efficient oscillator for the production of radio-frequency alternating-current power and have the proper characteristics to serve as a modulator of such power for radiotelephony. Furthermore, the adjustments necessary to the operation of both types must be reduced to the absolute minimum.

Specifically, the tubes must show uniform operation over ranges of 20 per cent variation of filament and plate voltages since no rheostats or potentiometers were to be allowed and the tubes must automatically adjust themselves over the range of voltage (initial to discharge) impressed by the fixed storage batteries and dry batteries or dynamotors used in the circuits. This requirement was a radical departure from practice with ordinary vacuum tubes, which depended for proper operation upon careful adjustments of filament and plate voltages. It required a combination of inherent stability, uniformity and flexibility previously unknown in radio practice. All tubes were to possess a high degree of electrical and mechanical ruggedness and a reasonably long useful life over which they would maintain their initial characteristics without appreciable change. They must be pumped to have and retain a high vacuum so as to be free of any appreciable effects due to ionization of residual gas.

The ideal condition desired was that it should be practical to replace any tube operating in any set by any other tube of the same type without affecting the operation or requiring any readjustment of the set. The completeness with which this ideal condition was finally realized is most gratifying. For example, the first type of Signal Corps amplifier built, and the one used most successfully and in the largest quantities, is entirely devoid of adjustments of any kind. It is merely a box containing the necessary transformers, wiring, dry battery units and vacuum tubes, and is provided on the outside with two binding posts for direct connection to a 4-volt storage battery, with two binding posts for the input current to be amplified, and with a jack for the insertion of the plug of the standard telephone headset. There are no knobs, switches or rheostats whatever. When connected up it amplifies and continues to do so until the batteries are exhausted. Greater simplicity could hardly be attained. With

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power tubes the conditions are somewhat more severe, and in some cases a filament rheostat has been used. However, this is only to compensate for gradual battery voltage drop due to discharge and the frequency of its adjustment is measured in hours.

Tube Development.—Actual tube-development work, which was started in August, 1917, proceeded rapidly through the remaining months of the year, and various sample tubes of both tungsten and coated-filament types were carefully examined, tested and compared in every way. The receiving tube which was finally adopted as most suitable for Signal Corps use is the type VT-1, illustrated in Figs. 1b and 1c. This coated-filament tube, developed and manufactured by the Western Electric Company, has well-balanced electrical characteristics and high electrical efficiency along the required lines, and it combines therewith such a remarkable degree of mechanical ruggedness as to have been commonly known as the "battleship type."

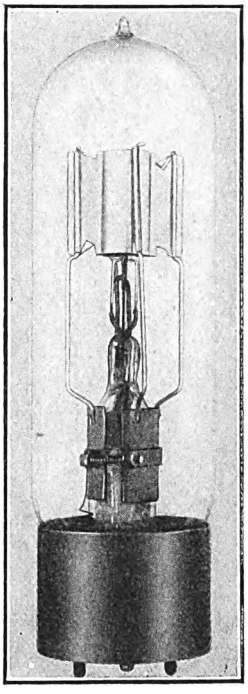

FIG. 5—SIGNAL CORPS TYPE VT-18 VACUUM TUBE

As shown in Figs. 1b and 1c, the corrugated plates, punched from sheet steel, form a cylinder at the bottom which fits tightly around the glass stem. At the top they join again and are clamped about a small square plinth of special insulating material. The grid, also punched from sheet steel, is supported at the bottom by the lead-in wires and at the top by bracing wires embedded in the plinth of insulating material. The V-shaped filament of twisted platinum strip coated with thermionically active compounds is held taut by an insulated spring support at the top. Thus the whole structure is rigidly tied together and clamped tightly to the stem, giving the strength and perfection of alignment which are essential to permanence and uniformity. The base consists of a metal shell with a phenol-fiber diaphragm at the bottom which carries the connecting studs. In assembly the base is fitted over the bottom of the tube, the leads are soldered to the contact studs, and the whole is inverted and poured full of insulating wax. The ends of the contact studs are capped with a non-corroding alloy, as are also the faces of the connecting springs in the sockets. This insures dependable contact under all climatic conditions.

The normal filament current of this tube is 1.1 amp. The filament circuit requires a 4-volt storage battery while the plate circuit operates from a fifteen-cell dry battery unit. When provided with the proper input transformer the average tube will give a power amplification of 200. This means that a two-stage amplifier composed of two of the tubes in cascade will give out 40,000 times the alternating-current power which is fed to its input terminals. The average life of the tubes is in excess of 500 hours. The ordinary characteristic curves of the VT-1 are given in Fig. 2.

It would be interesting to make a detailed mechanical and electrical comparison between the VT-1 and such previous designs as are typified by the tube illustrated in Fig. 1a. Unfortunately this would involve a more extended discussion than is allowable here. The reader can make a mechanical comparison from the pictures and statements already presented and an electrical comparison from the information given in these paragraphs and in previous literature.† Several excellent tubes of the tungsten-filament type were developed to the same specifications and standards as the VT-1, but none of these combined the necessary features to the degree of perfection attained by it. Some of them excelled in certain respects but were deficient in other important respects.

The development of power tubes proceeded somewhat more slowly than that of receiving tubes, and the difficulties of obtaining efficient design, mechanical strength and freedom from gas ionization and other electrical troubles were greater. The tube finally adopted for general Signal Corps use was a coated-filament tube developed and manufactured by the Western Electric Company. This tube, known as type VT-2, is illustrated in Fig. 1d, and its characteristic curves are given in Fig. 3. The normal filament supply is 1.36 amp. at 7 volts. The plate voltage is normally between 250 volts and 350 volts. The nominal high-frequency power output is 3 watts, but over 5 watts may be obtained without exceeding the safe limits of operation. The characteristics of the tube are such as to make it an excellent oscillator and modulator. While its output-input ratio as an amplifier is not much greater than that of the VT-1, it is capable of handling considerably more power, and it has thus been used where a more powerful amplifier than the VT-1 was needed. One or two types of tungsten filament tubes were developed along with the VT-2, but although they possessed desirable characteristics, such as greater freedom from gas and similar electrical troubles, they were not able to attain the same standard of performance and efficiency. In a tube of this size, hampered by considerations of efficiency and particularly by the use of a plate voltage of only 300, the tungsten filament is at a disadvantage and a successfully balanced design is difficult on account of the inherent physical properties of the material.

Although the types VT-1 and VT-2 have been adopted by the Signal Corps as standardized units for immediate use and the design and production of large quantities of equipment have been carried out on this basis, these tubes are by no means looked upon as the final solution of the problem of obtaining the best possible vacuum tubes for military use. Other very promising lines of development are under way.

Two main improvements are required in the receiving tube—a considerable decrease in the power necessary to heat the filament so that the storage-battery equipment and battery charging can be greatly reduced, and a decrease in the electrostatic capacity of the tube which will improve its operation as a radio-frequency amplifier, particularly for short waves. The VT-3 tube which has been developed and manufactured on an experimental basis by the Western Electric Company has these two improvements in view. It is particularly

†"Internal Relations in Audion-Type Radio Receivers," by Ralph Bown, *Physical Review*, September, 1917, Vol. X, No. 3.

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successful as regards the first one since its filament requires only 0.2 amp. at 2 volts. The filament power input is thus less than 0.5 watt as compared with 4 watts for the VT-1.

The possibilities of the tungsten-filament tube when designed to use the larger filament input and higher plate voltage to which it is inherently better suited are illustrated by the VT-18 tube (Fig. 5) developed by the General Electric Company. It requires a filament

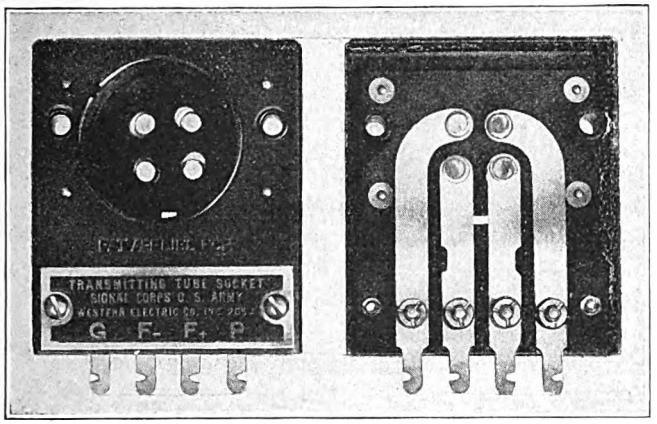

FIG. 6—TOP AND BOTTOM VIEWS OF SIGNAL CORPS STANDARD VACUUM TUBE SOCKET

current of 6.5 amp. at 10 volts and operates at a plate potential of 700 volts to 800 volts. It is capable of giving an output of 30 watts high-frequency power, and its characteristics are such as to make it well suited to use as a modulator. Its characteristic curves are given in Fig. 4. The tube is considerably more powerful than is required for the average equipment used in the past emergency, but for certain higher power equipment this sort of tube gives more satisfactory results than the combination of several low-power tubes in parallel.

The "type P" "Pliotron" made by the General Electric Company is a vacuum tube capable of producing 100 watts of high-frequency power. It takes a filament current of 3.5 amp. at 25 volts; approximately 0.2 amp. at 1500 volts is required by the plate. The tube is rather expensive and as now constructed is fragile. Nevertheless, from the electrical standpoint it is a fairly reliable piece of apparatus, and a limited use has been made of it by the Signal Corps. Tubes have been constructed similar in form to the type P which can successfully deliver a quarter kilowatt of high-frequency power. Such tubes usually require 2000 volts or 3000 volts potential on the plate electrode.

Standardization and Testing.—As a necessary preliminary to the standardization of the tubes themselves a standard design of base and socket was made. The four-contact bayonet type was selected as a basis of the design. The bases for receiving and transmitting tubes were made identical except for the angular position of the locking pin. In the bottom of each socket was placed an insulating shield pierced by four holes which allowed the base contact studs to project through and touch the contact springs beneath. The combination of this shield and the angularly displaced locking pins precluded the possibility of a tube being placed in the socket improperly or in the wrong socket and thereby eliminated a common source of annoyance and trouble. Fig. 6 shows one of the standard sockets.

The subject of specifications and the proper methods of testing receiving tubes had received careful study by the Signal Corps engineers during the progress of tube development, and with the beginning of quantity manufacture it became necessary to make definite and immediate application of these studies to the process of inspection. Therefore several rough sets of testing equipment were built in the laboratory, and officers were trained in their use. The sets were then installed by these officers at the various factories and inspection was started. The principles and methods applied in specifying and testing the tubes proved to be so satisfactory and effective that only a few very minor changes were found necessary in practice. After some weeks of actual trial had definitely settled the matter, several final testing sets were made up and installed to replace the rough laboratory sets. These new sets, together with the operating instructions and tube specifications, were turned over from the development to the inspection organization of the Signal Corps and have been operating successfully in its hands ever since. Aside from measuring instruments and storage batteries, a testing set consists of three parts—the amplifier test set, the detector test set and the oscillator test set (Figs. 7, 8 and 9).

In the amplifier test set the tube to be tested amplifies an 800-cycle alternating current. A double-throw switch allows cutting the telephone headset into either the input or the output side of the tube. The output side is provided with a variable shunt of the constant impedance type. The shunt is adjusted until the shunted output gives a signal of the same loudness as the direct input. The reading of the shunt is then a measure of the power amplification given by the tube. In order to pass inspection a tube must give more than a certain ratio of power output to power input. For the VT-1 tubes this ratio is 121. In the detector test set the tube is compared as a detector of modulated radio-frequency oscillations with a calibrated standard tube and must show equivalent or better signal response. In the oscillator test set the tube is connected to a standard circuit in which it must cause continuous oscillations if it is to be passed as a satisfactory oscil-

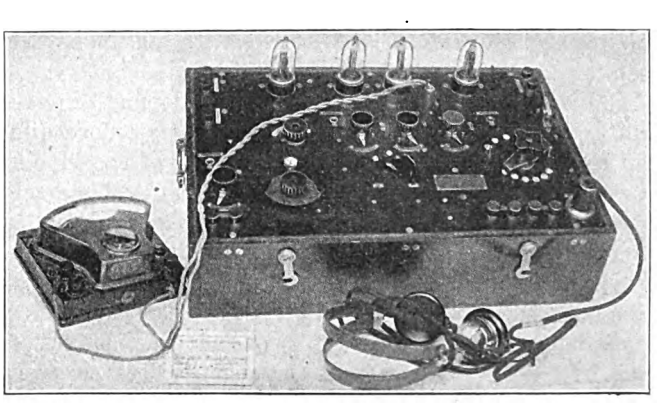

FIG. 7—STANDARD DETECTOR TEST SET FOR RECEIVING TUBES

lator. The tests are carried out at two filament and plate voltages corresponding respectively to the upper and lower variation limits of these factors under service conditions.

The sets are conveniently arranged so that other necessary measurements can be made in connection with

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those mentioned. The resistance of the filament circuit is measured and must fall within certain specified limits so that the tubes will operate properly in series or in parallel without losing their interchangeability. The plate current is measured and is held to a certain maximum limit so as to reduce the drain on the small dry battery which in service supplies the current. A measurement of grid current is made under conditions

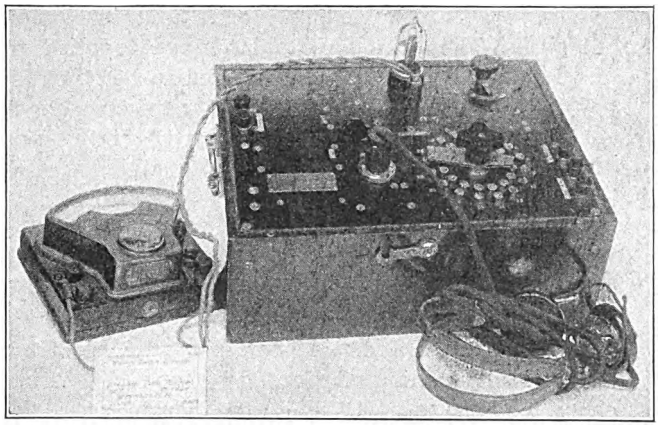

FIG. 8—STANDARD AMPLIFIER TEST SET FOR RECEIVING TUBES

such that it is indicative of the amount of gas in the tube, which must be within a limiting value. A determination of the insulation resistance between the various electrodes is made and the limit of this resistance is specified.

The sockets in the testing sets are ground accurately to size and form automatic limit gages which indicate defective tube bases as the tubes are inserted for test. A careful visual inspection of the tubes for bent electrodes, broken welds, cracked glass, loose or broken contact studs and similar defects is carried out. In the amplifier test the tube is jarred to detect noise due to excessive vibration of electrodes or any tendency of adjacent electrodes to strike together and short-circuit. A certain percentage of the tubes are selected at random and forwarded to the National Bureau of Standards for life tests and mechanically destructive tests which show any defects of material or construction. After having passed inspection the accepted tubes are packed in cartons and sealed with an inspection stamp.

The writing of specifications and development of test methods for power tubes was in some ways more difficult than for receiving tubes. On account of the smaller number of factories involved no formal testing sets were made up, the testing equipment being supplied by the manufacturer to meet the specification requirements. The requirements of mechanical perfection of tube and base were the same as for receiving tubes. Similarly, equivalent tests for gas, insulation resistance, ruggedness, life and filament resistance were applied. Tests for operation of the tubes as oscillators were made in a standard circuit. Specified power outputs were required for varying conditions of filament and plate voltage. An overload test was made in which the tube was operated a short time at excessive input. A test was applied which caused the rejection of tubes unsuitable for operation as modulators.

In connection with the standardization of vacuum tubes and their bases and sockets it was convenient and advantageous to standardize various auxiliary apparatus. A step-up input transformer, so necessary to the use of the tubes as amplifiers, was designed specially to fit the constants of the receiving tubes. Telephone headsets were designed to have impedances which suited them for most efficient operation with the tubes. A special fifteen-cell dry battery was developed to supply plate potential for receiving tubes, while for power tubes a small 10-volt to 300-volt dynamotor was used.

The vacuum-tube work has required the services of a considerable staff of Signal Corps engineers. The following are credited with important contributions to various phases of the work: First Lieut. R. E. Bitner, First Lieut. P. T. Weeks, Second Lieut. S. S. MacKeown, Second Lieut. L. J. Stacy and Dr. F. K. Richtmeyer.

General Applications.—Two other evacuated tube devices which are not strictly vacuum tubes in the accepted meaning of this term have been classed with vacuum tubes in their development. These are the regulator tube and the ballast lamp. The former consists of a hot cathode and single, cold anode, similar in general arrangement to the Fleming valve rectifier. The latter is merely an iron-wire filament normally operating near its recalescence temperature and maintained in a low-pressure hydrogen atmosphere. These two tubes are used in the airplane radio telephone set for automatically regulating the voltage of the fan-driven generator. Attention is called to them here, particularly the regulator tube, because they illustrate in an illuminating manner one trend of development in the practical application of thermionic phenomena and the principles of vacuum-tube design to the solution of the problems connected with electrical engineering in general.

In this connection the following quotation from the editorial page of the ELECTRICAL WORLD, issue of Oct. 19, 1918, is of interest:

> From a technical point of view, the most salient advance in radio engineering made since the opening of the world war has been in the construction and use of vacuum tubes. These tubes have been so far improved and so much utilized

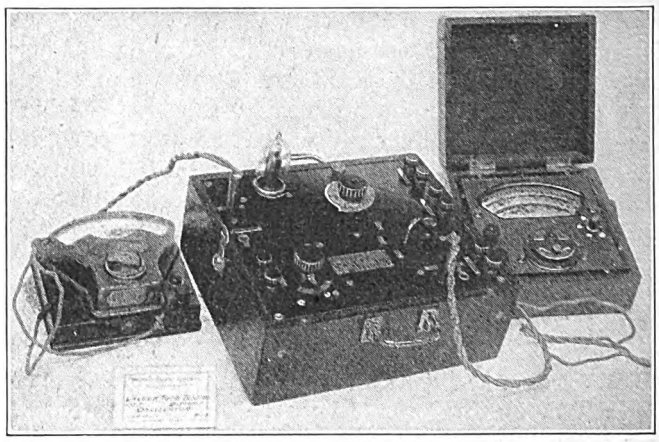

FIG. 9—STANDARD OSCILLATOR TEST SET FOR RECEIVING TUBES

> for many purposes that vacuum-tube engineering seems to offer a promising new branch of electrical engineering, intimately associated with radio engineering on one side and with electric power and wire communication on other sides. It is clear that the essential theory and the principal working applications of vacuum tubes will have to be learned by most electrical engineering students. The tech-

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nical colleges and engineering laboratories of the world will have to teach these subjects in the future.

Three years ago it might very properly have been said that the design and construction of the vacuum tube was far behind its application and that many valuable possibilities of use were waiting for the development of suitable tubes. To-day the opposite is true. The design of tubes to give predetermined performance is a fairly definite thing and only needs the experience of extended practical use to bring it to a high state of perfection. The feasibility of economically manufacturing tubes of desired characteristics in large quantities and with a remarkable degree of uniformity has been demonstrated.

Looking Into the Future.—While the use of the vacuum tube is as yet restricted almost entirely to the field of communication, it is to be anticipated that American engineers will not be backward in finding important applications for this unique device in the many other fields of electrical activity with which it has at present no connection and that it will soon become a common engineering tool, more familiar to the average electrician than it now is to the average scientist.

The comparative ease with which a tube of 0.25-kw. output may be constructed at once leads one to think of 1-kw. or perhaps 5-kw. tubes, and having encompassed this idea the imaginative mind easily leaps to the consideration of 10-kw. and 100-kw. installations. Where will the economic limit be reached? It is probably safe to say that aside from laboratories or experimental projects the economic limit to-day is reached in a tube approximately the size of the VT-18. As to the future, one can only guess, but the guess can be guided by limiting facts. In a well-designed tube the ratio of the alternating-current power output to the total direct-current filament and plate-circuit power input is scarcely ever greater than 20 per cent. On account of the law of space charge and the difficulty of efficiently obtaining large electron-emitting surfaces in the filament member, very high voltages must be resorted to in order to obtain large power inputs. Since 80 per cent of the total input is dissipated in heat, cooling becomes a serious problem. The combination of high voltage, high electrode temperature and large space currents makes it necessary to have a very perfect vacuum in order to avoid the destructive effects of gas ionization. Thus each difficulty aggravates the others and together they pyramid rapidly as efforts toward increased power are made. Even if the engineering obstacles could be successfully dissipated, the low efficiency and excessive cost of high-power tubes would make them questionable competitors of the high-frequency alternator or the Poulsen arc. To be sure, it is very probable that tubes of capacities up to perhaps 1 kw. will rapidly come into use as sources of continuous oscillations, since neither the alternator nor the arc is capable of effective operation at such low power or at short wave lengths. But, although a mammoth, water-cooled, all-metal vacuum tube continuously served by a high-capacity vacuum pump may be an engaging contemplation, it is hardly safe to predict that it will become a common sight in future power plants or radio stations.

On account of the same considerations of power and efficiency it is not to be expected that the vacuum tube will to any great extent replace or improve many of the host of satisfactory electrical devices which, for instance, may be found associated with the modern city power system both at the producing and consuming ends of its lines and feeders. Its real future lies in the possibility of its revolutionizing many things which are now done in inefficient ways and in that it has made available a means for the accomplishment of many things which have heretofore been unyielding to the scientist and inventor. As an instance of the former case may be cited the recent announcement by the American Telephone & Telegraph Company that through the vacuum tube it is now able to make one telephone trunk line carry a volume of traffic previously requiring five such trunk lines. For the latter case may be mentioned the radio direction finder which, owing to the use of vacuum-tube radio-frequency amplifiers, has been changed from a scientific toy to a very useful instrument capable of locating the source of weak radio signals. The broader possibilities of the vacuum tube along such lines have been scarcely touched.

PRIZE ESSAY CONTEST IN INDUSTRIAL ECONOMICS

National Industrial Conference Board Offers Thousand-Dollar Prize for Best Monograph on Selected Subject

The National Industrial Conference Board offers a prize of $1,000 for the best monograph on any one of the following subjects: (1) A practicable plan for representation of workers in determining conditions of work and for prevention of industrial disputes. (2) The major causes of unemployment and how to minimize them. (3) How can efficiency of workers be so increased as to make high wage rates economically practicable? (4) Should the state interfere in the determination of wage rates? (5) Should rates of wages be definitely based on the cost of living? (6) How can present systems of wage payments be so perfected and supplemented as to be most conducive to individual efficiency and to the contentment of workers? (7) The closed union shop versus the open shop, their social and economic value compared. (8) Should trade unions and employers' associations be made legally responsible?

The committee of award is composed of Frederick P. Fish of Fish, Richardson & Neave, Boston, chairman of the National Industrial Conference Board; Dr. Jacob Gould Schurman, president Cornell University, Ithaca, N. Y., and Henry R. Towne, chairman Yale & Towne Manufacturing Company, New York City. The contest is open without restriction to all persons except those who are members of or identified with the National Industrial Conference Board. The copyright of the prize manuscript, with all publication rights, will be vested in the National Industrial Conference Board. Each competitor should sign his manuscript with an assumed name, sending his true name and address in a sealed envelope superscribed with his assumed name. Manuscripts must be mailed by July 1 to the National Industrial Conference Board, 15 Beacon Street, Boston, Magnus W. Alexander is managing director of the board.

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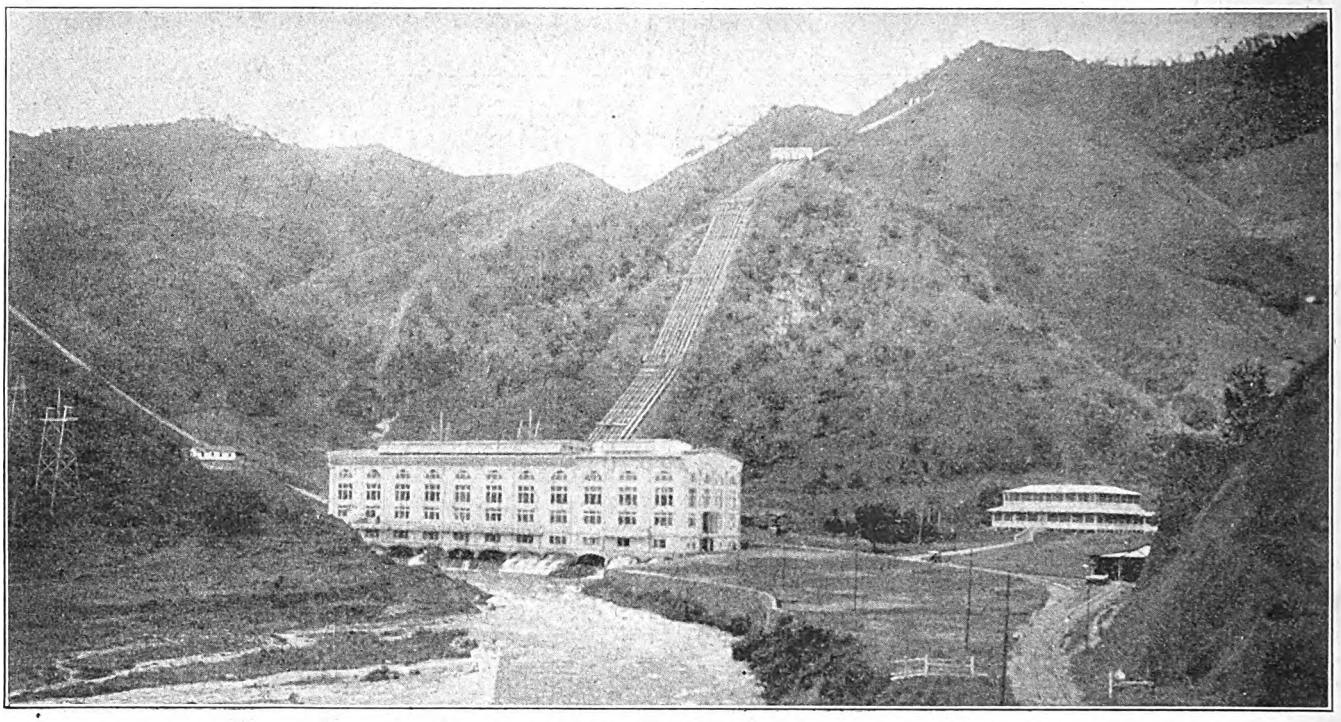

HYDROELECTRIC PLANT AT LAGES, SUPPLYING RIO DE JANEIRO, BRAZIL

Market for Electrical Goods in South America—I

Industrial Characteristics of the Various Republics in the Southern Half of This Hemisphere, Together with a Brief Description of the Inhabitants, Their Habits, Their Capabilities and Their Purchasing Power

BY PHILIP S. SMITH
Trade Commissioner, Bureau of Foreign and Domestic Commerce

SO MUCH has been said and written of late about South America as a market for goods made in the United States that its importance may have been overestimated in the enthusiasm of those who are now for the first time learning about that continent. For this reason many electrical manufacturers have taken steps to enter the field in a manner that companies with more experience would call unwarranted. It is true that quantities of goods are used, and that in normal times there is a decided increase from year to year, so that it is equally unwise to underestimate the market. The aim of this article, therefore, is to present certain fundamental facts that may help the manufacturer to form an opinion regarding the extent to which he ought to push his products and something of the results he might reasonably expect.

The continent of South America consists of thirteen countries, no two of which are exactly alike either topographically, economically or politically. There is also a great difference in the characteristics of the inhabitants, their purchasing power and their manner of living. For this reason it is necessary, even in a general survey of South America as a market, to divide it theoretically into several sections and to take up each one separately. In this article, therefore, the usual custom of considering that there are three natural groups will be followed.

The first group embraces the east-coast countries of Brazil, Argentina, Uruguay and Paraguay; the second, the west-coast countries, Ecuador, Peru, Bolivia and Chile; the third, the countries on the north coast, British, Dutch and French Guiana, Venezuela and Colombia. Colombia, with its great stretch of territory on the Pacific Ocean, might be classified in the west-coast group were it not for the fact that the principal cities and the only practicable ports of entry are on the north coast.

Agentina, Brazil, Uruguay and Paraguay are, generally speaking, non-mountainous and are especially suited to cattle raising and agricultural pursuits of various kinds. Argentina and Brazil are also making repid advances industrially. All the west-coast countries are mountainous, containing the high peaks of the Andes and abounding in mines, small and large and in various stages of development. Some of the largest and most productive copper mines in the world are in Chile, Bolivia and Peru; hence much of the heavy machinery imported is for this group. On the north coast, Colombia and Venezuela have been making surprising progress in the last few years and are now taking considerable quantities of insulated wire, lamps and motors. These countries are mountainous over a large part of their territory; nevertheless, very little mining is being carried on, the sources of wealth being chiefly coffee, bananas, hides and other products of agriculture and cattle raising. Apparently the greatest development will be made along this last line. Much of the interior of both countries is unexplored. Of the three Guianas, British Guiana is the only one that consumes electrical goods, and that only in small quantities.

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SOUTH AMERICAN IMPORTS OF ELECTRICAL GOODS

In 1913, the best year previous to the war, the total imports of electrical goods into South America amounted to approximately $22,250,000, and of this sum the share of the United States was $4,600,000, these figures having been taken from the statistics of the several foreign governments. It is interesting, in passing, to make a comparison of the American share with the shares of England and Germany, our two principal competitors during the same period. They were, respectively, $5,400,000 and $10,000,000. On account of the world crisis since that date the relative positions of the exporting nations have undergone a radical change, and the United States is now the leader, with exports, according to statistics compiled by the Department of Commerce, of $9,780,000 for the year ended June 30, 1918. This represents a decided increase in percentage of total imports. It will be worth the efforts that will be necessary to hold this same proportion when business shall have reached its normal point again.

Table I gives the electrical goods imports of each South American country, showing the amounts furnished by England, Germany and the United States for the calendar year 1913, the latest normal year, and the amounts sent from the United States to each country of South America for the year ended June 30, 1918.

TABLE I—ELECTRICAL IMPORTS OF SOUTH AMERICAN NATIONS

Countries	South American Imports of Electrical Goods in 1913				Exports of Electrical Goods from United States, 1917–1918
	Total	From United Kingdom	From Germany	From United States	
Argentina	$9,756,234	$3,358,711	$4,892,538	$577,126	$2,626,163
Bolivia	612,022	200,349	297,464	5,922	33,522
Brazil	8,504,518	1,420,958	2,977,488	3,239,564	3,183,016
Chile	2,288,292	346,141	1,636,215	194,834	2,162,887
Colombia	159,343	20,000	10,000	127,929	284,298
Ecuador	150,000	2,500	2,500	100,550	100,033
British Guiana	35,000	10,000	10,000	10,000	41,372
Dutch Guiana	.....	.....	.....	.....	1,435
French Guiana	.....	.....	.....	.....	308
Paraguay	82,914	17,090	27,027	5,496	22,929
Peru	223,958	9,235	74,115	126,233	647,296
Uruguay	230,708	30,745	49,846	49,431	438,114
Venezuela	207,503	25,000	5,860	137,933	238,724
Total	$22,250,492	$5,440,729	$9,983,053	$4,575,018	$9,780,097
Per cent	100.0	24.0	40.4	20.5	.....

LOWER PURCHASING POWER OF SOUTH AMERICA

The mistake is often made of taking it for granted that the average consuming capacity per capita is the same in South America as in North America. This is not true, and any selling estimate or campaign based on such a false assumption is bound to result in disappointment. Briefly, the principal reason for this is that the South American countries being still in the pioneer stages of development, the desires for modern luxuries or even conveniences are not yet so strong as in some other parts of the world. Moreover, as the wages paid are on a lower scale, while the prices of all imported articles are much higher than those of the country of origin, owing to the freight, duty and other expenses incidental to importation, many things are quite out of reach of the greatest part of the inhabitants even if they were educated up to their use. As an illustration of this situation, we may take the case of Peru, with a population of 4,500,000, of which it is estimated that 50 per cent are Indians, 35 per cent are half-breeds, negroes and Chinese, and only 15 per cent belong to the white race. Looked at in a most liberal manner, Peru as a market for electrical goods is no better than an American purchasing public of 100,000 people. This includes both the people as a whole and the foreign mining interests, whose annual business is a large proportion of the total. This is one of the extreme cases, but the same sort of allowances must be made for all countries. Those composing group 1 have the greatest purchasing power, the maximum being found in Argentina.

TABLE II.—STATISTICAL DATA ON SOUTH AMERICAN COUNTRIES

Countries	Area, Square Miles	Population	Equivalent Population in United States*
Argentina	1,153,400	8,000,000	3,250,000
Bolivia	514,464	2,535,000	200,000
Brazil	3,301,950	25,000,000	2,800,000
Chile	290,000	3,800,000	760,000
Colombia	494,340	6,000,000	55,000
British Guiana	89,420	300,000	6,000
Dutch Guiana	46,352	90,000	.....
French Guiana	31,550	50,000	.....
Ecuador	275,331	1,500,000	50,000
Paraguay	164,090	750,000	30,000
Peru	680,000	4,500,000	100,000
Uruguay	72,057	1,250,000	85,000
Venezuela	394,154	3,000,000	75,000

* This equivalent is based on the 1914 Census of Manufactures, which places the value of electrical machinery, apparatus and supplies made in the United States at $359,432,155. Allowing for an exportation of $30,000,000 and a population of 100,000,000, the domestic per capita purchase of electrical material is $3.29, while in South America, it is less than 50 cents.

Table II gives the area of each country, its population and its estimated purchasing power expressed in terms of an equivalent population in the United States.

BRAZIL

Growing Demand for Electrical Goods.—The consumption of electrical goods in Brazil is steadily growing, and before many years it will surpass that of any other South American country. With a population of approximately 25,000,000 and resources of a very varied character, Brazil will have a more diversified demand than it has at present. Mines will be developed, numerous industries have been established already, and steam railroads will be electrified.

Two of the largest and most progressive central stations in Latin America are situated one in Rio de Janeiro and the other in São Paulo. These are both owned and operated by the Brazilian Traction, Light & Power Company, Ltd., a Canadian company, largely under American managers and engineers. Its policy has been always to encourage the use of high-class material, and consequently standard American goods have had a ready sale in the district covered by its lines. This provides a good illustration of the advantages that American industries can expect to derive from the investment of American capital in foreign countries.

Electrical Power in Industry—Mining—Electric Railways.—An indication of the extent to which electric power is used in the industrial life of Rio de Janeiro and São Paulo will be had from the statistics of the central stations, which show that in São Paulo there

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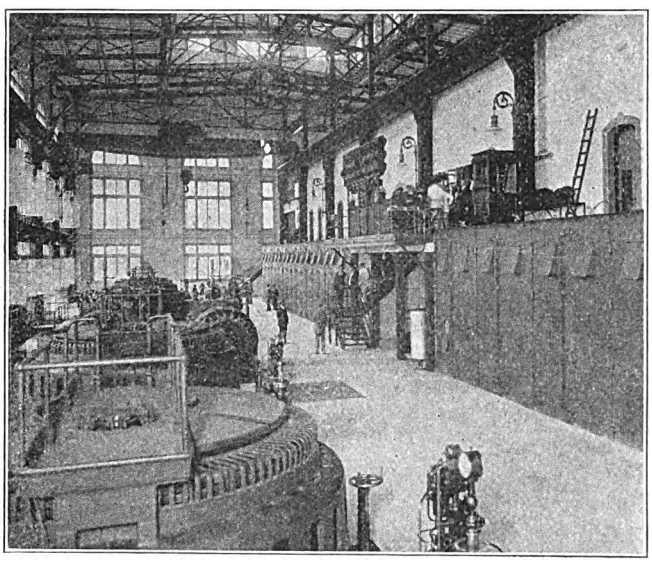
is more than 50,000 hp. in electric motors connected to the circuits, while in Rio de Janeiro there is more than 100,000 hp. connected. The normal yearly increase may be taken at not less than 5000 hp.

Already there are a number of mines in operation, and indications are that in the near future active work will be begun in the great iron-ore district in the State of Minas Geraes. Judging by the size of the known deposits and the importance of the companies owning them, it is evident that when this development takes place there will be required a large amount of modern mining and power machinery.

The railway that will tap this iron-ore district, known as the Victoria-Minas Railroad, will be electrified for a length of several hundred kilometers. Plans have been



INTERIOR OF 85,000-KW. PLANT AT LAGES, BRAZIL

completed already for electrifying a large portion of the Paulista Railroad, in the State of São Paulo, and other roads are expected to follow this example.

Power from Waterfalls.—The power for all these enterprises will be furnished by waterfalls, which are abundant in this particular section of Brazil. The country rises rather abruptly from the seacoast to a height of several hundred feet, and the interior uplands form a great drainage basin for rivers and streams that fall precipitately to the Atlantic coast. Many of these have been harnessed and are furnishing energy to a great many towns and cities. Some are capable of producing only a few hundred horsepower, but it is interesting to note that there are also streams from each of which, it is estimated, thousands of horsepower can be obtained. Three of the largest of these are the Sete Quedas, with about 20,000,000 hp.; the Iguassu, with 3,000,000 hp., and the Paulo Affonso, with 1,500,000 hp. The first two, however, are so far removed from industrial centers that they are not susceptible of development unless some means is provided for the utilization of electricity on a large scale.

Telephones—Street-Railway Systems—Household Devices.—There are a number of telephone companies, some of which are provided now with modern equipment, although most of the smaller ones will be needing new material to take care of their natural expansion. The more important companies are in Rio de Janeiro and São Paulo and are owned by the Brazilian Traction, Light & Power Company. They have about 40,000 subscribers and use only American material. Their yearly increase is approximately 10,000 instruments in service, most of which are European-made.

There are street-railway systems in Manaos, Para, Ceara, Bahia, Rio de Janeiro, Nictheroy, São Paulo, Santos, Porto Alegre, Pelotas and Rio Grande. With the exception of the last, which is a very small company, they all use English or American equipment exclusively. The total number of motor cars in active service is about 1500.

The small household devices used for heating and cooking are being introduced energetically and will enjoy an increasing popularity with dealers in electrical goods. In all the cities the dealers are very progressive, and both they and the central stations are engaged in active propaganda for the wider use of electrical material of all kinds.

ARGENTINA

Prospect of Rapid Development—Lack of Water Power.—At the present time and perhaps for the immediate future Argentina offers the best market in South America for electrical goods, owing to the fact that it is capable of easy development and produces articles of such prime necessity throughout the world as grain, wool and beef. It is expected that its progress will be more rapid than that of other countries that have more difficult transportation and production problems, and its point of maximum ability to absorb electrical goods will be reached while Brazil is still in the early stages of its development.

Argentina is handicapped in not having available for development any large amount of waterpower. Several of the interior cities, such as Tucuman and Cordoba, have hydroelectric plants, but these are furnishing practically all the power of which they are capable. The only large waterfall is the Iguassu, half of which may be ceded to Argentina, since it is on the boundary between that country and Brazil. As was pointed out, however, this is too far away to be of any use in the industrial development of either country.

Industrial Uses of Electricity—Central Stations in Buenos Aires.—There is a great deal of interest in local manufacturing, and government as well as private associations are attempting to increase it as much as possible. There is already approximately 130,000 hp. in motors in active operation, and the yearly increase for the last few years has been about 6000 hp. According to statistics, it would appear that there is at least 150,000 hp. in steam and gas engines in various industrial establishments, most of which are within the reach of central-station power.

There are two large central stations in Buenos Aires, the larger of which is a German company, with an installed capacity of approximately 100,000 kw. The smaller station is owned by a combination of Italian and Swiss manufacturers, and both these central stations are practically committed to the exclusive purchase of European goods, thereby indicating again the influence of invested capital in obtaining trade for the home country. The German company also has invested approximately $24,000,000 in other stations throughout Argentina. Its parent company owns one of the

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tramways in Montevideo and the central stations and tramways in Valparaiso and Santiago, Chile.

Telephones—Street and Other Railways.—A large number of small telephone companies operate in the various towns and cities and have a total of approximately 50,000 subscribers. The better companies are using American material almost exclusively, with English and German motors and controllers. Many extensions are contemplated, and the repair and supply business is one of considerable volume.

One of the steam roads has electrified one of its suburban lines for a distance of 30 km. and contemplates further electrification in the near future. Two other railways have made some progress toward electrification, one of them having installed its power plant and third rail. All these are English-owned companies and employ a firm of English consulting engineers to take charge of this work.

Increasing Variety of Devices on Market—Lack of Wiring Rules.—The retail dealers in electrical goods are progressive and handle all kinds of miscellaneous devices, as well as standard lines of wire and wiring supplies. These two items are the principal lines in the electrical trade, but with the assistance of the central stations there is being created a demand for heating and cooking devices and the more modern forms of lighting equipment.

There are no wiring rules or regulations to require the use of material of such high grades as the American standard goods, and the European factories for a long time have been making propaganda in favor of cheaper material, with the result that this market is one where cheap goods have the greatest sale and arguments concerning quality have little effect.

URUGUAY

Limitation of Market to Montevideo.—There is little of interest in Uruguay outside the city of Montevideo, since the central stations in the interior are of very small capacity and many of them operate only during the night time, which practically excludes all household devices and motors.

There are no waterfalls, as the country is comparatively flat. It is devoted almost entirely to agriculture and stockraising, though mining is attracting more attention than formerly on account of traces of a large variety of ores. Industrial progress is being fostered by the government, but it is hardly to be expected that it will ever reach great proportions. Exception may be noted, however, in the matter of the meat-freezing industry, several plants having been erected by United States companies.

Central Stations Owned by Government Telephone Companies.—The government of Uruguay owns, or will own, all the central stations, and consequently all business in connection with them may be done with the central office in Montevideo. This government department of central stations is unusually progressive and maintains attractive and well-equipped display rooms in which it demonstrates all grades of household devices. It also makes special rates for the energy used in cooking ranges, and the effect of its attitude has been to stimulate dealers into greater activity in the display of such material.

The telephone companies, of which there are approximately twenty, are now owned privately, but the government intends to take them over, under its policy of declaring all public utilities to be state monopolies. There are approximately 18,000 instruments in use, of which 10,000 belong to the two companies operating in Montevideo. The larger of these, an English company with 8000 subscribers, uses American material.

Street Railways—Municipal Lighting—Trade Methods.—There are two street-railway companies with 400 cars. The government has bought a mule-car line and intends to electrify it in the near future.

Montevideo is one of the few cities still lighted by arc lamps, of which there are now approximately 2000 in service. It is expected that these will be replaced by a system of incandescent lighting before very long.

Much of what was said about Argentina is true also of Uruguay, and the business in the latter country is handled usually through the representative or branch office in Buenos Aires. It is hardly of sufficient importance to require an independent agent, responsible to the factory direct.

CHILE

Good Prospects of Development—Power Project.—Although one of the smaller countries, Chile offers one of the best three markets for electrical goods. It has large and active mining development, and quantities of electrical material are employed in its nitrate fields. Many industries have been established under the stimulation of the abnormal conditions of the last few years, and everything possible is being done to extend them.

In the section from Coquimbo to Valdivia there is an abundance of water power, and the government has created a commission to study the possibility of constructing a longitudinal artery for the transmission of power throughout this stretch. If this can be done successfully, it will make available a large amount of cheap power, which, in turn, will greatly encourage the establishment of more industries.

Central Stations—Telephones—Railroads—Business Methods.—The two larger central stations are in Santiago and Valparaiso, and since they are owned by German capital their whole influence has been used to exclude material other than of German manufacture. Presumably they will continue the same policies.

There are several smaller independent telephone companies, but most of the more important places are controlled by the Chile Telephone Company, an English concern with headquarters in Santiago. They are preparing to replace much of the older equipment with more modern material.

The Chilean government has taken steps already looking toward the electrification of three sections of its railway system, and if the entire program is carried out, it will mean the installation of a large quantity of generating and power apparatus. This subject has been discussed for ten years or more but will probably be brought to a successful conclusion eventually.

Owing to the fact that business cannot be handled from one central point, as in Argentina, there are fewer exclusive electrical dealers, this business being handled by the central stations or by hardware and machinery houses. It is necessary to have representation in several of the important cities, each of which is a purchasing center for the surrounding district.

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COLOMBIA AND VENEZUELA

Although the characteristics of Colombia and Venezuela are far from identical, they may be considered as one, since many of the statements applying to one apply also to the other. They are noted more for their agriculture and allied industries than for their mines, with the possible exception of the gold and platinum and emerald producing region of Colombia. Some power machinery has been installed for the extraction of gold, but in general mining is done by hand labor.

There are many small central stations scattered through the interior, and the number is constantly being increased. There are numerous small waterfalls that can be used for developing electric power for the nearby towns, as well as several large sources of power that could be used only if energy-consuming industries were to be established near them.

Owing to the difficulties and expense of traveling, it is desirable to secure active local representatives rather than to attempt to cover the field with factory representatives.

PERU

Electric power is used in the large and small mines of Peru, the oil fields and the sugar plantations, all of which are following a program of expansion as fast as conditions will permit. In or near Lima a number of small industries also use electric power, and the central station is quite active in securing new customers.

The street-railway system in Lima and Arequipa and the telephone company in Lima use American material exclusively. The Central Railroad has been making studies of the electrification of its line, but apparently has not found that conditions warrant such a movement.

A great majority of the inhabitants are Indians and halfbreeds, living in the high inland plateau, so that the consumers of household and miscellaneous devices are not more than 15 per cent of the population.

[The second part of this article will deal briefly with Ecuador, Bolivia and British Guiana and will give a résumé of the facts brought out, together with a tabulation of central stations in some South American countries.]

Pull Together to Decrease Accidents

Co-operation Between Employer and Employee Will Increase Production and Efficiency and Will Reduce Accidents—Safety and Welfare Committees Should Be Formed and Should Encourage Suggestions

BY F. B. VAN DOREN
Safety Engineer, Utilities Mutual Insurance Company

CO-OPERATION is essential in all phases of successful living, and perhaps nowhere more so than in the work of preventing accidents. Of the safety-first idea it is the quintessence. The meaning of coöperation is "concurrent effort or labor," and there are at least two viewpoints from which to observe its accomplishment. One is the employee's and the other the employer's.

"Pull-together" spirit between employer and employee will not only increase production and efficiency but it will beyond any question decrease the number of accidents. Visit any public utility plant where the "pull-together" idea exists and inquire what its accident experience has been for the past year. One would not have the least hesitancy in saying that it has been exceedingly low. Then visit the plant where little or no coöperation exists, and one will find dissatisfaction, discord, low efficiency and numerous accidents.

Every one must have seen plants where the attitude of the employee is: "Why should I care? The boss doesn't care anything for me except to get ten or twelve hours' work. Why when we leave the shop he never thinks of us again." Do you suppose such a company is getting what it should in production, or what it would if some thought were given to the other fellow?

That employer who has no thought for his employees after working hours will sooner or later find the better employees seeking employment elsewhere, and the others reciprocating the feeling. His accident record will not only be high, but his labor turnover also will be high.

Most men are born sociable and appreciate it when a good word is spoken to them. You can call it what you please—salve or blarney; nevertheless, from the highest to the lowest they like it.

It should not be inferred that an employer should be insincere; that would mean disaster. But to give out words of good cheer and have them come from the heart works wonders. It will be found to pay large dividends in many ways.

Where it is the practice for the owner, manager or superintendent to make a daily inspection of the property he should never go into it with a "grouch." Put on the "Sunny Jim smile" and say "Good morning" to Jim, George or Bill. These men are human, and a personal acknowledgment means a great deal to them. It makes them feel as if they were part of the organization and not a machine.

No longer should any gap exist between the employer and employee. The "get-together" spirit has arrived. The first to adopt it will be the one not only to hold his old employees but to have a waiting list, and he will find also that he has the most efficient organization.

Let none of us forget that it is the man with the flannel shirt and overalls who brings in the dollars. There is an old but true saying, "Never judge a man by his clothes." Underneath many a ragged and soiled suit lies a heart of gold.

If sickness or injury comes to one of your employees, visit his home. See if he or his family is in need. This cannot always be done by the employer himself, but he

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can appoint some good person in his organization to do it. He will find it will never be forgotten by either the man or his family, and returns will follow beyond expectation.

Coöperation or the "pull-together" spirit must be strictly adhered to if accidents are to be kept at a minimum. The management of any concern will have no trouble from this cause if it will show that it is interested in the welfare of its employees. Follow the golden rule, "Do unto others as you would have others do unto you," and no trouble will be experienced.

Do not drive men. The man of to-day can think for himself and if driven will resent it in many ways. Try to lead, and see if the outcome will not be more satisfactory. "You can always catch more flies with molasses than vinegar."

Mistakes are bound to occur, but do not lose sight of the fact that nothing was ever accomplished without them. He who never makes mistakes gets but little. How many of us have ever tried to assign the reason when an employee has made some mistake? At the time his mind may have been occupied elsewhere; perhaps he has had trouble at home. These cases should be investigated, if possible, and help furnished so the man may know that while he is at his labors his family is being taken care of.

Coöperation among employees may be attained by the appointment of safety and welfare committees, and these should freely encourage suggestions. Do not lose sight of the fact that in many instances an employee holding one of the lowliest positions may be able to offer the best suggestion, which, if adopted, would be the means of preventing serious accidents and at the same time improving the efficiency of the plant and increasing the production.

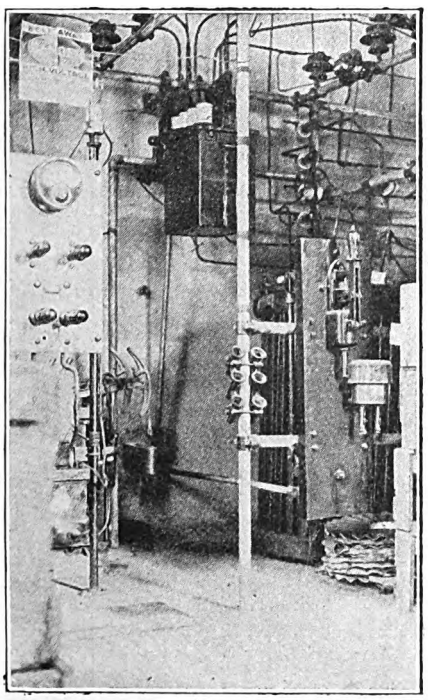
If the confidence of the employees is once gained, it is an easy matter to hold it. Before it can be held, however, one must lay all the cards on the table and be absolutely honest and sincere. Confidence once lost is very hard to regain. Employees are not slow to resent dishonesty, and if practiced it will soon cause trouble. Honesty is the best policy with employees and public alike, and it will be found to pay large dividends.

COÖPERATION FROM THE EMPLOYEE'S STANDPOINT

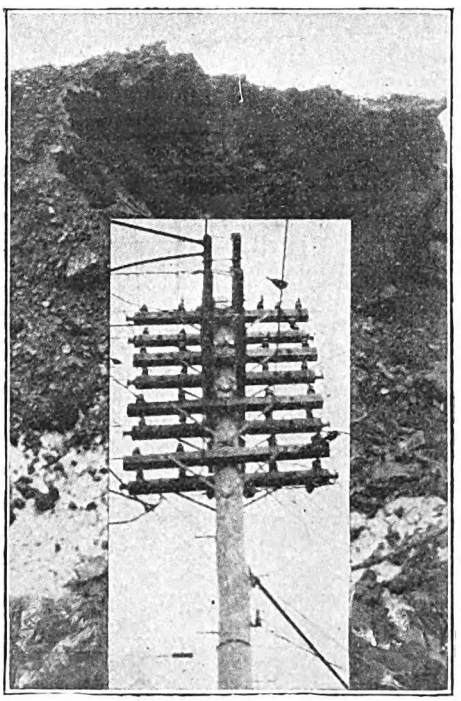
Now let us look at coöperation from the standpoint of the employee. Coöperation is a fifty-fifty proposition, and each must act accordingly. The employee must do his part if the management is expected to do its part. He must give an honest day's work, be punctual in his attendance and carry on his regular duties for the best interest of his employer. He must use the safety appliances furnished and strive in all ways possible to help educate his fellow workers along safety lines. He must remember that the management is operating the plant to obtain a livelihood as well as pay a fair return on the investment.

If the employee is looking for nothing beyond his daily labor and watches the clock instead of keeping his mind on his duties, the employer will soon lose faith in his desire to obtain coöperation. The labor turnover will be increased, and accidents will occur more and more frequently, with an increased loss to both employer and employee.

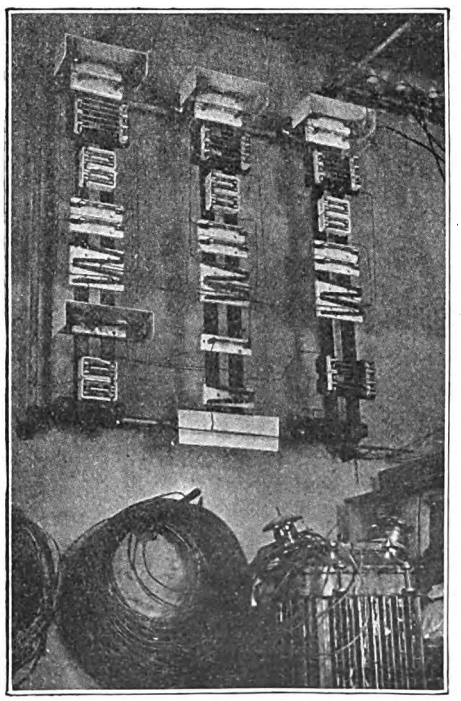
If each will look at it from his own side, he will soon see the error of his ways and will try to encourage the "pull-together" spirit at all times. The sooner both management and employee realize this, the sooner dissatisfaction, discord and strikes will come to an end. In their place greater production, greater efficiency and fewer accidents, with entire satisfaction for all, will result.



Surplus material should be removed for reasons of safety as well as better operating conditions.



Overhang in a coal pile may be the cause of accidents. Poles should have plenty of climbing space.



Removal of surplus material and storage in separate building is good operating practice.

FREQUENT INSPECTION BY THE EMPLOYER AND CARE BY THE EMPLOYEE WILL LESSEN ACCIDENTS

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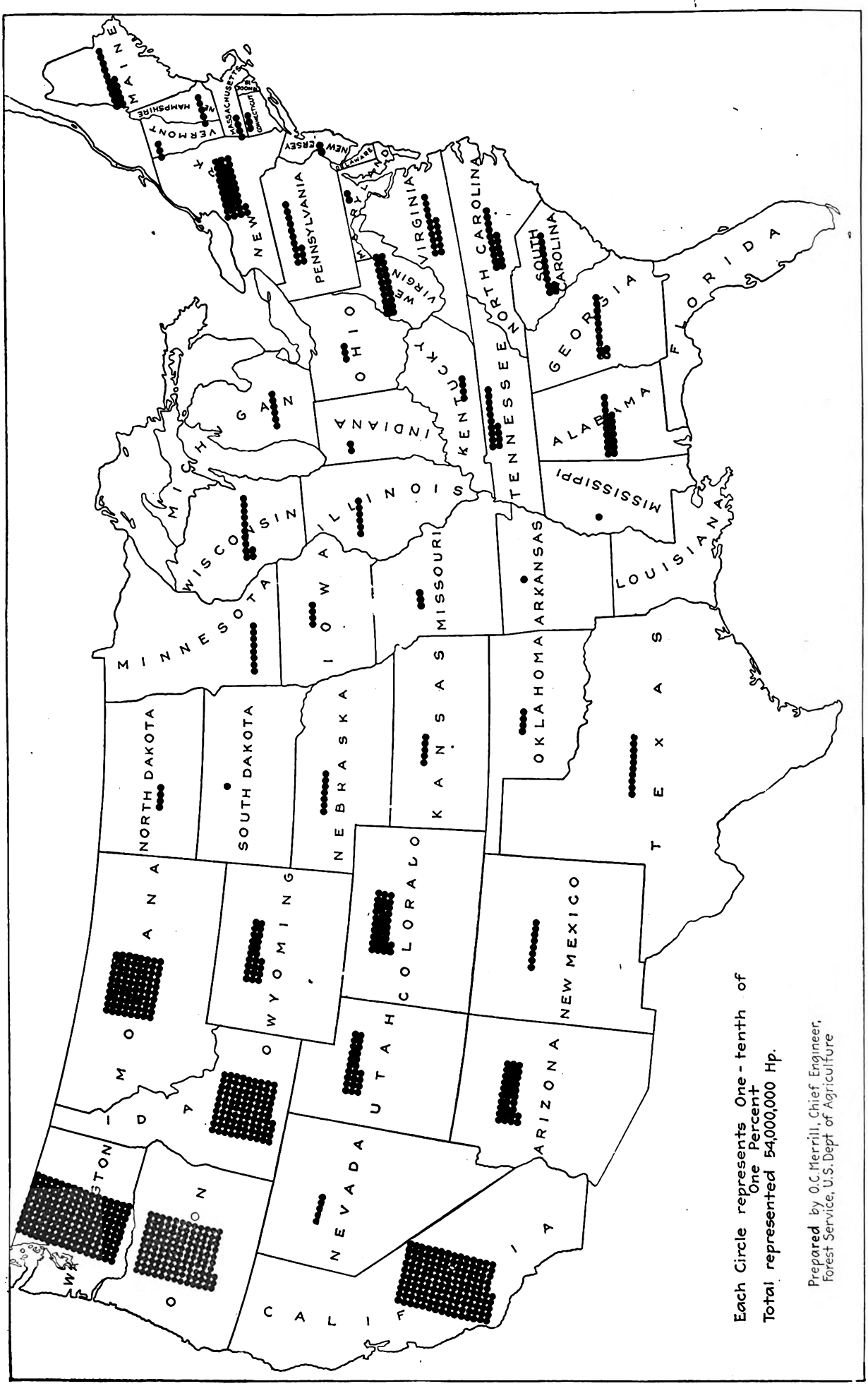

MAP SHOWING DISTRIBUTION OF WATER-POWER RESOURCES IN THE UNITED STATES

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Economic Aspects of Industrial Lighting

Cost Versus Wages—Increased Production and Greater Accuracy in Workmanship—Reduced Accidents—Less Eye Strain—Stimulating Effect—Comfort of Workmen—More Neatness

BY C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

In this and the two preceding articles the endeavor has been made to point out and summarize a number of valuable features in the industrial lighting problem, some of which have resulted from intensified studies during the war emergency. In the present discussion the principal emphasis is placed upon the economies which good lighting may effect, and it is endeavored to illustrate by several actual cases the excellence which may be obtained by the modern system. In the inspection of the views shown it should always be kept in mind that the illustrations represent conditions existing where the lighting system has been carefully designed and that these conditions do not exist in a great proportion of the industries, so that continued efforts toward improvements are needed in many directions.

THE fundamental importance of adequate light in industrial plants has long been recognized by engineers, but only within the last few years has it come to be a fairly well-accepted idea on the part of plant managers in this country. To verify the first part of this statement it is only necessary to refer back to the analysis of artificial lighting costs in terms of wages set forth in 1910 by Prof. Charles F. Scott in which a new viewpoint was taken as regards industrial lighting.[1] Thus nearly ten years ago the idea of evaluating lighting costs to an equivalent proportion of the wages in a given shop section was advanced as a practical working basis for looking at the value of good light under industrial conditions.

It is to be noted carefully that this original statement referred to the cost of good lighting in terms of the wages in a given section for so many minutes per day. The idea back of this plan was that if the total cost for the best form of lighting was equivalent to the wages in a given shop for, say, five minutes per day, a loss of, say, five minutes per day for each workman due to inadequate light and the saving of this time by good light could readily be looked upon as tending to show that the improved lighting system was economically well worth while. Such an analysis of proposed lighting systems has often proved to be an invaluable aid in convincing those responsible for the expenditures that the installation of a new system is necessary.

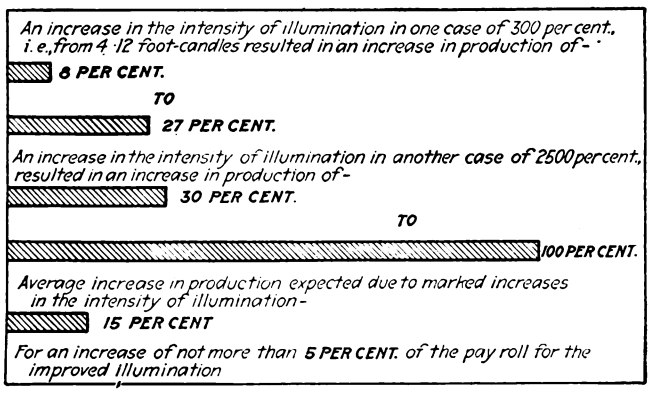

FIG. 1—GRAPHICAL REPRESENTATION OF INCREASES IN PRODUCTION WHICH HAVE BEEN EXPERIENCED AFTER MARKED INCREASES IN THE ILLUMINATION*

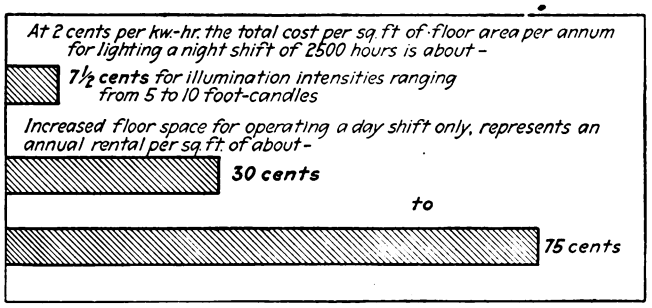

FIG. 2—COMPARISON OF COST OF LIGHT PER SQUARE FOOT WITH THE PROBABLE RENTAL COST PER SQUARE FOOT FOR INCREASED FLOOR SPACE FOR AVOIDING A NIGHT SHIFT.

It has not been uncommon during the last few years to find plants where an expenditure of the equivalent of the wages of five or six minutes per day for an improved lighting system has been the cause for reducing losses of time of five and ten times the cost of the improved light, thus greatly increasing the appeal of the argument outlined above. It is to be observed, however, that in the past it has been necessary to estimate roughly the time losses under the older and inferior lighting system, often based on opinions of foremen or superintendents in given shop sections. The improvements brought about by the new system have thus practically always been rough estimates and rather of a qualitative than of a quantitative nature. Notwithstanding this rather unsatisfactory aspect, these estimates have often been of great use in arriving at the probable value of a new lighting system to a plant, and they have usually appealed very strongly to the plant management.

From a slightly different angle a number of items have been set forth in the form of a summary of the objects to be gained by good lighting under the following heads: (1) Increased production for the same labor cost, (2) greater accuracy in workmanship, (3) reduced accidents, (4) less eye strain, (5) more cheerful surroundings, (6) greater comfort for the workmen, and (7) more order and neatness in the shop.[2]

Here again an effort is apparent so to classify the advantages of good lighting that any shop manager could by a study of these items in conjunction with the needs of his plant become convinced of the value of good light and consequently be likely to view favorably the necessary expenditures for a new installation. While the scheme of analysis advanced by Professor

*Fig. 1 is designed on a basis of data reported by W. A. Durgin, and Figs. 2 and 3 by Ward Harrison. Fig. 4 is due to the Edison Lamp Works and Fig. 7 to the Ivanhoe Regent Works, both of the General Electric Company, and Figs. 5 and 6 to the Cooper Hewitt Electric Company.

[1] Editorial in the *Electric Journal*, May, 1910.

[2] "Factory Lighting," McGraw-Hill Book Company, 1913, p. 1.

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Scott in 1910 and the summaries of the advantages of good factory lighting which have appeared from time to time have proved by their results that they filled a certain need in the propaganda for better industrial lighting conditions, there has long been felt the need for more tangible and definite data on the advantages of good versus poor illumination in the shops.

The fundamental and far-reaching question which would naturally arise in the mind of the typical shop

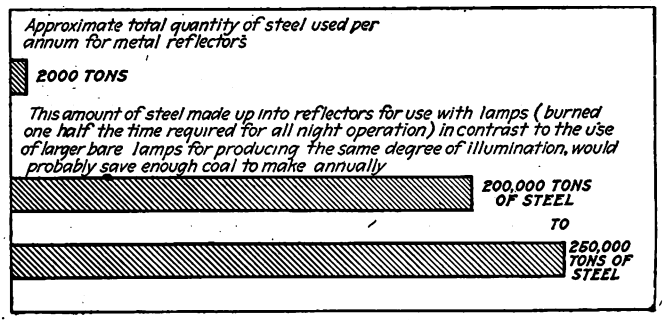

FIG. 3—AN INTERESTING ASPECT OF THE ECONOMY IN THE USE OF EFFECTIVE REFLECTORS

manager when contemplating a new system would be: By how much will the production of my plant be increased by a new and modern lighting system? This question, which is certainly a most reasonable one, has in the past been practically impossible to answer definitely owing to a lack of accurate data on the subject, and the lack of data has certainly to a considerable degree been due to the obvious difficulties in the way of securing such information. It is true that estimates have been made in the past on how much the production might have been increased, roughly, by a new system of lighting, but such estimates have been unsatisfactory to the extent that they were estimates unverified and often practically impossible to verify.

The foregoing comments will indicate some of the reasons why the tests conducted recently by the lighting committee of the Commonwealth Edison Company for the purpose of determining accurately the increase in production due to marked increases in the intensity of illumination furnished given classes of work have proved to be of such fundamental interest to the profession. In fact, it is difficult to form an estimate at this time of the intrinsic value of this kind of data to the immediate future of the industrial lighting field. With all the efforts which have been made to improve lighting conditions in the industries during the last ten years, it is easy to see that the progress in this field has been very discouraging and the improvements slow, except perhaps in certain more or less exceptional cases throughout the country, taking it as a whole. No one interested in this field, therefore, can be other than gratified at the appearance of these data, which, so far as the writer is aware, are among the first definite notes of this kind thus far published.

The results of these Chicago tests were first mentioned very briefly by Preston S. Millar in his paper on "Lighting Curtailment" in February, 1918,[3] and later in more complete form by William A. Durgin in his important contribution on "Productive Intensities" in October, 1918,[4] and it is very desirable at this point to mention briefly several of the more important aspects of these tests reported by Mr. Durgin, together with some of their more fundamental results.

The difficulty in the way of making tests to determine accurately the increase in production due to improved lighting as suggested above is emphasized by Mr. Durgin, who points out that the program for the remaining Chicago tests includes a four months' run, the first month to consist of observations with the lighting as it exists, a second month to be given over to a study of production after the installation of a good lighting system (providing an intensity 50 per cent higher than that recommended by the code of the Illuminating Engineering Society as a maximum for the given class of work), a third month to be given over to similar studies for an intensity corresponding to the lower specification of the code for ordinary practice, and a fourth month to observe production at the same high intensity of lighting as that of the second month.

The fundamental requirements for such a test have been summarized as an accurate tabulation of the plant production records throughout the test and the performance of a reasonable amount of work during the night hours. The two chief difficulties encountered in the realization of these points have been to locate plants having an effective system of production records and to persuade the management to operate after the second month at a lower intensity than that employed during the second month, particularly after the many advantages of the higher intensity have begun to be realized. Considering these very real difficulties in the way of such tests, it is particularly interesting to note that thus far data have been secured at two plants which point to a conclusion favoring higher intensities than those recommended by the I. E. S. code.

In fact, the tests in these two plants have shown in the first instance that an increase in the illumination

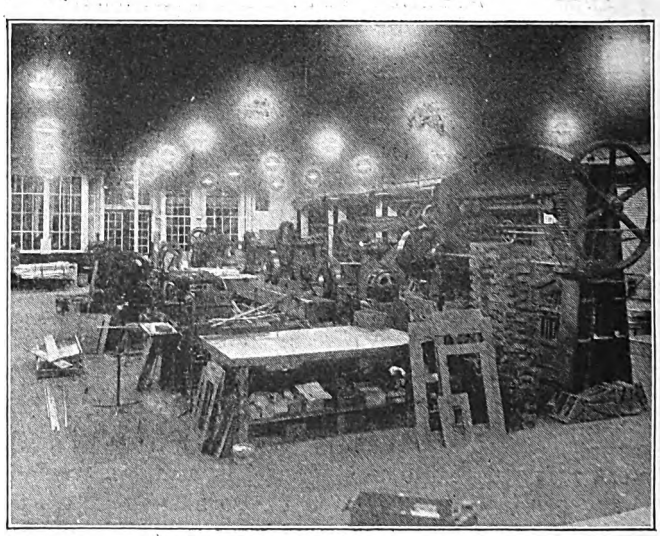

FIG. 4—SHOP WITH METAL-REFLECTOR LAMPS

An average intensity of 5 foot-candles is furnished in this shop by 150-watt Mazda lamps in metal reflectors. The lamps are 13½ ft. above the floor and are spaced 15 ft. apart.

from 4 to 12 foot-candles at the work resulted during the month of the higher intensity in from 8 to 27 per cent higher production as an increase over the previous month with the lower intensity. These data are shown graphically in the upper part of Fig. 1. This test was

[3] *Transactions I. E. S.*, Vol. XIII, No. 2, p. 123.
[4] *Transactions I. E. S.*, Vol. XIII, No. 8, p. 417.

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conducted in a machine shop, and, as might have been expected, the superintendent of the plant extended the practice of the higher intensity to other sections of the factory after its value in one section had been so convincingly established.

In another instance, where bare lamps had previously been used, a general lighting system was installed with

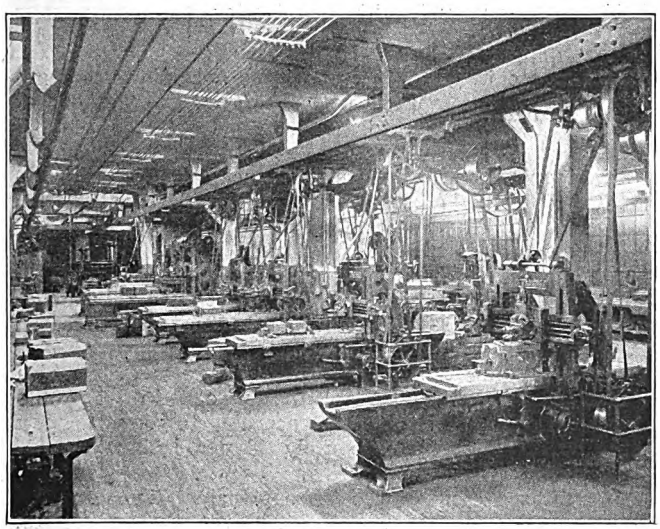

FIG. 5—AN INSTALLATION OF MERCURY-VAPOR LAMPS IN AN AUTOMOBILE PLANT

an increase of about twenty-five times in the illumination. Here Mr. Durgin reports an increase in production ranging from 30 to 100 per cent in the several operations of the shop. Observations, in lieu of accurate tests, have been made in nine other plants, and a general conclusion has been drawn that marked increases in the illumination provided for industrial operations are capable of increasing production around 15 per cent, with an increase in the cost of lighting of not more than say 5 per cent of the payroll.

Among the opinions which have been advanced by leading authorities since the announcement of these Chicago tests has been the idea that there is a stimulating effect in higher intensity lighting, which is a factor worth careful consideration in addition to the mere question of being able to see more clearly.

These tests and the comments made upon them have proved most interesting in their important relation to the whole question of industrial lighting. The results, which clearly show positive increases in production, appear convincing and applicable to problems which must be faced in the immediate future in this field. It would appear, however, that the tests made thus far are merely a beginning of studies which should be made.

No one who has given close study to the important question of how much light should be used for a given demand upon the eyesight can well have failed to consider how many-sided this question is in practical cases. Tests of the kind reported from Chicago certainly point to the great value which may result from the accumulation of as much information as possible of this general nature as an aid to the intelligent specification of intensities for given processes and operations. There is undoubtedly much room for further researches into this field, and it is to be hoped that the lighting committee of the Commonwealth Edison Company will continue these tests and make reports upon the results.

Another aspect of lighting economy has been touched upon recently in the relation of lighting costs to the rentals of increased floor space where a plant expands and prefers the increase of its floor areas with day shifts only to the use of night shifts in existing shops with the use of artificial light.[5] It has been shown in this connection that where the intensities of artificial light should range from 5 to 10 foot-candles, 1 watt per square foot (11 watts per sq.m.) of floor space is the approximate requirement, and that with a rate of 2 cents per kilowatt-hour, the total annual cost for lighting would amount to about 7.5 cents per square foot (85 cents per sq.m.) of floor space, where the night shift amounts to, say, 2500 hours per year. On the other hand, the elimination of the night shift and an extension of the plant to a larger size so as to increase the day shift has shown annual rental charges

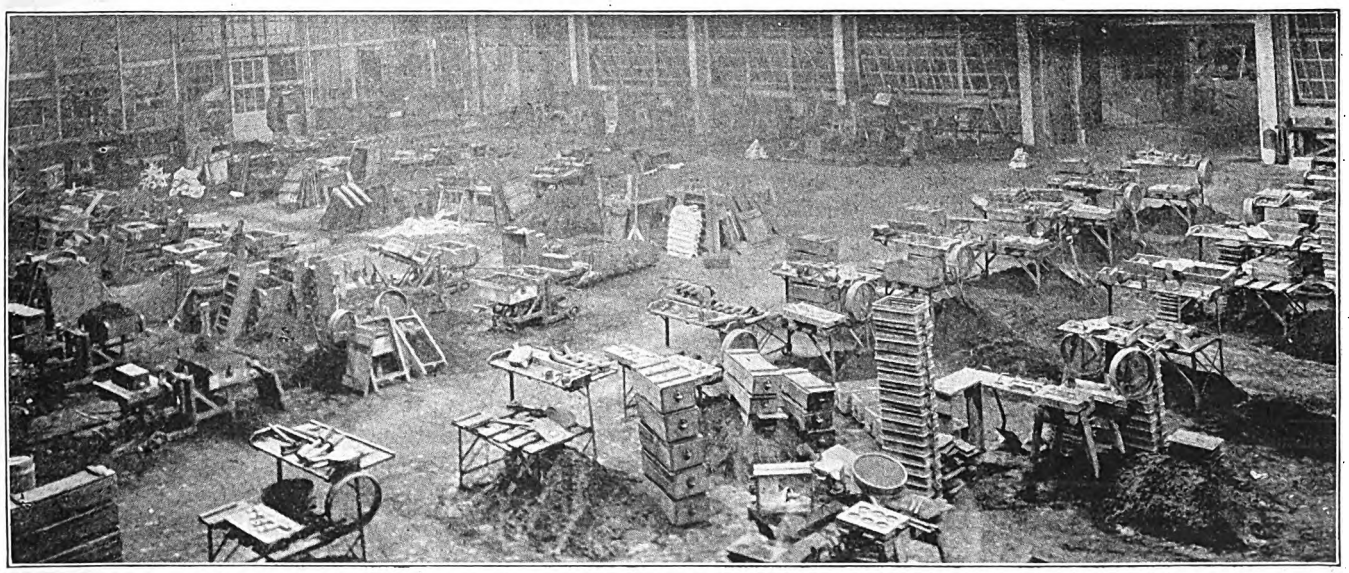

FIG. 6—A LARGE FOUNDRY ILLUMINATED WITH MERCURY-VAPOR LAMPS MOUNTED WELL OVERHEAD

[5] Ward Harrison, *Transactions I. E. S.*, Vol. XII, No. 8, pp. 420 and 421.

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of 30 to 75 cents per square foot. These figures, when compared with the lighting charge of 7.5 cents per year per square foot, form the basis for some very interesting conclusions. Fig. 2 represents these relations graphically.

One of the interesting facts brought out by the notable paper of W. A. Durgin previously mentioned was the relation of the gross metal used for reflectors and the corresponding economy of these reflectors.[6] This, obviously, has a bearing upon the general question of lighting economics. The comparison was made to disprove the erroneous impression in some quarters that the suspension of the manufacture during the war

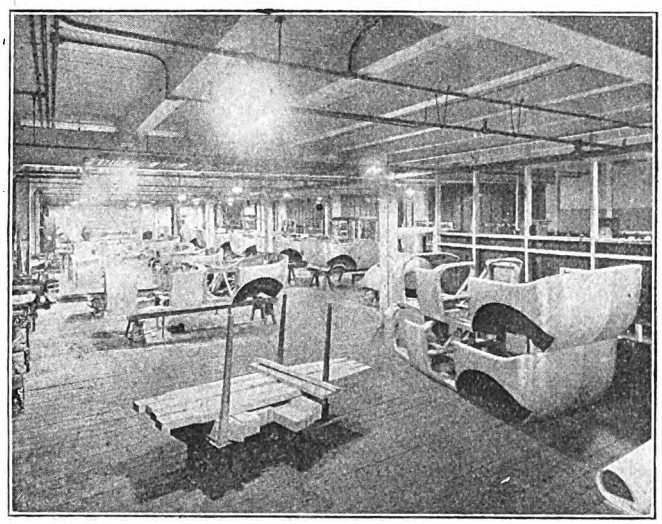

FIG. 7—A GENERAL LIGHTING SYSTEM WHERE DEEP-BOWL METAL REFLECTORS ARE USED

of all metal reflectors would be beneficial in adding to the available steel supply.

It has been pointed out, however, that whereas about 2000 tons of steel are used per annum for the manufacture of metal reflectors, the saving in coal through the use of these reflectors with relatively smaller lamps, in contrast to the use of larger bare lamps, might reach an amount sufficient to produce from 200,000 to 250,000 tons of steel annually. This conclusion, while relating to a war consideration primarily, has brought out in a very striking manner one of the ways in which the importance of reflectors for industrial lighting systems may be viewed, and hence forms an item of value in the consideration of this subject, irrespective of its war interest in the first instance.

[6]Discussion by Ward Harrison, *Transactions I. E. S.*, Vol. XIII, No. 8, p. 425.

SMILE! It costs nothing, and while you are smiling work like everything to make your property the best there is in the state. It won't be long before your subordinates, too, are beginning to take the same cheerful view of life, and the effect will be an increased efficiency in the individual and in the organization.—*Charles E. Morrison in Empire State Gas and Electric Association Bulletin.*

SEES ENCOURAGEMENT FOR LOWER OPERATING COSTS

President Alanson P. Lathrop of American Light & Traction Company Forecasts Probable Reduction in Abnormal Costs of Operating Expense

A statement to stockholders by Alanson P. Lathrop, president American Light & Traction Company, says in part:

The increase in gross income of the subsidiary companies for 1918, as compared with 1917, was $1,964,160, of which $430,367 was due to increased rates and $1,532,793 to increased business.

Cost of operation was materially increased over the abnormal costs of 1917 because of further advances in fuel, labor and taxes. Taxes for 1918 have been charged to operation on the basis of the federal tax bill, now before Congress. The increases in these items were: Coal and oil, $906,252; operating labor, $543,777; taxes—federal and local, $514,785; unclassified items, $222,719; total increased cost, $2,187,533.

Notwithstanding the large increase in costs over which the management had no control, the decrease in net profits on stocks of subsidiary companies accruing to your company is only $612,274, or approximately 28 per cent of the increased cost.

The increased costs of the three principal items for the two abnormal years 1917 and 1918 over the year 1916, which may be assumed to have been a normal year, are: Coal and oil, $1,890,952; operating labor, $855,077; taxes, federal and local, $1,219,785, making the total increased cost $3,965,814.

The encouragement derived from a study of these figures lies in their possible and probable reduction.

Coal should materially decrease; oil quotations already show large reductions. Labor will decrease some, and the federal tax bill now before Congress provides for a large decrease for the year 1919.

While in net results the report shows a decrease, an analysis of figures makes the report the most encouraging since conditions became abnormal.

TRANSITION TO PEACE FROM THE WAR BASIS

Forecast of Brooklyn Edison Company, Inc., Is that to a Large Extent This Will Be Accomplished in the Present Year

In the annual report to stockholders of the Brooklyn Edison Company, Inc., signed by N. F. Brady, president, and W. F. Wells as secretary to the board of directors, the following forecast based on existing conditions is made:

"The indications are that the present year will see to a large extent the transition throughout the country generally from a war to a peace basis. The company will, it is believed, be able to adjust itself to the changing conditions, and with the continuance of its established policy of economical management and a judicious campaign for new business, should be able to attain results that will prove acceptable."

Contracts signed in the last year, aggregating 52,000 hp., included installations for shipyards, the great army and navy bases at South Brooklyn, manufacture of torpedoes, ammunition, gyroscopes, stabilizers, searchlamps, gas-mask parts, shoes, uniforms, food products and various other war necessities. Twenty-two private plants were discontinued in favor of the company's service.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

FEATURES OF 13,200-VOLT UNDERGROUND CONSTRUCTION

Thickness of Manhole Wall Reduced to 8 in. of Concrete—Double-Pipe Ventilation Employed in New Construction by Kansas City Company

Several interesting features have been incorporated in a new underground system belonging to the Kansas City (Mo.) Light & Power Company. Concrete manhole walls 8 in. (20 cm.) thick are being tried out for this installation, ventilating pipes are carried up adjacent poles, and a novel protective coating of concrete is applied to cables within the manholes.

This system is to carry energy from its new 50,000-kw. power house on the Missouri River to its substations and transformer stations in several parts of the city. For economical distribution of material a duct arrangement of three ducts wide and four ducts high was selected.

MANHOLE CONSTRUCTION

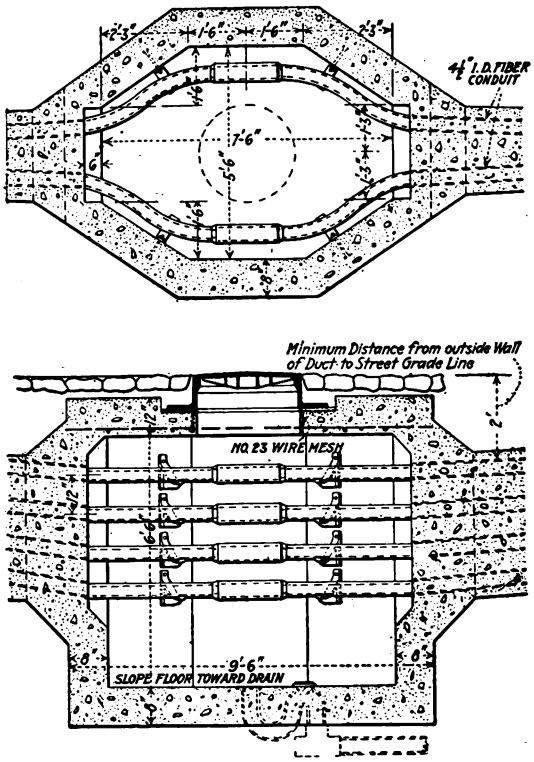
Concrete construction for manholes, some of which are below and some of which are above the high-water line of the river, was selected in preference to brick largely on account of the necessary labor entering into the construction. Engineers of the company believe it is possible to work concrete laborers at a much more satisfactory pace than brick laborers. One feature of these manholes, a cross-section of which is shown in the accompanying drawing, is that the walls and floor have been reduced in thickness from the customary 12 in. (30 cm.) to 8 in. (20 cm.). This reduction in thickness effected a considerable saving in material, and it is believed it will prove just as satisfactory as the thicker wall. The method of installing the manhole drain trap, with a hand-hole for cleaning in the bottom of the manhole, is considered very advantageous, as the hand-hole cover can be easily removed for draining the manhole after a flood if the drain basin has become clogged.

Provision against high temperatures in the manholes and against accumulation of gas is provided by a system of double-ventilation pipes. From each ventilated manhole two pipes, one coming from the top of the hole and one from the bottom of the hole, are carried up the nearest adjacent pole. The top of one pipe is also placed about 6 ft. (1.8 m.) higher than the other. This arrangement provides for circulation of air and eliminates any pocket effects. The 4.5-in. (11.4-cm.) pipes which are used for this purpose are fiber duct underground and iron pipe above ground. This selection of piping was chosen as the most inexpensive.

For making the joints between the sections of fiber conduit P. & B. cable paint was used instead of the customary tar. This joint was formed by painting the end sections of the duct, putting the sections together, then wrapping the joints with linen tape and painting over the tape. This type of joint is thought to be better than the tarred joint as the paint will not melt when subjected to high temperatures.

MECHANICAL PROTECTION OF CABLES

The 150,000 ft. (45,700 m.) of cable which is being laid is of the 400,000-circ.mil., three-conductor, 13,000-volt type and is insulated with mineral-base oiled paper. In the manhole it is supported on cast-iron brackets attached to the manhole walls by bolts cast in the cement as the manhole was constructed. All cables in the manhole are wound spirally with 0.25-in. (6.3-mm.) rope, free from oil or tar, on 0.75-in. (19-mm.) centers, after



STRAIGHT-LINE MANHOLE FOR USE ABOVE HIGH-WATER LINE

which they are covered with a one-to-one mixture of concrete, 0.75 in. (19 mm.) thick from end to end.

Cheesecloth is wrapped around the cable under the rope to facilitate removing this concrete covering if the occasion arises. A cheesecloth, concrete and rope type of covering was chosen in preference to others as it has been found to radiate heat readily from the cable. Where the cables leave the underground system to connect to the overhead lines single-unit terminals are employed.

This installation was made by the engineers of the Kansas City Light & Power Company under the direction of A. E. Gettis.

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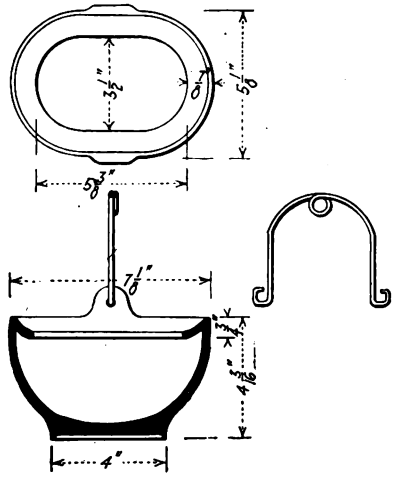
IMPROVED FORM OF POT FOR CONTAINING SOLDER

Space for Using Ladle and Safety Lip to Prevent Accidental Spilling or Loss of Cold Solder Are Desirable Features

BY L. V. SNYDER

The standard solder pot in general use when held by a lineman under a joint on the line does not allow sufficient space for the solder to fall back into the pot, and accidents are liable to occur from falling solder. Furthermore, when raising or lowering a standard solder pot on a pole there is a tendency for the solder to spill if the pot strikes a step or arm.

To avoid these objections, the Westchester Lighting Company, Mount Vernon, N. Y., adopted a specially designed solder pot of oval shape which has the advantage that there is space for the solder to fall back into the pot as well as for the lineman to use his ladle freely. If the pot did not have an oval shape, the safety lip would tend to obstruct the solder falling back into the pot and possibly make it spatter out. The safety lip on



OVAL-SHAPED SOLDER POT WITH SAFETY LIP INTO WHICH SOLDER CAN READILY FALL BUT FROM WHICH IT WILL NOT SPILL EASILY

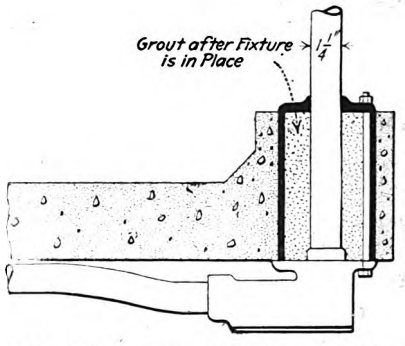
the inside of the pot prevents the solder from spilling out of the vessel when it is being raised or lowered on a pole.

Another advantage of this design is that the solder cannot be lost out of the pot as easily when it is cold because the lip projects inward enough to keep it from falling out.

SUPPORTING A BRACKET IN REINFORCED CONCRETE

Lower End of Gooseneck Threaded to Fit Condulet, Which Is Held by Metal Sleeve Grouted in Place

At the Boston army base a portion of the exterior lighting on one side of the storehouse is provided by 200-watt lamps mounted in reflectors carried at the ends of pipe brackets, as shown in the accompanying drawing. In order to provide a firm support for these brackets, which are 1¼ in. (32 mm.) in diameter and 3 ft. 6 in. (1 m.) high with a spread of 2 ft. (60 cm.), the pipe has been threaded into a special conduit fitting at the bottom of a cylindrical metal sleeve, the sleeve being filled with cement grout after the fixture is in place. Three bolts tie the condulet fitting into a cap on the top of the sleeve, and the whole construction is remarkably rigid and protects the wiring from moisture and mechanical disturbance. Total concealment is another advantage of this design. Fay, Spofford & Thorndike, Boston, were designing and supervising engineers for the terminal.



GOOSENECK LAMP BRACKET GROUTED IN LEDGE

RELATION OF LOAD FACTOR TO COAL CONSUMPTION

Averages of Data Collected by Ontario Commission from Seventy-three Stations and Arranged According to Plant Rating

Companies wishing to determine whether their plants are operating as economically as others of the same class may refer to the accompanying table for comparison. Of course, the values given for different-size plants do not necessarily apply to all plants of that size, because operating conditions may be different, but the values are typical of plants in this country and Canada, according to a report of the Hydro-Electric Power Commission of Ontario.

DATA ON LOAD FACTOR AND COAL CONSUMPTION FROM SEVENTY-THREE ONTARIO PLANTS

	Station Capacity	Maximum Load	Kw.-Hr. and Hp.-Hr. Generated	Kw.-Yr. and Hp.-Yr. Generated	Per Cent Load Factor	Lb. per Kw.-Hr. and Hp.-Hr.	Tons per Kw.-Yr. and Hp.-Yr.	Coal B.t.u. per Kw.-Hr. and Hp.-Hr.	Coal B.t.u. per Lb.	Consumption Tons per Year (2,000 Lb.)	Kw.-Hr. and Hp.-Hr. per 100,000 B.t.u.	Efficiency, per Cent
Kw.	650	425	1,123,820	128	29.3	7.65	34.60	95,600	12,500	3,930	1.04	3.5
Hp.	870	570	1,500,000	172	....	5.70	25.00	71,400	.....	.....	1.40	....
Kw.	2,980	1,570	4,703,600	538	34.2	4.30	19.00	55,500	12,900	9,230	1.80	6.2
Hp.	4,000	2,100	6,300,000	720	....	3.20	14.00	41,300	.....	.....	2.40	....
Kw.	7,230	3,820	10,422,000	1,190	31.7	4.07	17.80	48,500	11,900	20,200	2.06	7.0
Hp.	9,700	5,100	14,000,000	1,600	....	3.04	13.30	36,200	.....	.....	2.76	....
Kw.	24,600	10,760	33,500,000	3,820	36.0	2.90	12.75	39,600	13,600	48,030	2.50	8.6
Hp.	33,000	14,400	44,900,000	5,120	....	2.17	9.50	29,500	.....	.....	3.40	....
Kw.	96,000	62,060	200,679,750	23,650	36.9	2.00	8.80	28,000	14,000	201,420	3.57	12.1
Hp.	128,800	83,000	276,500,000	31,650	....	1.50	6.57	21,000	.....	.....	4.76	....
Kw.	149,000	92,080	360,218,000	41,000	44.7	1.92	8.40	25,900	13,500	345,580	3.86	13.1
Hp.	199,500	123,200	483,000,000	55,000	....	1.43	6.26	19,300	.....	.....	5.18	....

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

CENTRAL-STATION BUSINESS IS STEADILY PICKING UP

Reports from Minneapolis Show Better Gains in January than in the First Month of Previous Years

"From the standpoint of new business gained January was an exceptionally good month for Minneapolis compared with Januaries of past years," H. E. Young, sales manager of the Minneapolis General Electric Company, reports.

"The gain in electric meters was almost four times as much as in January, 1918. The gain in kilowatts of lighting load connected was three times, and twice as much power business was added, about 500 hp. in motors having been put on the lines. There were about 250 already-built houses wired for electricity during the month, and electrical appliances sold by the company show an increase of 32 per cent over January, 1918. Special attention to housewiring, commercial lighting and commercial window-display lighting should help to maintain brisk business in February."

CONSTRUCTIVE PLANNING FOR CENTRAL STATIONS

Problems to Be Met by Central Stations in Reconstruction Period Demand Closer Thinking than Did the War Emergency

D. L. Gaskill, secretary of the Ohio Electric Light Association, recently expressed the opinion that more brains will be required to work out the problems of central stations during the reconstruction period than was necessary to meet all of the problems caused by the entrance of the United States into the war. The war problem, he stated, was merely one of supplying an insistent demand, while the current problem is to get load to fill the valleys left by the cessation of war work. Some decision must be made as to what sort of business central stations will seek to fill these valleys. Electric heating is possibly one answer to this problem.

The acute labor situation has created a condition in which there has been no question of choosing labor for its quality. The problem has simply been to get enough labor in quantity. Now it will be the problem of the central-station executive to make a careful selection of his labor, and Mr. Gaskill expressed the opinion that the men who have returned from army service will be among the best material. Some of these men will want to go to work immediately, while others will wish to fit themselves for better positions. In order to aid the latter Mr. Gaskill stated that he had endeavored to set on foot a plan for providing a two years' university course in engineering.

One of the principal works of public utilities during this period, however, should be to capitalize the experience which they have had during the war period in molding public opinion in favor of the utilities. The taking over of the railroads by the government and similar action have shown the public generally that the burden of the war work has fallen heavily on utilities, and that in spite of this fact the utilities have served their communities in an admirable fashion. A spirit has been created in which the public is willing to deal more fairly with the utilities. That this should be analyzed and cultivated was Mr. Gaskill's belief.

POWER SALES AND PUBLIC POLICY POSSIBILITIES

Value of Frankness in Admitting Inability to Take Load at a Profit and in Seizing Good Publicity Situations

A public utility executive recently, addressing a meeting of power salesmen, declared it his belief that no business should be taken unless it showed a distinct profit for the company. The taking of other business will reflect on the company in many ways. His suggested method of dealing with isolated plants that were operating efficiently was that a very careful survey should be made to show the cost of operation. The survey should be prepared as a report and submitted with an estimate of the central-station service cost. If this survey shows that service cannot be taken efficiently, the report should be presented to the management of the isolated plant in just as great detail and with as much ceremony as if the business were expected. The only difference between this interview and the sales conference interview should be that at the end of the conference the power salesman should frankly inform the isolated-plant management that it could not economically buy service from the central station and that he was not soliciting the business but was merely presenting the facts in the case. The news of such treatment of the case will rapidly spread among other power-plant owners.

As illustrating a method of taking timely advantage of local situations, the speaker related a story from his earlier experience in Tennessee. When the shaft of a local flour mill suddenly broke, the speaker, who was then manager of the local transmission company, immediately offered his service in getting the mill started again. The management of the mill accepted the offer. It was 40 miles to the nearest motor that could pull the load, and this motor was then operating on construction work being handled by the transmission company in connection with one of its plants. Nevertheless, a truck was sent for the motor and instructions were tele-

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phoned ahead to have it ready to load on the truck. The entry of the motor into the town was "staged" for the benefit of the citizens, the truck driving down through the main street with a crew four times as large as was needed cheering lustily. The motor was installed at the flour mill in record time. The whole story was given to the newspapers by the enthusiastic utility executive in such an able manner that it was made a front-page article. As advertising for the company's power service this incident outranked anything else that the company had attempted.

RAPID PROGRESS MADE IN LIGHTING SALES IN CHICAGO

Seeking Business in Already-Built Houses and Industrial Plants and Selling Signs Are Among Major Commercial Operations

Since the armistice was signed the contract department of the Commonwealth Edison Company, Chicago, has begun to drive ahead intensively on all lines of new business. During the war it was necessary to make a number of rules regarding new business in order to conserve the company's capital. One of the first steps now being taken in getting back to a peace footing involves the revoking or modification of these rules. This work is proceeding gradually, there being no wholesale reinstatement of the pre-war status. To each situation careful study is given before a change is made.

In the direct selling activities intensive work is well under way, as is indicated by the comparative sale results for January, 1918, and January, 1919. The lighting sales for the first month of this year are more than double those for January last year. The power sales show an increase of 50 per cent for the same period. Signs and industrial lighting are among the features of the lighting sales business. While only seventeen signs were sold in January, 1918, there were seventy-two signs sold in the first month of this year. Most of these were purchased by small stores in "neighborhood-business" districts.

The company's industrial lighting units which are put out on either a direct sales or a rental basis are finding exceptional favor. In January of 1919 1250 units were put out. The average intensity of all these installations was 6 foot-candles. The keeping of data on the foot-candle intensities of all installations is thought to be an innovation. The data are kept on each installation made at Chicago and are recapitulated for each month. In one of the fall months of 1918 the average intensity of all commercial installations sold reached the high figure of 6.7 foot-candles.

There is also a brisk demand for street lighting among neighborhood merchants' associations. No less than five meetings were attended by the contract department in the first week of February to discuss street lighting for business districts. Individual merchants are also displaying interest in better lighting for their stores. It is possible that a canvass of the "loop" district will add further to this class of load. Residential wiring in already-built houses and apartment buildings is progressing at such a satisfactory rate that more men have been added to the sales staff for this work, and the department is still behind as regards its inquiries.

ENERGY CONSUMPTION OF ELECTRIC RANGES

Some Interesting Figures Obtained as the Result of Specially Prepared Meal for Forty-five People

Some interesting figures showing energy consumption of an electric range for a specially cooked roast-beef dinner were obtained at the recent sales banquet of the Northwestern Electric Equipment Company of St. Paul. Fifty-five members of the sales and executive staff of the company were present.

The menu prepared for the banquet included soup, roast beef, three vegetables, bread and rolls, pudding and coffee. These foods were prepared with the following energy consumption:

	Watt-hours
Ten cans soup	469
18 lb. roast beef	2,325
1½ pecks potatoes and two cans peas	1,188
Five cans corn	300
Six loaves bread	1,000
Five dozen rolls	700
Fifty portions pudding	1,275
Seventy cups coffee	525
Total	7,782

The average consumption per person served was, therefore, 172.9 watt-hours. The entire cost for energy at the prevailing rate of 4 cents per kilowatt-hour was 31.128 cents, or 0.00691 cent per person.

The meal was prepared on a model "D" Hotpoint range, manufactured by the Edison Electric Appliance Company, by Miss Bernice Bell, domestic science expert of the Northern States Power Company.

MEN MUST BE TRAINED TO SELL ELECTRIC HEATING

Central Stations Declared to Lack Salesmen with Extensive Knowledge of Applications to Industrial Processes

J. C. Matthieu of the Dayton (Ohio) Power & Light Company recently declared that central stations in Ohio are negligent in looking into the prospects for electric heating loads. They lack the men to talk industrial applications of electricity for heating to the manufacturers in their territory. Each company should have, said Mr. Matthieu, at least one industrial heating sales engineer, just as they have a power sales engineer. Manufacturing plants in Ohio are at present being driven to the use of oil or producer gas for their heating processes because they cannot get the facts about electric heating.

Electrical manufacturers have men quite competent to handle this class of business, but it is physically impossible for them to stay with a prospective customer until he thinks over each deal. Such men can only interest the local manufacturer and then must turn the closing of the sale over to a local central-station man. Unless he is versed in the application of electric heating, he usually loses the business. It is Mr. Matthieu's opinion that it will be necessary for central stations to provide for education of industrial electric heating sales engineers, in order to avoid wholesale adoption of oil and gas processes.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Rebuilding 25,000-Kw. Generator.—THOMAS WILSON.—A number of years ago the Commonwealth Edison Company installed in its Fisk Street station a Parsons turbine driving a 25,000-kw. generator, but during recent months, when the power supply was being severely strained, the company noted the fact that the turbine had considerable margin of overload capacity, and it was then decided to reconstruct the generator to make this a 30,000-kw. machine. The process was carried out with the coöperation of the company engineers, the reconstruction being done by the manufacturer. One of the serious problems involved in this reconstruction work was the handling of the great weight and supporting the generator structure during the assembly of the laminations and rewinding process. It should be noted that the stator frame weight amounted to 138 tons. The change was accomplished without mishap.—*Power*, Jan. 21, 1919.

Lamps and Lighting

The Decrease in Ultra-Violet and Total Radiation with Usage of Quartz Mercury-Vapor Lamps.—W. W. COBLENTZ, M. B. LONG and H. KAHLER.—Comparative data are taken on the ultra-violet component in the radiations from the sun and from the quartz mercury-vapor lamps, using the thermopile and yellow glass for the measurements. In addition, data on the dye-fading carbon-arc lamp are given. It was found that the transmission of the yellow glass did not vary appreciably with the power put into the lamps, and any change in transmission of this glass with usage of the lamp was ascribable to variations in emission of ultra-violet rays caused by absorption passing the quartz glass tubes, which become discolored. It was established that ultra-violet rays emitted from quartz mercury-vapor lamps decrease from an initial value of about 70 per cent when the lamp is new to about 50 per cent after 1000 to 1500 hours' usage. It was observed that the total radiation from these lamps decreased in intensity by one-half to one-third the initial value in the course of 1000 to 1200 hours.—*No. 330, Scientific Papers of the Bureau of Standards.*

Progress in Illumination: An Abstract of the Report of the Committee on Progress, I. E. S.—The advances made in the field of illumination during this period are very thoroughly presented in the full report of the committee on progress of the Illuminating Engineering Society.—*General Electric Review*, January, 1919.

Light as an Aid to the Transportation of Material.—A. L. POWELL and R. E. HARRINGTON.—As a factor in our transportation and industrial problems the authors have demonstrated in a most convincing manner the importance of modern methods of illumination as applied to express and freight stations, warehouses, piers, etc. Time saved in the delivery of shipments must necessarily reduce transportation embargoes and indirectly increase our industrial output.—*General Electric Review*, January, 1919.

Generation, Transmission and Distribution

Cost of Electric Transmission.—H. E. M. KENSIT.—The author presents an interesting table giving the cost of electric transmission for various typical installations in the vicinity of Niagara Falls. The population of the distribution center, the distance of transmission and the amount of power delivered are specified for each case.— London *Electrical Times*, Jan. 2, 1919.

Original and Present Supply of Coal in United States.—A table prepared from estimates made by the Geological Survey of coal within 3000 ft. (900 m.) of the surface in the number of net tons of each grade and in each coal area is given. The total of all grades of coal in millions of tons is 3,553,637. In the last 111 years, since 1807, the mining has been conducted and the exhaustion has been about half of 1 per cent, but more than half of that has been in the last twelve years.—*Fuel Facts* (second edition), United States Fuel Administration, December, 1918.

Hydroelectric Power Development.—The potential water power of the United States, as estimated by the Geological Survey under conditions of minimum and maximum flow exclusive of the increase which should be brought about by the construction of reservoirs, is given in a table which shows the estimates arranged in geographical subdivisions of the country. Only one-sixth of the estimated minimum potential water power available in the United States is now being utilized. The advantage of electric over steam locomotives under certain conditions is mentioned, and two instances are pointed out.—*Fuel Facts* (second edition), United States Fuel Administration, December, 1918.

Arrangement of Power Conductors.—A short paper setting forth concrete recommendations for the spacing of power lines as made by the California committee on inductive interference. Technical mathematical calculations and six years of experimentation and study back the report.—*Journal of Electricity*, Jan. 15, 1919.

Meteorology and Stream Regulation.—W. F. V. ATKINSON.—The writer discusses the effect of weather and the protection of forest growth on the flow in streams. The study of wind, temperature, precipitation and barometer records aids in the control of schemes for power purposes.—*Canadian Engineer*, Jan. 2, 1919.

Water Powers of New Manitoba.—In this article is summarized a government investigation covering the study of four rivers of considerable capacity with a view to supplying energy for mining operations in the district named.—*Electrical News*, Jan. 15, 1919.

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The Power Project at Hetch Hetchy.—RUDOLPH W. VAN NORDEN.—The Hetch Hetchy water and power project as planned by the city of San Francisco involves a development of power at Hetch Hetchy, another just above Early Intake and a third at Moccasin Creek. The one at Moccasin Creek, involving the development of 66,000 hp., will be carried out in the immediate future. Details of this project are given in this article.—*Journal of Electricity*, Jan. 15, 1919.

Experiences with an Electric Power Plant 11 Deg. from the North Pole.—JEROME LEE ALLEN.—It is of interest to learn that a complete electric generating plant has been installed and operated within a few hundred miles of the apex of the earth. This narration of experiences in connection with an Arctic electric plant is of particular interest on account of the geographical location of the plant and the prevailing severe climatic conditions.—*General Electric Review*, January, 1919.

Guying Pole Lines.—CHARLES R. HARTE.—The writer points out that practice in line guying has been standardized by the telephone, telegraph and power companies. Their experience is summarized as a guide on electric railway transmission-line construction. The problem is to keep the line safe without using unnecessary material in guys and anchors.—*Electric Railway Journal*, Jan. 18, 1919.

Combustion and Boiler Settings.—A. D. WILLIAMS.—In the first article of a series the author mentions a number of interesting points concerning the location of heating surfaces and the placing of baffles. He discusses soot formation in relation to combustion and indicates certain fundamentally wrong practices in the usual forms of boiler settings.—*Power*, Jan. 14, 1919.

Boiler Equipment.—MARTIN O'CONNOR.—The author discusses proper provision for boiler feeding, blowing down and insurance of safe operation.—*Power Plant Engineering*, Jan. 1, 1919.

Economizer Practice.—RAINES KESSLER.—In this paper are discussed the possible savings that may be expected from the use of the economizer and also its care and operation.—*Power Plant Engineering*, Jan. 1, 1919.

Economizers.—OSBORNE MONNETT.—The ranges of water and gas temperatures in economizer practice are discussed, as well as the influence of other equipment of the plant, draft requirements and inspection.—*Power Plant Engineering*, Jan. 1, 1919.

Traction

Regenerative Braking with Single-Phase Commutator Motors.—DR. H. BEHN-ESCHENBURG.—In this article is given a description of a system of regenerative braking in which the wiring and switching operations are simplified and the range within which regeneration is practical is greatly extended, according to the writer.—London *Electrician*, Dec. 20, 1918.

Automatic Substations on the North Shore Line.—CHARLES H. JONES.—Three new substations recently installed by the company and a fourth under construction are said to save 177 miles of 500,000-circ.mil cable worth $650,000. Feeder economics are discussed in this paper and details of a typical substation layout are given.—*Electric Railway Journal*, Jan. 11, 1919.

The Cam-Operated Railway Controller.—R. S. BEERS.—An early description of the cam-operated railway controller appeared in the October, 1915, *General Electric Review*. Since then this type of controller has been put in service under all the various conditions of electric car operation. This article presents the confirming evidence that the cam-operated controller has fulfilled in a most satisfactory manner the expectations of the engineers responsible for its design, and describes the salient features of its operation.—*General Electric Review*, January, 1919.

Installations, Systems and Appliances

Pumping Plant and Electrical Equipment at Balboa Shops.—R. D. GATEWOOD.—A brief description of the power plant and pumping equipment in use at the Balboa shops in the Canal Zone. It is said that this layout has proved to be particularly dependable.—*Power*, Jan. 28, 1919.

Electric Smelting on the Pacific Coast.—W. L. MORRISON.—The high prices of the war developed the smelting industry in the West and created an opening for the use of the electric furnace. The absence of cheap power precludes a general development along this line in normal times. There is a real opportunity in the smelting of silicon manganese as pointed out in a paper recently given before the Portland sections of the A. I. E. E. and N. E. L. A.—*Journal of Electricity*, Jan. 15, 1919.

Application of the Electric Furnace to the Metallurgy of Iron and Its Alloys.—H. ETCHELLS.—A comparison is made between the results attained with electric (arc resistance and induction type) and combustion furnaces.—London *Electrician*, Dec. 27, 1918.

Notes on Regulations for Arc Welding.—Regulations to secure the safety of operators using electric welding apparatus are under consideration by the British government. The subject is treated in two parts, namely (1) the protection of operators and workers in the vicinity and (2) proposed regulations affecting the reliability and control of supply systems.—London *Electrician*, Dec. 20, 1918.

Electricity Supply in Sheffield.—A historical sketch of the development of the generating plant in this important manufacturing district of Great Britain.—London *Electrical Review*, Jan. 3, 1919.

Equipment Accessories in Electric Arc Welding.—The paper is abstracted from the 1918 report of a committee of the Association of Railway Electrical Engineers, which points out proper protection for operators and shows that such arrangements insure better workmanship.—*Electric Railway Journal*, Jan. 11, 1919.

Machine-Tool Drives; Motors and Controllers.—H. W. TICE.—The writer gives a useful table of motor failures in a certain machine shop and points out conclusions to be drawn in selecting and arranging the apparatus.—*Journal Engineers' Club of Philadelphia*, February, 1919.

Electric Welding in Navy Yards.—LIEUT.-COMMANDER H. G. KNOX.—In the introduction of this article the author first outlines the are-welding and resistance-welding processes as related to their general application in navy yards. Following this preliminary treatment, he considers the work conducted in each type of

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shop in a navy yard, recommends the kinds of welding equipment desirable in each shop, and illustrates by many photographs the character and variety of the work done. In conclusion, he gives figures on the speed and cost of welding ship structures and cites from steam railroad records comparative cost data of welding and other methods.—*General Electric Review,* December, 1918.

Recent Developments in Machines for Electric Spot Welding as a Substitute of Riveting.—J. M. WEED.—The author's description of recent developments in machines for electric spot welding are very comprehensive. Evidently electric welders can be designed for use in all trades wherein metal is joined, with results superior to present methods. The author's experiments have demonstrated that the previously supposed natural limits of the process as to the thickness of the parts to be welded are governed only by the capacity of the apparatus available for doing the work.—*General Electric Review,* December, 1918.

Spot Welding and Some of Its Applications to Ship Construction.—H. A. WINNE.—Starting with the early practice of spot-welding light-weight construction, Mr. Winne describes the extension of this type of welding to heavy work, notably the fabrication of the parts used in the construction of ship hulls. He discusses the advantages of spot welding over riveting with respect to strength, time and labor and outlines the limitations of the spot welder. In conclusion, he describes in detail the application of spot welding to the construction of ladders and gratings and to the plugging of misplaced holes.—*General Electric Review,* December, 1918.

Electrochemistry and Batteries

Power Factor of Electric Arc Furnaces.—As a result of theoretical and experimental study, the author has arrived at these conclusions: (1) The power factor of electric arc furnaces depends not alone on the inductive action of the circuits but also, and in general chiefly, on the physical and chemical phenomena which take place in the oven. It follows that in the same oven with the same arrangement of the circuits power factor may vary greatly. (2) In properly constructed arc furnaces, where the electrodes are constant in section and the applied potential is also constant, the power factor increases with the effective intensity of the current. (3) Where the electrodes are constant in section and the effective intensity of the current is also constant the latter diminishes as the effective value of the applied potential grows. (4) With constancy of current and of applied potential the power factor varies with variations in the section of the electrodes and increases with greater density of current. (5) With constant applied potential and current density the power factor increases with increase in the section of the mobile electrode; that is to say, with the growth of the power used in the furnace. (6) With constancy of applied potential the variation of the power factor relative to a given variation of the density of the current is, within large limits, greater as the diameter of the electrodes is greater. (7) The power factor of the oven, all the other conditions being constant, will diminish greatly when an open arc is substituted for a closed arc. (8) Regular performance of the oven as concerns stability of the arcs will correspond to high power factor. (9) With high power factor there is an absence of loud irregular noise from the arc, which will instead emit a characteristic heavy note, corresponding, it may be, to the frequency of the current. (10) The power factor of arc furnaces depends also upon the values of the differences of potential which result from its application to the extremities of the interior resistances of the oven (electrodes and bath) and to the extremity of the true arc. Other conditions being equal, when the first differences of potential increase as compared with the second the power factor is better. (11) The power factor of arc furnaces depends in many cases on the nature of the load, of the bath and of the chemical reactions which are produced in the crucible. Other things the same, it increases as the ionizing power of the charge and of the bath augments, and it may have values especially high when chemical reactions of a special nature have just taken place in the crucible.—*L'Industrie Electrique,* Dec. 25, 1918. *(Abstracted from Rivista Tecnica d'Elettricita.)*

Miscellaneous

Some Developments in the Electrical Industry During 1918.—JOHN LISTON.—A résumé of the developments in electrical machinery, and particularly in the line of industrial heating and welding appliances and lighting equipment.—*General Electric Review,* January, 1919.

Salvaging Industrial Wastes.—W. ROCKWOOD CONOVER.—A beneficial result of the war, and one which ought to be lasting, was the great effort on the part of industry to eliminate waste. The government campaign for conservation of materials showed the manufacturers what could be accomplished, and they were enthusiastic to put these economies in force. The salvaging of industrial wastes is a big factor in the economy of materials, and in this article Mr. Conover briefly outlines what saving can be accomplished by reclaiming scrap materials.—*General Electric Review,* January, 1919.

Coal Handling at Ports.—H. HUBERT.—A description and illustrations are given of a number of modern plants for handling coal at ports by means of large electric cranes and coal transporters. The specifications for these cranes are given, together with an idea of the amount of coal that can be handled in this manner.—London *Electrician,* Jan. 10, 1919.

Phase Displacement and Its Relation to Methods of Charging for Power.—H. BUSSMAN.—The paper, which is abstracted from one printed in the *Elektrotechnische Zeitschrift* No. 10, 1918, considers a hypothetical case in which two stations operate in parallel with one station underloaded and the other overloaded. The trouble arising from improper excitation is discussed, together with a notation of the several methods used for overcoming the phase displacements. The method recommended for eliminating the low-power-factor condition is to make the consumer liable for reductions in efficiency in using an inductive load. New developments on power-factor meters can be advantageously used in determining the exact liability of the consumer. By means of the sine meter it is possible to supervise two stations working in parallel and to provide for the proper excitation of each.—London *Electrician,* Jan. 17, 1919.

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Power Factor and Power Rates

To the Editor of ELECTRICAL WORLD:

Sir: Power factor and coal costs have long been with us, but it took the war to emphasize the fact that there is a decidedly definite relation between variations of these quantities and electricity rates. The discussions by Will Brown relative to the first-named quantity and the editorial comment thereon published in recent issues of the ELECTRICAL WORLD have interested me very much.

That it is more costly to serve a low power-factor load than one requiring an equal amount of energy at unity power factor we can, I believe, all agree. But, desirable though it may be from the central-station viewpoint to insert power-factor or other modifying clauses in power contracts, we must, at least so far as the small consumer is concerned, not forget to look at the problem from the consumer's viewpoint. The cost-of-service theory is a beautiful one in many respects, but like many another beautiful thing it has its limitations, as any one who has ever juggled with rates knows only too well. Rates based thereon easily become complicated, and complications bewilder the consumer. Confronted by such things as load factor, power factor, diversity factor, maximum demand, integrated maximum demand, lagged maximum demand and all of the other numerous but honorable members of the demand and other families, the poor lay consumer is likely to become hopelessly befuddled. If he operates a 5-hp. motor and is asked to pay a bill one part of which comes from a demand-charge rate scale, another from an energy-consumption scale, another from a coal-price scale and still another from a power-factor scale, he begins to wonder whether he is really paying for electric service or the salaries of an office force which he did not employ.

The experience of some at least of our public utility commissions is that rates are already too complicated and that any changes made should be toward simplification rather than complication.

The above is written, not with the thought of disparaging the importance of power factor or any other controlling element in rate making, but to emphasize the need of simplicity in the rates for a given class of consumers even if such simplicity is gained at the expense of certain individuals of the class. Assuredly all the elements of cost should enter the rate, but the scale finally evolved should be simple. Of course, for the very large consumer who maintains a technical staff of his own complications in rate schedules are not of serious moment and the insertion of power-factor or other special limiting or modifying clauses in the power contract may be highly desirable.

As Mr. Brown points out, the metering problem presents difficulties when it comes to enforcing power-factor clauses. We need to know not only what might be termed the "load-factor effect" of low power factor but also something which gives us a clew to the distribution losses caused by the long-time operation of low-power-factor loads. These losses form a not negligible portion of the 15 to 40 per cent of generated energy which is never recorded on the customers' meters. The graphic recording power-factor meter has about the same relation to the desired meter as the graphic recording wattmeter has to the watt-hour meter. The development of a suitable meter would greatly simplify the problem.

It has been for some time an open question in my mind as to whether a reactive-power clause is not better than a power-factor clause. Space limitations forbid an extended discussion of the matter here, but it may be pointed out that such a clause has marked advantages from the standpoint of metering. We have so long focused our attention on the power component of volt-ampere-hours that the significance of the reactive component has escaped our attention. The reactive volt-ampere-hours input to a polyphase circuit may be simply and directly measured with existing metering equipment. For single-phase circuits a reactive volt-ampere-hour meter would have to be developed, possibly, but the difficulties in the way of such development appear far less serious than those attendant on the development of a straight volt-ampere-hour meter as suggested in Mr. Brown's article, or of any form of integrating power-factor meter. Further, it seems to me that the reactive ampere-hour-meter readings would possess much the same psychological advantages that the modern reactive-factor indicator possesses over the power-factor indicator in connection with the operation of synchronous motors and converters.

D. D. EWING.
Purdue University, Lafayette, Ind.

Readers' Views and Comments

Bell-Alarm Protection

To the Editor of ELECTRICAL WORLD:

Sir: In a letter to the editor published in the ELECTRICAL WORLD of Dec. 21, 1918, E. H. Beckert of the switchboard department of the General Electric Company takes issue with certain recommendations made in our article on "Safety Features in Switching Installations" which was published in the ELECTRICAL WORLD of Nov. 9, 1918.

Bell Alarm on Hand-Operated Circuit Breakers. — The scheme suggested by Mr. Beckert is well known. It consists of an attachment directly on the circuit breakers. Such circuit breakers are generally mounted high up near the top of a switchboard, and the operator when resetting them will often accidentally touch energized parts. It is for this reason that operators often seriously object to this arrangement. The system suggested by us makes the resetting device more accessible, in our opinion.

Electrically Operated Circuit Breakers.—Mr. Beckert also suggests that an additional contact be installed on the overload relay for the purpose of bell-alarm operation. If Mr. Beckert had consulted the relay department of the company for which he signs, we believe he would not have recommended this change because the relay department does not favor the addition of any contacts on relays. On induction relays it is practically impossible to install additional contacts; even on bellows relays they are not recommended. An alternative to the scheme suggested by us would be to install two additional auxiliary relays in each circuit, which, of course, would be much more complicated and expensive than our scheme.

Mr. Beckert's statement that the two schemes described by him seem to be better and less expensive than those suggested by the authors must therefore be considered as not in keeping with the recommendations of his own company.

M. M. SAMUELS,
New York. F. BECHOFF.

Balance Protection of Cable Systems

To the Editor of ELECTRICAL WORLD:

Sir: In your issue for June 29, 1918 (Vol. 71), there is a description of the "Balance Protection of Cable Systems," in which not only the balance protective device is mentioned but also the split-conductor system.

I notice that in this article no reference is made to the men responsible for the introduction of these protective devices, which have been acknowledged to be the best system and the only one capable of protecting large interconnected cable work, generators and transformers. It would appear from your article that the idea emanated from Mr. Cole, whereas the patents are held by Messrs. Merz and McLellan in the name of the Merz-Price system and the Merz-Hunter split-conductor system. It is by these names that we know them in England, and I think that, in virtue of what has been done by them, it should be pointed out that it is to their genius that we owe to-day the means of protecting large interconnected systems.

If you will refer to the *Proceedings* of the American Institute of Electrical Engineers, Vol. 36, No. 2, February, 1917, page 282, you will find that had the system of protection with the Merz-Price or Merz-Hunter apparatus been used, an 80,000-kw. station would not have been isolated, which should be the best testimonial that can be given.

WILLIAM T. TAYLOR,
Electrical Superintendent Western Australian Government Electricity Supply, East Perth, Australia.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

N. E. L. A. WILL MEET AT ATLANTIC CITY IN MAY

Next Annual Convention to Be Held During Week of May 19—Announcement of the Exhibition Committee Plans and Activities

The exhibition committee of the National Electric Light Association held a meeting at the headquarters, New York, on Feb. 15, under the chairmanship of J. W. Perry. It was formally decided to approve the proposition to hold the next annual convention at Atlantic City during the week of May 19 and to resume all the proposed plans and activities that had been so carefully worked out in 1917, with additional features of interest to the operating member companies. These will be given in full for publication as soon as possible.

In the meantime the committee desires to announce to the Class D exhibiting members that all reservations made in 1917 as to exhibition space will be given priority and be carried out by the exhibition committee, which is communicating immediately with all the pledged and prospective exhibitors, upon whom it is impressing the fact that this is the reconstruction convention after the great war, the most notable and historic in the life of the N. E. L. A.

H. G. McConnaughy, secretary of the exhibition committee, can be addressed on all such matters at the association offices, and it is suggested that all exhibitors get in touch with him at once.

ANNUAL MEETING OF THE ASSOCIATED MANUFACTURERS

Fourth Annual Gathering to Be in New York on March 20—Schedule of Committee and Section Meetings to Precede Association Convention

The fourth annual meeting of the Associated Manufacturers of Electrical Supplies will be held at Delmonico's, New York, on March 20. The business sessions will be at 10:30 a.m. and 2:30 p.m. In the evening of the same day the fourth annual banquet will be held in Delmonico's. This will be a social event, with entertaining speakers, music, etc., to which members may invite guests, table reservations being made for those desiring to sit together.

It is desired that there be a full attendance at both the annual meeting and banquet. Charles E. Dustin, the general secretary, notifies members that much of interest will be presented covering the work and progress of the association.

Following is a schedule of the section and committee meetings to be held during the week of the meeting of the Associated Manufacturers of Electrical Supplies:

Monday, March 17, 1919.—Industrial and Street-Lighting Fixture Section, 10 a.m.; Signaling Apparatus Section, 2 p.m.

Tuesday, March 18, 1919.—Air-Circuit-Breaker Section, 10 a.m.; Heating-Appliance Section, 10 a.m.; Snap-Switch Section, 10 a.m.; Molded or Formed Insulation Section, 10 a.m.; Lamp Receptacle and Socket Section, 2 p.m.; Line-Material Section, 2 p.m.; Outlet-Box Section, 2 p.m.; Attachment-Plug Section, 4 p.m.

Wednesday, March 19, 1919.—Fan-Motor Section, 10 a.m.; Fuse Section, 10 a.m.; Panelboard and Switchboard Section, 10 a.m.; Rigid-Conduit Section, 10 a.m.; Electrical Porcelain Section, 11:30 a.m.; Non-Metallic Conduit Section, 2 p.m.; Insulating Materials Section, 2 p.m.; Knife-Switch Section, 3 p.m.; Armored Conductor and Metallic Flexible Conduit, 4 p.m.

PRODUCTION CONDITIONS AT PITTSFIELD DISCUSSED

Manager of General Electric Company's Plant Tells of Unfilled Orders and Cancellations—How Product Is Divided

Interesting sidelights upon production conditions at the Pittsfield (Mass.) works of the General Electric Company were brought out at a recent public hearing before the State Board of Conciliation and Arbitration by C. C. Chesney, general manager of the plant. Mr. Chesney said that the number of employees at Pittsfield about the middle of January was 6683, compared with 5777 in the week before Christmas. The unfilled orders at these works on Jan. 1, 1918, totaled $10,500,000, and on Dec. 1, 1918, they totaled $6,500,000. Up to the middle of January the unfilled orders were reduced by about $1,000,000 more, due to cancellations, chiefly of government orders. The total reduction of unfilled orders in the year from Jan. 1, 1918, to about Jan. 15 last was therefore $5,000,000, representing the labor of 2000 men for six months.

The contracts canceled since the armistice was signed included gas shells and searchlight controllers. Mr. Chesney said that the Pittsfield works manufacture transformers up to 10,000-kw. rating and motors up to 25-hp. rating. Stocks had been increased during the year above noted by about $1,500,000. Transformers represent about 50 per cent of the total business done by the plant. On Jan. 15 the factory was filling orders for the following material or equipment at the named percentages of the capacity for such apparatus: Large transformers, 10 per cent; small transformers, 16 per cent (capacity 1500 a week); regulators, 6 per cent; lightning arresters, 25 per cent; motor work, 60 per cent; foundry, 50 per cent.

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OUTLOOK FOR INDIANA ELECTRIC PROPERTIES

On Basis of Mining Cost There Is Little Possibility of Much Decrease in Price of Coal for Central-Station Consumption

BY ALEX. R. HOLLIDAY

An industry will develop and prosper only when the reward attracts capital and brains. Under present conditions the Indiana electric properties offer no such reward. The net income to these properties must increase unless the industry and the people served are to suffer.

This increase in net may be accomplished through decreased expenses or through increased revenues per kilowatt-hour. Expenses may be decreased by operating economies or by paying less for labor and materials. Operating economies have been closely studied during the past two and a half years of high costs and offer in most plants little further in possible saving. The skilled labor market shows no indication of decreasing in price. Of the materials constituting the cost per kilowatt-hour coal is by far the largest.

Prior to April 1, 1916, Indiana screenings sold fo.b. mine at 75 cents per ton. An average freight rate at that time was 75 cents, making a total cost at plant of $1.50 per ton. The recent government price at mine was $2.05. The freight above quoted plus war tax is now $1.33, making a total cost at plant of $3.38, an increase of $1.88, or 125 per cent, in three years.

How much can the price of coal be reduced and still leave a profit? Roughly, the mining costs per ton of a thousand-ton-per-day Indiana mine are as follows (Federal Trade Commission classification of accounts is used):

LABOR	
Mining	$0.75
Yardage and dead work	.15
Haulage	.25
Tipple	.05
Power	.03
Other labor	.15
Maintenance structures	.02
Maintenance equipment	.03
Supervision and engineering	.08
Total	$1.51
SUPPLIES	
Mine timber	$0.05
Feed and stable supplies	.02
Power house fuel	.05
Power purchased	.01
Other supplies	.04
Maintenance and repair structures	.01
Maintenance and repair equipment	.04
Total	$0.22
FIXED CHARGES	
Royalty	
Depletion	$0.02
Depreciation structures	.06
Depreciation equipment	.07
Taxes	.01
Insurance	.04
Officers' salaries	.01
Clerical and office expenses	.02
Miscellaneous expenses	.01
Total	$0.24
SUMMARY	
Labor	$1.51
Supplies	.22
Fixed charges	.24
Total	$1.97

to which are to be added selling expense, bad debts, etc.

The total figure is correct for approximately a hundred mines, running nearly full time, although the division of the total in the various accounts differs. Less than full time running will increase the per ton of all items except the first labor charge.

On a basis of producing 40 per cent screenings and 60 per cent lump, selling both at the recent government price of $2.05 and $2.55 respectively, the average price per ton is $2.35. If, therefore, all profit, selling expense and bad debts are eliminated, an average of 38 per cent per ton may be deducted. Screenings under this competition and supposing they bore the per ton mining cost would sell for $1.67, or 18 per cent less than at present. When this point is reached the smaller and the high-cost mines will soon be eliminated, the thousand-ton mines will break even or lose a little, and the larger mines will make a profit. Three-quarters of the expense is labor. This labor receives a high wage per ton or per hour. The minimum day wage is $5. But with the present market this labor gets only two or three days' work a week, which brings the return to the miner to quite a modest figure. The miner is more apt to demand an increase in wage than to accept a cut under present mining conditions. Obviously there should be fewer coal miners and fewer mines to reduce cost materially. That situation may come about through economic pressure, but years may be required. It is with the immediate situation we are dealing.

There is not the slightest indication that the freight rates under federal or private control of railroads can be reduced. So we have the possibility, under keen market competition, that the average plant price of coal may be reduced from $3.38 to $3.01, or 11 per cent. In the total generating cost this amount is virtually nil.

The one remaining solution of the electric utility problem is increased selling price. The Indiana Public Service Commission has granted so-called "temporary surcharges" sufficient to keep the companies from bankruptcy but not sufficient to keep them in a healthy financial condition. Not only these surcharges must be made permanent, but other raises approved, if our electric utilities are to prosper, if they are to attract capital and brains, and if they are to continue to perform their function in the life of the state.

STATUS OF TELEPHONE CASE IN MASSACHUSETTS

Full Bench of Massachusetts Supreme Court Will Hear Arguments on Appeal from Postmaster-General's Toll Rates

The full bench of the Massachusetts Supreme Court will hear arguments relative to the jurisdiction of the Public Service Commission in the Postmaster-General's telephone toll-rate case probably during the last week of the present month. The case was called up before Judge De Courcy at Boston and was referred to the full bench. The Attorney-General of Massachusetts will urge the full bench to grant an injunction against the New England Telephone & Telegraph Company in order that the former intrastate toll rates may be put back into service. United States District Attorney Boynton will probably be present on behalf of the Postmaster-General, and President Matt B. Jones will appear for the New England company.

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DAMAGE TO HYDROELECTRIC PLANT AT CLINTON, MASS.

Metropolitan Water and Sewerage Plant Flooded by Water Through Broken Wheel Casing—Estimated Damage Is About $5,000

The hydroelectric plant of the Metropolitan Water and Sewerage Board at Clinton, Mass., was flooded by water from a broken wheel casing Monday morning and damaged to the extent of $5,000. The station contains four 1000-kva. Westinghouse three-phase, 13,800-volt alternators, each directly connected on a horizontal shaft to a 1200-hp. S. Morgan Smith hydraulic turbine, and two independently driven exciter generators rated at 60 kw. each. The plant was installed in the summer of 1911, and the wheels are operated under available heads ranging from 80 ft. to 100 ft. (24 m. to 30 m.), depending upon the elevation of water in the reservoir and the quantity flowing in the aqueduct. The station is at the base of the Clinton dam, which impounds water stored for the domestic and industrial supply of metropolitan Boston, and the energy developed is mainly sold to the New England Power Company.

The water supplying each of the wheels flows from the reservoir into a masonry chamber built in the dam, which is provided with screens, stop-planks and sluice valves; thence through a vertical well 7 ft. (2.1 m.) in diameter extending to a depth of 111 ft. (33.8 m.) below high water in the reservoir; thence through a 48-in. (121-cm.) cast-iron pipe extending horizontally 114 ft. (34.7 m.) through the dam into the power house. There are besides connections with the Wachusett aqueduct and with waste pipes for conveying the water to the Nashua River below the dam. The wheels and generators are supported on a foundation of heavy concrete masonry, forming wells into some of which the draft tubes discharge, while others contain valves controlling the flow of water. In each penstock directly under the turbine there is placed a 48-in. (121-cm.) Pratt & Cady valve operated by water pressure by means of a 24-in. (60-cm.) diameter hydraulic piston. The upper gates controlling the admission of water to the penstock are ordinarily electrically operated.

A crack which developed in the wheel casing about a year ago in the unit which failed had been repaired, and the fracture Monday morning occurred on the opposite side of the casing. At the time of the accident the supply of energy gave out before it was possible to close the gate valves electrically or to close the hydraulic valve under the affected unit. The gates were closed by hand in about thirty minutes. Meanwhile the water flooded the operating room, submerging generating units and switchboard and finally breaking open a doorway and flowing into the river bed. The interior furnishings were considerably tossed about, but the operators succeeded in shutting down the injured units before the water reached them, thus preventing short-circuit or grounding damage.

Census Bureau Report of Electric Light and Power Stations—1917

Preliminary figures, published herewith, of the forthcoming quinquennial report on the central electric light and power stations of several states have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics cover both commercial and municipal plants. They do not cover electrical plants operated by factories, hotels, etc., which generate for their own consumption, those operated by the federal government and state institutions, and those that were idle or in course of construction.

	New Jersey			Florida			Oregon		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	63	64	—1.6	82	50	64.0	68	66	3.0
Commercial	47	56	—16.1	50	33	51.5	53	54	—1.9
Municipal	16	8	100.0	32	17	88.2	15	12	25.0
Income	†$23,480,320	†$10,944,367	114.5	‡$2,376,908	‡$1,361,201	74.6	¶$2,577,297	¶$1,422,703	81.2
Electric service	$20,188,244	$10,587,513	90.7	$2,334,876	$1,338,781	74.4	$2,454,047	$1,380,785	77.7
All other	$3,292,076	$356,854	822.5	$42,032	$22,420	87.5	$123,250	$41,918	194.0
Total expenses, including salaries and wages	$18,760,138	$9,348,864	100.7	$1,684,569	$1,052,696	60.0	$2,276,169	$1,205,738	88.8
Number of persons employed	5,065	2,989	69.5	678	455	49.0	636	§532	19.5
Salaries and wages	$4,821,852	$2,479,219	94.5	$471,035	$286,053	64.7	$583,195	$387,119	50.6
Total horsepower	367,743	239,514	53.5	58,195	33,836	72.0	68,706	46,015	49.3
Steam engines:									
Number	188	251	—25.1	140	90	55.6	46	54	—14.8
Horsepower	353,021	235,585	49.8	50,477	27,606	82.6	27,062	15,879	70.4
Internal-combustion engines:									
Number	24	21	14.3	24	6	300.0	15	9	66.7
Horsepower	12,665	2,360	436.7	2,008	500	301.6	578	334	73.1
Waterwheels:									
Number	15	18	—16.7	5	3	66.7	80	60	33.3
Horsepower	2,057	1,569	31.1	5,710	5,700	0.2	41,066	29,802	37.8
Kilowatt capacity of dynamos	249,521	179,477	39.0	37,812	23,619	60.1	47,917	32,416	47.8
Output of stations, kilowatt-hours	781,230,790	383,891,504	103.5	50,887,992	25,895,751	96.5	107,886,973	58,789,342	83.5
Stationary motors served:									
Number	30,679	12,772	140.2	2,097	1,121	87.1	3,284	1,527	115.1
Horsepower	262,858	85,011	209.2	22,235	14,141	57.2	31,682	15,843	100.0
Number of street lamps:									
Arc	13,580	16,052	—15.4	1,249	1,213	3.0	489	1,128	—56.6
Incandescent, etc	53,652	33,708	59.2	12,621	4,752	165.6	10,363	6,239	66.1

* A minus sign (—) denotes decrease.
† Exclusive of $42,313 in 1917 and $116,829 in 1912 reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $749,113 in 1917 and $561,416 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $2,047,853 in 1917 and $2,327,822 in 1912, reported by street and electric railway companies as income from sale of electric energy.
§ Includes approximately 100 part-time employees.

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AWARD OF SERVICE MEDAL TO GEN. GUY E. TRIPP

Distinguished-Service Medal for Chairman of the Board of Westinghouse Electric & Manufacturing Company for War Service

By direction of President Wilson, Secretary of War Baker has announced that the distinguished-service medal has been awarded to Gen. Guy E. Tripp, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company. The citation as published in army orders follows:

"Guy E. Tripp, as chief of the production division of the Ordnance Department, and later as assistant chief of ordnance, displayed fine technical ability and broad judgment in systematizing methods and practices resulting in the efficient coöperation of industries producing articles of ordnance for the army."

INTERIM REPORT OF THE PUBLIC POLICY COMMITTEE

Committee of the N. E. L. A. Says that Members Will Now Be as Willing to Co-operate in Reconstruction as They Were Eager to Support the War

After consideration and discussion of the conditions arising from the ending of the war, the public policy committee of the National Electric Light Association has submitted an interim report of comments and recommendations.

The committee recalls the resolution passed at the Atlantic City convention last June in which the association pledged "all that we have and all that we are" to the winning of the war, and through such success, "the winning of a great peace."

"The members of the association may take just pride in the active and unqualified support which has been given to our government by the industry in the form of money, men and utility service, which have contributed in some measure to the glorious results that have been achieved," says the committee. The report adds:

"The members of the association will now be as willing to take hold of reconstruction problems and coöperate heartily and effectively in their solution as they were eager to support the war program, and it is not too soon to formulate policies to meet the conditions of the near future."

Planning future activities, the judgment of the committee is that all association committee work should be resumed promptly and restored to the full measure of activities as soon as possible; also that the 1919 convention should be along pre-war lines as nearly as practicable under present conditions.

Regarding reëmployment of soldiers the judgment and recommendation of the committee is:

Resolved, That we commend the action of the large number of corporations which gave to their employees who entered the military service in the present war the definite promise that they would be restored to their former employment at the conclusion of that service, and we strongly recommend to all our member companies that, as far as practicable, they adopt the same practice.

Employees who gave up their positions to serve in the army or navy or other governmental war service deserve well of their country, and it is but a just recognition of their patriotism to insure them against the loss of the means of livelihood which they could have continued to enjoy except for their disinterested and patriotic action in entering the military service of the country in its time of need.

On the subject of public ownership of utilities it is stated that public opinion will be divided as to the influence of war experiences upon the question.

"The former advocates of public ownership," says the report, "will try to see in the extension of public control exercised during the war a trend which is likely to continue. On the other hand, the general public will be likely to judge the merits of the question by its opinions as to economic and service results achieved under direct government control in comparison with the results of previous operations under corporate management.

"Government control of the railroad systems of the country during the war has been universally recognized as a wise procedure, because of the necessity of subordinating the individual interests of the various railroads to the all-important idea of securing the maximum of transportation service throughout the country for the movement of troops and essential commodities. The serious curtailment of the usual passenger and freight service, coincident with the greatly increased charges for both classes of service, has been accepted by the public as necessary to the quickest possible success of the war program.

"Now that hostilities have ceased, the railroad administration will be judged by other standards than those of war necessities, and already the editorial columns of prominent papers are extremely critical of the operating and financial results of government control. In the opinion of your committee, there is nothing in the experience of the government thus far to justify or encourage permanent public operation of the railroads either from the standpoint of economics or of service, and while doubtless the ardent advocates of public ownership will seek to capitalize recent experiences of the government in favor of their theories, it is indisputable that those who travel on the railroads and those using them regularly for shipping are anxious for the termination of direct government operation as soon as may be practicable."

A section of the report is devoted to street railways. Commenting that the condition of these properties "is rapidly becoming desperate," the committee then refers to the suggestion in some quarters that the most practicable and effective solution is in municipal ownership since that would mean that the additional revenue required would be forthcoming either through increased fares or indirectly through taxation. It adds:

"We recognize the extremity of the street car companies and the advantage that such suggestion may offer to some of them individually, but we deem it necessary to say that the opinion of your public policy committee, as hitherto frequently expressed, continues with increasing conviction that municipal ownership of electric lighting, gas and street railway companies is economically unsound and cannot redound to the mutual benefit of the consumers and the municipality. We think it is but fair publicly to reaffirm our views upon this subject at this time when temptation to the encouragement of municipal ownership by utilities companies themselves seems apparent."

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The public policy committee is composed of H. G. Bradlee, N. F. Brady, J. A. Britton, E. W. Burdett, Walton Clark, H. L. Doherty, C. L. Edgar, Samuel Insull, J. W. Lieb, J. B. McCall, T. E. Murray, H. A. Wagner, W. F. Wells, ex officio; W. W. Freeman, chairman.

GOOD ATTENDANCE AT THE A.I.E.E. MIDWINTER CONVENTION

Prof. Comfort A. Adams, Presiding at Opening Joint Session with American Institute of Mining Engineers, Tells of Welding Society

Preliminary registration indicated a good attendance at the midwinter convention of the American Institute of Electrical Engineers held from Wednesday to Friday of this week at the Engineering Societies Building, New York. A joint technical session with the American Institute of Mining Engineers on Wednesday afternoon opened the convention. Prof. Comfort A. Adams, president of the A. I. E. E., who presided, spoke of the plan to form an electric welding society, composed of representatives of manufacturers, engineers and the government. A full report of the convention will be printed in next week's issue of the ELECTRICAL WORLD.

FOREIGN TRADE WORK OF THE ASSOCIATED MANUFACTURERS

Outline of Information Regarding Elements of Cost Desired by International Trade Committee for Use in Its Studies

A letter to members of the Associated Manufacturers of Electrical Supplies by William Burgess, adviser to the international trade committee, outlines the method to be followed in giving information for the use of the committee. Mr. Burgess says that in obtaining proper tariff protection it is necessary to know all elements of cost, both factory and merchandising, so as to compare them with similar elements of foreign costs. Factory cost, in this instance, means the addition of all elements entering into the total factory cost of the goods, packed and ready for shipment, approximately figured, but does not include merchandising costs.

The elements of cost should be divided, Mr. Burgess adds, under six main headings, viz.:

1. Direct Materials.—All materials entering directly into the article produced, including freight and other charges thereon.
2. Indirect Materials.—All other materials used in the process of manufacture, such as coal or other fuel, mold and die materials, etc., including freight and other charges thereon.
3. Direct Labor.—All labor directly employed in the making of an article.
4. Indirect Labor.—All other labor or payroll costs, such as superintendents, foremen, firemen, watchmen, designers, draftsmen, engineers, factory clerk hire, etc.
5. Factory Overhead.—All rents or interest on factory investments, depreciation of plant, repairs to buildings, maintenance of machinery and equipment, insurance and taxes of all kinds, light, water, royalties on patents and all other factory expenditures.
6. Merchandising.—All selling and administrative costs, including officers' salaries, commissions, traveling expenses, advertising, etc.

If more convenient to group under one heading all materials indicated in 1 and 2 as total material cost, and all labor, as in 2 and 3, as total labor cost, it will be satisfactory, although a separate grouping is more desirable for the special purpose in view, according to Mr. Burgess.

The information desired is to be given on a percentage basis, thus avoiding the giving of any figures which might be considered confidential or private. All reports, however, are to be considered strictly confidential and only the total averages will be used in any public way.

The committee also desires information as to the approximate average normal earnings per hour of employees, divided between male and female and skilled and unskilled labor, over and under sixteen years of age.

EFFECT OF ECONOMIES IN WAR-TIME LIGHTING

Reduction of $5,000 in Revenue in York, Pa., with Saving of 100 Net Tons of Coal, Valued at $500, During Six Months of 1918

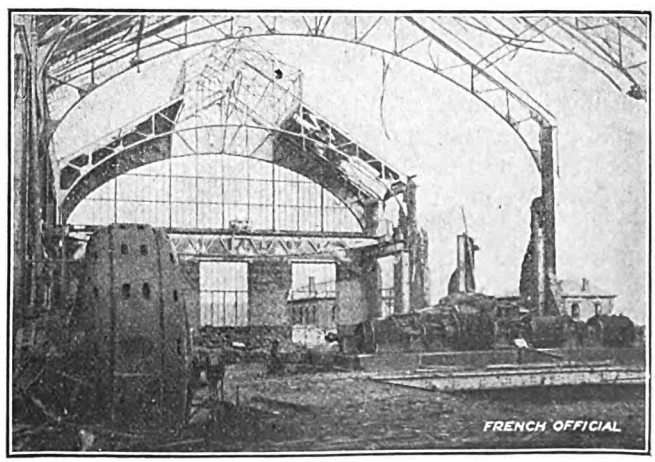
Gordon Campbell, president York (Pa.) Railways Company, gives in his annual report for the year ended Nov. 30, 1918, the following particulars regarding the effect of war economies:

In the lighting department receipts have been diminished by orders of the Fuel Administration curtailing lighting and advising economy.

As to the effect of these economies, it might be interesting to note that during the six months of summer the energy sold for lighting decreased 76,605 kw.-hr. and the loss in revenue was approximately $5000. The resultant reduction in coal consumption was hardly 100 net tons, which, at $5 per ton, amounted to $500.

With the advanced cost of fuel and labor, curtailment of revenue from this source was an added hardship. Nevertheless, the company loyally coöperated with orders and suggestions for fuel economies. Both railway and lighting receipts were also seriously affected by the epidemic of influenza during the fall of 1918.

Destruction Wrought by the Germans in Northern France



All except the heaviest of the machinery in the power plant of the Pas de Calais Department in France was removed by the German invaders. The picture shows what was left of the plant.

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PRESENT STATUS OF THE BOSTON EDISON RATE CASE

Hearings to Be Resumed March 17, and Company Is Preparing Answers to Queries Covering a Wide Range of Subjects

Hearings in the Boston Edison company rate case before the Massachusetts Gas and Electric Light Commission will be resumed March 17. Three public hearings were held during January, the time being devoted to the consideration of sixty-nine interrogations propounded by the petitioners for lower rates, who are represented by Maurice Palais. These queries in regard to earnings, billing meter arrangements, classification, etc., cover a wide range and in some cases their answer involves so much time, labor and expense that the commission has ruled informally that they be simplified or else abandoned. During the interim the company will prepare as many answers as possible for use at further hearings in the case.

DEALERS IN LIGHTING FIXTURES NOW ORGANIZE

National Council of Lighting Fixture Manufacturers and Illuminating Glass Manufacturers' Association Are Formed

The convention of the Lighting Fixture Dealers' Society of America in Pittsburgh on Feb. 10 and 11 was responsible for bringing two new trade associations into existence. Among those attending the convention were representatives of leading fixture manufacturers and manufacturers of illuminating glassware. These two interests organized associations of their own while in Pittsburgh—the National Council of Lighting Fixture Manufacturers and the Illuminating Glass Manufacturers' Association.

Fred R. Farmer, president of the Beardslee Chandelier Manufacturing Company, Chicago, was elected president of the National Council of Fixture Manufacturers; Albert Wahle, of the Cassidy & Son Manufacturing Company, New York, vice-president, and Charles H. Hofrichter, of the Crescent Brass Manufacturing Company, Cleveland, secretary-treasurer.

Charles Ott, of the Eagle Glass & Manufacturing Company, Wellsburg, West Va., was elected president of the Illuminating Glass Manufacturers' Association. Conrad J. Netting, of the C. J. Netting Company, Detroit, was reëlected president of the Lighting Dealers' Society of America.

Commenting on the organization of a fixture manufacturers' association, Mr. Farmer said:

The formation of a National Council of Lighting Fixture Manufacturers has been attempted many times before but without success. This year a new spirit seemed to animate the representatives of the industry—a spirit of coöperation—a realization that individual interests must be subordinated to the common good. There is much work of an educational nature that we can do better collectively than individually. The radical improvements that have been made in recent years in lighting fixtures are not generally known. People are still satisfied with the inartistic and inefficient fixtures installed a decade ago because they do not realize the greater comfort and economy of modern fixtures. We believe that by closer coöperation with fixture dealers we can greatly augment the volume of replacement business. Another object of our national council is to suppress existing trade evils, particularly the practice of copying one another's designs.

The next meeting of the National Council of Lighting Fixture Manufacturers will be called early in the summer to perfect organization. Any fixture manufacturer who would be eligible for membership in a local association of fixture manufacturers is eligible for membership in the National Council.

REFUSE DARKNESS FOR BOLSHEVIKS IN SEATTLE

"Not a Light Blinked," Says Superintendent of Lighting Ross — Hundreds of Citizens Reported to Help in the Emergency

Some details of the success with which electric service was maintained in Seattle, Wash., during the general strike there from Feb. 6 to Feb. 10 were printed in last week's issue of the ELECTRICAL WORLD. A letter to a representative of this journal from J. D. Ross, superintendent of lighting of the city of Seattle, gives the following additional particulars:

You are conversant with most of the details of the present strike. Bolshevik handbills, "Russia Did It" and "The Revolution Is Now On," were distributed. The great mass of union men were dominated by a few radicals. They demanded that all homes and streets be in darkness. Only a few of our men responded, and not a light blinked. We therefore became the first to fight the revolutionary program of the "general strike." I believe this is the first time it has been invoked in America. Twenty-five thousand men left the shipyards, and then all other trades were called on to walk out—probably as many more.

City light stood fast, and of the 400 men only a few went out, so we are stronger to-day than ever. One of the novel features was that, as stations are scattered, Seattle being 20 miles long, tampering with telephone lines would isolate a station, so I thought of wireless and found a number of sets with the Kilbourne & Clarke Company. These were loaned free of charge. E. C. Kilbourne and R. O. Hall, the manager, worked all night helping us install them. One was put in the Federal Building, and our stations were in instant touch with each other and Uncle Sam and local stations, thence Bremerton Navy Yard and Camp Lewis. Three shifts of operators were used. I think this is the first time this has been done. Of course, it is a perfect system, as aerials are not necessarily high and may consist of one temporary wire.

Another feature was that hundreds of citizens from all classes reported to help in the emergency, many of them who could not be used staying in the office or keeping in touch all day to act as anything from engineer to errand boy. Old men turned away disappointed that they could not be used as guards. A number were union men loyal to their city. A steady stream came in all day long.

RESCINDS ITS WAR RULING ON ELECTRIC EXTENSIONS

Public Utilities Commission of Illinois Annuls Amendments Designed to Conserve Use of Capital for Line Extensions in War Time

The Public Utilities Commission of Illinois has entered an order, effective as of March 1, 1919, annuling and canceling all amendments to Rules 19 and 31 which were intended to conserve the capital of utilities that might have been expended in line extensions during the war.

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A. S. M. E., Spring Meeting.—June 17 to June 20 has been tentatively chosen as the time for the spring meeting of the American Society of Mechanical Engineers in Detroit.

New Member Society in Engineering Council.—The American Society for Testing Materials has become a member of the Engineering Council, thus bringing the membership up to six.

A. I. and S. E. E., Cleveland District Section.—"Telephones" will be discussed at the March 1 meeting of the Cleveland District Section, Association of Iron and Steel Electrical Engineers.

New York Electrical Society.—A. Russell Bond, managing editor of the *Scientific American,* lectured on "Deep-Sea Salvage After the War" before the Feb. 19 meeting of the New York Electrical Society.

Electric Club of Chicago. — Dr. Scherger, Armour Institute of Technology, spoke on the history and meaning of Bolshevism at the Feb. 6 luncheon, while on Feb. 13 Capt. Oliver T. Reilly told of his war experiences.

Engineers' Club of Philadelphia.—Alfred D. Flinn, secretary of the Engineering Council, will speak on "Joint Activities of Engineers, a Résumé of the Work of the Engineering Council and Foundation," at the luncheon on March 4.

I. E. S. New England Section.—Preston S. Millar, general manager of the Electrical Testing Laboratories, New York City, spoke on "Lighting in War Time" before the New England Section of the Illuminating Engineering Society on Feb. 18.

A. I. and S. E. E., Philadelphia Section.—"The Substitution of Electric for Hydraulic Power in Steel Mills" will be the subject of R. B. Gerhart, electrical engineer of the Bethlehem Steel Company's Sparrows Point (Md.) plant, at the March 1 meeting of this section of the Association of Iron and Steel Electrical Engineers.

Jovian League, Kansas City Chapter.—The first rejuvenation of the Kansas City Jovian League in eighteen months was held on Feb. 8. Speeches were made by Reigning Jupiter L. C. Ripley, J. F. Porter, president of the Kansas City Light & Power Company, and H. C. Blackwell, vice-president and general manager of this company.

N. A. E. C. and D., Missouri State Section.—Trade conditions, construction, outlook costs and coöperation were among the topics discussed at the Feb. 8 meeting of the Missouri State Association of Electrical Contractors and Dealers in Kansas City. W. J. Squire, Kansas City, was elected chairman of the state board of directors, and W. L. Hutchinson was elected secretary.

N. E. L. A., Philadelphia Electric Company Section.—Clifford W. Bates spoke on "Fundamental Principles of Electrical Apparatus" and F. D. Day on "Keeping Tabs on Customers' Meter Registration for Billing Purposes" on Feb. 11 before the meter department branch of the Philadelphia Electric Company Section, National Electric Light Association. "Underground Construction" was the subject presented by L. G. Kraft before the engineering branch on Feb. 18.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Massachusetts State Association of Electrical Contractors and Dealers.—A special meeting of the Massachusetts State Association of Electrical Contractors and Dealers will be held in the American House, Boston, on Feb. 25. At this time George J. Murphy, chairman of the accounting committee of the National Electrical Credit Men's Association, will discuss the accounting system which has been adopted by the National Association of Electrical Contractors and Dealers. J. E. Wilson, 263 Summer Street, Boston, is state secretary.

San Francisco Electrical Development League.—At the weekly luncheon of the league on Jan. 24 there was a symposium on the subject of "How to Wire Houses so as to Care for Socket Appliances," participated in by men speaking from the viewpoint of five different branches of the industry. L. H. Newbert spoke for the California Electrical Coöperative Campaign; E. N. Brown represented the manufacturers; W. D. Kohlwey spoke from the retailers' point of view; Arthur Kempsten represented the city department of electricity, and Clyde Chamblin spoke for the electrical contractors.

War Activities of Illuminating Engineering Society.—Civilian lighting in war time in connection with the activities of the war service committee of the Illuminating Engineering Society was the topic of a paper presented by P. S. Millar before the New York Section of the society on Feb. 13. The promotion of production, providing protection for properties, promoting safety and conservation were the four principles for which the committee worked. Some of the most notable work was that of W. A. Durgin, who increased production of industrial plants in Chicago from 30 to 100 per cent. H. A. Hornor told of problems in lighting shipyards. According to him the electrical and the illuminating engineer will be standbies of shipbuilders and will be called upon to solve many problems which now are confronting this industry. The chair was filled jointly by Dr. G. A. Hoadley, president of the society, and F. M. Feiker, editorial director of the ELECTRICAL WORLD, chairman of the New York Section. The papers were discussed by Dr. A. S. McAllister, F. D. Pembleton, J. A. Somers, H. D'Olier, Jr., S. E. Doane and G. H. Stickney.

American Institute of Electrical Engineers

San Francisco Section.—Joseph N. LeConte recently presented a paper on "New Charts for the Ascertaining of Sag Constants in Aërial Suspension."

Toronto Section.—R. C. Harris, Commissioner of Works for Toronto, gave an illustrated lecture on "The Bloor Street Viaduct" at a recent meeting.

Schenectady Section.—"Our Foreign Commercial Relations" was the subject of Dr. Frank R. Rutter, Bureau of Foreign and Domestic Commerce, Washington, D. C., at the Feb. 7 meeting.

Lynn Section.—An illustrated address was delivered by C. A. Kelsey of the power and mining engineering department of the General Electric Company on "The Sugar Industry" on Feb. 12.

St. Louis Section.—At the annual meeting on Jan. 28 J. L. Hamilton was elected chairman, H. G. Hake secretary, and H. W. Eales was appointed to represent the section on the joint council of the associated engineering societies of St. Louis. Dr. J. J. Kessler gave a paper on "Materials of Machine Insulation," discussing briefly each material and noting its good points and drawbacks.

Baltimore Section.—The Baltimore Sections of the A. I. E. E., A. S. C. E. and A. I. M. E. met jointly with the Maryland Section of the American Chemical Society and the Engineers' Club of Baltimore on Feb. 14 to hear F. B. Craft, assistant chief engineer of the Western Electric Company, on "Electrical Communications in War Times." Lantern slides and moving pictures were shown with this talk, in which wireless telegraphy and telephony received particular attention.

Program for the March Meeting at Boston.—On March 14 the American Institute of Electrical Engineers will hold its three hundred and forty-eighth meeting in Boston. At the morning session papers will be presented by Drs. A. E. Kennelly and H. Nukiyama on "Electromagnetic Theory of the Telephone Receiver with Special Reference to Motional Impedance," and by Dr. A. G. Webster on "The Absolute Measurement of the Intensity of Sound." Following a general discussion of these papers there will be an exhibition of the A. I. E. E. tablet commemorating the work of William D. Weaver, former editor of the ELECTRICAL WORLD. Calvert Townley will speak in the afternoon, his subject being "The Rehabilitation of Our Transportation System with Particular Reference to Electrification." Following a dinner in the evening addresses will be given by Dr. Charles W. Eliot on "University Training for Engineers," by Prof. Harry Clifford on "Science and the Engineer," by Prof. E. B. Wilson on "Mathematics and the Engineer," by Dr. A. G. Webster on "The Place of Science in Engineering," and by Saul Dushman on "Our Mental Attitude Toward Scientific Investigation."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Decision in Wireless Apparatus Suit.—The Court of Error, which is the court of last resort in the State of New Jersey, has affirmed Vice-Chancellor Lane's judgment awarding royalties of $300,000 to the International Radio Telegraph Company of New York. This payment covers the right to use patents owned by the International company in a large quantity of wireless-telegraph apparatus made by the Marconi company and supplied to the Navy Department during the war. Suit for recovery of the royalties was brought under a contract between the two companies. The decision made last fall was appealed by the Marconi company.

Electric Club Statistics.—A few statistics have been compiled from the report of the auditor of the Electric Club of Chicago for 1918. This club now has about 750 members. Its initiation fee is $5, and its annual dues are $5. The total income from all sources was $4,388.80. Of this amount $1,304.82 was invested in Liberty bonds. For entertainment $621.07 was expended. There was an average attendance on the part of each member of six times during the year, or 15 per cent. During the year forty-three bulletins were published at a total cost of $775.01. Committee work cost $227.25. Administration expense amounted to $1,057.22. This includes $461.19 for such general expenses as stationery, printing and postage and $393.50 for clerical hire in the secretary-treasurer's office. The lowest attendance at any meeting in 1918 was 59, the highest was 266, and the average was 123.

Columbus (Ohio) Changes.—In order to insure its slate of directors at the annual meeting of stockholders of the Columbus (Ohio) Railway, Light & Power Company, the proxy committee secured an increase of two members in the personnel of the board. The new board consists of W. C. Willard, W. A. Gill, Norman McD. Crawford, Charles L. Kurtz, D. Meade Massie, A. S. Hammond, Walter B. Beebe, Samuel Ungerleider, Emil Keisewetter, F. R. Huntington, Harry S. Holton, B. W. Marr, E. A. Reed and Frank P. Hall. The last four are new members nominated by the proxy committee. One of them succeeds E. K. Stewart, recently resigned, and another takes the place of R. H. Platt, who was elected at the reorganization meeting but could not serve because of pressure of other interests. The other two are the additional members, making fourteen in all, instead of twelve. The board is now fully in the hands of the stockholders' protective committee, which will soon pass out of existence, since its purpose has been accomplished. The board organized by the election of the following officers: President, Charles L. Kurtz; vice-president and treasurer, Norman McD. Crawford; vice-president, Samuel Ungerleider; secretary and auditor, P. V. Burington; assistant secretary and auditor, H. M. Burington; executive committee, Charles L. Kurtz, F. R. Huntington and Walter B. Beebe. Harold W. Clapp was retained as general manager. The annual report shows a decrease of $168,933 in railway operating revenue and an increase of $410,158 in power and light revenue.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Maintaining Integrity of the Investment.—In authorizing new electric rates for the Heppner Light & Water Company the Oregon Public Service Commission says in part: "The commission believes that a slight overdevelopment of the electric system in Heppner has resulted in fixed charges and operating costs somewhat beyond the ready ability of the community adequately to defray. But to criticise the past zeal or judgment of the management of the company or the requirements of the municipality in this respect will not tend to alleviate the present urgent need for relief which the utility faces. Normally a public utility is entitled to sufficient revenue from its operations to meet fully its necessary production and distribution expenses and to provide a fair and reasonable return on the fair value of the property. But there are certain other correlated bases which must be given due weight. The first and most important of these is the value of the service to the consumer, in order that we may avoid the imposition of prohibitive rates which in themselves by loss of business might defeat the purpose of increased revenue sought by the higher rates. More important than a profit on the investment is the preservation of the integrity of the capital investment itself, and this phase of the subject deserves the commission's first consideration, in order that the community may be assured of uninterrupted electric service. While the advanced rates may not allow an appreciable return on the investment, it is believed that, coupled with the practice by the utility of rigid economies in overhead expenses, fuel consumption and operation, and by extension of the metered service, they will insure the stability of the investment in the system under the present onerous conditions."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Negligence as to Inexperienced Employee.—Employer knowing that duty of turning on electric switch was dangerous, and that employee was ignorant of such danger, was negligent in ordering employee to turn on switch, the Court of Civil Appeals of Texas held (207 S. W. 967).

Extent of Jurisdiction of Commission.—The public service commission law, giving the commission power to fix rates, is applicable to the city of St. Louis, in view of Constitution 1875, Article 9, Section 23, providing that the "charter and amendments shall always be in harmony and subject to the constitution and laws of Missouri," and Section 25, giving the General Assembly the same power over such city as over other cities, according to the Supreme Court of Missouri (207 S.W. 799).

Double Indemnity Recovery.—In the case of an electrician fatally burned as a proximate result of a sudden flash at a switchboard installed along the inside of a building, occasioned by a short circuit which threw oil over him, ignited his clothing and partly burned the switchboard, double indemnity could not be recovered under accident policy provision for double indemnity for injuries "by reason and in consequence of the burning of a building while the insured is therein," the St. Louis Court of Appeals held (207 S. 281).

Effect of Higher Rates on Contract.—Private contract with a public service electric company, fixing rates, is subject to the police power of regulation, so that exercise thereof, by fixing a higher rate, does not impair obligation of contract, according to the Supreme Court of Georgia (39 S. C. R. 117). One having a contract with a public service electric company fixing rates is not deprived of property without due process by the fixing of higher rates in the exercise of the state's police power of regulation.

Rates Jurisdiction of Commission.—Where a city enters into a contract with a light and power company by the terms of which the city sells its municipal light plant to the company, and as part of the consideration the company agrees to furnish electric energy to the inhabitants of the city at rates mentioned in the contract for a fixed period, the Corporation Commission has jurisdiction to make an order authorizing a change in the schedule of rates, the Supreme Court of Oklahoma held (177 P. 361) in City of Durant versus Consumers' Light & Power Company.

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Elmer Dover, vice-president of H. M. Byllesby & Company in charge of the Byllesby properties in the Pacific Northwest, resigned on Feb. 1.

Charles G. Adsit, for several years advisory and consulting engineer of the executive department of the Georgia Railway & Power Company, Atlanta, Ga., has been appointed consulting engineer for all departments of the company. Mr. Adsit has been closely identified with several big engineering tasks which the company has undertaken since it entered upon the Tallulah Falls development.

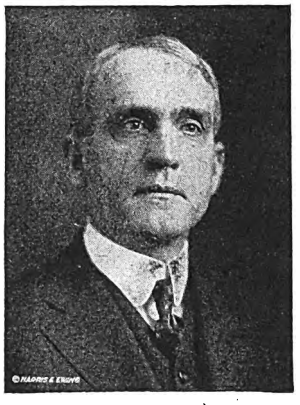
William Rawson Collier, sales manager of the Georgia Railway & Power Company, Atlanta, Ga., has been appointed operating manager of the electrical department of the company in addition to his duties as sales manager. Mr. Collier upon graduation from the Massachusetts Institute of Technology entered the consulting engineering field as junior member of the firm of Collier & Browne. In 1902 he entered the service of the Georgia Railway & Power Company in charge of the drafting department. Four years later he was appointed contract agent, resigning in 1907 to become manager of the Electric Manufacturing & Equipment Company. Upon the dissolution of this company he became associated with the B-R Electric Company as engineer, which position he held until the formation of the present Georgia Railway & Power Company, when he was appointed sales manager. In addition he became sales manager of the Atlanta Gas Light Company, manager of the Carrollton Electric Company and manager of the Suburban Gas & Electric Company, holding these two latter positions until the companies were merged with the parent organization.

Stuart Wilder has resigned from the public service companies with which he was formerly identified and has become chief engineer of the Russell, Burdsall & Ward Bolt & Nut Company, Port Chester, N. Y., Pemberwick, Conn., and Rock Falls, Ill. Mr. Wilder was born in Rockwood, Tenn., in 1872. After being graduated from Swarthmore College, he was identified with lumber and railroad interests in Tennessee for some time and then became connected with the Stanley Electric & Manufacturing Company of Pittsfield, Mass. Later he joined the staff of Sanderson & Porter, engineers and contractors of New York City, leaving to become assistant electrical engineer of the Westchester Lighting Company, Mount Vernon, N. Y. Since 1914 he has been chief electrical engineer for that company. In 1905 he was made vice-president and general manager of the Northern Westchester Lighting Company, Ossining, N. Y., and vice-president and general manager of the Peekskill (N. Y.) Lighting & Railroad Company. Mr. Wilder is a past-president of the Empire State Gas & Electric Association and a past vice-president of the New York Railways Association.

Men of the Industry

Changes in Personnel and Position—
Biographical Notes

Philip H. Gadsden of Charleston, S. C., who was chairman of the American Electric Railway War Board and is now chairman of its successor, the committee on national relations of the association, and also chairman of its committee on readjustment, has been elected vice-president of the United Gas Improvement Company of Philadelphia and will take charge of a new department of national public relations of that organization. For some time Mr. Gadsden has been president of the Charleston Consolidated Railway & Lighting Company, which is controlled by the U. G. I., but in which he is personally a heavy owner. During the war, however, he has made his headquarters at Washington, where he has attained national prominence in connection with his work in behalf of public utilities. The new activities which Mr. Gadsden is about to undertake are not expected to interfere with his continued interest in the association work. Mr. Gadsden was born in Charleston fifty-one years ago. He was educated in the schools of that city, and afterward in the South Carolina University, at Columbia. The same university has conferred upon him the degree of LL.D. He is a lawyer, and has practiced at the bar for fifteen years.



P. H. GADSDEN

Obituary

Frank Morris Baum, retired vice-president and general manager of the Portland Wood Pipe Company, who for eight years was State Senator from Spokane County, Wash., died on Feb. 5 in Pasadena, Cal.

William W. Henry, assistant electrical engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, died on Jan. 19. Mr. Henry was with the company for fifteen years. Most of that time he was investigator of the engineering division of the electrical department. He was promoted to the position he held at the time of his death but a few months ago.

Roland T. Oakes, for many years prominent in the electrical trade at Holyoke, Mass., died at Holyoke Feb. 10. He was born in Athol, Mass., in 1835. Mr. Oakes entered the electrical field in 1880 in the firm of the Amherst Motor Company, and in 1885 he retired from this organization and established an electrical store, Arthur J. Newell entering the business with him a year later. The firm was incorporated in 1892. In 1912 Mr. Oakes sold a controlling interest in the firm to Mr. Newell and retired from business. The house is one of the largest supply and contracting establishments in the upper Connecticut valley.

Henry S. Anderson, for seventeen years associated with electric lighting interests in Springfield, Mass., died recently in Toronto, Ont., at the age of forty-eight. Mr. Anderson was born in East Orange, N. J., and later attended the Massachusetts Institute of Technology. He left at the age of seventeen to enter the service of the United Electric Light Company, Springfield, as an office boy. Promotion was rapid, and he finally became general manager of the company. During the last twelve years Mr. Anderson had made his home in Toronto, where he was prominent in the electrical supply field and also in mining and other outside interests.

Philip Henry Wynne, an inventor of electrical instruments of precision, died at Deerfield, Mass., Feb. 11, at the age of fifty-one years. After a course of study in the Massachusetts Institute of Technology he entered the employ of the Illinois Steel Company at Chicago, soon joining the organization of the Thomson-Houston Electric Company at Lynn, Mass. After several years he was employed by the Boston Elevated Railway Company for about two years in varied work in the engineering department in connection with the building and electrical equipment of the rapid transit system, including calculations and tests. For ten years thereafter he engaged in the design of scientific instruments, for a time being employed by the L. E. Knott Apparatus Company of Boston. A short teaching period in the university at Austin, Tex., was followed by his return to Springfield, Mass., where he made his home for the rest of his life, spending the summer in Old Deerfield and as his health permitted devoting himself to musical composition. Mr. Wynne's inventions include precision galvanometers and an ore separator. He was a man of acute scientific insight and marked artistic genius.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

SLACK SEASON IS USED AS EDUCATIONAL PERIOD

Outside Salesmen Have Opportunity to Instruct Retailers in the Principles of Operation and Construction of Socket Appliances

One of the prominent electrical supply jobbing concerns of the country, while looking for a lessened buying activity among its customers for the next few months, still feels that salesmen can be profitably kept outside. This concern is instructing its salesmen to use this time to educate retailers thoroughly in the rapidly growing line of socket devices and other electrical appliances handled by the house. It has been some time since jobbers or manufacturers could devote any considerable time to such work. Retail distributers of electrical goods are contractor-dealers, central stations, dry-goods stores, hardware stores, drug stores, and recently it has been noticed that a prominent grocery concern in the East is distributing incandescent lamps. Thus there is a wide expansion in the field of retail distribution. It stands to reason that, outside of the central station perhaps, an amount of education by no means small is necessary if the retailing salespeople are to be fully conversant with the qualities of the lines handled. Where the first cost of the article is apparently great, as with the fan, vacuum cleaner or washing machine, the salesman must have a pretty sound education in the merits of his wares.

This practice of utilizing the present to prepare for the future has been urged upon the industry before. In this instance an idea in offered to both jobbers and manufacturers. When the time comes for big business the distributers' representatives will not have so much time to devote to such education.

CANCELLATION PRIVILEGE IS NOW BEING ABUSED

Suggestion Is Made that Electrical Manufacturers Should Require the Payment of a Cancellation Charge in Such Cases

Immediately upon the signing of the armistice in November last manufacturers began to receive cancellation orders not only from the government but also from other customers. Even where orders were supposed to be firm, cancellations came in.

Electrical manufacturers, of course, were hard hit by this situation because long deliveries had occasioned the placing of orders far in advance. On some of the large equipment, for instance, it was impossible in November to get promises of deliveries prior to 1920. Shipments of heating appliances are still taking place on back orders.

Of course, the manufacturers are really to blame for allowing the practice of cancellation to go as far as it has. To be sure, the manufacturer in the past has felt that if the customers could be accommodated without too much trouble or expense it was the proper thing to do. As a result the cancellation privilege has been abused and the manufacturers in order to protect themselves and their employees must take some vigorous action.

It has been suggested by a prominent electrical manufacturer that the remedy for this abuse is a cancellation charge. The manufacturer has been put to a certain expense in taking and holding the order. With an accumulation of orders he may have gone ahead and made arrangements for raw materials, new machinery, additional labor, additional factory space, etc. Besides, it costs a certain amount of money just to book an order and the same work to take that order off the books. Some one has to pay these charges. If the one canceling the order doesn't, the charges go against general expense and must therefore be absorbed by the customer who sticks by his contract.

The manufacturers have to pay such a charge to get out of their raw-material contracts. Only a couple of weeks ago an instance came up where a cable manufacturer paid $45,000 to be released from his cotton-yarn contract. If such is the condition, it does not seem unreasonable to require a cancellation charge of the electrical manufacturer's customer where cancellation is allowed.

PRODUCTION OF LAMPS ON PACIFIC COAST LARGE

With Local Manufacture in Full Blast the Necessity for the Trade's Carrying Large Stocks Has Greatly Diminished

Incandescent-lamp trade on the Pacific Coast has been aided materially in the last eighteen months by the fact that a lamp factory is located at Oakland, Cal. This is the only one west of Chicago, and, needless to say, it has been working at capacity during the times of abnormal demand. The 1,000,000 lamps per month which the plant turned out not only relieved the local situation materially but supplied greatly needed orders for government cantonments and navy yards. By manufacturing the stock as wanted the trade has been saved the necessity for carrying large quantities of lamps on hand, this being one of the disadvantages peculiar to the Pacific Coast trade in lines which have no Western factories.

The plant has about 500 employees. All types, including gas-filled lamps, are manufactured, excepting only the minature sizes. Shipment is made to the trade in Oregon, Washington, California and Arizona. It is a well-known fact that the Western trade is very loyal to home industry, and the Oakland plant has received much encouragement on this score. Typical of such encouragement is the California state contract, which now calls for about $20,000 worth of lamps per annum.

SOME PRICE DEVELOPMENTS OF AN INTERESTING NATURE

Certain Items with High Manufacturing Cost Increase in Spite of the Decreasing Prices of Raw Materials

Some interesting developments in the price situation have come up within the past few days. At this time, when everybody is looking for lower prices, when prices of raw materials are rapidly approaching the level of normal times, prices on certain items of schedule material have been advanced. This increase, which is on the whole in the neighborhood of 15 per cent less discount, seems to be an emphatic answer by the manufacturers to the increasing

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number of inquiries regarding the probable date of lower prices.

In the item of increased price, the element of raw-material costs is not large. A drop of 9 cents in the price of copper has no appreciable effect on the price of screw plugs, for instance. The big cost is the manufacturing cost. In other words, some reduction in the labor cost, either through lower wages or greater output per worker, seems necessary before any very great drop can come in these lines.

In some kinds of schedule material the raw-material item is, of course, an appreciable part of the cost of the finished product. In such lines it would be more natural to expect a price revision when raw materials are substantially reduced than in those lines where the cost of raw materials figures but slightly in the individual item.

It must also be remembered that the manufacturers are probably not running on 100 per cent capacity but that a number of machines are idle. This, of course, increases the overhead charges proportionately on the products turned out. In fact, it would not be surprising if this item was one of the largest factors in the price situation at the present time.

METAL MARKET SITUATION

The Price Is Still Holding Back Sales in Any Volume, Although Some Copper Moved

The price question, more than any other single factor, dominates the economic situation, according to *Dun's Review*. Purchasing only for immediate and well-defined necessities, which has continued to be the rule for several weeks in most leading branches, has brought a sharp industrial reversal, and strikes have been but a contributing cause of the steadily diminishing activities and lessening employment of labor.

Copper sold nominally at 17½ cents, but some was quoted as low as 17 cents by small producers. It declined from 1 cent to 1½ cents per pound as compared with the past week, and sales of approximately 10,000,000 lb. were recorded, including some speculative transactions. Exports amounted to 5265 tons last week, mostly to Great Britain. There was a drop amounting to nearly £5 per ton in the London market.

Import licenses for shipment of tin to this country are not yet possible. British export restrictions on tin are reported to have been lifted. Spot tin in the London market has declined £13.

Spot spelter is off slightly, as is antimony. As for old metals, no large price changes are noticeable. Scrap zinc, which increased slightly the previous week, came down to a still lower level. Heavy brass declined slightly.

NEW YORK METAL MARKET PRICES

	Feb. 10	Feb. 18
Copper:	£ s d	£ s d
London, standard spot	80 0 0	74 10 0
	Cents per Pound	Cents pr Pound
Prime Lake	18.50	17.50 to 18.00
Electrolytic	18.00	16.75
Casting	17.25	16.50
Wire base	21.75	20.75
Lead, trust price	5.00	5.00
Antimony	7.37½	7.25
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.85	6.72½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	Govt. price 33.10	31.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.50 to 15.00	14.50 to 14.75
Brass, heavy	8.00 to 8.25	7.75 to 8.00
Brass, light	6.50 to 6.75	6.50 to 6.75
Lead, heavy	4.00 to 4.25	4.00 to 4.25
Zinc, old scrap	5.25 to 5.50	4.75 to 5.00

THE WEEK
IN TRADE

INQUIRIES apparently are becoming more numerous. Orders are still of the hand-to-mouth variety and consequently are rather numerous but small. Motor-driven appliance manufacturers are ordering fractional-horsepower motors somewhat freely.

Some building projects are coming through, but it is still too early for ground to be broken. Local stocks of electrical supplies are in good shape and can adequately take care of any building that takes place.

Shipments on back orders are still going forward, but, generally speaking, this work, especially on small articles, is about completed. Local and factory stocks are again being built up, and in certain cases of small motor manufacturers are reported as being in rather good shape.

Raw-material prices are lower, but labor shows no lower cost. As a consequence some items of schedule material have advanced in price slightly. Wire, however, is again lower.

Labor is very unquiet, but local disturbances seem to be well in hand. They have, however, a bad effect on local tradesmen and thereby tend further to diminish buying.

The reports of the United States Employment Service for last week show an increase of the cities reporting heavy unemployment of 57 per cent to 58 per cent. The cities reporting the demand equal to the supply have dropped from 32 per cent to 29 per cent. Non-employment reported for last week was 321,785, an increase of 30,954.

NEW YORK

Large building projects have been more quiet than usual this week. Secretary Glass stated that it was his impression that inactivity in building trades was directly traceable, not to any insufficiency of credit, but to the continuance of abnormally high costs. Building and loan associations are endeavoring to utilize more of their large deposits in fostering private building through more advantageous relations with Federal Reserve banks and through longer mortgages on the houses. On Feb. 17 the general strike of building mechanics on contracts of members of the Building Trades Employers' Association began.

General trade conditions have not materially improved. Wire has been still lower this week, but prices on certain items of schedule material have stiffened slightly.

FLEXIBLE NON-METALLIC CONDUIT.—The market for large orders continues quiet pending opening up of building construction. Manufacturers report no ground for expectation of decline in prices regardless of drop in cotton. High labor charge continues to be the main item in that respect.

LARGE MOTORS.—One manufacturer reports several orders in the last two weeks, while other manufacturers report no movement.

SMALL MOTORS.—One manufacturer has reported good sales, another that his factory is busy with left-over orders, and a third reports nothing satisfactory.

FRACTIONAL-HORSEPOWER MOTORS.—Orders have been reported as very satisfactory, especially from manufacturers of washing machine and of office appliances.

COPPER LUGS.—A discount sheet dated Feb 1, sent out by a prominent New England manufacturer of copper-wire terminals, shows prices on certain sizes as follows: 5000 or more of one size, 45 per cent, 1000 to 4999; 40 per cent, 1 to 999, list.

SOCKET DEVICES.—Sales have not been very satisfactory on this general class of material, although certain devices in different localities have moved well. Department

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stores and jobbers have rather large stocks and on this account some are cutting prices. Washing machines and vacuum cleaners are moving in good shape. Heaters are very quiet at this time, but dealers expect large sales in the spring when furnace heating begins to fall off.

ATTACHMENT PLUGS.—One manufacturer of screw-base plugs reports an increase of $5 per 1000 in lots of 10,000. Another manufacturer makes the following changes in discounts on all plug material: Standard package, from 35 per cent to 20 per cent; broken package, from 20 per cent to 5 per cent, and less than one-fifth standard package, from list to list plus 20 per cent.

WIRE.—Rubber-covered wire has been quoted on an average lower base of 1.2 cents. One manufacturer is on a 26-cent base, two on 25 cents, three on 24 cents, four on 23 cents, one on 22 cents, and one on cost.

FLUSH PLATES.—An increase of roughly 15 per cent is being quoted on one of the well-known lines.

BOSTON

Although the volume of trade reflects dull buying, a better feeling has been noted within the past week or two in jobbing circles. Inquiries are coming in rapidly, and not a few manufacturers' agents report that they are busier on quotation and delivery data than for many months. Collections are only "so so," though nothing serious is noted in the credit department of the trade. It seems likely that the extremely open winter may lead to earlier resumption of building operations than was expected. As yet nothing remotely resembling a boom in building can be discovered, but it is a fair guess that even present prices would be unable to prevent at least a moderate expansion in this direction now that war restrictions on materials are off. The United Electric Light Company of Springfield, Mass., is completing a six-hundred-thousand-dollar switch house built on the "cost-plus" plan; a new office building is to be erected at Westfield, Mass., and some new garage construction is planned for Boston soon. Jobbers are not buying much at present, but are keeping reasonably well stocked in anticipation of revived industry. Labor conditions are rather unsettled, and at this writing some danger of a strike of telephone employees is evident. A surplus of wiremen is reported. War contract cancellations have cut into central-station loads, and policies continue conservative. Deliveries are in good shape.

FARM-LIGHTING SETS.—The winter trade has hardly come up to expectations. Prices show little change, although one fifty-light set was recently marked down about $30 by a large farm machinery house owing to a weakening in battery prices. Gasoline engines hold firm in price, and a 10 per cent increase was recently announced in a popular make for general farm use. Dealers do not look for any very rapid drop in prices, and it is predicted that the next six months will show little change. Stocks are in good shape, and vigorous solicitation of new business is planned.

LAMPS.—A temporary shortage of 50-watt and 75-watt units is rapidly being overcome. Stocks are being built up well, despite the increasing use of light in displays. Sign lighting is picking up very fast.

WASHING MACHINES.—In some cases stocks are now ahead of the retail demand, although the latter is strong and prices appear to have little effect on the turnover.

VACUUM CLEANERS.—These are moving well, and a good year's business seems to be in realization. Stocks of cleaners reflect good production conditions in manufacturing plants.

ELECTRIC RADIATORS.—Jobbers and dealers are well supplied to meet the expected spring revival of demand. Sporadic price cutting has not upset the general market much as yet.

MOTORS.—Few orders are being placed at the moment, but inquiries are very numerous, and salesmen report distinctly better feeling among customers. The second-hand motor released from war duty has not affected prices to any extent. Stocks are in good condition up to about 75 hp. Trade is improving in smaller motors.

SCHEDULE MATERIAL.—Stocks are excellent and prices are firm. Distributers are well fortified against a real "drive." The demand is rather quiet, and few large jobs are being handled just now.

CONDUIT.—New England is now getting pipe on pretty satisfactory deliveries. The latest card increased the price to the contractor about 2½ per cent, the "spread" between the price to the jobber and his selling price being regarded as too small to cover handling charges. In the two weeks small wiring jobs have shown a tendency to increase.

ELECTRIC TRUCKS.—Interest is increasing in electric road trucks and pleasure cars. There will be a display of these at the Springfield (Mass.) Automobile Show, Feb. 24-March 1, as well as at the Hartford show, Feb. 22-March 1. Service results in Springfield will be featured as the basis of a real trade opportunity, and it is believed that the time has arrived to develop this business within its proper field as intensively as the gasoline automobile is being merchandised. Local distributers report an encouraging-looking market.

INDUSTRIAL ELECTRIC TRUCKS.—Inquiries are holding up well and manufacturers are planning on a good year. Even should labor costs fall to 1914 levels, which seems doubtful, these equipments will pay for themselves in many cases in a year or two of service. Increased attention is being given to adequate engineering supervision in industrial truck applications.

CHICAGO

The housing facilities of Chicago are rapidly becoming inadequate. Real estate is being purchased for building purposes, but the owners want lower prices in building materials before they break ground. The Morton Corporation of New York is having plans prepared for a fourteen-story, 400-room hotel to be erected at a cost of about $1,500,000. Contracts will probably be let in April. Horace and Thomas Dodge, automobile manufacturers, have offered to lend the city of Niles, Mich., their old home town, $1,000,000 for the building of houses to accommodate some 600 families, to be brought there when the division headquarters of the Michigan Central Railroad are moved from Michigan City to Niles.

As illustrative of the efforts of manufacturers to keep labor employed, the Pelton Steel Company of Milwaukee is using its regular employees to equip a new steel foundry which the company has taken over. The company has not sufficient business for its present foundry just now, but expects later on to need the increased capacity of the new foundry, and every effort is being made to keep the regular employees doing some sort of work until business picks up. It is felt here that the present labor problems of the country are responsible for the large stocks of finished material being piled up by the Steel Corporation and other large manufacturers.

Jobbers report that dealers until they are sure that copper has reached its bottom price will buy only for their immediate needs. Good business is expected from Illinois utilities because the State Public Utilities Commission has canceled, as of March 1, 1919, the war rule requiring customers to pay for line extensions. So many prospective central-station customers have been holding off, waiting for such a ruling, that it will take some of the companies a long time to get service to all the customers requiring free line extensions.

WIRE.—Rubber-covered wire base is narrowing down to 25 cents, though some is still sold at 27 cents.

CONDUIT.—Conduit is holding its own, and it is expected to continue firm on account of the present needs of the navy and the extensive naval program now contemplated.

ELECTRIC FANS.—Jobbers' stocks have not yet begun to move fast.

MOTORS.—Demand is light and deliveries are normal.

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ATLANTA

Keen interest is manifested this week in the Southeast in shipping and shipbuilding industries. Details covering the formation of the South Atlantic Maritime Corporation have been made public. This corporation is composed of five South Atlantic ports, including Jacksonville, Savannah, Brunswick, Charleston and Wilmington. Extensive plans are under way to open up permanent trade lines with Central and South American ports. For a time it was thought that the building of wooden ships would be abandoned, but information from reliable sources indicates that both the Shipping Board and private plants will resume construction on a larger scale. Although the yards are comparatively quiet at present, plans on foot will create a demand for all classes of materials as great as previously experienced. The feeling that prevails at coastal cities is very optimistic and jobbers are beginning to realize the future possibilities of this trade. A large cement plant is contemplated at Demopolis, Ala.

Trade in general is about the same as last week. A few lines such as automobile accessories are highly active. The demand for horns exceeds the present supply and shipments are improving slowly. Independent telephone com panies are increasing their purchases at the price levels now prevailing.

SCHEDULE MATERIAL.—The call for all types of porcelains continues fairly steady, and a satisfactory volume of orders is being recorded for sockets. Knife switches and associated lines are moving freely and there is very little change in the demand that carried over from 1918. All transactions are based on the market and no change in price has been noted.

CABLE.—Immediate spotty requirements have brought a slight activity, but the demand will have to increase considerably before a volume of business equivalent to that for the latter months of 1918 will be transacted. Lead-covered telephone cable is off approximately 10 per cent. Freer deliveries are noted, and factory shipments have been brought down to ten days to three weeks.

LINEMEN'S APPLIANCES.—Jobbers report no let-up in the demand for tools and other apparatus; in fact, stocks are below normal and great difficulty is experienced in taking care of current needs. Factory facilities are rapidly being changed to meet commercial requirements. Prices remain firm.

INSULATORS.—Activity has lessened, but it is expected that the spring will see a resumption of buying for maintenance. Prices are holding up remarkably well and shipments are good.

CONDUIT.—The lull in trade is tending to bring stocks back to normal conditions, and last week's scarcity in certain sizes has almost vanished. A further price reduction is looked for.

POLES.—Sales have sagged off, and the present volume is sustained by independent telephone activity and increased purchases from the smaller central stations. Cedar stocks are piling up and immediate deliveries are being promised. In the face of stock surplus and lessening demand, prices have not changed.

HARDWARE.—Orders are less frequent and call for smaller quantities. This condition has no doubt resulted in bringing about the perceptible weakening in prices noted this week. Local deliveries have improved, stocks are accumulating, and factory shipments are coming through much more quickly

SEATTLE—PORTLAND

Electrical jobbing business in both Seattle and Tacoma has been virtually at a standstill owing to the strike. The volume of business since the end of the general strike is considerably improved but is still at a very low ebb. Large houses during the strike, when street railways and trucking were tied up, shipped all large orders from out-of-tow branches. Retailers have suffered heavily since the beginning of the strike difficulties on Jan. 21. During the general strike business was at an absolute standstill.

In Seattle stocks of both jobbers and dealers are reported to be in good shape. Shipments are coming through in a fairly satisfactory way, and no change in prices is noted. Steel and wooden shipyard owners and contract shops announce opening of yards and shops and resumption of shipbuilding on Feb. 19 at scale of wages in effect Jan. 21. In Seattle electrical jobbers predict within two months that independent telephone, rural power companies and prospective builders will begin buying. Since America entered the war this trade has bought for maintenance purposes only. Several power companies already have tentatively announced plans for early constructional activities, including extensions and additions.

The Portland district states that manufacturers report business during January exceeded expectations, although it did not equal that for January last year. Stock movement does not seem to be especially pronounced in any one line, but is quite general in nature. No particular large sales have been reported recently. A number of new enterprises are being seriously considered, and if these are carried out, they will require an appreciable amount of power and light equipment. Owing to the fact that manufacturers refuse to cancel orders received from their distributing agencies in the Portland district, and also to the fact that sales have been less than they were a year ago, agencies find their stocks rapidly filling up, so that they will be in good condition to care for increased business expected to develop.

SAN FRANCISCO

Although the past week's business has not been much of an improvement, still there are more hopeful signs for the future. Most building materials, such as lumber, which has been reduced 20 per cent, have decreased in value, and there have also been big decreases in standard electrical wiring material, so that it is possible that some of the urgently needed private buildings will be actually under way soon. Another encouraging feature has been some very heavy showers, which thoroughly saturated the state as far south as Fresno. Furthermore, this rain was accompanied by a snowfall on the higher Sierras that actually doubled the quantity of snow on the ground. As the prosperity of the state depends principally upon its natural products, the merchants as well as the farmers are very optimistic concerning the result of the season.

On the other hand, the labor situation is badly demoralized in the Oakland ship plants. In defiance of the orders of the leader of the boilermakers' union, the Oakland boilermakers have struck, and the immediate result has been the cancellation of $10,000,000 worth of orders for the United States government. San Francisco unions have opposed any such action, and the San Francisco labor situation is very healthy at this time.

San Francisco commercial societies are laying broad plans for additional overseas trade. For several years past traveling conditions to the Orient have been uncertain and passage difficult to secure on account of the lack of ships. The Japanese line has recently voted the construction of two 25,000-ton liners, which will be the biggest ships seen in the Pacific since the ill-fated Hill freighters. The following January, 1919, building permits are reported: Los Angeles, 649 permits, value $813,000; San Francisco, 253 permits, value $493,000; Oakland, 187 permits, value $261,000.

RANGES.—Jobbers report a number of range inquiries from central stations regarding cost and deliveries, so that they can stage several sales or assist local dealers. There are big local stocks at the present time, and the manufacturers promise quick deliveries. In regard to the mooted question of prices, a definite and official notice has been sent out to the trade by the president of a group of range manufacturers, stating that there will be no decrease in costs before April 1, and as far as can be ascertained at the present time there will be none until the latter part of the year.

WEATHERPROOF WIRE.—The Pacific Coast price on base sizes of weatherproof wire in coil lots is now $28 per 100 lb., it having gone down in one jump from $37 per 100 lb.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
1/16	250	$5.00
1/8	250	7.50
1/4	100	10.00
3/8	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25-50	35.00
2	25-50	45.00
2 1/2	25-50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25 to $78.75	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05½	1	$0.25
1/2	.06	1 1/4	.33
5/8	.09	1 1/2	.40
3/4	.12	1 3/4	.47
7/8	.15	2	.55
1	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-50.70	$24.00-35.20	$23.00-30.25
1/2-in.—	30.00-56.40	28.00-38.40	26.00-33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$60.00	$30.00	$26.00-26.50
1/2-in.—	65.00	32.00-32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08½
3/8	.08½
1/2	.08½
3/4	.11½
1	.17
1 1/4	.23
1 1/2	.27½
2	.37½
2 1/2	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.00—$36.00
Coil to 1000 ft.	25.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$26.00
1/5 to std. pkg.	13.60	21.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	70
10-amp. double-pole	50	70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.46–$0.66
No. 18, full spools	.44– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.60 to $0.90
No. 18, full spools	.53 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00–$25.00	$11.00–$17.00	$11.00–$15.00
12	21.40– 27.09	19.26– 23.22	16.05– 23.22
10	28.94– 32.40	26.06– 32.40	20.83– 27.45
8	35.82– 45.72	32.84– 45.72	28.66– 38.10
6	56.70– 72.36	51.98– 60.30	45.36– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$19.50–$20.00	$14.50–$15.00	$13.00–$14.50
12	17.50– 24.57	17.55– 24.57	17.55– 21.06
10	24.05– 32.97	24.05– 32.97	21.16– 28.26
8	33.35– 46.69	33.35– 46.69	29.35– 40.02
6	52.95– 73.71	46.60– 63.18	46.60– 52.65

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$29.75 to $34.75
25 to 50 lb.	29.75 to 34.75
50 to 100 lb.	28.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$32.75 to $35.75
25 to 50 lb.	31.75 to 34.75
50 to 100 lb.	30.75 to 37.35

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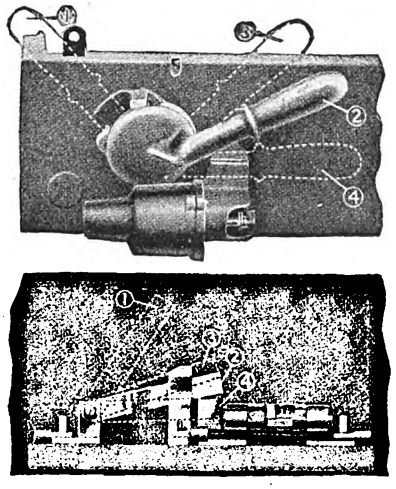
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Externally Operated Motor-Starting Switches

Recent additions to the products of the Trumbull Electric Manufacturing Company of Plainville, Conn., are its externally operated motor-starting



MOVEMENT FROM "OFF" TO "RUNNING" POSITION; 1, "OFF"; 2, "START"; 3, "RELEASE"; 4, "RUN"

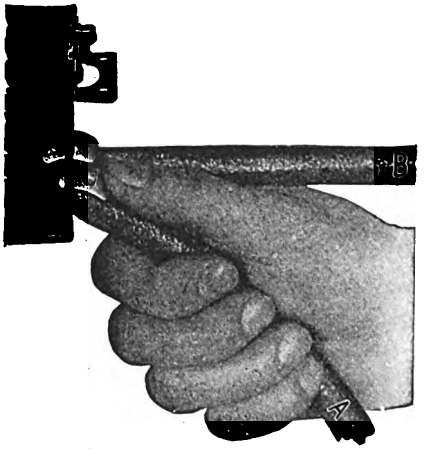
switches of the "straight-through" type furnished with either hand release or an under-voltage release coil. These switches have the safety features common to others made by this company since the box cannot be opened until the switch is in the "off" position and a catch prevents the switch from being closed with the box cover open. Hence, with fuses and blades always "dead" whenever the switch is exposed, shock and fire hazards are eliminated.

In using the new-type switches the operator throws the handle forward until it comes to a dead stop in the first or no-fuse starting contacts. When speed is up he draws the handle slightly back, about 15 deg., but not out of contact, until the plunger is released and then throws the switch forward into the second or fused running contacts. In this way the contact is never broken because the switch passes directly through starting into running contacts, and as the switch does not leave the starting contacts until it enters the running contacts there is no arc at this stage of operation. In addition, there is no arc from the running contacts when the switch is opened, since the running contacts are not used to break the current.

By pushing the button of the plunger in the under-voltage release coil the switch is automatically thrown into the "off" position. A catch kept in place by the current holds the switch in the running contacts, and when the power is off or the voltage materially reduced the switch is automatically thrown into the "off" position. When the hand release is used merely pressing the lever automatically throws the switch into the "off" position.

Loom Fastener

An improved-type flexible-tubing bushing for keeping the loom in position in an outlet box has recently been placed on the market by the K-B Manufacturing Company, 287 Second Street, San Francisco, Cal. It is shaped like an Egyptian scarab with a transverse groove on its back to engage the wall of the outlet box. The tapered ends of the fastener hold the tubing on one side while the opposite side rests against the wall. Not only is the con-

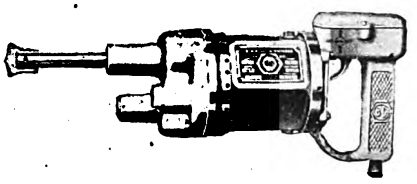


METHOD OF ATTACHMENT

nection made through the use of this device between the loom and the outlet box permanently secure, but the manufacturer also points out the simplicity of applying the bushing. The insertion of the tubing and the fastener in a "knock-out" is done from any convenient angle, and by bringing the tubing to a position at right angles to the wall of the box the fastener snaps into a positive and permanent locking grip. In this way no tinkering is necessary, the locking snap of the fastener proving that it is holding the loom to the best of its ability. There are no prongs present to injure the tubing, whose circular form is also retained, since the fastener grips the loom at three isolated points. The fastener is made to withstand a large amount of abuse in a wireman's kit or elsewhere without suffering injury.

Valve Grinder with Pistol Grip and Trigger Switch

To supplant the old laborious method of grinding valves by hand the Black & Decker Manufacturing Company of



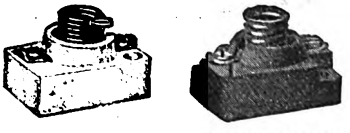
DIFFERENT TYPE VALVES MAY BE GROUND

Baltimore, Md., has recently developed an electrically driven valve grinder. The spindle of the new device is said to oscillate with a long steady sweep similar to the movement obtained in hand grinding but many times more rapid. The pistol grip and trigger switch are employed and make it possible to operate and control the grinder in a very convenient manner. An air-cooled ⅛-hp. motor is used and operates on standard circuits of either alternating current with a range of 25 to 60 cycles or direct current, being made for 110, 220 and 32-volt circuits.

The motor and gearing, together with the reciprocating mechanism, are completely inclosed in an aluminum housing, the gearing and oscillating movement being separated from the motor compartment and packed in grease. The grinding spindle runs in a ball thrust bearing, the armature shaft runs on Norma ball bearings, while the gears are mounted on shafts ground to size and supported at both ends in long phosphor-bronze bushings. The tool is adaptable to various types of valves, bits for this purpose being provided.

Candelabra Cleat Receptacles

The wiring devices made by the Bryant Electric Company of Bridgeport, Conn., have recently been sup-



VIBRATION DOES NOT LOOSEN THE BULB FROM THE CONTACTS

plemented by new candelabra cleat receptacles which conform to National Electrical Code standards. They are made with a regular spun-copper screw shell and also with a shell of spring

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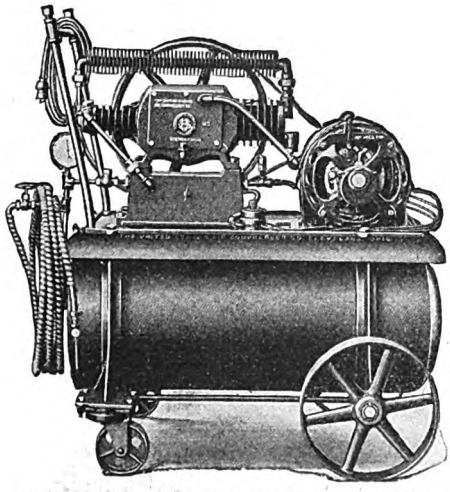
wire which expands as the lamp base is threaded into it. The tension of this spring wire is stated to be more than sufficient to prevent the lamp becoming loosened when subjected to great vibration and jar. The base of the block is made of high-grade molded composition of the character approved by the United States Navy and is said to be amply strong to withstand very severe service. The new receptacle is applicable for use where it is necessary to illuminate instruments in the cabs of railroad locomotives, on board vessels, etc.

Two-Stage Portable Air Compressor Outfit

Many uses for the new "Usaco" two-stage portable air-compressor outfit are mentioned by the maker, the United States Air Compressor Company, Cleveland, Ohio. Dust and oil which accumulate in electrical machinery, and which if neglected may cause short-circuiting, can be cleaned from machines by this compressor more quickly and thoroughly than by hand cleaning with rags and bellows. The device is also adapted to clean textile or other machinery with delicate parts, where dust, lint or grit impairs efficiency and hastens deterioration. The outfits are also useful in removing soot from tubes of heating boilers and for various other services requiring high-pressure air.

The compressor is self-oiling and is furnished with a balanced check valve to prevent air leakage, a filtering trap and a safety valve as well as a reducing valve. It is mounted on a metal base and is belt-driven by a motor for any current. An idler and belt tightener are installed, and further adjustment can be secured by turning a screw which moves the motor along the slotted base. Motors for alternating current are equipped with a pressure release, permitting them to start against no pressure and thus eliminating any possibility of burned-out motors or fuses. A 20-gal. (76-l.) tank, equipped with wheels, supports the rest of the machinery, which also includes 25 ft. (7.6 m.) of armored hose, a push-button air nozzle, a pressure gage, a needle valve, 15 ft. (0.46 m.) of electric cable, a switch and a plug.

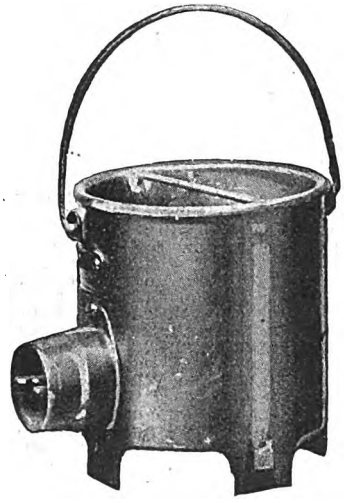


USEFUL IN CLEANING ELECTRICAL AND OTHER MACHINERY

This outfit, it is said, will operate continuously against 100 lb. (7 kg.) pressure without overheating. The tank regularly furnished is tested to 200 lb. (14 kg.) working pressure, but tanks for higher pressures can be supplied. The tank capacity of this machine is said to be sufficient to store air from fifteen to thirty minutes, depending upon the size of nozzle used and the pressure delivered. A regulating valve permits a tank pressure of from 150 lb. to 200 lb. (10.5 kg. to 14 kg.) to be delivered at the nozzle by simply turning the adjusting screw. An automatic control can be furnished with this outfit if desired so that the compressor is started and stopped automatically, maintaining the tank pressure at the desired point.

Dry-Type Glue Pots

A number of advantages and points of improvement are claimed for the new dry-type electrically heated glue pots made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., over other ways of heating glue. There is no water bath in the new pots and consequently no water to evaporate and cause the heater to burn out and the glue to burn. The dry type having a single-heat constant input heater, there is no necessity for two heats, "high" and "running," since the temperature is the same for continuous operation. No energy is required to heat a water bath before the glue is heated, resulting in more economical operation. Time is also saved since the glue is heated directly without heating a water bath first. In addition, the advantage of eliminating the inconvenience and sloppiness attending a water bath which has to be constantly added to is pointed out.



NO ENERGY WASTED IN HEATING WATER BATH

These new dry-type pots are made in three sizes, 1-pt. (0.47-l), 1-qt. (0.9-l.) and 4-qt. (3.8-l.) and are rated respectively at 60, 80 and 140 watts. The spun-copper glue vessel fits snugly into the sheet-steel bottom plates so as to make proper thermal contact with the heating element, which is an integral part of the sheet-steel bottom plates. Underneath the heater is placed an extra steel plate with a dead-air space between to keep the heat generated in the heating element from being conducted downward from the pot. The heater itself is said to maintain the glue at the correct working temperature when the pot is being operated continuously. Consequently whether the glue is being used or not, no danger of overheating is present. Fifteen minutes is the approximate time taken to bring the glue to the proper temperature for use. These dry-type pots are supplied with cord and plug for connection to a lamp socket.

Locking Lamp Guards for Reflectors

A new line of locking lamp guards for use with reflectors is about to be placed on the market by Harvey Hubbell, Inc., Bridgeport, Conn. As shown in the accompanying illustrations, they are radically different in design from the other types made by this company, but are said to possess the same rugged strength due to the strong steel wires and electrically welded joints. The locking device, operated by a special key, draws the guard tight around the reflector, making the two parts practically one unit and insuring the protection of the lamp against both breakage and theft. These guards can be readily adapted to slight variations in reflector sizes.

GUARD ATTACHED TO A STEEL REFLECTOR

Recent Appliances

Lighting Unit

The Bullock Manufacturing Company with offices at 408 West Thirteenth Street, New York City, has placed on the market a dust-proof lighting fixture with a diffusing bowl of daylight glass.

Vacuum Cleaner with Comb

A positive suction cleaner made in two sizes, one having a larger nozzle than the other, and which uses a special comb instead of a revolving brush, has been placed on the market by the Maytag Company of Newton, Iowa.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An electrical engineer in France (No. 28,357) desires to purchase large quantities of electrical accessories and requests quotations on these goods. Correspondence may be in English.

A firm in Denmark (No. 28,320) desires to purchase and also secure an agency for the sale of electric motors of 220 volts and 110 volts, direct and alternating current and electric bulbs. Quotations should be made f.o.b. New York. Terms cash. Correspondence may be in English.

A company in India (No. 28,335) desires to purchase and to obtain an agency for the sale of electrical goods.

A man in France (No. 28,345) wishes to secure agencies for the sale of railway materials and electrical apparatus. Correspondence should be in French.

A man in Italy (No. 28,316) desires to secure an agency for the sale of electrical materials. Correspondence in Italian.

A firm in Australia (No. 28,287) wants agencies in a number of lines including electrical sundries.

An electrical supply firm in Belgium (No. 28,290) desires to be placed in communication with firms for the purchase of electrical appliances, electrical machines, machine tools worked by electricity, insulating material, conductive wire, lamps, glassware, etc. Catalogs and price lists are requested. Correspondence should be in French.

A firm in Belgium (No. 28,294) wishes to be placed in touch with manufacturers of electrical material.

A wholesale dealer in France (No. 28,296) desires to secure an agency for the sale of electric motors and supplies. Correspondence may be in English.

A man in Norway (No. 28,297) desires to purchase or secure an agency for the sale of copper wire and cable. Correspondence may be in English.

An agency is desired by a firm in Switzerland (No. 28,303) for the sale of motors, telephone apparatus, high-tension equipment and insulators. Correspondence should be in French or Italian.

A man in Norway (No. 28,305) desires to purchase electrical apparatus and supplies, light, heat and power service, lead, and steel and copper wire and cable. Terms, cash against documents at destination. Correspondence may be in English.

Alexander Smith, Ltd., Bulletin Place, Sydney, Australia, wishes to enter into correspondence with American manufacturers of electrical apparatus and electrical household appliances with a view to securing representation in Sydney for up-to-date lines.

James J. Niven & Company, Ltd., Wellington, New Zealand, P. O. Box 579, wants to secure sole New Zealand representation for an American line of electric motors.

BRITISH STORAGE BATTERY CONSOLIDATION.—The New Peto & Radford Accumulator Company and the Pritchett & Gold and Electrical Power Storage Company, Ltd., have amalgamated interests. These firms, which have been prominent in the British manufacture of storage batteries for some time, expect a largely increased business.

POLISH COMMERCIAL BUREAU.—There was opened on Jan. 1 the Commercial and Industrial Bureau of the Polish National Department with the object of helping to start commercial connections between the United States and Poland and of collecting all data and information which should form a basis for the work of the future official Polish commercial agencies in the United States and facilitate mutual economic relations. The bureau will be glad to send any information concerning trade conditions and business possibilities in Poland.

ITALIAN GOVERNMENT SPECIFICATIONS FOR ELECTRICAL MACHINERY.—The Italian *Gazetta Ufficialle* for Dec. 12, 1918, according to Trade Commissioner O. M. Smart, published a decree announcing that the standards of the Italian Electrotechnical Association for 1916 will be followed in the specifications of electrical machinery for the government. The regulations are printed in detail and include conventional signs, terms, definitions and instructions for bidding on government work.

A. E. G. REPORT.—The report of the Allgemeine Elektrizitäts-Gesellschaft of Germany for the financial year of 1917-18, as noted in the London *Electrical Review*, states that the company, although working on government orders, at the same time had preparations made for work on peace manufactures in the ordinary departments, and in this connection it was frequently possible, with lasting advantage, to meet the scarcity of materials by the use of substitutes. The report stated that the organization in Germany and in those foreign countries which could be reached had worked satisfactorily, and no ousting of the company's manufactures from accessible markets had anywhere taken place.

LARGE BRITISH MANUFACTURING CONCERN TO EXPAND.—At the annual meeting of the Edison Swan Electric Company, Ltd., of England it was stated that the board of directors had in view a general policy of expansion, feeling as it did that in the near future, if the company intends to hold its own, it must be in a position to supply direct from its own factory every class of electrical material from the smallest to the largest. To do this a bid for capital is going to be issued at an early date. In connection with the scheme of expansion at that time the company had practically concluded negotiations for obtaining a large interest in a well-known and old-established firm of cable and electrical wire manufacturers. Negotiations also are being carried on which, it is stated, if successful, will give the company an important interest in the manufacture of all classes of heavy electrical machinery.

NEW ENGLAND WILLARD STORAGE BATTERY CONVENTION.—Sixty New England service station representatives of the Willard Storage Battery Company convened at Lorimer Hall, Boston, on Feb. 11 and 12. The convention is the second of fifteen which are being held in all parts of the country in the period from Feb. 6 to April 8 inclusive, trade and service topics forming the chief subjects of discussion. The Boston program of the opening day included the following events: Registration; address, "How Is Your Gravity?" by Hobart A. Adams, district manager, New York City; "Taking an Inventory of Ourselves; Our Responsibility to the Public; What Should We Do in the Future?" by W. W. Wyneken, sales manager, Cleveland, Ohio; "The Personal Element in Business," by H. S. Bentley, manager of sales promotion, Cleveland; the Willard film, "Opportunity," and an open discussion by service-station owners and managers on "Making Satisfied Customers," and "How to Avoid Lost Sales." The second day opened with a discussion on "How to Get Dealers' Co-operation," "When to Repair" and "The Still Better Willard Battery," which was scheduled to occupy practically the entire morning. The afternoon session was planned to include a motion-picture trip through the Willard factory, an address, "Facts and Figures in a Willard Service Station," by W. W. Wyneken, and a closing reel entitled "Through Service We Grow." Mealtime announcements on the program made a hit from the battery man's standpoint as follows: "Recharge," "Free Testing and Filling Service," and "Inspection of Plates." The first convention was held at Cleveland Feb. 6 and 7, and dates assigned for the succeeding meetings were: New York City, Feb. 13-14; Detroit, Feb. 17-18; Chicago, Feb. 20-21; Indianapolis, Feb. 24-25; Atlanta, Feb. 27-28; Dallas, March 3-4; Kansas City, March 6-7; Denver, March 11-12; Los Angeles, March 17-18; San Francisco, March 20-21; Portland, Ore., March 25-26; Butte, March 31-April 1; Minneapolis, April 7-8.

THE SQUARE D COMPANY has removed its San Francisco offices to 324 Rialto Building.

W. S. ECKART has been elected vice-president in charge of sales of the National Conduit & Cable Company.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces that three-phase motors of 1-hp. and 2-hp. sizes for 110 volts and 220 volts, 60 cycles, are now carried regularly in stock.

THE CANADA WIRE & CABLE COMPANY, LTD., Toronto, it is reported, will exhibit at the Lyons, (France) fair, to be held in March next.

THE BLAW-KNOX COMPANY announces that its San Francisco office has been removed from its warehouse at 528 Second Street to 630 Monadnock Building.

F. M. HIBBEN has resigned from the Cleveland Electric Illuminating Company after eleven years of service to become vice-president of the Cleveland Armature Works.

THE LEWIS ELECTRICAL SUPPLY COMPANY, Boston, announces that John B. Ward, formerly manager of the company, terminated his connection with it on Feb. 3.

ANDERSON PACE has been appointed director of advertising of the Mercury Manufacturing Company, Chicago, manufacturer of electric industrial tractors, effective Feb. 15.

H. BOKER & COMPANY, 101 Duane Street, New York City, who have been importing a line of Italian fans, motors, dynamos, etc., since 1916, are liquidating their electrical department.

THE UNITED ELECTRIC SUPPLY COMPANY, Boston, writes that it intends to continue and intensify its selling campaign during the current year, which it has every reason to believe will be its banner year.

DANIEL J. GILBERT has been appointed Eastern sales representative of the Fafnir Bearing Company, New Britain, Conn. Mr. Gilbert was previously superintendent of the grinding department of the company.

S. P. RUSSELL has resigned as manager of the electrical department of the H. W. Johns-Manville Company of San Francisco and purchased an interest in the firm of H. B. Squires, manufacturers' agent, San Francisco.

THE FRED W. L. FULLERTON COMPANY, INC., and the Fullerton Electric Company, electrical merchandisers, have removed from 21 East Twenty-second Street to larger space at 15 West Twentieth Street, New York City.

THE EPPING-CARPENTER PUMP COMPANY, Pittsburgh, Pa., announces that Theodore R. Hermanson, formerly of the Harrison Works of the Worthington Machinery Corporation, has become associated with it as works manager.

WARREN WEBSTER & COMPANY, manufacturers of power-plant specialties, Camden, N. J., announce the opening of their Texas office at 805 Sumpter Building, Dallas, Tex., with W. B. Irwin in charge as district representative.

F. A. PUTT, formerly with the General Electric Company and the Clyde Iron Works, is now department manager for Edward Jobbins, Marquette Building, Chicago, where he handles railway, power and contractors' equipment and supplies.

DR. MILTON W. FRANKLIN, for several years consulting engineer for E. P. Houghton & Company, Philadelphia, has resigned to become associated with the Remy Electric Company of Anderson, Ind. On Jan. 21 Dr. Franklin was given a farewell dinner by his associates in Philadelphia.

THE CHANDEYSSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is now completing its factory buildings, which will be equipped to produce motors and generators. This company's product it is reported, has been manufactured by the Pan Electric Manufacturing Company under license.

THE DUPLEX LIGHTING WORKS OF THE GENERAL ELECTRIC COMPANY have established headquarters for "Duplexalite" at 6 West Forty-eighth Street, New York City, with Rex J. Cole as manager. This organization specializes in a line of light-diffusing units which can be used with Mazda C lamps only.

H. H. SKINNER, formerly of the power engineering bureau of the sales department of the Narragansett Electric Lighting Company, Providence, R. I., is now representing the Westinghouse Electric & Manufacturing Company in Rhode Island and eastern Connecticut. Mr. Skinner is well known in the New England central-station field. He was at one time actively identified with electric vehicle development on behalf of the Narragansett company. His headquarters are in the Union Trust Building, Providence.

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THE MANHATTAN ELECTRICAL SUPPLY COMPANY, INC., New York City, showed an increase in gross sales last year of about 6½ per cent. The gross sales for 1918 were $5,836,632 and for 1917 $5,483,472.

THE ISCO MANUFACTURING COMPANY, manufacturer of refrigerating machinery including electrical refrigerators, is about to remove its business from Detroit to Chicago, where it has leased 60,000 sq.ft. of floor space in a building on the northeast corner of Clybourn Avenue and Terra Cotta Place.

THE EDISON ELECTRIC APPLIANCE COMPANY, Chicago, has announced plans for a large expenditure in publicity for the current year. Orders have been placed for space in national magazines and weeklies of largest circulation. The advertisements, it is stated, will appear in more than 18,000,000 copies of these publications.

THE CROUSE-HINDS COMPANY is now represented on the Pacific Coast by F. A. Gerhart, with headquarters at San Francisco. Mr. Gerhart succeeds George A. Gray, who resigned from the company after nine years' service. Mr. Gray has started a manufacturers' agency in the Sheldon Building, San Francisco, where he expects to represent electrical manufacturers.

VALENTINE J. BURGER, D.S.C., first lieutenant, aviator observer with the French and American air forces, has recently returned to the Standard Underground Cable Company, where he resumes charge as the New York manager of exports. He was the guest of honor at a presentation

FIRST LIEUT. V. J. BURGER

luncheon tendered by the New York officers of the company on Feb. 13 at the Railway Club. C. J. Marsh, vice-president of the Standard Underground, acted as chairman, and with him were T. L. Wiley, Eastern manager, R. S. Hopkins, assistant Eastern manager, and other members of the New York construction, sales and office force. Lieut. Burger received the distinguished service cross, the French croix de guerre with palm and star, and is cited for oak leaf to the D. S. C., another palm to the French cross and for the Congressional medal of honor. He rendered repeatedly distinguished service under great personal danger and has been officially credited with three Boche planes.

LE ROY SCOTT, formerly engaged in sales promotion work for the storage-battery division of the National Carbon Company, Cleveland, Ohio, is now acting as consulting engineer for the storage-battery department of the company's San Francisco office and as manager of the electrical and battery department of the company in Los Angeles, Cal.

PAUL CAMPBELL has been appointed factory manager of the Electric Service Supplies Company of Philadelphia. Through the greater part of 1918 Mr. Campbell was connected with the New York district office of the Bureau of Aircraft Production as a special investigator of production problems in the New England States, previously having been production manager for James Cunningham, Son & Company, Rochester, N. Y., and superintendent of the F. B. Stearns Company, Cleveland, Ohio.

H. G. STEWART, who was formerly with the engineering firm of Sargent & Lundy, Chicago, has joined the sales forces of the Electro Magnetic Tool Company, 2902 Carroll Avenue, that city.

JAMES N. HATCH, consulting engineer, Chicago, has formed an association with Henry C. Eckland, formerly Eckland, Fagard & Knapp, as Henry C. Eckland & Company, architects and engineers. Mr. Hatch, however, will continue his consulting practice of public utility and industrial engineering as heretofore.

BROWN, HANSON & BOETTCHER were dissolved Dec. 31, 1918. Charles A. Brown, Arthur H. Boettcher and John A Dienner continue the practice of patent, trademark and copyright law at 1550 Monadnock Block, Chicago, under the firm name of Brown, Boettcher & Dienner. Brown, Boettcher & Dienner will also continue the Milwaukee office at 1136 Wells Building.

THE POWDERED COAL ENGINEERING & EQUIPMENT COMPANY, Chicago, announces that John F. Nealis and Lester E. Armstrong have become associated with the company as advisory engineers. Mr. Nealis was formerly in charge of research work for the United States Steel Corporation, and Mr. Armstrong was associated with Babcock & Wilcox. Both men have been in the Air Service.

Trade Publications

VALVE GRINDERS.—The B. F. S. Manufacturing Company, Worcester, Mass., is distributing a circular on its heavy-duty and "baby" electric valve grinders.

COMPRESSOR.—Bulletin No. 119, which has for its subject the various models of air compressors made by the Globe Manufacturing Company of Battle Creek, Mich., has been distributed by that company.

INDUSTRIAL TRUCKS.—The Industrial Truck Company, division of the Cowan Truck Company, Holyoke, Mass., has prepared bulletin No. 28 about its electric industrial truck with an elevating platform.

CANOPY RING.—A circular giving detailed information about the new "Non-Twist" canopy ring for use in the connection of fixtures has been got out by the Non-Twist Canopy Ring Company, Toronto, Canada.

AUTOMOBILE BULBS.—An automobile lamp-bulb guide has been issued by the A. C. Mannweiler Company, Fort Wayne, Ind., and gives the proper lamp made by it for different types and models of gasoline passenger cars.

CLAMSHELL BUCKETS.—The Lakewood Engineering Company, Cleveland, Ohio, has issued bulletin No. 26. Its twenty-one pages are devoted to a general description and illustrations of this company's clamshell buckets.

AIR COMPRESSOR.—Four models of the electrically driven air compressors manufactured by the General Utility Company, 1326 Ogden Street, Philadelphia, are the subject of a folder entitled "The Low Cost of Cool Air" issued by this company.

VEGETABLE PEELERS.—The Maxim Manufacturing Company, 700 West Twenty-second Street, Chicago, has issued an illustrated circular on its "Sim-Peel-O" electrically driven peeling machines, knife polishers, butter cutter and potato masher and creamer.

AIR COMPRESSOR.—The "Usaco" two-stage portable air-cleaning motors, generators and similar machinery, an outfit which can be used for cleaning and has other applications, is described in a folder issued by the United States Air Compressor Company of Cleveland.

FLEXIBLE VARNISHED TUBING.—A card containing two samples of the new flexible varnished tubing made by the Irvington Varnish & Insulator Company, Irvington, N. J., and bearing a table of the different sizes of wire this tubing covers, is being distributed.

SAWING, FILING AND LAPPING MACHINES.—Four styles of sawing, lapping and filing machines are illustrated, described and priced in a recently issued leaflet from the Oliver Instrument Company of Adrian, Mich., which makes these machines.

PORTABLE ELECTRIC DRILLS.—The Black & Decker Manufacturing Company, Baltimore, Md., has recently prepared a folder relating the advantages of its portable electric drills.

CENTRIFUGAL TURBO BOILER FEED PUMP.—A new booklet setting forth the features and advantages of type CCC Coppus centrifugal turbo boiler-feed pumps has just been issued by the Coppus Engineering & Equipment Company, Worcester, Mass., which will supply copies upon application.

SCALE FOR FLEXIBLE COUPLINGS.—The "Selectometer," a device consisting of two separate cardboard circles mounted on a common center and forming a rotating scale for determining the correct size of "Francke" flexible coupling for different drives, has just been got out by the Smith-Serrell Company, 90 West Street, New York City. This concern, which is the general sales agent for the Francke Company, will send a "Selectometer" to those making requests.

WIRING DEVICES.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has just prepared a new sixty-four-page catalog entitled "C-H Wiring Devices; Push-Button Specialties," which is intended for distribution to jobbers, dealers, contractors, central stations and others interested. Push sockets, switches, conduit fittings, plugs and receptacles form the general subjects listed and described, space being devoted to the many different types made by this concern.

BOILERS.—The Heine Safety Boiler Company of St. Louis, Mo., has just completed printing the latest edition of its booklet, "Boiler Logic," which is an eighty-six-page well-illustrated treatise on steam boilers. Some of the main divisions of this book are "Some Fundamental Considerations of Boiler Design," "Practical Baffling of Water-Tube Boilers," "Heine Boilers for Different Fuels," "Firing and Services," "Overloads," "The Boiler as a Pressure Vessel," and "Details of Construction in Heine Boilers." This publication should prove of interest to all those concerned with steam-boiler engineering.

New Incorporations

THE FOREST ELECTRIC COMPANY of Arlington, N. J., has been incorporated with a capital stock of $15,000 by James K. Elderin, John W. Oliver of Newark and Daniel T. Dobyns of East Orange.

THE MURRAY WIRE COMPANY of Newark, N. J., has been incorporated by J. H. Murray, P. Igoenan and J. R. Cooney. The company is capitalized at $125,000 and proposes to manufacture wire products.

THE YANKEE BATTERY COMPANY of San Diego, Cal., has been incorporated by C. D. James, C. C. Benjamin and W. E. Zelley. The company is capitalized at $75,000 and proposes to manufacture electric batteries.

THE ROCKFORD FAN COMPANY of Utica, N. Y., has been chartered by M. Rockford, W. F. Bond of Utica and W. H. Clove of Rome. The company is capitalized at $100,000 and proposes to manufacture electric fans, etc.

THE DIXIE BATTERY & MANUFACTURING COMPANY of Pine Bluff, Ark., has been incorporated with a capital stock of $12,000 by Leo C. Graham, H. A. Irish and Arthur Graham. The company proposes to manufacture batteries.

THE UNION MACHINE COMPANY of Louisville, Ky., has been incorporated by Harry and Ray Buckley and M. L. Kannapell. The company is capitalized at $15,000 and proposes to manufacture milling machinery and electrical devices and conduct a brass foundry.

THE TIDEWATER ELECTRIC COMPANY of New York, N. Y., has been incorporated by P. E. Matteson, C. Bohling and W. H. Shotwell, 91 Monroe Street, Brooklyn, N. Y. The company is capitalized at $6,000 and proposes to manufacture electrical specialties, etc.

THE SAFETY IMPULSE STARTER COMPANY of Harrisburg, Pa., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,500,000 to manufacture starting and lighting equipment for automobiles and trucks. The incorporators are E. M. Jauss and M. C. Miller.

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New England States

YARMOUTH, ME.—The town of Yarmouth has petitioned the State Legislature for an amendment of its charter authorizing the town to supply gas and electricity.

BOSTON, MASS.—Bids will be received by B. Leighton Beal, secretary of Transit Department, city of Boston, until Feb. 25 for furnishing and installing roof lights in the Massachusetts Avenue surface station of the Boylston Street subway. Specifications and forms of contract may be obtained at 15 Beacon Street, ninth floor.

CLINTON, MASS.—The office building and power plant of the Metropolitan Water and Sewerage Board below the Wachusett Dam were destroyed on Feb. 17 by an overflow of water due to the breaking of the iron work in one of the large hydroelectric turbines within the plant's section of the works.

HOLDEN, MASS.—The installation of a fire-alarm system in Holden is under consideration.

LEOMINSTER, MASS.—The City Council is considering the question of establishing a municipal electric light plant.

MARLBORO, MASS.—The Marlboro Electric Company has authorized the erection of a new electric transmission line between the Marlboro station and the generating station at the Metropolitan reservoir at Fayville and also many practicable changes in the street lamps on Main Street as may be determined upon by the Mayor and the Council Committee.

NEW BEDFORD, MASS.—Bids will be received in the spring by the city of New Bedford for construction of hospital group on Mount Pleasant, Myrtle, Van Buren and Jefferson Streets, to include ward and operating buildings, laundry and power house, to cost about $100,000. J. S. McIntyre, 22 Clifford Building, is architect. H. T. Borden, 154 Fair Street, is chairman of committee.

SOUTH BOSTON, MASS.—Bids will be received by the Commission on Waterways and Public Lands, Room 473, State House, Boston, until Feb. 26, for furnishing and installing ready for operation electric distribution systems for electric power and electric lighting, including large lead-sheathed copper cables and junction boxes for power, and small transformers, conduit, wiring, fixtures, etc., for interior lighting in pump house, at the dry dock which the Commonwealth is constructing at South Boston. Frank W. Hodgdon is engineer.

PROVIDENCE, R. I.—The United States Shipping Board is planning to erect a building, 60 ft. by 304 ft., for machine shop and office at the new marine railroad at Fields Point.

Middle Atlantic States

BROOKLYN, N. Y.—The Board of Trade, Bedford Section, is said to be considering plans for improvements in the electric street-lighting system on Nostrand Avenue and Fulton Street in this district.

BUFFALO, N. Y.—Plans are under consideration by Arthur W. Kreinheder, commissioner of public works, for various municipal work during the present year, including the completion of the large power station on Porter Avenue.

CREEDMOOR, L. I., N. Y.—Arrangements are being made by the State Hospital Commission, Capitol, Albany, for the erection of a group of hospital buildings at Creedmoor, to be used in conjunction with the Brooklyn Hospital for the Insane. Large quantities of electrical equipment, it is understood, will be required.

KINGSTON, N. Y.—Arrangements are being made by the Hudson Power Corporation for the construction of a new electric power plant to be located on the Wallkill River, near New Rifton. This company, it is understood, is affiliated with the Kingston Gas & Electric Company. The J. G. White Engineering Corporation, 43 Exchange Place, New York, is engineer.

MOHAWK, N. Y.—Plans are being prepared for the construction of a new hydraulic power plant to be used in connection with the operation of the Barge Canal. W. W. Wotherspoon is superintendent of public works; Frank W. Williams, Telephone Building, Albany, is state engineer.

NEW YORK, N. Y.—Contract has been placed by the United Electric Light & Power Company with the Westinghouse Electric & Manufacturing Company for an additional 22,000-kw. turbo-generator, with the necessary condenser and auxillary apparatus, to be delivered late in 1919, for installation in the 201st Street station of the company. With this additional unit the station will have a generating capacity of 129,000 kw.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NIAGARA FALLS, N. Y.—Contract has been awarded by the Union Carbide Company, Union Street, to the J. F. McKinney Company, Union Street, for the construction of an electric station, about 53 ft. by 139 ft., to cost about $45,000.

SALAMANCA, N. Y.—Arrangements are being made to begin work on the installation of a new 350-hp. engine in the municipal electric power plant.

SANGERFIELD, N. Y.—The Public Service Commission has granted the Waterville (N. Y.) Gas & Electric Company permission to erect an electric transmission line from Waterville to Sangerfield.

WARD'S ISLAND, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until March 4 for dining-room accommodations for patients in main building, including construction work, heating, sanitary and electric work at the Manhattan State Hospital, Ward's Island, N. Y. E. S. Elwood is secretary of State Hospital Commission.

EAST ORANGE, N. J.—Plans are under consideration by the City Council for the installation of a new electric street lighting system on Central Avenue and Main Street. The service will be supplied by the Public Service Electric Company.

NEWARK, N. J.—Plans are under consideration by the Hillside Township Committee for the installation of a new street-lighting system on Fairbank, James, Bond, Clark and Virginia Streets and Coe, Roanoke and Ridgway Avenues.

NEWARK, N. J.—Electrically operated equipment, it is understood, will be installed in connection with the proposed development of watersheds at Wanaque and Pequannock, for which bond issues for $500,000 and $300,000 respectively have been disposed of by the city.

NEW BRUNSWICK, N. J.—Considerable electrical equipment will be required in connection with new construction of the proposed new Albany Street drawbridge, to cost about $128,575, now under consideration by the Board of Freeholders.

TRENTON, N. J.—Plans, it is understood, are being considered by the Council for the installation of new pumping equipment at the Riverside Heights and Fair Street sewage-pumping station.

VERONA, N. J.—The Board of Chosen Freeholders has engaged Runyon & Carey, 845 Broad Street, Newark, as consulting engineers, for electrical, heating and ventilating work in connection with the construction of the proposed group of five one-story hospital buildings at the local Hospital for Tubercular Diseases. The cost is estimated at about $120,000.

HARRISBURG, PA.—The Public Service Commission has granted the Harrisburg Light & Power Company permission to issue $215,000 in notes and $35,000 in bonds.

MEADVILLE, PA.—Contract has been awarded by the Meadville Malleable Iron Company for the construction of a new power plant at its works to the Harper Building & Lumber Company, to cost about $10,000.

PHILADELPHIA, PA.—Plans have been prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for additions to shops Nos. 2 and 3 at the League Island Navy Yard, Philadelphia, to cost about $325,000.

PHILADELPHIA, PA.—Plans have been prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the erection of a substation at Piers A and B at the League Island Navy Yard (Specification 3796).

TORRANCE, PA.—The board of trustees of the Western State Hospital for the Insane is considering plans for the construction of a new group of hospital buildings, to cost approximately $2,000,000. A large power plant and mechanical laundry building are included in the plans. Samuel S. Richard of Altoona is chairman of board.

UPPER DARBY, PA.—Contract has been awarded by the Philadelphia & Western Railway Company for the construction of two electric substations at its properties at Villa Nova and Beechwood. H. P. Friend, Boyer Arcade, Norristown, has the contract for the erection of the buildings.

BALTIMORE, MD.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 3, for furnishing the labor required in the construction, complete, including heating, plumbing, electric conduits and wiring, with materials that will be furnished by the government, of hospital unit A-special, hospital unit B-1, the attendants' quarters, additions and changes in the kitchen and mess hall, at the United States Marine Hospital at Baltimore, Md. Bids will also be received at the same time and place for furnishing electrical and lighting materials for the hospital unit A-special, hospital unit B-1, the attendants' quarters, additions and changes in the kitchen and mess hall, and for outside services at the United States Marine Hospital at Baltimore. Drawings and specifications may be obtained from the custodian or from the above office.

CUMBERLAND, MD.—Revised plans are being prepared for the proposed rubber-tire factory to be erected in Cumberland by the Kelly-Springfield Tire Company of Akron. Bids for construction will probably be received in April or May. The original plans provided for an expenditure of $5,000,000 for land, buildings, equipment, power plant, electric lighting system, etc. Construction work was delayed on account of the war. Harry B. Blanchard of Akron, Ohio, is the company's engineer; D. S. Diescher & Sons, Farmers' Bank Building, Pittsburgh, Pa., are consulting engineers.

BECKLEY, W. VA.—Contract, it is reported, has been awarded by the Virginian Railway Company for the construction of a power plant which, when completed, will furnish electricity along its system from Elmore to Clarks Gap, a distance of 14 miles. H. Fernstrom of Norfolk, Va., is chief engineer.

WILLIAMSBURG, VA.—The Williamsburg Power Company, it is reported, would like to receive prices on generators and boilers.

WASHINGTON, D. C.—The Potomac Electric Power Company has recently completed the extension to the turbine and boiler rooms at its Bennings plant, consisting of the installation of one 15,000-kw. Westinghouse turbo-generator and Worthington surface condenser, and also six 1000-hp. Babcock & Wilcox boilers, with Taylor stokers, together with coal and ash-handling equipment, boiler-feed pumps, heaters, etc. Plans have been completed and contracts are now being awarded for the second extension of the turbine room, consisting of the installation of one 20,000-kw. General Electric turbo-generator and Worthington condenser. Work on this extension will begin on March 1. Plans have been prepared by and all work will be carried out under the supervision of Francis R. Weller, consulting engineer, Hibbs Building, Washington, D. C.

North Central States

OXFORD, OHIO.—The Village Council has decided to abandon the municipal electric light plant and to purchase energy from the Liberty Light & Power Company of Richmond, Ind., to operate the local system. It is also proposed to equip the waterworks station for electrical operation later on.

ROCKY RIVER, OHIO.—The sale of the plant of the Rocky River Light & Power Company to the village of Rocky River at $63,000 has been authorized by the State Public Utilities Commission.

ALBION, IND.—Improvements are contemplated to the municipal electric lighting system, including the installation of one constant-current transformer for series street lamps and 50 suspension type street lamps for series system. Contracts will probably be let about May 1, 1919. E. M. Maloney is superintendent.

LOGANSPORT, IND.—The City Council has approved a resolution to appropriate $5000 for the purchase of poles and wire for the purpose of erecting a transmission line from the electric plant to the new Pennsylvania shops.

SHELBYVILLE, IND.—Plans have been completed by the Board of Commissioners of Shelby County for the installation of a new power plant at the Shelby County Hospital.

BENTON, ILL.—The Hamilton Utilities Company, operated by the Central Illinois Public Service Company of Mattoon, is erecting a new substation, outdoor type, equipped with three 100-kva. transformers. Aluminum-cell arresters will be used. A. W. Mann, electrical engineer, of Mattoon, has charge of the work.

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DECATUR, ILL.—The installation of a power and heating plant, to cost about $35,000, is reported to be under consideration by the Comet Automobile Company.

NEW ULM, MINN.—Extensions to the municipal electric light and water plants are under consideration by the City Council. A. J. Mueller is superintendent.

TYLER, MINN.—At an election held recently the proposal to issue $20,000 in bonds to rebuild the electric and water plants was carried.

WILLMAR, MINN.—The City Council is considering the purchase of an engine and electric generator for the municipal electric light plant.

ATLANTIC, IOWA.—Plans are under consideration for improvements to the municipal electric light plant, including the installation of one 625-kva. turbine, one 500-kw., two-phase, 60-cycle, 2200-volt generator, switchboard and two ammeters. Contracts for the above equipment will probably be let about March 1. T. E. Nichols is superintendent.

BATTLE CREEK, IOWA.—Extensive improvements are under way at the plant of the Charles E. Churchill Electric Light, Heat & Power Company, including the installation of one 100-hp. horizontal return tubular boiler, one Murray Corliss engine and one Chandler-Taylor engine, one 75-kva. Fairbanks-Morse and one 50-kva., Westinghouse generator, automatic regulator and two sets of instruments for three phase, 2300-volt, 60-cycle service; two 10-kva., six 5-kva. and twelve 2-kva. transformers, and overhead material for about 10 miles of line; 250 5-amp. and 10-amp. meters. Incandescent lamps to cost about $1,200 will be purchased this year. Charles E. Churchill has charge of the work.

KANSAS CITY, MO.—Extensive improvements are contemplated by the Kansas City Light & Power Company, involving an expenditure of about $5,500,000. H. C. Blackwell is vice-president and manager.

MARSHFIELD, MO.—Contract, it is reported, has been awarded by the Missouri Valley Water Company of Lebanon for the construction of a hydroelectric power plant on the Niangua River, about 12 miles from Marshfield. From this plant the company proposes to furnish electricity in the towns of Marshfield, Conway, Phillipsburg, Lebanon, Stoutland, Richland and Dixon, which have voted the company franchises to furnish power. It is estimated that about 2900 hp. can be developed at this point. The cost of the dam, plant and transmission lines to Lebanon and Marshfield is estimated at $235,000. The company expects ultimately to build five dams on the Niangua River. J. D. Whitmore of Valley, Neb., is at the head of the company.

MARSHALL, MO.—Plans are being prepared for the installation of an electric light plant in connection with the present waterworks system, for which bonds to the amount of $75,000 were recently sold. The equipment will probably consist of one 150-kw. and one 250-kw. generator, steam driven; one boiler, switchboard and pole-line materials. Henrici-Lowry, Commerce Building, Kansas City, Mo., are engineers.

ARLINGTON, NEB.—An election will soon be called to submit to the voters the proposal to issue $15,000 in bonds for the erection of an electric transmission line.

PLYMOUTH, NEB.—The Nebraska Gas & Electric Company of Beatrice is reported to be considering the installation of an electric plant in Plymouth. B. M. Conlee is manager.

DOWNS, KAN.—The United Light & Power Company, recently organized, has purchased the property of the Solomon Valley Power Company, consisting of electric generating plant, transmission and distribution lines. One boiler will be repaired and a new boiler installed at once. Later a second unit will be installed. A. G. Blankenship is secretary.

OTTAWA, KAN.—Plans are being prepared for the installation of a 500-kw. electric generating unit with condensing equipment in the municipal electric light plant. Bids on steam engines and turbines will be considered. W. C. Myers is superintendent of the water and light department.

RANDOLPH, KAN.—The property of the Randolph Light Company, consisting of an engine, generator, batteries moving picture machine, etc., it is reported, will be sold at auction on Feb. 22.

TOPEKA, KAN.—An appropriation of $10,000 has been voted by the State Legislature for improvements to the water system and steam heating and electric light plants at the State Hospital in Topeka.

Southern States

SPARTANBURG, S. C.—The Manufacturers Power Company has been granted a franchise to supply electricity in Spartanburg. The company has completed an electric transmission system from its hydroelectric plant on Green River, near Hendersonville, N. C., to the city limits of Spartanburg. Walter S. Montgomery is president of the company.

ALBANY, GA.—The property of the Albany Power & Manufacturing Company, it is reported, has been purchased by the Foy & Shemwell & Foy Company, who will operate the system in Albany under the name of the Georgia-Albany Power Company. The new owners propose to connect all their plants, making an available supply of 50,000 hp. from the three plants, with their steam auxiliary plants.

ASHBURN, GA.—The transmission lines of the municipal electric light plant may possibly be extended into the country, a distance of 2½ miles, to furnish electricity for lamps and motors to farmers along the line. Nothing definite as yet has been decided upon. S. K. Smith is superintendent.

ATLANTA, GA.—At an election to be held March 5 the proposal to issue $300,000 in bonds to construct an electric generating plant at the city garbage crematory will be submitted to the voters.

BAINBRIDGE, GA.—Improvements are contemplated to the municipal electric light plant, including the installation of one 250-hp. boiler, engine, generator and switchboard. The proposed work depends upon authorization of a bond issue. E. N. Edwards is superintendent.

JACKSONVILLE, FLA.—The C. I. Capps Company of Jacksonville, recently organized, would like to receive prices on electric furnaces. C. I. Capps is president and manager.

MARIETTA, OKLA.—The City Council is considering calling an election to vote on the proposal to issue bonds for improvements to the municipal electric light plant and waterworks system.

TULSA, OKLA.—The Pioneer Coal & Mining Company of Tulsa, recently incorporated, is reported to be in the market for coal mining equipment, power-plant machinery, etc. The company is capitalized at $200,000. R. B. Pugh and C. A. Coffey of Morris, Okla., are interested in the company.

WALTERS, OKLA.—An election will soon be held to vote on the proposal to issue $45,000 in bonds for extensions to water, light and sewer systems. A. H. Japp is city attorney.

WOODWARD, OKLA.—An election will soon be held to vote on the proposal to issue $30,000 in bonds for improvements to the municipal electric plant and waterworks system.

MATAGORDA, TEX.—Contract has been awarded by the Texas Gulf Sulphur Company to the J. G. White Company of Dallas for the construction of a model town at its sulphur mines near Matagorda. An electric light and power system will be installed. The proposed town will be known as Welfare Settlement and will accommodate 1500 families.

SAN ANGELO, TEX.—In a report submitted to the Municipal Commission by the Citizens' Committee the purchase of the electric light and water plants of the San Angelo Water, Light & Power Company is recommended. The value of the these plants is estimated at $350,000. If the utilities are taken over by the city extensive improvements, it is stated, will be made.

SAN BENITO, TEX.—The San Benito Water & Electric Company is considering improvements to its system.

WICHITA FALLS, TEX.—The Texas Gulf Refining & Pipe Line Company has purchased a site of 135 acres, 4 miles south of Wichita Falls, on which it will build a model town, to be called Oildom. A large oil refinery will be erected on the land and public utility plants will be installed.

Pacific and Mountain States

SPOKANE, WASH.—The property of the Spokane Heat, Light & Power Company has been purchased by the Washington Water Power Company of Spokane. The steam distributing system of the Spokane company, it is understood, will be operated by the Washington Water Power Company.

YAKIMA, WASH.—The pole lines of the Pacific Power & Light Company in the Yakima Reservation were damaged to the extent of $12,000 by the high wind during recent storms.

ASTORIA, ORE.—The Pacific Power & Light Company, it is reported, is considering the installation of an additional generating unit at its local plant.

ASTORIA, ORE.—Additional bonds totalizing $750,000 have been authorized by the Port of Astoria, the proceeds to be used in proposed extensions during the coming year, which will include an export and import pier and warehouse, an additional power plant for the city, etc.

PORTLAND, ORE.—The West Coast Coal & Dock Company of Portland is contemplating the construction of large coal bunkers for handling ship fuel and exporting coal.

LOS ANGELES, CAL.—Plans have been prepared by the City Commission for the erection of an electric transmission line to supply electricity to the municipal pumping plant in the Ellendale district, to cost about $4100.

SACRAMENTO, CAL.—An election has been called to vote on the proposal to issue bonds for the construction of a new filtration plant, to cost with machinery and equipment $1,200,000; wharf and warehouse, $160,000, and incinerator plant $143,000. If the project is carried through considerable electrical and mechanical equipment, including motors, hoisting and conveying apparatus and general transmission machinery, will be required. The proposed work will be in charge of the city engineering department.

COOKE, MONT.—The Western Smelter & Power Company is contemplating the installation of a 100-hp. motor to operate an air compressor at its mine and also to install additional transformers at its hydroelectric plant to step up the voltage to 23,000 for transmission to other mines in this district.

Canada

VANCOUVER, B. C.—Plans are being prepared by the Canadian Pacific Railway Company for the construction of a coaling plant at North Bend. The company also contemplates building a power house at Smithers, B. C., to cost including machinery about $25,000. F. W. Peters of Vancouver is superintendent.

WINNIPEG BEACH, MAN.—Extensive improvements are contemplated by the Canadian Pacific Railway Company to its local property, including the erection of a power house, rebuilding a number of the present dwellings, etc.

FREDERICTON, N. B.—The Minto Coal Company is contemplating the installation of new machinery at its mines. Large steam and electrically operated shovels are under consideration. John Henderson is manager.

PEMBROKE, ONT.—Bids will be received by A. J. Fortier, Pembroke, until March 7 for furnishing and installing a pumping unit at the waterworks station, consisting of a turbine pump of 2000 gal. capacity against a 350-ft. head and steam turbine or gasoline engine directly connected to pump.

WINGHAM, ONT.—The Town Council is considering improvements to the municipal electric lighting system.

REGINA, SASK.—The International Harvester Company is planning to dispose of its present quarters in Regina and erect a new plant at Sixth Avenue and Broad Street, to cost about $1,000,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until Feb. 24 for cable, bolts, nuts, conduit, condulets, indicator, rheostats, sockets, grommets, pipe covering, etc. Blanks and further information relating to this circular (1256) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

PANAMA.—Bids will be received at the office of the general purchasing agent, the Panama Canal, Washington, D. C., until March 8 for steel, iron, pipe, lead, wire, copper, bronze, brass tubing and tubes, motors, marine electrical fixtures, junction boxes, electrical receptacles, duct tile, etc. Blanks and further information relating to this circular (1257) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, California.

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(Issued Dec. 31, 1918)

1,289,354. STORAGE-BATTERY GRID; Edward F. Andreae, Newark, N. J. App. filed June 29, 1916. Of the double-latticed type and does not require use of destructible cores, drawbars, etc., but may be made in a two-part mold.

1,289,362. SYSTEM OF ELECTRICAL DISTRIBUTION; Ernst Bauer, Niagara Falls, N. Y. App. filed July 17, 1916. Relates to car-lighting systems in which the generator, driven by the car axle, supplies a variable voltage for charging a storage battery and supplying a translation circuit.

1,289,365. ELECTRIC BATTERY; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed July 13, 1916. Negative element consists of a perforated receptacle containing copper oxide bound together by sulphur and an alkaline electrolyte.

1,289,366. ELECTRIC BATTERY; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed July 31, 1916. An alkaline electrolyte combined with a zinc electrode and a negative element containing a mixture of copper oxide and selenium.

1,289,369. METHOD OF INCREASING THE CAPACITY OF PHOTOSENSITIVE ELECTRICAL CELLS; Sven A. Berglund, Stockholm, Sweden. App. filed April 24, 1916. Consists in absorbing, while the cell is exposed to light, the heat generated in the cell as fast as it is generated.

1,289,371. SIGN; Le Roy Blades, Chicago, Ill. App. filed Sept. 10, 1915. Especially adapted for indicating the time of day.

1,289,374. TERMINAL BLOCK FOR ELECTRICAL MEASURING INSTRUMENTS; William M. Bradshaw and Walter G. Mylius, Wilkinsburg, Pa. App. filed Feb. 3, 1916. Will not be subject to fracture because of the unequal expansion of the insulating member and the contact terminals.

1,289,406. TRANSFORMER; Walter M. Dann, Wilkinsburg, Pa. App. filed Oct. 2, 1914. Weighs considerably less than a transformer of equal capacity and of the common type of construction.

1,289,418. HIGH-FREQUENCY DETECTOR; Gustaf W. Elmen, Bogota, N. J. App. filed Nov. 23, 1915. For detecting the presence of oscillatory currents in a conductor.

1,289,419. IGNITION DISTRIBUTER; Lawrence Ericson, Chicago, Ill. App. filed Jan. 17, 1916. Operates to automatically advance and retard the spark furnished to an internal-combustion engine by the distributer in response to changes of speed in the engine.

1,289,668. SYSTEM OF ELECTRIC SIGNALING; Louis Cohen, Washington, D. C. App. filed June 30, 1916. Dispenses with the artificial line or cable in duplex systems of telegraph and also lends itself to embodiment in systems designed for multiplex telegraphy.

1,289,672. METHOD OF PRODUCING AND MAINTAINING VACUUMS; William D. Coolidge, Schenectady, N. Y. App. filed Feb. 5, 1916. A desired high vacuum is maintained in an electric apparatus operating with an electron discharge to prevent harmful positive ionization of gas.

1,289,686. ELECTRIC PIPE-THAWING APPARATUS; Emmet C. Davey, Mankato, Minn. App. filed July 26, 1918. Can be operated by current of ordinary voltage and permits bare copper wire to be used to connect to the pipes and to be laid across streets without danger of animals or pedestrians passing over the same.

1,289,704. TELEPHONE SYSTEM; Alfred H. Dyson, Montclair, N. J. App. filed March 14, 1917. The caller's coin is returned in case a connection is not obtained and is deposited in a receptacle at the substation in case a connection is obtained.

1,289,787. COMPUTING MACHINE; Shohei Iyesaka, Seattle, Wash. App. filed May 25, 1915. The features are magnetically operated finger keys, electrical carrying and electrically operated clearing mechanism.

1,289,788. MOTOR STARTER; Benjamin B. Jackson, Chicago, Ill. App. filed May 9, 1916. For a non-self-starting prime mover such as an internal-combustion engine or a single-phase alternating-current motor of the induction type.

1,289,823. ELECTRIC-DISCHARGE-CONTROLLING DEVICE AND METHOD OF OPERATING THE SAME; Irving Langmuir, Schenectady, N. Y. App. filed Nov. 6, 1914. Comprises an electrical discharge apparatus and systems of connections suitable for utilization in electric signaling, such as aërial telephony.

Record of Electrical Patents

Notes on United States Patents

1,289,826. HEAD RECEIVER SET; Burton L. Lawton, Meriden, Conn. App. filed June 28, 1918. The two earpieces may be worn with comfort and at the same time will be positioned for the best results.

1,289,853. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Feb. 26, 1914. Improved means for enabling one subscriber on a party line to signal a second subscriber on the same line.

1,289,854. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Feb. 21, 1916. Invention relates particularly to systems comprising a main exchange and one or more sub-exchanges.

1,289,863. ELECTROMAGNETIC STEP-BY-STEP MECHANISM; Jay G. Mitchell, Chicago, Ill. App. filed May 4, 1918. Of the type employing an electromagnet and a ratchet-actuating pawl moved by the magnet.

1,289,864. ELECTRICAL MASSAGE APPARATUS; Alfred Modern, Chicago, Ill. App. filed May 31, 1917. Electrotherapeutic device enables the person undergoing treatment to self-administer the same.

1,289,896. TUNGSTEN-REDUCING FURNACE; Carl A. Pfanstiehl, Waukegan, Ill. App. filed April 26, 1915. Very fine tungsten powder of a non-crystalline character may be produced.

1,289,898. MEANS FOR TRANSMITTING AND RECEIVING ANGULAR OR ROTARY MOTIONS; Robert W. L. Phillips, County of Bedford, England. App. filed June 4, 1917. Apparatus comprises two ring stators with secondary closed, ring winding interconnected at three or more points of uneven number and surrounding diametral "bar" rotors, one to each, one or both of which rotors carry primary coils.

1,289,899. TELEGRAPH TRANSMITTER; Edwin H. Piersen, Topeka, Kan. App. filed May 28, 1918. The character members may be accumulated and released in proper sequence irrespective of the speed at which the keyboard is operated.

1,289,900. TELEGRAPH TRANSMITTER; Edwin H. Piersen, Topeka, Kan. App. filed May 19, 1913. Key levers punch apertures in a traveling web which, when carried past the circuit closer, actuate the closer and in turn make and break a circuit to transmit electrical impulses corresponding to the Morse or other telegraphic codes.

1,289,901. TELEGRAPH TRANSMITTER; Edwin H. Piersen, Topeka, Kan. App. filed May 31, 1913. Characters are set by means of a keyboard and transformed into electrical impulses through the medium of a circuit closer.

1,289,913. ELECTRIC LIGHT SUPPORT; Paul J. Riviere, Jersey City, N. J. App. filed July 19, 1918. A plurality of electric lamps are mounted and may be adjusted to a variety of positions.

1,289,932. WELDING SYSTEM; John A. Seede, Schenectady, N. Y. App. filed Sept. 12, 1917. Arc may be supplied with current from a device having an inherent regulating characteristic suitable for welding while avoiding the deleterious effect of an initial rush of current prior to the establishment of welding conditions.

1,289,935. DIFFERENTIAL MAGNETIC SPEED-CHANGING TRANSMISSION MECHANISM; Charles H. Seidel, Havana, Cuba. App. filed Oct. 30, 1916. A rotating field and armature electrical machine forms a clutch between the engine and driving wheels of a vehicle.

1,289,941. APPARATUS FOR LOADED TELEPHONE-LINE SYSTEM; Thomas Shaw and William Fondiller, Hackensack, N. J. App. filed Sept. 12, 1914. Invention relates more particularly to loaded phantom-line systems.

1,289,969. CONTROLLING APPARATUS FOR AUTOMOBILE RADIATOR SHUTTERS; Edgar Tregoning, Attleboro, Mass. App. filed March 9, 1918. Thermostatically controlled, electrically operated device is under the influence of changes in temperature in the engine of the motor.

1,289,981. WIRELESS SIGNALING APPARATUS; Roy A. Weagant, Roselle, N. J. App. filed April 2, 1915. Adapted for use as a detector of electrical oscillations in association with a local circuit and an indicating device such as a telephone receiver, and in addition the oscillating circuit is electrically connected with the valve and the telephone circuit.

1,289,996. ELECTRIC SWITCH; Gilbert Wright, Schenectady, N. Y. App. filed May 5, 1915. Aims to minimize the danger of operating and working with switches and with the apparatus they control.

1,290,012. TROLLEY-COLLECTOR DEVICE; De Witt W. Bisbee, Los Angeles, and Peter A. Cressey, Long Beach, Cal. App. filed Jan. 2, 1917. A rotatable disk engages the wire instead of a roller or sliding bow.

1,290,013. ELECTRICAL REGULATION SYSTEM; William F. Bouche, Buffalo, N. Y. App. filed June 18, 1915. Additional resistance is automatically inserted in series with the carbon-pile regulator when the load is too large for the latter.

1,290,036. THERAPEUTIC APPARATUS; Fritz A. Anderson, Milton, Wis. App. filed March 4, 1918. A rigid but light and foldable supporting structure is provided for the casings of heating and lighting devices intended for therapeutical use.

(Issued Jan. 7, 1919)

1,290,053. SCREW-CONTACT DEVICE; Reuben B. Benjamin, Chicago, Ill. App. filed Sept. 10, 1915. Can be formed by stamping.

1,290,066. ELECTRIC TRAIN-LINE COUPLING; Thomas R. Brown, Sparkill, N. Y. App. filed Dec. 8, 1916. Engaging surfaces kept clean and high degree of conductivity maintained through coupling joint at all times.

1,290,075. RHEOSTAT; Charles A. Cadwell, Cleveland, Ohio. App. filed May 10, 1917. Is portable, so that it can be kept within reasonable compass and be carried by two men.

1,290,076. METHOD OF AND APPARATUS FOR ELECTRIC WELDING; Charles A. Cadwell, Cleveland, Ohio. App. filed June 2, 1917. A current of relatively high voltage may be utilized in welding one metal part to another.

1,290,079. ELECTRICALLY OPERATING TRANSLATOR; Allen D. Cardwell, Brooklyn, N. Y. App. filed Dec. 1, 1915. Particularly adapted for use at transmitting or receiving stations, or both, in telegraph typewriter systems.

1,290,082. PUSH-BUTTON SWITCH; Ivar Carlson, Leominster, and Rudolf A. Johnson, Worcester, Mass. App. filed Dec. 29, 1917. Characterized by compactness, inexpensiveness, simplicity of construction and facility of operation.

1,290,089. APPARATUS FOR ELECTRIC WELDING; William B. Cleveland, Cleveland, Ohio. App. filed April 23, 1915. Adapted for welding or brazing of bonds onto rails in accordance with so-called "Herrick" process.

1,290,114. THERMIC TELEPHONE; Pieter de Lange and Baron Van Lynden, Utrecht, Netherlands. App. filed Nov. 4, 1915. Sounding chamber so constructed that the parts inclosing it may be displaced relatively to each other.

1,290,147. DEAD END FOR ELECTRIC AND TELEPHONE WIRES; Harry Fairclough, Los Angeles, Cal. App. filed Jan. 26, 1916. Minimizes breakage from heavy strain and from crystallization.

1,290,148. AUTOMATIC TELEPHONE RELEASE; Edward D. Fales, Western Springs, Ill. App. filed Feb. 27, 1908. For automatic systems in which electrically propelled and step-by-step-actuated switches are employed for extending connection from one point to another.

1,290,153. WIRE TAPPER; Joseph Fitzpatrick, Douglas, Ariz. App. filed March 30, 1918. Employs a two-part casing of insulating material, the sections being connected by hinges.

1,290,167. CURRENT-RECEIVING APPARATUS; John E. Gallant, Boston, Mass. App. filed May 29, 1917. Sparking in the rectifying apparatus when the current is broken or reversed is materially reduced or entirely prevented.

1,290,190. GENERATING MECHANISM; Albert B. Herrick, Cleveland, Ohio. App. filed Nov. 29, 1912. Particularly for use in an igniter attached to an engine cylinder in the position usually taken by the spark plug.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, March 1, 1919 *Number* 9

Desirable Locations for Institute Conventions

THE large attendance at the midwinter convention of the American Institute of Electrical Engineers at New York last week is a visible sign of the interest which engineers take in Institute affairs. It also indicates the desirability of giving thought to the matter of selecting accessible places with ample hotel facilities for meetings and conventions. There are many such cities besides the metropolis, magnetic and ideal as New York is, and we hold no brief for any of them. Mountains and wooded hills afford delightful recreation during the summer, but not all mountain resorts are accessible and not all possess ample, suitable and reasonably priced hotel accommodations. The Institute membership now approximates 10,000, and it is to the interest of the electrical industry in general and of the Institute in particular that conventions and meetings be well attended. Granted an excellent program, one way to assure a large gathering is to choose for a meeting place some locality convenient of access to a majority of the membership, an effort being made to change the place of meeting so as to accommodate the great geographical sections.

Who would have thought that daylight saving would be abhorrent to the farmer? Just as the public is anticipating turning back the hands of the clock, up bobs the tiller of the soil and threatens to kick the whole scheme into the discard. Alas and alack! Lighting companies unconsciously are making friends.

Need of Coal Storage

THE winter of 1918-1919 is almost gone. It passed without a severe strain on the coal reserves built up to meet abnormally severe conditions. Available facts seem to indicate that even the most severe weather and the greatest war demand could have been met successfully, because the plea for the storage of coal was heeded. Fortunately, the conditions that had to be met were not severe. It is to be hoped, however, that the present situation will not cause those who are thoughtless to discount the value of coal storage. Such neglect would be unwise, especially at this time when the miners are not working steadily and when coal production shows a rapid decline. Certainly, labor conditions in the coal fields as well as elsewhere are far from encouraging, and new and maybe more exacting labor agreements must be negotiated with the signing of the peace treaty. Therefore judicious coal storage, beginning now, is really worth considering.

New Branch of Electrical Engineering

MANY interesting papers dealing with electric welding problems and results were presented at a joint meeting of the American Institute of Electrical Engineers and the American Institute of Mining Engineers in New York last week. To be sure, electric welding work received great impetus during the war, because of the shipbuilding program of the nation, but, while that particular field is exceedingly promising, it by no means embraces all of the art. Moreover, the interest lately manifested in the subject would indicate the possibility of an entirely new branch of electrical engineering, with problems peculiarly its own and with engineers and workers specializing along electric welding lines. The American Institute of Electrical Engineers fortunately took an active interest in electric welding from the very outset, and many of its members were of inestimable value to the government, and particularly to the Shipping Board, in experimental and constructive electric welding work. Electric welding also played an important part in the fabrication of the famous Liberty motors for aëroplanes. It is to be hoped that the Institute will retain its grip and interest in the subject and offer every encouragement to investigators and specialists so as to foster the work as a part of its activities rather than have its devotees form a separate organization. The electrical industry has too many national bodies for its own good.

Conservation deals with the creation of effort, efficiency with its application, and together they symbolize the fundamental philosophy of our time, namely, that all energy and effort should be created in the most economical way and applied in the most useful manner. This means fuel conservation in coöperation with skillful technique in the administration of interconnected hydroelectric systems.

Interconnection a Reasonable Policy

IT IS pretty late in the day to set forth the advantages of interconnecting electrical supply systems in general. The results of this progressive policy speak for themselves in many parts of the country where a practical *modus vivendi* has been attained through intelligent coöperation among the producers, transmitters and distributers of electricity. Nevertheless, some excellent plans are lagging in circles which display a very limited comprehension of the opportunities immediately ahead, and this state of things ought not to be permitted to continue among reasonable men.

There is an idea in some quarters that interconnec-

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tion involves heavy expenditures to realize the economic benefits latent in particular situations. This notion may arise from the publication of estimated costs of comprehensive interconnection programs over state-wide areas, or it may hang over, so to speak, from experience with construction costs incurred in this or that department under war conditions. It is true that the projects realizing the largest annual savings throughout extended areas of country of the thickly settled type necessitate large outlays in order that the complete programs may be attained, but along with this condition we must not forget that returns can usually be derived from such projects even when they are but partly finished and that many interconnection schemes which will pay well involve the outlay of only trifling sums. Certainly there should be no holding back of meritorious schemes after it has been shown by sound engineering analyses that they will pay.

Jealousy of operating control is another factor which sometimes retards interconnection. Most of the plans which we have seen give little reason for this attitude. It is entirely feasible to draw contracts of intersystem arrangements and dealings under various operating circumstances that will leave nothing to chance and permit each organization concerned to retain its maximum independence. For convenience, it may be desirable in some cases to lodge operating authority at a central dispatching point, but a properly drawn contract will safeguard the interests of all concerned, define the limits of such control, and enable each party to the agreement to supply his customers with even more facility than in the older days of go-as-you-please, now-coal-now-water operation. Interconnection is a reasonable policy, when justified on engineering and economic grounds, and the spectacle of systems whose lines actually cross refusing to have anything to do with each other through imaginary fears of giving up their control over their affairs should be dismissed after a single conference among those who are meanwhile losing the benefits of such interrelations.

Interest in the post-war convention of the National Electric Light Association will be keen. This will be a meeting for laying some foundation stones for future central-station development. Everybody get ready, please.

Wave-Shape Standards

IN THE early days of alternating-current distribution for electric lighting no particular attention was paid to the shape of the wave of electromotive force produced in the alternators. So far as incandescent lamps were concerned it made no difference. When alternating-current motors began to appear it was found that they worked most efficiently on smooth sine waves of emf. Ever since that time the designers of alternators have aimed at generating a smooth sine wave of emf. under all conditions. The standardization rules of the American Institute of Electrical Engineers in recent years have indicated the desirability of securing sinusoidal waves.

Meanwhile, telephone circuits were spreading and ramifying in all directions on the one hand, while alternating current lighting and power systems were spreading their networks broadcast on the other. Wherever these two systems came into mutual proximity they began to interfere. The telephone circuits hampered the power-transmission lines when broken-down telephone wires fell across the high-pressure power wires, and the alternating-current power-transmission circuits hampered the telephone circuits by inducing noisy disturbances in them, often making conversation by their means impossible.

In the valuable paper recently presented by Dr. Harold S. Osborne before the A. I. E. E. midwinter convention a large number of experimental measurements are reported, made in various ways, as to the relative disturbing effect, in a simple telephone receiving circuit, of a given value of superposed alternating current over a wide range of adjustable frequency. It is shown that the telephonic disturbance has a sharp maximum in the neighborhood of 1100 cycles per second, which is also approximately the resonant frequency of many standard telephone receivers. Above and below this resonant frequency the disturbing effect falls off rapidly, but it is still very appreciable even down to 200 cycles per second.

The ingenious plan was adopted of making an alternating-current measuring instrument which would measure the effective value of any alternating impressed emf. the harmonic components of which were automatically intensified substantially in accordance with the ordinates of the observed disturbance curve. The instrument is read first without any weighing of harmonics, like an ordinary alternating-current voltmeter, and then with the harmonics weighted. The ratio of the latter to the former reading then gives a telephone interference factor for the particular emf. wave tested. Numerous tests of alternators with the instrument are tabulated, showing interference factors ranging from 5 up to 543, with an average value reaching approximately 100.

The inference is that, while the amount of telephonic disturbance actually produced in any given case depends upon the physical conditions of the two systems, such as how near the wires approach, how far they run parallel, how great the voltages and currents are in the power system, yet, other things being equal, those alternators which generate a high interference factor, when tested in this manner, are correspondingly to be dreaded by the telephone engineers.

While it would be desirable for all alternators to have the ideal telephone interference factor of unity, if that were possible, it is impracticable to construct them in that way at the present time. It would mean that they had no harmonics or upper frequency ripples. Nevertheless, the paper will be very serviceable to electrical engineers at large by drawing attention to the real electrical conditions involved in the problem of non-interference and in appealing to alternator designers to aim as nearly as they can for a pure sine wave.

The only hope of solving the non-interference problem practically is to have coöperation between the power engineers and the telephone engineers, so that they may treat the matter as a joint effort and not in a spirit of mutual hostility. If the power interests and the telephone interests will join hands to keep the telephonic peace between them, the engineers can be trusted to find a *modus vivendi.*

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Radio Apparatus for Artillery Fire Control

ONE of the most important and extensive uses of radio apparatus in the war has been the maintenance of communication between flying aëroplane observers and the allied artillery officers of the ground, whereby the artillery fire can be regulated and directed. It has been aptly said that in this war "the guns have aimed on what they did not shoot and have shot at what they could not see." However, with the aid of the eyes of an observer in an aëroplane this difficulty has been more than overcome. What will strike the reader of Capt. G. Francis Gray and First Lieut. John W. Reed's article in this number is the simplicity and portability of the radio apparatus which has been used for artillery regulation of aëroplanes. A very real difficulty with such aëroplane radio sets is the danger of interference. With a number of aëroplanes scattered along the flying front it becomes very easy to receive messages from the wrong observer and so introduce confusion into the communication system. This difficulty has been practically overcome by the use of five selective spark frequencies and also nine selective wave lengths.

The description of the apparatus in detail will be very interesting to all who are familiar with radio systems. For example, the use of a flame-proof key is something that in ordinary station sets would not be considered necessary but which in the air, with gasoline vapors present in possibly dangerous proportions, is a necessary element of safety.

The interesting story at the end of the article leads one to hope that a collection of such events may be made before the men who have taken part in this service have all been scattered. There is a fascination and adventure in radio communication under war conditions that ordinary radio service is unable to supply, and many thrilling tales of victories won and disasters averted can doubtless be told by those who practiced it.

Edison's fame is not lessened but strengthened by the passing years. It is made greater by his steady devotion to work. With strong purpose and untiring industry he has pushed on from one accomplished aim to the call of a new vision.

Cost of Hydroelectric Power

THERE have been many estimates made in past years of the general and specific costs of hydroelectric developments. These estimates represent various stages of the growth of the art. Most of them have had direct reference to some particular plant and are therefore only roughly applicable to other localities. By far the most complete report of the economic side of the hydroelectric situation as of the present time is that made to the Maine Public Utilities Commission by H. K. Barrows of Boston, the features of which are presented in the article beginning on page 413 in this issue of the ELECTRICAL WORLD.

It appears from the report that under conditions similar to those of the State of Maine hydroelectric energy with storage regulation can be delivered on the average as primary power at the end of a long transmission line at a cost of about 0.6 cent per kilowatt-hour. Mr. Barrows estimates that the cost of electric power generated by steam at tidewater would be slightly more than double this amount, which may be correct for the locality considered, but is certainly very high for the cost of generation in really large modern stations under moderately favorable conditions. Our own impression is that the case here made out for hydroelectric development is in general rather too favorable. It is only very rarely that a water-power plant can be given adequate storage for anything like its full utilization without running into local conditions which mean considerable increase in cost. And, further, an actual load factor of even 50 per cent requires time and favoring circumstances for its development. In addition, it can generally be secured only in operation on a very large scale with a distributing network sufficient to insure the full advantage of a favoring diversity factor.

What the conditions of costs will be in the next few years nobody can safely predict. The construction costs for hydroelectric work cited in the report would to-day be very much greater than the figures given, and so too would be the costs of a steam plant of similar capacity. The smaller amount of labor involved in the conduct of a hydroelectric system is a factor which is likely to work for some little time to come in its favor, but, on the other hand, the tendency now is greatly to decrease the cost of labor per kilowatt-hour in steam plants by the more extensive use of automatic machinery and the employment of bigger units, much bigger and hence relatively cheaper than anything available to the ordinary hydraulic plant.

The tendency now and henceforward is toward the installation of very large plants with networks commensurate with their capacity, and the general strategy of the situation will be to utilize the great water powers which can be developed in a relatively inexpensive way in combination with steam stations of very large capacity erected at favorable points. As between these the costs of power generation are very much more nearly alike than the figures here noted would indicate. There is, however, a good opportunity for working out locally combinations of hydraulic plants which can be developed at moderate cost even if of no great size. These can serve an immensely useful purpose either for near-by industries or as casual feeders to the bigger networks from time to time established. The fact of the matter is that, while averages form an interesting guide for a general view of things in hydroelectric matters, each situation must be judged on a somewhat exhaustive study of things as they are.

To meet world competition under peace conditions we must retain and practice the economies learned under the compulsion of war necessities. Fuel saving must be continued, although service may now safely be expanded. Coal or oil consumed per unit of output tells the story. While the war was at its height plant economies were chiefly gained by improving the use of existing equipment, but to-day there is a great opportunity to realize still broader gains in efficiency through the introduction of betterment equipment whenever conditions make this possible.

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Radio Apparatus for Artillery Fire Control

Radio Apparatus Successfully Developed Through Co-operation Between Electrical Manufacturers and Signal Corps—Supply Alternator Is Driven by Air Fan Which Maintains Constant Frequency Through Wide Range of Airplane Speeds

BY CAPT. G. FRANCIS GRAY, SIGNAL CORPS, U. S. A., AND FIRST LIEUT. JOHN W. REED, SIGNAL CORPS, U. S. A.

THE most important and extensive use of radio apparatus by the army during the war was for directing artillery fire from airplanes. The system used for this purpose by all armies is essentially the same; the airplane circles over the target and the bursts of the shells are noted by the observer, who telegraphs a code message back to a receiving station near the battery.

When the United States entered the war and the Signal Corps began the development of new types of

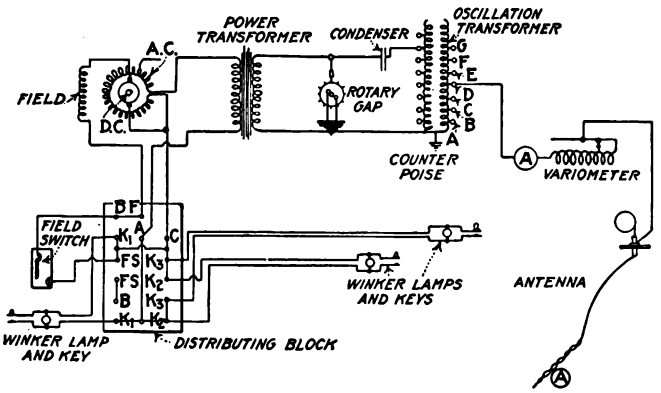

FIG. 1—CIRCUIT DIAGRAM OF AIRPLANE RADIO TELEGRAPH TRANSMITTING SET, TYPE SCR-73-A

apparatus to equip our expeditionary forces two general types of transmitting sets for this service were considered. For a limited part of the training work a very light battery-driven induction coil set was developed, but the design chosen for the majority of the work used an alternator mounted on the wing of the airplane and driven by an air fan as the source of power, the radio apparatus being of the synchronous gap type. This fan maintains fairly constant speed independent of velocity of airplane. In this article only the radio apparatus is dealt with. In both cases the receiving apparatus used a double tuned circuit and a crystal detector. The communication provided was entirely one-way, the air plane carrying a transmitting set only and the battery station having only the receiving set.

TRANSMITTING APPARATUS

In order to obtain the maximum possible speed of development and the best available apparatus, the advice and assistance of a number of manufacturers were obtained. The design arrived at has since required only very minor detail modifications. Reports from abroad indicate that the set is entirely satisfactory and compares favorably with any foreign set in use for the same service.

Circuit.—The circuit used is of the synchronous spark type and is shown in detail in Fig. 1. It is so well known as to need no comment.

Generator.—The generator is an inductor alternator, self-excited. Models were worked out by the Holtzer-Cabot Company, the Westinghouse Electric & Manufacturing Company and the Crocker-Wheeler Company. The Westinghouse design as finally put into production is shown in Fig. 3A. It has the following characteristics: Diameter, 6¼ in. (15.9 cm.); length of frame, 5⅜ in. (13.6 cm.); weight, 11 lb. (4.9 kg.); output, 335 volt-amp. at 94 volts, 900 cycles and 60 per cent power factor; excitation, 0.4 amp. at 45 volts; speed, 4500 r.p.m.

A particular requirement in designing this generator was that it should always build up when the field switch is closed. It was found that occasionally in shutting down the set the condenser discharged back and destroyed the residual magnetization of the machine. The comparatively low field voltage also led to occasional failures to build up due to brush resistance. Although the percentage of failures was small, it was considered advisable on the first lot of machines to provide a small dry battery with convenient switching arrangement for starting the excitation if needed. On the second lot of machines the use of higher field voltage, a damper winding around the field poles and the change from the simple alternating-current winding shown in Fig. 2 (left) to the split winding shown in detail in Fig. 2 (right), which prevents the demagnetization of the field mentioned above, entirely eliminated the failure to build up, and the dry battery was omitted.

Radio Apparatus.—The radio apparatus, with the exception of the antenna variometer, is mounted in the stream-line casing of the generator. The detail development work and the production of this material were handled principally by the International Radio Telegraph Company, and the resulting extremely simple

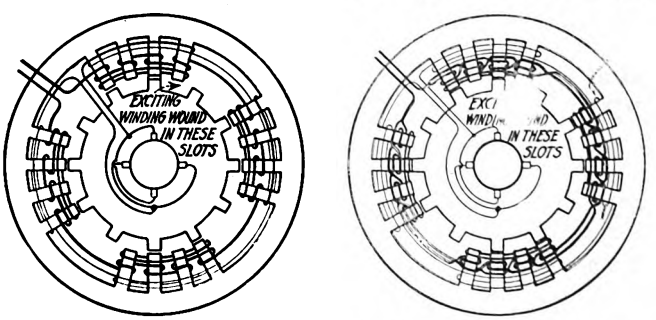

FIG. 2—WIRING OF INDUCTOR ALTERNATOR AS ORIGINALLY MADE (LEFT); METHOD OF PREVENTING DEMAGNETIZATION OF FIELD (RIGHT)

and ingenious design is due in great measure to its chief engineer, F. H. Kroger. The construction is shown in Fig. 3C. A number of spark wheels are provided, giving the following spark frequencies: 1800, 1275, 900, 600 and 450. Nine wave lengths are provided for, and

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by varying the coupling it is possible to reduce the output current in several steps to a minimum of approximately one-fourth of the maximum. Under normal conditions the current in the antenna is approximately 2 amp.

Stream-Line Casing.—The stream-line casing, which incloses the radio apparatus and provides the necessary

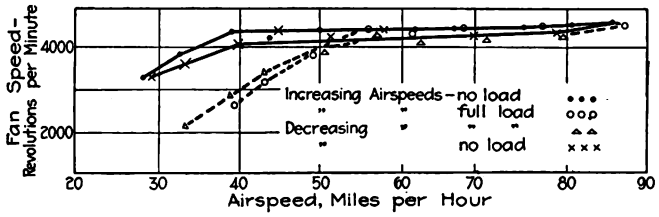

FIG. 4—CHARACTERISTIC CURVE OF REGULATING AIR FAN SHOWN IN FIG. 3D
(American Propeller & Manufacturing Company; diameter 20 in.; variable pitch)

stream-line shape for the generator mounted in the air stream, is particularly notable as an example of the possibilities of "duck micarta." It is 16 in. (40.6 cm.) long, 6¼ in. (15.9 cm.) in diameter at its open end, has walls $\frac{1}{16}$-in. (1.5 mm.) thick, and is not only an insulator but is stronger and lighter than an equivalent aluminum casing. The surfaces are given two coats of baking varnish to prevent absorption of moisture or surface leakage.

Antenna Variometer.—The antenna variometer, shown beside the air fan in Fig. 3E, is used for tuning the antenna to the proper wave length, and the antenna ammeter is mounted in the same case. This variometer is a simple helix of copper wire wound on a bakelite tube and provided with a suitable trolley for short-circuiting more or less of the inductance. This device and the keys, antenna reel and field switch are the only parts of the apparatus that must be mounted within reach of the operator.

Air Fan.—The air fan which supplies the power for driving the generator has been the subject of a considerable amount of development. The simplest form is, of course, a solid wooden fan. However, the speed of an airplane is quite variable, and a fixed-blade air fan varies its speed almost in direct proportion. Since the frequency of the alternator determines the note of the spark, and as this note is depended on to enable the receiving operator to read the signals through very serious interference, there was extreme need for a constant-speed air fan. An indication of the amount of development work done to meet this need may be had from the fact that more than 100 different designs have been tested by the Signal Corps, one of these being shown in Fig. 3D. The success of the work may be understood from consideration of Fig. 4, which shows the performance of the fan shown in Fig. 3D. In the more successful types of regulating air fans the principle of operation is to vary the pitch of the blades by means of the movement of weighted arms, which tend to move in response to centrifugal force and are restrained by springs, the resultant of the two opposing forces determining the angle of the fan blades with the line of flight, and consequently the ratio of air speed to speed of rotation. Details of this development will be described elsewhere in a later publication.

As an evidence of the compactness and light weight of this apparatus, Fig. 3E shows it in comparison with a set of approximately the same rating, the old army "pack set." The relative weights of these two for the corresponding parts shown are: Pack set, 156 lb. (70.7 kg.); SCR-73-A, 28 lb. (12.7 kg.).

Antenna System.—The antenna system on an airplane generally consists of a trailing wire having a maximum length of about 300 ft. (90 m.), the "ground" connection being furnished by the metal parts of the machine, which are all bonded together. Certain fittings and detail parts are required to handle this trailing wire.

Antenna Reel.—The antenna reel development led through a number of stages to the design of William Schramm of Philadelphia, shown in Fig. 3F. This reel has a simple centrifugal governor which limits the speed at which the antenna pays out and prevents the loss of the antenna due to carelessness on the part of the operator. It also is provided with removable bobbin, so that a spare antenna may be carried on an extra bobbin and installed if needed.

Floor Insulator.—The floor insulator through which the antenna wire passes, and at which the high-voltage connection to the radio apparatus is made, is commonly known by the British designation "fairlead." Two forms of this are shown in Fig. 3G and Fig. 3H, one being made entirely of molded material and the other of micarta tubing having a suitable flange molded in place. The importance of careful design in this insulator will be appreciated when it is understood that the high-frequency potential in this set may reach 30,000 volts.

Antenna Weight.—The antenna weight used at the end of the antenna wire was originally of the stream-line shape which gave it the name of "fish." It was made of lead and weighed 1¼ lb. (0.57 kg.). Later the use of a number of lead "beads" ½ in. (1.27 cm.) in diameter was substituted in order to permit of a new antenna being installed with the airplane in flight, the new weight being dropped through the opening in the fairlead.

Antenna Wire.—The antenna wire itself is a braided

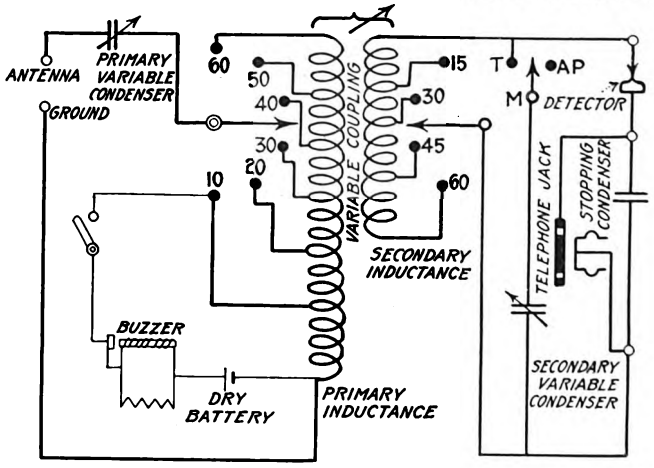

FIG. 5—CIRCUIT DIAGRAM OF RADIO TELEGRAPH RECEIVING SET, TYPE SCR-54-A

cable made up of sixteen strands of No. 30 B. & S. copper and having an average breaking strength of about 60 lb. (27 kg.).

Various auxiliaries to the set also required considerable development work.

Keys.—The keys (Fig. 3I), of which there are three for each set, are of flameproof construction and have

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very heavy knobs and levers with fairly stiff springs, since they must be used by men wearing heavy gloves. This particular design was developed by the General Radio Company, and modified by the Signal Corps to include a small incandescent lamp connected in parallel with the contacts. If the set is in working order, this lamp glows when the key is not depressed, which in itself is a valuable indication. In addition, the lamp serves to indicate to the pilot when the observer is sending and vice versa, since all lamps wink when any key is closed. The various circuits are wired through a molded compound distributing box, and a toggle-joint switch is used for the field circuit. The official Signal Corps designation of this set is "airplane radio-telegraph transmitting set, type SCR-73-A."

The receiving set used with the transmitting set described above is generally installed in the neighborhood of its artillery battery, with which it is connected by wire telephone. In this exposed position it would often be undersirable to supply charged storage batteries (hence the use of vacuum-tube detectors and amplifiers was impracticable), and the set was designed to use crystal detectors, galena or silicon being generally specified. The circuit used is shown in Fig. 5, while Figs. 3J and 3K show the construction of the "set box." It is believed that these are self-explanatory, with the possible exception of the use of the buzzer, which is so connected as to excite the antenna circuit. This reacts on the calibrated secondary, so that the operator can adjust his set to listen for a signal of predetermined wave length without the use of a separate wave meter at each receiving station.

The exposed position occupied by these receiving stations makes the mechanical design of the antenna particularly important. It must be light, inconspicuous, easily erected in a short time and adaptable to a variety of surroundings and local conditions. In general the design used is a 60-deg. "V" composed of two wires 100 ft. (30 m.) long and mounted approximately 20 ft. (6 m.) from the ground. When trees or buildings are not available masts are required. After considerable experimenting the Signal Corps developed the mast

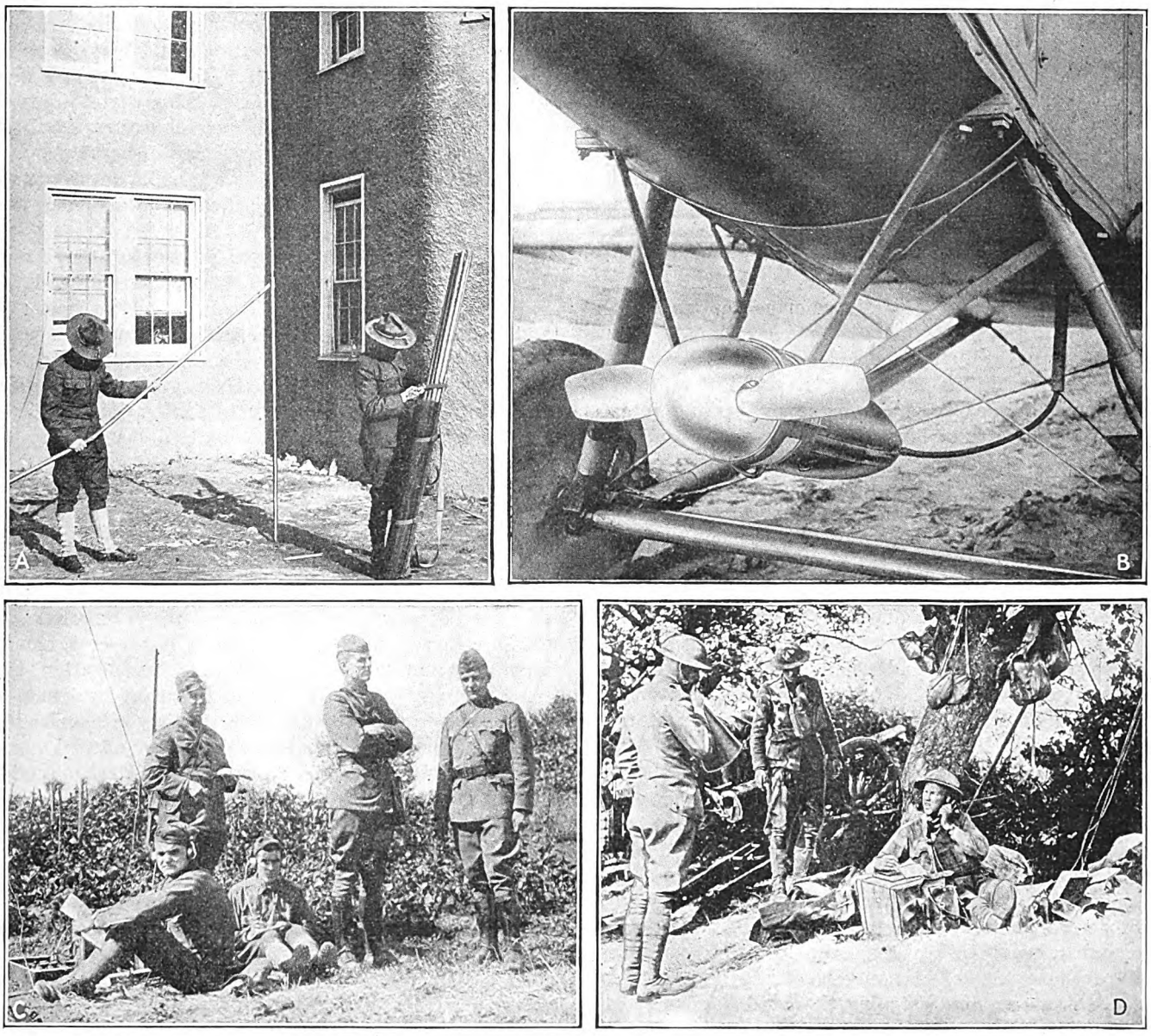

FIG. 6—VIEWS OF ACTIVITIES ON THE GROUND

A—Antenna mast, type MS-14. B—SCR-73-A set mounted on an airplane. C—Typical artillery receiving post. D—Artillery battery receiving telephone message from radio receiving station.

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shown in Fig. 6A, made of spruce or pine wood, the sections being joined by a socket joint, slightly conical, the two parts being made of dissimilar metal to prevent rusting together. Simple strain insulators of bakelite material and light guy ropes were also provided.

The ground connection is made in a variety of ways depending on local conditions. Generally a woven copper mat in direct contact with the earth proved the most useful. In other cases insulated counterpoise wire was stretched along the ground, and in still other cases ground stakes were employed. Material for all of these was supplied with the sets.

The official designation for this receiving set is "radio receiving set, type SCR-54-A."

Fig. 6B shows the transmitting equipment mounted on the landing gear of an airplane, Fig. 6C shows a typical receiving post, and Fig. 6D shows a battery of auxiliary with the telephone operator receiving instructions from the radio receiving station.

Normal service for this combination requires a range of communication of at least 5 miles (8 km.). In field tests the sets here described have operated over 30 miles (48 km.), while with a vacuum-tube detector at the receiving station signals have been received from this transmitting set at 90 miles (145 km.) distance.

To the average person the romance of war lies altogether in the use rather than the development of such tools of the army as are here described, and if the story were told, the exploits of the users of radio apparatus would rank second to none in thrilling interest. It is not the purpose of this article to deal in such tales of heroism and adventure, but the following first-hand account of an every-day episode on the front may serve to visualize for the reader something of the conditions under which these sets were used. It happened during the period of the day when the receiving operator was not working with his own plane, but according to custom was "listening in" for anything he might hear.

This particular operator had been in school in Germany several years and could speak and understand the language very well. If the Germans sent down messages in their language, it was just as easy for him to take as English, and if in code he could translate it, since our intelligence department had all of their codes. He was "listening in" one evening about 6 o'clock, when he heard an enemy airplane send the message that he could see two divisions of our infantry filing into a certain wood and that the Germans should train all their guns on this wood, and the minute our forces were all in he would give the signal to fire. As soon as the operator heard this message he told his commanding officer just what had occurred, that the emeny machine was over him watching the woods, and that when all the infantry were in this wood he would send down the message to open fire on it. The officer as soon as he got the message telephoned to battalion headquarters and told exactly what was occurring. Some one from headquarters took the message to the infantry commander, telling him to get his men out as quickly as possible. Just as the last men were coming out the Germans opened fire with about 200 guns, and this stretch of woods was literally blown to pieces. If it had not been for the operator acting quickly, probably not twenty of the men would have come out alive. As it was there was not a single casualty.

PUBLIC OWNERSHIP DECRIED AT BOSTON

Arguments Advanced in Regard to Proposal to Make Appropriation for Investigation of Power Plant Centralization and Public Ownership

W. Rodman Peabody, counsel for the Turners Falls (Mass.) Power & Electric Company, spoke briefly against public ownership and operation of contral-station systems at a legislative hearing in Boston, Feb. 14, and predicted that the day of the small and inefficient electric station is doomed to yield to the superior economies of plants rated at around 100,000 kw., situated on the tidewater and transmitting energy to manufacturing districts over interconnected lines.

L. W. E. Kimball, for the Brotherhood of Electrical Workers, appeared on behalf of a bill to establish a state commission of light, heat and power, to investigate the power resources of Massachusetts and to assemble data bearing upon the public-ownership policy. Mr. Kimball favored public ownership in a general attack upon central-station rates as contrasted with municipal-plant rates.

Mr. Peabody, who was legal adviser of the Massachusetts Fuel Administration during the war and who has been identified with the Turners Falls hydroelectric and steam developments since their inauguration under the direction of Philip Cabot of Boston, said that he agreed with Mr. Kimball as to the necessity for securing the utmost possible efficiency in fuel utilization. The time is coming, Mr. Peabody stated, to look upon industrial districts like the Merrimac Valley as units from the power supply standpoint.

The speaker said that he believed that the policy of the State of Maine relative to the prohibition of water-power exportation would ultimately give way to one of interchange. It is no reflection on the policy or success of either a private or a municipal plant to cease generating energy and purchase at a lower cost from a large transmission or distributing organization supplied from a high-powered central plant or group of stations operated at maximum economy. The load of the steam locomotive, a notorious waster of fuel, seems likely in time to be taken over by the large electrical supply systems.

The mill owner of to-day, the speaker maintained, takes very little interest in his power plant. Every dollar which he spends on boilers and turbines brings him no direct result in earning additional revenue, as do spindles and looms. Central-station power is the coming thing. "Under public ownership," said he, "there is not the same inducement to keep a plant up to date as in privately managed power systems, and there is far more bravery in development, in extending industries, in risking capital, and far more ingenuity, far more Americanism, in putting plants into the hands of men whose life they are, subject to proper supervision, than there is in putting them into the hands of the public."

The hearing closed after a suggestion was made that the Gas and Electric Light Commission be requested to investigate power-plant centralization and public ownership data instead of appropriating perhaps $300,000 for a special light, heat and power commission as advocated in the Kimball bill.

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Cost of Hydroelectric Development

Conclusions Based on Study of Maine Water Powers—Effect of Load Factor—Costs of Water Rights, Power, Transmission Lines, Storage Reservoirs—Comparative Utility of Hydraulic and Steam Power

COMPREHENSIVE data on the economics of hydroelectric development were given in a report by H. K. Barrows, consulting engineer, Boston, to the Maine Public Utilities Commission recently. Brief reference was made to this water-power report in the ELECTRICAL WORLD of Jan. 18, page 120, and some of the more interesting and significant facts and conclusions are set forth in the following paragraphs.

From the investigations made during the past few months fairly complete data of the cost of water-power and storage development are available for the Kennebec, Penobscot, Presumpscott, Union, Androscoggin and Saco Rivers (the last two in the State of Maine only). On these rivers over 700,000 hp. is available, about 55 per cent being at developed sites. To develop the remaining power will cost about $32,000,000, at an average outlay of about $99 per horsepower. More than half this undeveloped power is on the Kennebec River.

Increased storage amounting to over 81,000,000,000 cu.ft. (2,300,000,000 cu.m.), at a cost of about $2,700,000, would regulate to a high degree the flow of these rivers at comparatively low cost. Hydroelectric energy with storage regulation can be produced on these rivers and transmitted long distances (to tidewater if in large units) at a cost ranging from about 0.4 cent. to 0.9 cent and averaging about 0.6 cent per kilowatt-hour of primary power at the substation of a transmission line. About 20 per cent of additional power in excess of the primary power would also be available in an average year.

COST OF STEAM-ELECTRIC POWER

The cost of steam-electric power in good-sized stations adjacent to tidewater would be about 1.25 cents per kilowatt-hour at the switchboard, depending considerably upon the future costs of coal and labor. There is in general a considerable margin of cost in favor of hydroelectric power, provided sufficiently large developments to warrant transmission cost can be made.

In the light of present-day methods, the earlier water-power developments in New England were not made to give the best results as regards power utilization at low cost. Much space was required for canals, and the number of wheels required for the complete development was in many cases very large. Thus, there are something more than 155 water turbines used at Holyoke, Mass., while at Millinocket, Me., ten turbines develop a power about one-half as large. Many of these older developments would be reconstructed if it were not for practical difficulties involved by multiple ownership and the existence of many long-time or perpetual leases of water made in the past by the power companies to mill owners. Undoubtedly the time will come when the urgent need of power will bring about reconstruction. The large modern units now made by half a dozen leading American companies are without superiors in the world, and wheel efficiencies exceeding 90 per cent have become quite common. The maximum size of unit is constantly being exceeded, the limit at present being about 30,000 hp. Even in moderate-head plants the wheel-shaft efficiency has reached 93 per cent, whereas formerly 75 to 80 per cent was obtained.

COST OF WATER POWER

General Factors Affecting Cost of Construction.—The first cost of a hydroelectric plant is likely to be greater per horsepower than that of the steam electric plant, although with favorable natural opportunities for water-power development this may not be true.

Where fall is well concentrated and conditions of flowage permit, the simplest and most economical method of development is to build a dam with the power house at one end (or sometimes in the dam itself), simply utilizing the fall developed by the dam. For heads up to the vicinity of 30 ft. (10 m.) such developments can be made with the turbines placed in open wheel pits. Above this amount of head the cost of the bulkhead walls is likely to be such that a more economical development is made by bringing the water through short penstocks (or pipes under pressure) to the wheels. Frequently natural conditions are such that it is more economical to carry the water in a canal or closed penstock for some distance along the river below the dam, rather than to obtain the full fall by means of the dam. This is likely to be the case where there are limitations to the height of the dam on account of resulting damage due to flowage.

For a large stream (perhaps for quantities of flow in excess of 500 cu.ft. or 600 cu.ft. (14 or 17 cu.m.) per second) it is usually more economical to use a canal, for the necessary size of penstock required increases quite rapidly with the quantity of water to be carried and the cost of very large penstocks is relatively much greater than for smaller ones.

With large rivers, however, it is often desirable on account of the topography of the river banks to carry the water the greater part of the distance in a canal with small slope, and then for a short distance in penstocks (usually one for each wheel unit) which drop rapidly from the canal level at its end or "forebay" to the wheel units at the level of the power house.

Obviously the general items which will most affect the cost of a water-power development are those of the dam and waterways. Where natural conditions are such that these features of the development can be made at low cost, the resulting total cost of development will be low, as in general the other features (power house and equipment) will vary in cost within a comparatively narrow range.

As will be noted by reference to Table VI, the average total cost per horsepower of plants at developed sites in the State of Maine is about $114. This is the roughly estimated reconstruction cost of hydroelectric plants at the various sites where power has been developed and

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is based on the development having the flow available 60 per cent of the time after regulation, with 100 per cent load factor.

The estimates made of the cost of constructing plants at undeveloped power sites, which are also summarized in Table VI, show an average cost for the four principal

TABLE I—EFFECT OF LOAD FACTOR ON COST OF HYDROELECTRIC PLANTS

Cost of Plant to Deliver 1 Hp. on Wheel Shaft with Different Load Factors								
100 per Cent Load Factor			80 per Cent L. F.	50 per Cent L. F.	30 per Cent L. F.	Per Cent Increase in Cost Over That for 100 per Cent L. F.		
Equipment and Power House, Etc.	Other Costs	Total Cost	Total Cost	Total Cost	Total Cost	80 per Cent L.F.	50 per Cent L.F.	30 per Cent L.F.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$40	$210	$250	$260	$290	$343	4.0	16.0	37.3
40	160	200	210	240	293	5.0	20.0	46.5
25	175	200	206	225	258	3.1	12.5	29.1
30	70	100	108	130	170	8.0	30.0	70.0
25	35	60	66	85	118	10.4	41.6	97.2
20	40	60	65	80	107	8.3	33.3	77.7

rivers of $99 per horsepower on the same general basis as that previously stated. The average cost of all plants—both developed and undeveloped—is $107 per horsepower.

The cost of individual plants will vary very greatly from these figures—from about $60 per horsepower as a minimum up to $250 or more where sites are not especially good or conditions of development difficult. These are pre-war costs. Present costs would be probably more than double these figures.

Effect of Load Factor.—To indicate the general extent to which load factor affects the first cost of plant, Table I has been prepared.

In the table referred to the two approximate extremes in cost of development in the State of Maine have been assumed, with the usual variation in cost of equipment and power house. In a general way a power development which costs $200 to $250 per horsepower to develop is likely to be on a large stream tending to a moderate or low-head development, under which condition the cost of equipment and power house is likely to be at a maximum, as well as the features of construction. For this case, therefore, the range in cost of equipment and power house has been taken from $25 to $40 per wheel horsepower.

Similarly, a low cost of development at $60 per horsepower is likely to be a high-head development with usually a moderate amount of water. This tends toward lower cost of equipment and power house, and the range here has been assumed to be from $20 to $25 per horsepower, on the basis of 100 per cent load factor.

The cost per horsepower of wheel rating of hydroelectric plants will be less as the load factor decreases, as the increase in cost of plant with lower load factor is offset because of the greater relative increase in wheel capacity.

The variation in total cost with load factor is, as would be expected, much greater where the cost of the plant is low, as the variable factor of cost of equipment and power house is a much greater percentage of the total cost.

Cost of Water Rights.—The determination of the value of water rights is fundamentally a question of engineering, taking into consideration cost or feasibility of development as well as proximity to market. Their value should not be a matter of mere speculation, as has often appeared to be the case.

On the basis of development upon a 60 per cent flow basis and 100 per cent load factor, used in estimating the cost of development for the various rivers in the State of Maine, the approximate range in cost of water rights, including land, is $10 to $40 per horsepower.

Cost of Power.—Fixed charges on the cost of a water-power development, or the basis for annual cost of power, constitute approximately 10 per cent of the construction cost, the variation being about as follows: Interest, 5-6 per cent; depreciation, 2-3 per cent; taxes and insurance, 1-2 per cent.

Operating charges, the principal items of which are wages and repairs, are low. These will naturally vary materially with the capacity of the station and with load factor. They will usually be 0.1 cent or less per kilowatt-hour of power delivered at the switchboard for good-sized hydroelectric plants with a load factor of approximately 50 per cent. Assuming annual fixed charges at 10 per cent and twenty-four-hour, 365-day operation, the figures in Table II are obtained.

A hydroelectric plant on the rivers considered would not deliver its full output for 40 per cent of the average year. The 95 per cent or primary output is from 70 to 80 per cent of the full output on these rivers, with the suggested storage regulation, so that only about 5 per cent less than the full output would result for the average year. Making this slight deduction and keeping in mind 50 to 60 per cent load factor, it is evident

TABLE II—FIXED CHARGES FOR HYDROELECTRIC PLANTS WITH VARYING COST OF PLANT AND LOAD FACTOR

Cost of Plant per Hp.		Fixed Charges in Cents per Kw.-Hr. of Output at Switchboard			
	Cost of Equipment	Load Factor			
Total Cost	and Power House	100 Per Cent	80 Per Cent.	50 Per Cent	30 Per Cent
$250	$40	0.41	0.43	0.48	0.56
200	40	0.33	0.35	0.40	0.48
200	25	0.33	0.34	0.37	0.43
100	30	0.16	0.18	0.21	0.28
60	25	0.10	0.11	0.14	0.19
60	20	0.10	0.11	0.13	0 18

that hydroelectric power can be delivered at the switchboard for from about 0.25 cent to 0.6 cent per kilowatt-hour, for the range of cost of developments found on the rivers discussed in this report.

COST OF TRANSMISSION LINES

The great amounts of undeveloped water power—particularly on the upper Kennebec and Penobscot—must be transmitted long distances to reach a market. The cost of transmission must, therefore, be included for comparison with steam or other power near or adjacent to the coast.

Table III, giving estimated transmission-line costs for different lengths of line, capacity, voltage, etc., has been prepared by Prof. Ralph G. Hudson of the Massachusetts Institute of Technology, an expert on this subject.

To estimate the cost of various transmission lines, a size of the line wire was selected in each case which

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would give a minimum annual cost of operating the line; that is, the interest, depreciation and tax charge per year was made equal to the annual cost of the electric energy lost in the line wires. In all the calculations leading to the final estimates pre-war costs were assumed throughout.

The line voltage suggested for each of the typical transmission lines is high enough to make the power

TABLE III—ESTIMATED COST OF TRANSMISSION LINES

Distance, Miles	Capacity of Line, Kw.	Line Voltage	Number of Tower Lines	Number of Wires per Tower	Total Cost per Mile
25	5,000	66,000	1	6	$3,500
25	10,000	66,000	1	6	5,000
25	20,000	66,000	1	6	7,000
50	10,000	66,000	1	6	5,000
50	25,000	66,000	2	6	10,000
50	50,000	100,000	2	6	14,000
75	50,000	100,000	2	6	14,000
75	100,000	150,000	2	6	20,000
100	100,000	150,000	2	6	20,000

lost in transmission comparatively small. Among all the cases cited in the estimates of first cost the power lost in heating the conductors will range from 2 to 4 per cent of the total power transmitted. In most of the lines the total cost will be divided equally between the cost of conductors and the cost of the towers, including erection and right-of-way. In the case of short low-power lines the total cost may be divided in the proportion of two-thirds for the towers and one-third for the conductors, while in the case of short high-power lines employing a single line of towers the total cost may be divided in the proportion of one-third for the towers and two-thirds for the conductors.

Annual operating cost of transmission lines (per cent of capital invested): Interest, 7; depreciation, 6; operation, maintenance and taxes, 12; total, 25.

Table V shows that power transmission at a cost of about 0.10 cent per kilowatt-hour or less is readily obtainable, also that power to be transmitted most economically over long distances must be in large

TABLE IV—COST OF RIVER CROSSINGS

Length, Feet	Capacity of Line, Kw.	Line Voltage	Number of Tower Lines	Number of Wires per Tower	Total Cost per Crossing
500	20,000	66,000	1	6	$2,000
1000	50,000	100,000	2	6	16,000
2000	50,000	100,000	2	6	70,000

amounts. Thus, with a 50-mile (80-km.) line the cost per kilowatt-hour with a line of 50,000-kw. capacity is only about one-half that where the capacity is but 10,000 kw.

COST OF STORAGE RESERVOIRS

In Table VII are summarized costs of constructing storage reservoirs upon six of the rivers in the State of Maine. As will be noted, the average cost per 1,000,000 cu.ft. of storage capacity is about $33 ($1,200 for 1,000,000 cu.m.)—a low figure which reflects the unusually favorable opportunities for storage development to be found in this state.

Storage on the Presumpscott River has already been developed and the extremely low cost of $10.79 per 1,000,000 cu.ft. ($330 per 1,000,000 cu.m.) of capacity has been made possible by the great natural storage facilities of Sebago Lake.

The proposed storage reservoirs on the Union and Presumpscott Rivers are also unusually low in cost. The Saco River storage is relatively the most expensive, but even this is moderate in cost compared with storage reservoirs in other localities.

The principal item of cost of a storage reservoir is likely to be that of the dam, particularly if the reservoir site is in wild or forest land, as is frequently the case in the State of Maine. On the other hand, where farm lands or villages are affected or railroad locations require change, these items of cost may be a considerable proportion of the total.

Cost of Operation and Maintenance of Storage Reservoirs.—The cost of operation of storage includes the wages of men employed in operating gates and in general supervision, ordinary repairs and the cost of keeping records of the height of reservoir, flow from reservoir, etc., which require some engineering supervision.

TABLE V—ESTIMATED COST OF POWER TRANSMISSION

Length of Line, Miles	Capacity of Line, Kw.	Total Capital Cost of Line	Capital Cost per Kw. Transmitted (50 per Cent L. F. and 5 per Cent Losses)	Cost per Kw.-Hr. (with Annual Cost 25 per Cent of First Cost)
25	5,000	$87,500	37	0.10
25	10,000	125,000	26	0.08
25	20,000	175,000	18	0.05
50	10,000	250,000	53	0.15
50	25,000	500,000	42	0.12
50	50,000	700,000	29	0.08
75	50,000	1,050,000	44	0.13
75	100,000	1,500,000	32	0.09
100	100,000	2,000,000	42	0.12

The total annual cost would include also, of course, items covering interest on investment, taxes and insurance.

With permanent concrete construction the rate of depreciation is low. The fixed charges, including interest, depreciation, taxes and insurance, would be about 9 per cent per year, and usually a further allowance of 1 per cent would cover charges for operation and maintenance.

Through the courtesy of Walter H. Sawyer, consulting engineer, Lewiston, Me., data in regard to the cost of operation and maintenance of storage reservoirs on the upper Androscoggin River have been furnished. In the case of the Rangeley Lake system, with a total storage of about 18,500,000,000 cu.ft. (518,000,000 cu.m.) operating expenses and repairs for the period 1902-1913 inclusive average a little under $10,000 per year or about 52 cents per 1,000,000 cu.ft. ($18.50 per 1,000,000 cu.m.) of storage capacity. The total storage capacity in use from 1911 to 1913 was about 28,300,000,000 cu.ft. (775,000,000 cu.m.) and the average cost per 1,000,000 cu.ft. for these two years was about 97 cents.

It seems likely that an annual cost of operation and maintenance of 50 cents per 1,000,000 cu.ft. ($12.50 per 1,000,000 cu.m.) of capacity would be ample as regards normal conditions at storage reservoirs in the State of Maine.

Table VII shows strikingly the extremely low cost of increasing the primary power capacity of several Maine rivers by means of storage. To guarantee primary

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power with steam auxiliary means for annual fixed charges alone at least $7.50 per horsepower of plant, or more than double the average annual cost of storage, including its operation. Furthermore, to operate the steam plant entails further heavy expense of labor, fuel, etc. In a few words, it is evident that, both as a commercial proposition and from the viewpoint of conservation, the development and operation of storage facilities on these rivers offer the best means of increasing and guaranteeing primary power.

From Table VIII it is evident that the additional power gained throughout the year by storage regulation will be large in amount and very low in cost.

The power available from 81,000,000,000 cu.ft. (2,290,000,000 cu.m.) of increased storage used through an average head of 469 ft. (143 m.) would be about 111,000 hp. per year. During the average year, as shown in Table VIII, the increase in power due to storage would be about 68,000 hp., or in other words, about 61 per cent of the full storage capacity would be used dur-

TABLE VI—SUMMARY OF COST OF DEVELOPED AND UNDEVELOPED WATER POWER

River	60 per Cent Hp. of Capacity After Storage Regulation: At Developed Sites	At Undeveloped Sites	At Both	Cost of Power: Developed: Per Hp.	Developed: Total	Undeveloped: Per Hp.	Undeveloped: Total	Total: Per Hp.	Total: Total
Presumpscott	16,770	0	16,770	$153	$2,561,000	....	.....	$153	$2,561,000
Union	6,530	0	6,530	51	334,000	....	.....	51	334,000
Kennebec	63,900	169,560	233,460	150	9,600,000	$100	$17,092,000	114	26,692,000
Androscoggin*	118,020	42,770	160,790	120	14,200,000	134	5,730,000	124	19,930,000
Penobscot	158,310	94,560	252,870	(90)	(14.200,000)	76	7,150,000	84	21,350,000
Saco*	30,070	17,070	47,140	130	3,900,000	116	1,978,000	125	5,878,000
Total or weighted average	393,600	323,960	717,560	$114	$44,795,000	$99	$31,950,000	$107	$76,745,000

TABLE VII—COST OF INCREASED HORSEPOWER CAPACITY 95 PER CENT OF AVERAGE YEAR DUE TO STORAGE REGULATION

River	Increased Storage, Million Cu.Ft.	Total Cost of Increased Storage	Increase in Hp. Capacity, 95 per Cent of Average Year Due to Storage Regulation: At Developed Sites	At Undeveloped Sites	At Both	Total Cost of Increased Storage per Increased Hp. Capacity: At Developed Sites	At Undeveloped Sites	At Both	Annual Cost of Increased Storage, Including Operation, Fixed Charges, Etc.: Total Annual Cost	Per Increased Hp. Capacity: At Developed Sites	At Undeveloped Sites	At Both
Presumpscott	14,000	$151,000	10,650	0	10,650	$14.10	.....	$14.10	$15,100	$1.41	.....	$1.41
Union	9,150	136,000	2,920	0	2,920	46.50	.....	46.50	13,600	4.65	.....	4.65
Kennebec	17,060	802,000	27,050	58,490	85,540	29.70	$13.70	9.40	80,200	2.97	$1.37	.94
Androscoggin*	7,550	200,000	8,590	2.340	10,930	23.30	85.50	18.30	20,000	2.33	8.55	1.83
Penobscot	22,630	447,000	17,220	20,280	37,500	25.90	22.00	11.90	44,700	2.59	2.20	1.19
Saco*	10,720	957,000	12,400	7,980	20,380	77.00	120.00	47.00	95,700	7.70	12.00	4.70
Total or weighted average	81,110	$2,693,000	78,830	89,090	167,920	$34.20	$30.20	$16.00	$269,300	$3.42	$3.02	$1.60

TABLE VIII—COST OF INCREASE IN HORSEPOWER-YEARS DUE TO STORAGE REGULATION

River	Increased Storage, Million Cu.Ft.	Total Cost of Increased Storage	Increase in Hp.-Years for Average Year Due to Storage Regulation: At Developed Sites	At Undeveloped Sites	At Both	Total Cost of Increased Storage per Hp.-Year of Increased Energy: At Developed Sites	At Undeveloped Sites	At Both	Annual Cost of Increased Storage, Including Operation, Fixed Charges, Etc.: Total Annual Cost	Per Hp. Year of Increased Energy: At Developed Sites	At Undeveloped Sites	At Both
Presumpscott	14,000	$151,000	3,350	.....	3,350	$45.00	.....	$45.00	$15,100	$4.50	.....	$4.50
Union	9,150	136,000	900	.....	900	151.00	.....	151.00	13,600	15.10	.....	15.10
Kennebec	17,060	802,000	9,300	21,800	31,100	86.00	$38.50	25.80	80,200	8.60	$3.68	2.58
Androscoggin*	7,550	200,000	2,920	800	3,720	68.50	250.00	53.80	20,000	6.85	25.00	5.38
Penobscot	22,630	447,000	11,070	11,220	22,290	40.50	39.80	20.00	44,700	4.05	3.98	2.00
Saco*	10,720	957,000	4,250	2,540	6,790	225.00	377.00	141.00	95,700	22.50	37.70	14.10
Total or weighted average	81,110	$2,693,000	31,790	36,360	68,150	$84.80	$74.10	$39.50	$269,300	$8.48	$7.41	$3.95

TABLE IX—COST OF INCREASED STORAGE PER MILLION CUBIC FEET PER FOOT OF FALL

River	Increased Storage, Million Cu.Ft.	Total Cost of Increased Storage	Average (Weighted) Head for Storage Use: At Developed Sites, Ft.	At Undeveloped Sites, Ft.	At Both, Ft.	Cost of Increased Storage: Per Million Cu.Ft.	Per M. C. F. per Ft. of Fall: At Developed Sites	At Undeveloped Sites	At Both
Presumpscott	14,000	$151,000	250	...	250	$10.79	$0.04	.....	$0.04
Union	9,150	136,000	78	...	78	14.85	.19	.....	.19
Kennebec	17,060	802,000	185	666	851	47.00	.25	$0.07	.06
Androscoggin*	7,550	200,000	427	213	640	53.60	.13	.25	.08
Penobscot	22,630	447,000	211	284	495	19.70	.09	.07	.04
Saco*	10,720	957,000	202	105	307	95.70	.47	.91	.31
Total or weighted average	81,110	$2,693,000	216	253	469	$33.20	$0.153	$0.131	$0.071

* In the State of Maine only.

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ing the average year. This percentage of storage utilized would vary, of course, with the individual rivers; it would vary also with the percentage of flow used as a basis for development. The figure of 61 per cent represents a general average.

The cost of storage per horsepower of hydraulic plant capacity after regulation is also an item of interest. For the six rivers considered in Table VI the 60 per cent power after regulation will be about 394,000 hp. at developed plants and 717,000 hp. after complete power development. The first cost of storage per horsepower of capacity would therefore be about $6.85 for developed plants and $3.75 per horsepower if assessed upon the entire available fall.

The annual cost of storage, including operation, on this basis would be about $0.68 per horsepower for developed plants and $0.38 per horsepower for the entire fall. Expressed per kilowatt-hour of total plant output this is less than 0.01 cent—a very small cost.

COMPARATIVE UTILITY OF HYDRAULIC AND STEAM POWER

Power from a steam-electric plant in the State of Maine adjacent to tidewater, with no transmission costs, is likely to cost 1¼ cents per kilowatt-hour—with perhaps a little reduction from this figure for large plants. Hydroelectric power can be delivered at the switchboard for from 0.2 cent to 0.6 cent per kilowatt-hour and about 0.3 cent for the average-cost plant. Transmission costs from interior points to tidewater will add 0.10 cent per kilowatt-hour, making a range of cost of from 0.3 cent to 0.7 cent per kilowatt-hour and 0.4 cent for the average plant. However, the steam-electric power will be primary power, while the primary water power will be from 70 to 80 per cent of the full plant capacity (with 100 per cent load factor), assuming storage regulation. (The average cost of increased storage and its regulation, apportioned evenly among developed plants, is very small, as previously explained, although on individual rivers, like the Saco and Union, this would add perceptibly to the cost of hydraulic power.) Even considering primary power alone, which omits from consideration about 20 per cent of the water power really available, the cost of water power per kilowatt-hour will vary between about 0.5 cent and 0.95 cent (about 0.55 cent for the average-cost plant), as compared with steam-electric power costing (with very favorable future costs of fuel and wages assumed) from, say, 1 cent to 1.25 cents per kilowatt-hour.

There is one additional factor not yet discussed which would in general tend to increase the relative cost of hydroelectric power, as compared with steam, viz., the including in annual costs of a fair return upon investment, in addition to that assumed, of 6 per cent. In other words, instead of assuming 10 per cent and 12 per cent respectively for annual fixed charges for water and steam plants, these should, to take allowance of investment considerations, be, say, 17 per cent and 18 per cent respectively (allowing 1 per cent greater in this added factor for water power, on account of the greater risks involved).

With low-cost hydroelectric plants, costing no more than steam-electric plants, this would not change the relative costs of power—in fact, it would slightly favor the hydraulic plant. With the more costly hydraulic developments—those say of over $200 per horsepower (which are relatively few in number on the six rivers considered) the inclusion of this added factor of cost would result, as a rule, in little or no advantage for hydraulic as compared with steam power.

So far, no administrative or overhead charges have been included in the cost comparison of hydraulic and steam power. These must, of course, be considered in determining retail costs of power, but do not affect this economical comparison, as they are costs common to either type of power development.

Keeping in mind the low average cost of developments, in the vicinity of $100 per horsepower, on these rivers and the large amount of available power, there appears to be a very considerable margin in favor of hydraulic power. With an opportunity to use this power in sufficient amounts, even carried long distances, it would be cheaper than steam power, unless the latter was essential for process use.

To make transmission low in cost large units must be developed, however. Regulation by increased storage is also a fundamental requisite.

NEW POWER PLANT ON THE SAN JOAQUIN RIVER

San Joaquin Light & Power Corporation to Spend Immediately $1,750,000 to Construct Another Station of 20,000-Hp. Capacity

A. G. Wishon, general manager of the San Joaquin Light & Power Corporation, has announced the immediate expenditure of $1,750,000 for the construction of another large power house on the San Joaquin River. The new plant will have an output of 20,000 hp., and work is being rushed to complete it within one year from present date. The new power house will be known as San Joaquin Plant No. 6. It will be situated on the main San Joaquin River near what is known as Macy Flat, about 6 miles below the present big power house.

The new project comprises several unique features. A diversion dam 70 ft. in height will be erected across the river about 2 miles below the present power house. The water for the new plant will be taken from the river at this point and carried to a point 375 ft. above the power-house site, where it will be dropped through a pipe line 800 ft. in length to the generating machinery in the power house. To carry the water on this journey, more than 4½ miles of tunnels and conduit will be built.

The first work to be undertaken will be the tunnel work. A huge 400-lb. air compressor will be erected at the upper end, and by the aid of the latest improved air-driven tunneling machinery the big hole will be driven through the mountains. As the débris and crushed rock is carried out of the tunnel, it will be used in building up the big diversion dam. This dam will be 100 ft. long on the base and 450 ft. across.

To carry in supplies and equipment, the old road through Auberry Valley via Wellbarn will be reconstructed and will be extended 5 miles to reach the scene of operation. A new road will then be built from this site over the mountain pass connecting with the present Auberry road near the San Joaquin bridge at No. 1 power house.

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Improving Relations of Employer and Employee

Ways to Bring About a Closer and Better Relationship Between Employees and the Industry Are Discussed by Richard H. Rice, Acting Manager of the Lynn Works of the General Electric Company

It is clearly recognized in the industry that friendly cooperation between employee and employer is essential to a solution of their common problems. How the two can be helped to appreciate their joint interest in the settlement of these problems is discussed by Mr. Rice in this interview with a representative of the ELECTRICAL WORLD. Ways and means of keeping a close contact between the men and the management are outlined, and Mr. Rice recognizes the importance of creating peaceful industrial conditions. These are an essence of prosperity and advancement.

"EVERY manager of an industry who brings about a closer and better relationship between his employees and his industry, who increases their effectiveness and knowledge, is doing his bit to help win the industrial victory necessary for America's prosperity," said Richard H. Rice, acting manager of the Lynn (Mass.) Works of the General Electric Company, in response to an inquiry by a representative of the ELECTRICAL WORLD relative to the advantages of the joint committee system of representation in the conduct of factory affairs.

LABOR THE GREAT QUESTION

"The great question to-day in the proper and successful management of an industry," said Mr. Rice, "is how to handle justly and fairly the labor which is an essential part of the industry, how to maintain production unimpaired, and how to keep the cost of the product at a reasonable figure. If America is to retain her position as an industrial nation in the years of reconstruction and post-reconstruction to come, she must be able to manufacture and export to foreign countries all those articles of commerce which her genius and inventive ability have produced and will produce under competitive conditions more severe than any which we have as yet known. She must be able to manufacture and market her products at home under similar competitive conditions. The industrial facilities existing in America to-day are so much more extensive than they ever have been that our home markets will no longer be sufficient to absorb our products.

"In 1913 electric motors were landed in New York from Italy and put on the market at prices which would barely pay the labor and material cost of similar motors made in this country. Although the world war stopped these importations, the tariff laws are unchanged and no reason exists why a similar situation will not arise in the future."

The utmost possible coöperation between employers and employees, therefore, is believed by Mr. Rice to be vital to the industrial success of the country under the conditions of world-wide competition in the post-war period.

Mr. Rice emphasized the difficulties of maintaining close personal relations with workmen in the great modern organizations as contrasted with the intimacies of twenty years ago and more. These relations are now in a transition stage brought about by the growth of industries. "Old methods of management are inadequate to-day," he said. "In many cases the good relationships formerly existing have broken down, and managements have suddenly awakened to the fact that a seemingly peaceful working force has been full of hidden discontent and of legitimate cause for complaint which the existing systems of management have failed to disclose and deal with. In the meantime, in other shops other methods have been in use, and these methods have been equally faulty. With the growth of trades unionism there has been a growth of shops dealing with these unions, and here also the system has failed to function properly."

In the trades-union shop the tendency is to magnify causes of dispute and even to manufacture differences. The whole tendency of such a relation is to cause separation between management and men, to pull apart, to dissociate instead of to coöperate. The output tends to be restricted, the efforts of able, industrious and loyal employees are hampered, and the full possibilities of team work can never be realized. Moreover, the chief weapon of trades unionism is the strike. This weapon completely disrupts good relationships, which can only be restored after the lapse of a considerable period.

"It is not my purpose to antagonize labor unions," said Mr. Rice, "or to propose any means for antagonizing them. I recognize the right of employees to join such unions, but I also recognize the right of employees to refrain from joining if they see fit. I am clear, however, that no means has been devised of dealing with the employees through labor unions which has shown any efficiency. It must be evident that it is impossible to deal effectively with outsiders in the settlement of questions relating to an industry because it is impossible that such outsiders should have any intimate knowledge of the questions with which they are dealing. It is equally impossible to secure best results when the parties in controversy have diverse interests and are not animated with the spirit of mutual interest and coöperative endeavor.

DISASTROUS LOSS FROM STRIKES

"During the period of the participation of this country in the great war the number of strikes occurring and the loss of production resulting therefrom was far larger than in any other period of our history, and this at a time when, if ever, 100 per cent production was needed to back up our troops, to feed them, and to transport them and their material to the front and to maintain them there. Does not this indicate a breakdown in the effectiveness of old methods of management? Only after a particularly disastrous strike was a plan devised and put into operation which abandons the objectionable methods of the past and really deals with large organizations in a proper and adequate way. This plan has been in operation for nearly four years with complete industrial peace where formerly such relations

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were unknown, and with entire satisfaction to employees and to management. It does not affect, prevent or discriminate against membership in trade unions, and the unions have lately quoted the plants where this plan was first inaugurated as examples of good conditions

FEATURES OF THE PLAN

"The essentials of the plan are:

"(a) Establishment of representation of employees by representatives who are workers, elected by their fellows, by secret ballot, in such a way that complete representation is secured.

"(b) These representatives are empowered and encouraged to assist employees to present their cases to the management in an effective and thorough manner.

"(c) From these representatives are elected members to serve on joint committees with an equal number of representatives of the management. These joint committees serve as committees of appeal from the decisions of the foreman, try the facts and endeavor to reach an agreement.

"(d) These joint committees are chosen for the different parts of the plant or the different mines or mills of a large industry.

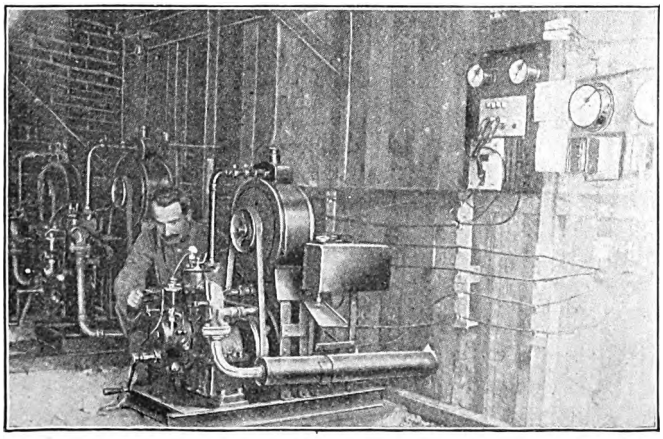
"A further joint committee, consisting of an equal number of employees and management members, constitutes an appeal committee for the entire plant. This committee brings a broader and a freer viewpoint to the consideration of the question. The head of the works or of the group of shops, mines or mills is the final resort to settle all major questions not disposed of by these means. Failing settlement by him, appeal must be had to arbitration. The president or manager of the works keeps in touch with all activities conducted under the plan by means of a special representative, whose chief duty is to see that all matters are promptly handled.

"Other joint committees are established which deal with matters having to do with plant economies, safety, sanitation, recreation, education, etc. By taking the representatives into partnership in these matters an esprit de corps, a coöperative relation for the general good, is built up which is invaluable. Through these joint committees one of the chief advantages of the plan may be realized, viz., education of the employee members of these committees in the needs, requirements and technicalities of the business, and through these members an education of the employees themselves may be secured which they would otherwise miss entirely. The employees find that many of the things with which they are dissatisfied are promptly remedied while others are more fanciful than real. They come to a better realization of managerial difficulties, learn the need of output, of a fair day's work for a fair day's pay; they get the spirit of the management and get 'in phase' with it. The foremen, on the other hand, learn to sympathize with the viewpoint of fair and loyal employees; they learn better methods of dealing to secure results, and learn not to be arbitrary but to be right. The management is in better touch with the spirit and atmosphere of the shop, and vice versa.

"The management of an industrial plant is a trustee responsible for the well-being of stockholders and employees, and has a real duty to the community, the prosperity of which, quite generally, depends largely upon the prosperity of the industry. To receive the support of the community, the stockholders must receive a proper return on their investment, and this investment must be built up and protected. The employees must be fairly compensated and cared for, healthy and reasonably contented. If the industries of the country had been well managed in past years in both these directions and if the managements had convinced the communities of these facts, much of the bad legislation and much of the wild and dangerous political and social propaganda of past and present would have been spared us.

SET THE HOUSE IN ORDER

"Industrial agitation and discontent give rise to social agitation and discontent. The managers of industry owe it to the country to set their houses in order. By some such means of dealing fairly, promptly and effectively with all disputed questions, and of giving employees a voice in matters affecting their health, comfort and education, and of exhibiting to them frankly the problems of management and the needs of the business, industrial peace has been and can be secured, provided that a spirit of fairness and justice animates the management. I take it for granted that this will be a case, for any other spirit is sure to result in disaster."



THE UTMOST POSSIBLE CO-OPERATION BETWEEN EMPLOYERS AND EMPLOYEES IS VITAL TO INDUSTRIAL SUCCESS

"The great question . . . is how to handle justly and fairly the labor which is an essential part of the industry, how to maintain production unimpaired and how to keep the cost of the product at a reasonable figure."

"The foremen learn to sympathize with the viewpoint of fair and loyal employees; they learn better methods of dealing to secure results, and learn not to be arbitrary but to be right. The management is in better touch."

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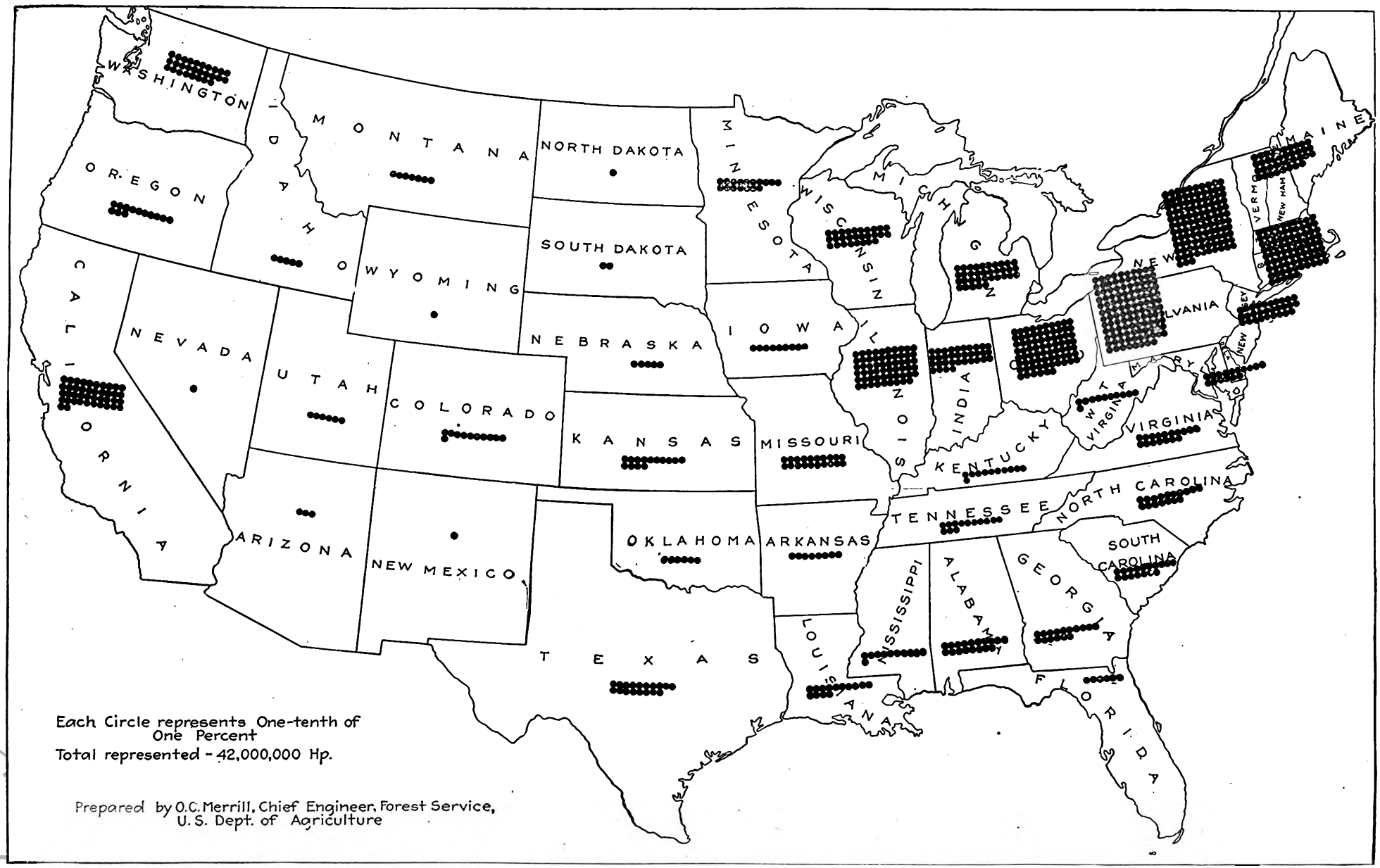

DISTRIBUTION OF PRIMARY POWER, WATER POWER, STEAM POWER AND GAS POWER, 1918

Primary power, which consists of the installed capacity of waterwheels, steam engines and gas engines in commercial and municipal central stations, street and electric railways and manufacturing plants, has been estimated for 1918 by assuming a rate of increase in each state from 1912 to 1918 corresponding to the rate of increase for such state from 1902 to 1912 as indicated by the data given in Table No. 4, Part II of Senate document No. 316, Sixty-fourth Congress, First Session. The figures do not include horsepower of locomotives.

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Midwinter Convention of the A. I. E. E.

National Engineering Standardization, Electric Welding, Improvement of Insulations, Radio-Telephony and Electrophysical Subjects Hold Attention of New York Gathering

DESPITE the pressure on hotel accommodations in New York City which has existed for some time, many engineers attended the midwinter convention of the American Institute of Electrical Engineers held in that city on Wednesday, Thursday and Friday of last week. Great interest was evident in all the subjects which were under review, either from the large attendance or from the amount of participation in the discussion; but the sessions devoted to electric welding and the effect of entrapped air on the strength of solid insulations appeared to attract the most attention. Owing to the handicaps which have existed from the lack of engineering standards and because of the advantages which would obviously result from improvement of conditions, the method outlined by President C. A. Adams for establishing and operating a national standardization body was particularly well received. Scientific as well as popular interest was attached to the presentation of authoritative information regarding radio development during the war.

Features of the principal papers and discussions are presented in the following pages, these being grouped according to their general classification and not necessarily according to their order of presentation.

INTEREST OF ENGINEERS IN INDUSTRIAL STANDARDIZATION

Importance of Standardization Pointed Out—Machinery Proposed by American Engineering Standards Committee to Remedy Present Chaos

President C. A. Adams, in his convention address, "Engineering and Industrial Standardization," pointed out the efficiency and economy effected by careful standardization. The problem is not only national but is world-wide, and the purposes and organization of the American Engineering Standards Committee should be thoroughly understood. Professor Adams said in part:

"Most of us speak of standardization in a vague sort of way, not realizing that the coöperation without which our modern society would be impossible would in turn be impossible without a large measure of standardization. It might almost be said that the degree of standardization in any nation is a measure of its civilization, certainly in the material or industrial sense. . . .

"One of the most striking examples of standardization possibilities is the attempt only just made by one of our most progressive manufacturers of electrical machinery, a member of this Institute, to develop coöperative standard electric motor designs. Nine manufacturers are working together to this end. Consider the immense advantage to the consumer resulting from the general interchangeability of parts and the reduction in the number of spare parts carried by a user who has motors of several of these coöperating manufacturers. Moreover, the designs still contain the best features of all these makes, and there will still remain ample opportunity for competition in production cost and quality of workmanship."

The work of the standards committee of the A. I. E. E., Professor Adams said, "has placed competition on a far more equitable and generally satisfactory basis. It has encouraged more careful and thorough designing and a more careful selection of size on the part of the user, and generally has resulted in better machines. In certain fields, notably in standardization of types and in dimensional standardization when the latter is carried into complete designs, there is an obvious danger that standardization may develop into crystallization and serve as a brake on progress; but this is merely an obstacle and not an argument, since it is obviously possible to keep the standards abreast of progress."

In outlining the present machinery for national standardization, the speaker said: "The fields of the several engineering organizations overlap in large degree; there is much duplication of effort and confusion of result, and many of the standards promulgated are practically useless. Coöperation between two or more organizations has been tried, sometimes successfully, but there is no recognized machinery of coöperation, no standard procedure, and confusion still reigns. To meet this need there has been recently created an American Engineering Standards Committee."

This committee serves as an authoritative national body to deal with the corresponding foreign bodies and is made up as follows:

(a) The "main committee" (with three representatives from each of the five "founder societies" and three government departments), whose functions are chiefly those of an organizing, coördinating and steering committee.

(b) Sectional committees, one for each group of standards (with representatives from all organizations or government departments vitally interested in that particular group of standards), whose function is to prepare the standards in question under the direction of the most vitally interested organization, known as the "sponsor body."

(c) The "sponsor body" may be one of the founder societies, a government department or one of the "cooperating societies" or organizations.

(d) Under "coöperating societies" it is intended to include all organizations interested in the production of standards and willing to coöperate.

"The machinery," said Professor Adams, "thus provides for absolutely comprehensive coöperation, eliminates overlapping and duplication of effort, and yet does not undesirably restrict the initiative of the several coöperating societies. With proper support and the cooperation of all interested organizations, it should contribute largely to the industrial development of the country. Moreover, it should be a potent factor in promoting international standardization and commerce."

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ELECTRIC WELDING

While intense interest in the subject of electric welding was indicated by the large attendance at the joint welding session of the A. I. M. E. and the A. I. E. E. on Wednesday, the volume of discussion was disappointingly meager for the number present. President C. A. Adams presided, opening the session by calling attention to the disappearing lines of demarkation between different branches of engineering and by referring to some of the work of the electric welding committee of the Emergency Fleet Corporation. Announcement was made of the organization of a national welding bureau which will be representative of all interests—manufacturers, users, engineering societies and government.

PATH FOLLOWED BY RUPTURE IN STEEL FUSION WELDS

Oxide Films at Grain Boundaries and Iron-Nitride Needles Possible Causes of Brittleness—Heat Treatment and Prevention of Oxides

From investigations made by S. W. Miller, the first evidence of strain in electric welds appears where visible defects may exist in the weld, such as film of oxide around the grains or around small particles of metal. Therefore, every effort should be made to avoid the formation of oxides. If there are no defects in the weld, the rupture is invariably along the grain boundaries. These conclusions apply to welds as made and not to those that have been heat-treated. Also, the path of rupture due to shock or alternating stress may possibly be different from that due to tensile stress.

Since all brittle welds resemble each other in having more or less columnar structures and containing such impurities as pearlite, cementite and nitride of iron, it is possible that quenching may help remedy the trouble since it produces an entirely different structure.

EFFICIENCY AND ECONOMY IN WELDING MILD STEEL

Pros and Cons of More Than Thirty Electric Welding Practices the Value of Which Is Open to Discussion

By stating both sides of questions concerning electric welding based on investigation of the welding research sub-committee of the welding committee of the Emergency Fleet Corporation, H. M. Hobart has opened the door for a discussion that in all probability will do much to extend knowledge of the subject. Some thirty-four controversial subjects are considered in his paper and comments pro and con are given. Some views which he sets forth follow:

Uniformity is very essential in welding electrodes, otherwise during welding an operator may come to bad places in the welding wire and the arc will probably sputter. However, if the electrodes are dipped in milk of lime (whitewash) good work can be done with electrodes that otherwise would be useless. While some claim that a thin covering obtained by dipping accomplishes the desired purpose, others contend that it is desirable to provide a covering designed so as to be consumed at a definite rate as compared with the rate of consumption of the inclosed welding wire. The welding committee recommends the following electrode composition: Carbon, not over 0.18 per cent; manganese, not over 0.55 per cent; phosphorus, not over 0.05 per cent; surphur, not over 0.05 per cent, and silicon, not over 0.08 per cent.

Experiences of specialists indicate that electric welding may be done as well with alternating current as with direct current. It is a little more difficult to hold the arc, but this simply resolves itself into a matter of practice. Alternating current for arc welding has been used with a frequency as low as 12½ cycles and as high as 500 cycles, and although there is no consensus of opinion on the correct frequency, it is known that the alternating arc can be held better at the higher value.

Some observers believe that alternating-current produces a more dense weld than direct current, whereas others refer to the fatiguing effect of attempting to hold an alternating-current arc and say that consequent frequent breaking of the arc produces bad spots in the weld. The power factor obtained with alternating-current welding leads to capital and operating costs offsetting any advantages, in the opinion of some authorities, but others are of the opinion that since, for ship welding on an extensive scale, motor-generators are required, power factor affects only the generator circuit and not the motor circuit. With thirty or forty outfits distributed fairly evenly on the different phases of a polyphase system, the load would be sufficiently balanced to be satisfactory, but this would correspond to an unusually large welding installation.

Where a number of arcs are to be used within a reasonable distance of each other the series system may be used. In this arrangement the secondary of an ordinary constant-current transformer supplies current to the primary of all the welding transformers in series. The individual transformers insulate the welding apparatus from the series circuit and transform from the series current to current of proper value for the arc. In this case the inherent reactance of the series transformer is low. The power factor of such a system can be safely made much higher than where individual arcs are operated in multiples from constant-potential circuits.

For spot welding plates from ⅜ in. to ¾ in. (9.6 mm. to 19.2 mm.) in thickness, the single-phase currents required would be from 30,000 amp. to 50,000 amp. and the kva. required at 60 cycles would range between 300 and 900 at power factors of from 0.35 to 0.50. These low power factors, combined with the fact that this load would be for short periods at very frequent intervals, would make it decidedly undesirable from the central-station standpoint. The condition would be much improved at 25 cycles, as the machine would operate with about half the kva. and about double the power factor.

Attention has been pertinaciously drawn to results of a very few tests which have appeared to indicate that metal-arc welds are inherently utterly deficient in ductility, yet the committee has had also before it the results of many well-authenticated tests of ductile metal-arc welds.

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The comparative strengths of some joints follow:

	Ultimate Load lb.
Spot and fillet welded	50,350
Fillet welded	37,000
Riveted and fillet welded	35,000
Spot welded	28,000
Riveted joint	13,000

According to one American authority, "the present well-tried field for electric arc welding is confined entirely to welding plates and forms; a great deal of work has been done on plates ranging in thickness from $\frac{1}{16}$ in. (1.6 mm.) to $\frac{3}{4}$ in. (19 mm.). Up to $\frac{1}{8}$ in. (3.2 mm.) the costs of gas and electric welding are about the same; above this the electric process is less expensive.

By some authorities ductility is believed to be most readily obtained by employing flux-covered electrodes. On the other hand, the committee has knowledge of several kinds of bare electrodes of various compositions which, in competent hands, make reasonably ductile welds.

All sorts of values are given for the speed, in feet per hour, with which various types of joints can be welded. In general, and within reasonable limits, the speed of welding will increase considerably (25 to 35 per cent) when larger currents are employed. This increase is not directly proportional to the current employed because a greater proportion of time is taken to insert new electrodes and the operator is working under more strenuous conditions. Up to a certain point ductility and strength improve with increased current, but when these conditions are met the best speed is not obtained, owing to increased heating zone and size of weld puddle.

Using highly skilled welders, an average rate of welding of only 2 ft. (0.6 m.) per hour was required to do the best possible work, varying the kinds of joints made in one long test. The amount of electrodes used up was about 2.7 lb. (1.1 kg.) per hour, of which approximately 16.5 per cent was wasted as short ends and 13 per cent burned or vaporized, the remainder being deposited at the speed of 1.9 lb. (0.85 kg.) per hour.

Rates up to 7 ft. (2.1 m.) per hour have been obtained in practice, but from his observations the author is of the opinion that a representative rate for a good welder of half-inch plates is about 2 lb. (0.9 kg.) per hour.

The practice heretofore customary of stating the speed of welding in feet per hour has led to endless confusion as it depends on type of joint, height of welt and various details. A much better basis is to express the speed of welding in pounds of metal deposited per hour.

The welding research sub-committee considers that the preferable current for a double-V $\frac{1}{2}$-in. (1.27-cm.) weld is at least 200 amp. If the weld of the plate is of the double-bevel type, some 50 amp. less current should be used for the bottom layer than is used for the second layer if two layers are used. For $\frac{3}{4}$-in. (19-mm.) plates the most suitable welding current is some 300 amp. This is of the order of twice the current heretofore most usually employed for such a weld.

Investigations of the welding committee are indicating that at least 10,000 amp. to 12,000 amp. per square inch is suitable for electrodes of $\frac{1}{8}$ in. and $\frac{5}{32}$ in. (3.2 mm. and 4 mm.) diameter and well up toward 10,000 amp. per square inch for electrodes of $\frac{3}{16}$ in. and $\frac{1}{4}$ in. (4.8 mm. and 6.4 mm.) diameter.

Metal-arc welding is at present proving very attractive to engineers, but it is too early to return a verdict as to whether this widespread tendency toward metal-arc welding is based on sound premises or whether there ultimately may not be a reaction (for certain kinds of work) back to carbon-arc welding.

One company has long followed the practice of using a 30-deg. bevel for plate edgings and finds it satisfactory for all thicknesses up to $\frac{3}{4}$ in. (19 mm.). If the smaller angles give welds which are equally satisfactory in all respects, the decreased amount of electrode material required, the decreased consumption of electricity and the increased speed are advantages not to be overlooked. The tendency is toward the use of at least two layers for $\frac{1}{2}$-in. plates, and three layers for $\frac{3}{4}$-in. plate.

Obviously, the procedure for testing the original metal should follow standard practice as recommended by the American Society for Testing Materials, but there is considerable difference of opinion and uncertainty as just how and what mechanical tests should be made of the welded joint and of the deposited metal.

ELECTRIC WELDING IN CONSTRUCTION OF SHIPS

Economy Possible Through Replacement of Rivets —Reliable Welds Possible if Trained and Skilled Men Are Employed

The cost of ship construction must be reduced, says Commander S. V. Goodall of the British Admiralty, and a reduction in riveting is the most fruitful field for economy. The welding committee of the Emergency Fleet Corporation has found by actual experience that a labor saving of at least 60 per cent results from the substitution of arc welding for riveting on minor parts of a ship, and J. H. Anderton has estimated that a saving in time of 70 per cent was effected at Hog Island.

The best method of overcoming the difficulties ahead appears to be to build up a staff of thoroughly skilled welders, to gain experience by the adoption of welding on minor parts, to proceed cautiously in the extension of the process to more important members, not to expect a great saving in time and cost immediately, but to persevere, not necessarily toward the rivetless ship but toward a vessel in which the employment of both processes of riveting and welding is so adjusted that more riveting or more welding could only be done at greater cost.

It is strongly urged that steps should be taken at once to establish welding as a skilled trade and that only certified men should be employed. Skilled men working under an experienced foreman would know, for example, that clean surfaces are necessary for good work, they would quickly learn what types of joint are made with ease, in what portions of a ship welding is cheap or where it is unreliable, and from their ranks should be drawn the draftsmen who will design in detail the welded vessel of the future.

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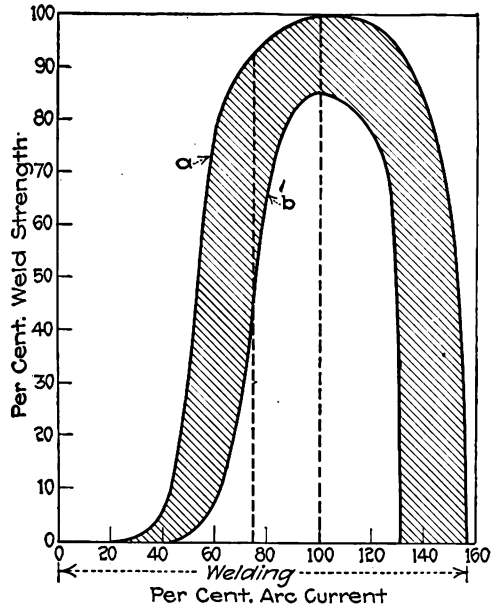
FUSION IN ARC WELDING EASILY DETERMINABLE

Indicated by Overlap of the Edge of the Deposit Layer on the Plate—Penetration Comparable to Depth of Arc Crater

After a study of the penetration, overlap and effect of arc length on fusion O. H. Eschholz has concluded that the fusion obtained in arc-welded joints between the plate and deposited metal is determined by the penetration of the deposit metal into the plate metal and the overlap of the edge of the deposit layer on the plate. These indications of the quality of a weld can be easily observed by visual inspection. The penetration is comparable to the depth of arc crater as observed by the welder when moving the arc terminal over the



VARIATION IN STRENGTH OF WELD TO BE EXPECTED WITH CURRENTS ABOVE OR BELOW NORMAL

plate with uniform velocity, and the overlap is indicated by the contour of the surface of the congealed deposit in the region adjacent to the material welded. For most welds a crater depression of $\frac{1}{16}$ in. (1.6 mm.) will give the desired penetration, while a contour which does not show a re-entrant angle between plate and deposit indicates an overlap per layer of approximately $\frac{1}{32}$ in. (0.8 mm.) or less.

Other observations made by Mr. Eschholz will be reported in a later issue.

Discussion on Electric Welding

Strength of electric welds and factors affecting their characteristics, such as kind of labor to employ, arc length and current strength, exclusion of contaminating influences of the air, etc., were the principal subjects discussed in the electric welding session.

President Adams declared that mild-steel welds had been made with a strength of 60,000 lb. per square inch (4218 kg. per sq.cm.), while armor plate welds have been produced having a strength of 75,000 to 85,000 lb. per square inch (5270 kg. to 6000 kg.). These results have not been consistently attained, but they indicate what can be done by controlling all influencing factors. Means have been developed whereby welds may be tested non-destructively in the laboratory with great accuracy, and it only remains to adapt the method to commercial use. Many specimens have broken outside the welds.

It is a mistake to employ ordinary labor for electric welding, H. A. Hornor contended, since the ordinary workman does not have the right temperament.

A. M. Candy referred to a decarbonizing effect on the parent metal of a weld apparently produced by using carbon electrodes. Considering metal electrodes, he pointed out that the surface tension of the molten electrode metal may have considerable effect on the contamination of the weld metal and arc current since this factor determines the size of the molten globules. Since hot-rolled steel electrodes produce weaker welds than some other metals which are apparently less desirable chemically, it seems that the chemical analysis is not much indication of the weld characteristics which will be obtained. The speaker warned against allowing a high open-circuit voltage when unskilled workmen are employed because of the long arc possible.

There will be a big field for electric welding where high-pressure steam pipes are used, said H. R. Woodrow, who pointed out that very successful results were obtained in one place where 200-ft. (61-m.) lengths made up of welded 10-ft. (3-m.) sections were lifted into place and tested for 600 lb. (42 kg.) pressure.

If speed of welding is an advantage, said C. J. Holslag, the alternating-current system is faster (33 per cent at 100 volts) than the direct-current system using a negative electrode. With the work negative the electrode melts too fast. Since the closer the electrode is to the work the less chance there is for impurities to enter, it is desirable to use a short arc, Mr. Holslag said. This also assures the metal being deposited in the crater with the least overlap. Metal penetration is reduced with low voltage, he contended, so reactance in series with resistance is desirable to secure the desired penetration.

W. L. Merrill disagreed with Mr. Hornor, saying that good welds can be secured with ordinary labor, provided that proper training is given. He pointed out that whereas spot welding could only be used successfully on plates up to $\frac{3}{4}$ in. (19 mm.) thick formerly, it is now possible to spot weld where the total thickness is 3 in. (7.5 cm.). Spot welding can be performed satisfactory under most conditions because very few variables enter. Since spot welds can be made stronger than the parent metal, the thickness of the latter can be reduced where it has been based on the strength of riveted joints.

D. C. Alexander contended that properly covered electrodes are essential, since the right vapor produced around the molten metal will protect the outside.

According to tests being made by the Electrical Testing Laboratories on samples of electric welds, there is no advantage to large beveling angles in butt-welded joints, said William Spraragen. Furthermore, the power, amount of metal and time required are excessive for large angles.

T. M. Hunter said that the efficiency of direct-current welding sets is not so high as many think, 12 per cent in some cases. With an alternating-current set higher efficiency is obtainable, and the power factor can be maintained around 38 to 50 per cent.

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CALCULATION OF TRANSMISSION AND TELEPHONE LINES

FINDING THE DANGER ZONE OF LINE DISTURBANCES

Propagation of Steep Wave Fronts Along Transmission Lines Investigated Mathematically—Limiting Danger Zones at High Frequency

In his paper entitled "The General Equation of the Electric Circuit—III," Dr. C. P. Steinmetz undertook the investigation of transmission-line phenomena such as those due to lightning disturbances and circuit switching. Heretofore these problems have been attacked on the assumption that the circuit constants, resistance, inductance, capacitance and shunted conductance, are in fact constant. This assumption was shown by Dr. Steinmetz to be far from the truth when the equivalent frequency is extremely high. In the case of steep wave fronts *r*, *L*, *C* and *g* change rapidly "due to the unequal current distribution in the conductor and the finite velocity of the electric field." Rectangular waves are rounded off, and the attenuation is so great that dangerous conditions are confined to limited zones near the origin of the disturbances.

In grouping transmission-line problems for purposes of calculation Dr. Steinmetz shows that this classification depends upon the frequency. "Four successive stages may be distinguished in the expressions of the circuit constants as functions of the frequency: (1) Low frequencies, such as the machine frequencies of 25 and 60 cycles, where the resistance is the true ohmic resistance and the internal reactance and inductance those corresponding to uniform current density throughout the conductor, with conductors of moderate size and of non-magnetic material. (2) Frequencies of the magnitude of 1000 to 10,000 cycles, where the resistance and internal reactance or inductance are those due to unequal current distribution in the conductors; that is, the resistance is rapidly increasing and the internal inductance decreasing. The conductance, *g*, is still negligible, radiation effects still absent, and all the energy loss that of thermal resistance. (3) High frequencies of the magnitude of 100,000 to 1,000,000 cycles. The radiation resistance is appreciable and becomes the dominating factor in the energy dissipation. The internal inductance has practically disappeared. A considerable shunted conductance exists due to the dielectric radiation. (4) Extremely high frequencies, of the magnitude of many millions of cycles, when the quarter wave length has become of the magnitude or less than the distance of the return conductor. Radiation effects entirely dominate, and the usual expressions of inductance and of capacity cease to apply.

"Only when the frequencies which are of importance in the problem lie fairly within one of the four ranges above discussed is a general theoretical investigation possible at present."

Instances of industrial importance were considered as follows:

(1) The conduction of high-frequency currents such as produced by lightning and similar disturbances; (2) the attenuation of waves in overhead transmission circuits; (3) the rounding of rectangular waves; (4) the flattening of steep wave fronts. The body of the paper was devoted to the formulation of these four problems.

The author was highly complimented for his apparent successful formulation of the high-frequency phenomena. Professor Adams, Prof. C. F. Scott, C. R. Underhill, Dr. J. B. Whitehead and Dr. A. E. Kennelly took part in the discussion

GENERAL EQUATIONS FOR ELECTRIC CIRCUITS

Account Is Taken of Transient Oscillations and Phenomena of the Steady State in Equations Developed for Transmission-Line Calculations

General equations for the calculation of current in any network whether of transient or steady character were presented by John R. Carson. In this paper the current is expressed in terms of two functions, the applied voltage and a characteristic function of the system which is independent of the form of the applied voltage. The function which depends only upon the system is called the "indicial admittance," indicating that it is an index of the system and completely determines the behavior of the system to all types of applied voltages.

In addition to the development of the general theory and formulas Mr. Carson devoted considerable effort to the derivation of fundamental solutions which admit of easy interpretation and computation for transmission lines having continuously distributed inductance, capacity, resistance and leakage.

Lack of time prevented any extended discussion of Mr. Carson's paper.

NEW WAVE-SHAPE STANDARD IS BEING WORKED OUT

Telephone-Interference Factor Is Proposed for the Determination of Voltage Wave Forms—Instrument Developed to Test Alternator Waves

Until the past year the only standard of wave shape included in standardization rules of the American Institute of Electrical Engineers has been the rule that the maximum deviation from the equivalent sine wave should not exceed 10 per cent of the amplitude of the equivalent sine wave. It has been pointed out, however, that the deviation standard has marked disadvantages, and consequently the sub-committee on wave shape standard, as reported by Dr. Harold S. Osborne, continued the study of the effects of harmonics in voltage waves and their influence on operation. Few data were found to show the effects of these harmonics on the operation of power systems, but their inductive influence on telephone circuits has been under investigation for a number of years.

When telephone systems come within the inductive influence of power systems much trouble has been experienced, and this trouble bears a definite relation to the frequencies of the harmonics in the wave form. The committee therefore has collected experimental data regarding the relative effect of harmonics of different

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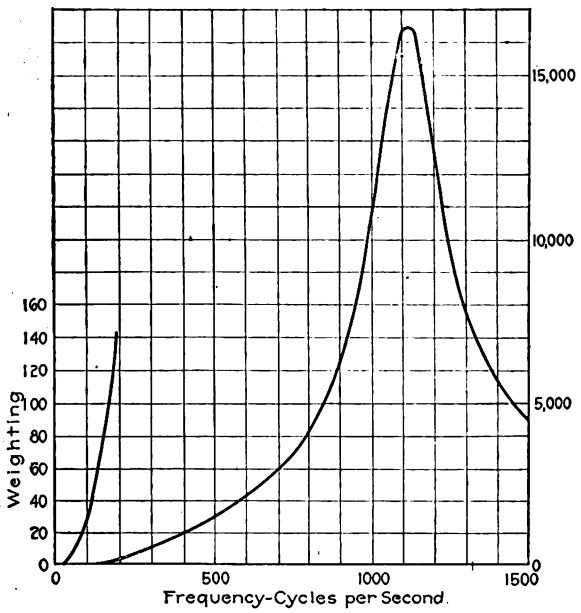
frequencies in producing interference in telephone systems. It is proposed that the present deviation factor be retained for all alternators and that an additional factor be adopted to be applied to alternators which will be used on open-wire (that is, one which is not in cable) transmission and distribution systems. This additional factor is based entirely on the effect of the harmonics in producing interference in telephone circuits when the power and telephone circuits are parallel. No attempt has been made to set values of the telephone-interference factor which should be used as limits, it being considered important that a large amount of data and experience be obtained before values are set.

The telephone-interference factor is the ratio of the square root of the sum of the squares of the weighted values of all the sine-wave components (including in alternating waves both fundamental and harmonics) to



CURVE SHOWING WHAT FREQUENCIES INTERFERE IN TELEPHONE CIRCUITS MOST SERIOUSLY

the root-mean-square value of the wave. Frequencies near 1100 cycles are regarded as most obnoxious.

Telephone-interference factor may be readily found by means of a portable instrument when connected through a definitely specified network to the voltage wave under investigation. This instrument is described as "a sensitive vacuum thermocouple provided with a shunt and a direct-current milliammeter."

An extensive table giving the telephone-interference factor for machines of well-known design was included in the report.

Great interest was shown in the paper, and in the ensuing discussion. W. J. Foster pointed out that many machines having excellent wave forms, as indicated by oscillograms, were listed as having high telephone interference factor. J. B. Taylor said the report dealt apparently with alternator wave forms without taking account of the influence of the line under load. Dr. Steinmetz stated that the report should deal with other difficulties than those in the telephone circuit, and he did not think that power engineers were ready for a standard wave form. Attention was directed by Dr. A. E. Kennelly to the fact that the curve for weighing frequencies amounted to a resonance curve for the telephone diaphragm. Professor Adams stated that the report was only intended to cover the telephone-interference problem, leaving other difficulties for the future committees. The report was also discussed by L. W. Chubb, Dr. J. B. Whitehead, J. J. Linebough, Dr. E. E. F. Creighton, and L. T. Robinson.

MUCH PROGRESS ACHIEVED IN RADIO-TELEPHONY DEVELOPMENT

Great Future Is Predicted for Wireless Telephony—Historical Development During the War Period and Apparatus Devised Are Described

In discussing "Radio-Telephony," with particular reference to development during the war period, E. B. Craft and E. H. Colpitts called attention to the usefulness of this form of intercourse. The possibility of oral communication between any two persons in the civilized world at any time is, of course, the ultimate object for which engineers are striving. Mr. Craft summed up the possible use of wireless telephony as follows:

"It is easy to see that radio-telephony can never compete with wire telephony in densely populated districts, while wire telephony is a physical impossibility at sea and in the air. Fortunately, however, the connection of a wire system to a radio system is no more complicated than connecting two wire lines by means of a repeater, and therefore these two fields, although distinct, are adjacent. The establishment of communication between two given individuals will be most efficiently realized through the use of a combination of wire transmission on a network extending over perhaps 99 per cent of the stations and radio transmission to those relatively few stations to which it is either impossible or impracticable to build lines."

The authors of the paper traced the whole historical development of the theory of radio-telephony and then described the communication sets especially designed and built for war purposes. Before the armistice was signed production had reached the necessary quantity basis, according to the authors. The major part taken by the engineering staffs of the Western Electric Company and the American Telephone & Telegraph Company was explained.

Donald McNicol presided at the Friday morning session devoted to telephony. When he called for the discussion of the paper by Messrs. Craft and Colpitts, Major-General Squier paid high tribute to the engineers of the Bell system for their coöperation with the Signal Corps. He also called attention to the fact that the government now invites the efforts of any engineer who can improve the efficiency of the ocean cable systems, which are badly overloaded. Owing to the great capacity of these cables, it is necessary to devote nine hours out of every twenty-four to running off the charges accumulated each time the key is closed. He said the government would finance promising experiments and permit the use of the Alaskan cable for tests. Dr. M. I. Pupin said that the development of the audion by Dr. Lee De Forest was one of the most important inventions of the last twenty years.

"Telephone Circuits with Zero Mutual Induction," by William W. Crawford, was read only by title.

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INSULATION AND ITS IMPROVEMENT

The last session of the convention, which was devoted to discussions of factors affecting the design and performance of insulations, was opened by President Adams, who said that the fact that higher voltages are not being used with generators and cables is chiefly due to the inability to approach the ideal of homogeneous insulation. The papers mark an epoch, he said, in the study of insulations and indicate paths along which manufacturers can develop insulation.

IONIZATION OF OCCLUDED GAS IN INSULATIONS

Weak Point in High-Tension Insulation—Method of Measuring Stress at Which It Starts—Need of Reducing Gas Spaces

Assuming that the solid part of insulation for high-tension equipment is in perfect condition and has a low enough dielectric loss to insure against cumulative heating that may cause excessive temperature rise, occluded gases are the weakest points in insulation, according to G. B. Shanklin and J. J. Matson. This is true because, above a certain thickness, air is dielectrically weaker than commonly used insulations and because the corona which occurs when it is overstressed will deteriorate the solid insulation. Therefore special attention must be given to preventing air pockets or films or at least to minimizing their thickness. Since the stresses exerted on these pockets are greater the higher the permittivity of the solid dielectric is, materials of the lowest permittivity should be used. Roughly the life of insulation in which izonization occurs is from six months to six years, showing that the damage is gradual but still deserving of serious consideration.

With these limitations to satisfactory use of insulations in mind, Messrs. Shanklin and Matson have measured the dielectric losses of various insulated coils and cables for gradually increasing voltages to determine the point at which ionization starts.

According to the tests made, it was concluded that 19 kv. or 20 kv. per centimeter should be the maximum allowable working stress that should be allowed in ordinary lead-sheathed, single-conductor paper cables filled with mineral hydro-carbon base compound. In well-constructed varnished-cambric-covered cables with half-lap turns, the maximum thickness of air space found next to the conductor was 0.008 cm. at 25 deg. C. and 0.003 cm. at 100 deg. C. This was about the order of thickness found in paper cables with mineral hydrocarbon compound. The maximum values of voltage gradient were lower, however, because of the higher permittivity of the cambric. For black-varnished cambric taped cables, carefully brushed in the making, the gas spaces were 0.011 cm. and 0.0035 cm. at 25 deg. C. and 100 deg. C. respectively.

The dielectric loss caused by ionization in baked flexible mica-wrapped cable was much greater than in fresh samples, and aging enlarged the gas spaces. For fresh samples the thicknesses of the gas spaces next to the conductors were of the order of 0.0075 cm. at 25 deg. C. and 0.0025 cm. at 100 deg. C. For aged samples the corresponding thicknesses were about 0.023 cm. and 0.012 cm. respectively.

VOLTAGE GRADIENT IN ENTRAPPED AIR

As might be expected, the dielectric strengths of air films between solid insulating material are practically the same as between conductors, according to tests conducted by F. Dubsky. He has also shown that the voltage gradient in entrapped air where a uniform field exists is equal to the product of the resultant permittivity and impressed voltage divided by the total insulation thickness.

In cable insulation the electric field is radial so the stress in entrapped air will be expressed by the formula $(KE/r_x)\ (1 \div \log_e^{\bullet} R/r)$, where K is the resultant permittivity of the insulation, E the impressed voltage, r_x the distance from the center of the cable to the film considered, r the radius of the conductor, and R the outside radius of the insulation.

Where the air pockets distort the electric field, the foregoing relations do not apply and the field may introduce lateral stresses at the surface of division of the air and taping. According to the gradients which will be ordinarily obtained in air pockets, those not exceeding 5 mils thick will give little trouble in insulations designed for voltages of 12 kv. and less.

PREVENTIVES TRIED AND OBSTACLES ENCOUNTERED

Of all the subjects considered at the convention probably none aroused so much discussion as the study of ionization in air films entrapped in solid insulations. Among the principal phases discussed were the following: Mechanical conditions that give rise to corona; preventives tried and obstacles encountered; reasons for deterioration of insulation by corona; method of outlining investigations when certain information is desired and the method of presenting reports, and the need of coöperative research.

H. G. Reist pointed out that the greatest trouble with internal ionization has been experienced in England, where conductors are insulated with tubes that may not fit tightly. In this country the greatest difficulty is in connection with the insulation of flat rectangular conductors, especially when mica is used, because the insulation tends to bulge away from the flat sides, leaving air pockets. Any fillers that melt may leave voids by running to other parts. Where coils are embedded in slots the sides will help mechanically to prevent bulging if the coils are tightly fitted. As an alternative insulations which are not easily attacked by corona may be used.

Other methods used to avoid ionization were mentioned by L. W. Chubb, among them being the use of dielectrics of low specific-capacity and winding machines that produce enough tension in the wrapping to minimize bulging. He pointed out that it is difficult to obtain a material which has both low specific capacity and heat resistivity, so the problem is attacked mechanically in most cases. The formation of nitric acid inside the air pockets was suggested as the cause of insulation deterioration when ionization occurs. There-

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fore, if the insulation is not allowed to "breathe" air the destruction should not be great. Insulations outside of slots have not the mechanical support to prevent bulging, but the potential gradient is less there.

Dr. J. B. Whitehead criticised the preceding investigations because, in his opinion, air films do not usually occur in large areas or with uniform thickness. He urged tackling problems from a less speculative point of view and presenting reports of investigations with more exactness so the accuracy of results can be better judged.

While it is difficult to determine in advance all conditions which will be brought about by usage of insulation, W. J. Foster suggested that valuable information might be obtained by subjecting insulated conductors to distortions which are likely to happen in assembling or during operation and then conducting tests on the ionization of the insulations. In so doing consideration must be given to the effects of temperature change.

In H. W. Fisher's opinion it is practically impossible for air films to be as thick as 3 mils in well-made cables. He suggested that it might be interesting to determine the cause of rise in dielectric strength after the resistivity reaches a certain point. Thin compound might fill cable insulations satisfactorily, but stretching of the lead sheath may allow air spaces into which compound will run if the cable slants, Mr. Fisher contended. It might be better to have a compound with slightly higher dielectric losses if higher flexibility and less fluidity can be obtained.

From observations, R. R. Argersinger said that mica insulations show more evidence of corona than combination insulations, but the damage is not so great.

To throw some light on the reason why corona disintegrates solid insulation, Prof. C. F. Harding said that nitric-acid yield is dependent on certain critical amounts of air supplied, pressure, temperature, etc. He had also observed that combinations of ozone and nitrous oxides attack materials more severely than nitric acid alone.

L. W. Chubb expressed the belief that the corrosive effect of corona is due more to the nascent nitrous oxides formed than it is to presence of ozone. While pitting of mica does not go far, it does penetrate several layers, he said.

F. W. Peek, Jr., pointed out that the effect of dielectric capacity on charging current also has to be taken into account in selecting dielectrics for insulations.

Pitting from corona seems to be due more to mechanical bombardment than to other causes mentioned, said Professor Adams, because it powders the solid dielectric and because not enough air is usually present in pockets to produce sufficient nitric acid to cause damage. The frequency of corona discharge is many times line frequency when an air film breaks down, thereby increasing the energy losses. Another interesting phenomenon was mentioned by Professor Adams—that of the displacement current in dielectric being forced at right angles to its direction by the magnetic flux, present around all conductors, causing concentration of flux. High vacuum inside the pockets would also augment corona.

ABNORMAL VOLTAGES WITHIN TRANSFORMERS

Prevention of Breakdown of Transformers Possible by Studying Distribution of Voltage Along Windings, Eliminating Excessive Concentration

By showing in what way transformer constants influence voltage concentration along the windings, L. F. Blume and A. Boyajian indicated how a transformer may be designed so as to mitigate the stresses occasioned by a given voltage disturbance. This method of avoiding breakdown is more economical than the one which uses external protective devices, in the authors' opinion. Some of the conclusions drawn are that transformers differ from transmission lines as regards distribution of voltage, capacitance, etc., chiefly on account of the presence of coil to coil capacitance and mutual inductance. Three kinds of disturbances are recognized—abrupt impulses, rectangular wave fronts which have long tails, and sustained high-frequency voltages.

In considering abrupt impulses the authors show that the presence of coil capacitance causes the transformer to respond as a pure capacitance and not as an inductance to abrupt impulses and toward all frequencies above its lower natural frequencies of oscillations. The voltage distribution within the transformer windings for abrupt impulses and for high frequency depends upon a factor alpha which is equal to the square root of the total capacitance of the winding to ground divided by the total coil capacitance from one end of the coil to the other. The greater the value of alpha the greater the concentration of voltage at the line ends and the smaller the voltage in the interior of the winding. The maximum volts per unit length of coil stack at the line end are equal to alpha times the value of the voltage corresponding to uniform distribution.

If the impulse is of the rectangular wave form with long sustained tail, the phenomenon within the transformer will be the same as before, but it will now be followed by a series of damped oscillations, the amplitudes of these oscillations depending not only on the amplitude of the impressed wave but also on the value of alpha and on whether the neutral is isolated or grounded. In addition to being proportional to the value of the impressed wave the amplitude of oscillation for a given harmonic is smaller the higher the harmonic and the smaller the value of alpha.

When the applied frequency is greater than the natural frequency of the transformer, the reaction of transformer is similar to its reaction toward abrupt impulses. High internal voltages are built up only at the lower frequencies.

Among the engineers who discussed Mr. Blume's paper were Dr. E. E. F. Creighton, H. R. Summerhayes, G. Faccioli, Prof. C. A. Adams, F. Dubsky and F. W. Peek, Jr.

Professor Adams said that it is to the men who develop laws and foundations which serve as a basis for future design that great appreciation is due. Since it is difficult for the most highly trained mind, however, to state mathematically and accurately conditions that may exist, the only check on mathematical analyses is actual test.

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Starting Synchronous Motors

How to Avoid Excessive Currents and Mechanical Strains in Synchronous Motors Started as Induction Machines—Switching May Be Guided by Field Ammeter or Accomplished by Properly Arranged Relays

BY E. E. GEORGE
Electrical Engineer, Chicago, Ill.

GETTING a synchronous motor into step with the line, under its own power, is comparable to shifting two high-speed gears into mesh with more or less load on the driven gear. Within certain narrow limits of difference of velocity the shock is less than full-load stress and is allowable. Above these limits the operation of starting appreciably shortens the life of the machine and may even wreck it. But directions for starting any polyphase synchronous motor as an induction motor can be made very simple if the starting characteristics are once observed and analyzed by the electrical engineer in charge. Starting under normal conditions can then be left to inexperienced operators. The use of relays for automatically changing from starting to normal voltage is highly recommended. In case of manual operation, however, a field ammeter can be arranged to show when the motor has reached synchronous speed.

During starting the field windings may be: (a) Sectionalized by a break-up switch provided by the manufacturer; (b) short-circuited by a double-throw field switch; (c) open-circuited; (d) shunted through an intermittent duty discharge resistance by leaving the field switch in an intermediate position; (e) shunted through a continuous-duty discharge resistance at all times, but with the field switch open during starting; (f) closed on an independent source of direct current; (g) closed on the armature of a generator or exciter driven by the motor itself, so that the exciting current is zero to start.

Analysis of Starting Torque

Certain phenomena of starting should be considered before deciding on the best procedure. For convenience in description a three-phase motor with a rotating field will be considered. It will make no quantitative difference whether spool-wound or slot-wound fields are assumed, although spool-wound (or salient-pole) fields ordinarily have the best starting characteristics.

The starting torque of a synchronous motor is due to any or all of three sets of induced currents in the field structure: (a) in the iron of the poles; (b) in the copper or brass squirrel cage, if any (modern self-starting motors have a carefully designed squirrel cage which helps also to prevent hunting, surging and phase unbalancing); (c) in the field windings if the circuit is closed.

Owing to its uniform distribution around the air-gap periphery the second circuit (b) has a torque equal to a constant times $SR/(R^2 + X^2)$, where R is the resistance and X is the reactance at any slip S for the squirrel cage.

The first circuit, if the machine has coil-wound poles, and the third circuit in any case, are not uniformly distributed, and the torque pulsates, owing to the pulsating nature of interaction between the primary field and the secondary current-carrying circuits. The three phases of the primary produce a steady field, unidirectional and revolving synchronously with respect to the primary or stator windings. The secondary field winding on the rotor cannot exert a constant unidirectional or a revolving reaction on the primary field, as a squirrel-cage winding would. The iron, however, acts like the field winding, in the case of a coil-wound field, while in a slot-wound field it acts like a squirrel cage.

The torque due to the field winding does not vary as a continuous function of $RS/(R^2 + X^2)$, but becomes zero or negative at certain fractions of synchronous speed. It is practically zero between half and three-quarters of synchronous speed. Such a winding alone is of little help in starting a motor as it will not accelerate it beyond half speed. The reaction of the single-phase secondary field also tends to cause an unbalance of the primary currents.

Although the effectiveness of the reaction in the secondary depends upon the distribution of the iron and copper of the secondary, the power losses involved in the internal reactions and the negative torque due to their odd harmonic components will, in general, utilize all the available energy, and the machine cannot accelerate. Accordingly the field winding is a hindrance to starting to some degree, and in certain motors has to be kept open or closed through a high resistance.

Before the motor reaches synchronous speed it acts like a transformer and induces a high voltage in the fields, particularly if they consist of many turns, as for 220-volt and higher sources of excitation. This high voltage may break down the insulation or endanger the operator should he touch the slip rings or field switches. If the external resistance across the field terminals can be made reasonably small without interfering with starting, the voltage drop across it at low speed may be low enough to be comparatively safe.

Field Circuit Closed Through Exciter

The armature of a direct-current generator offers moderately high inductance and very low resistance to the alternating induced field currents, regardless of whether the generator is developing direct current or not (disregarding the tendency of the superimposed direct current to cause odd harmonics in the alternating-current circuit). And if the field can be left permanently connected across the armature of the generator which furnishes the excitation, the field circuit is thus closed during starting.

If the exciting generator is driven by the synchronous motor, the direct-current voltage will be zero to start, and by adjusting the motor and exciter-field rheostats

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so that the motor reaches about three-quarters speed before the excitation builds up to about half of that normal for no load, the field can be left permanently connected to the exciter armature. If the voltage does not build up to about one-third normal, it will not pull the rotor into synchronism with the proper polarity.

It is assumed that the field will be excited while the machine is still on reduced voltage, as this is preferable for ordinary conditions. In changing from the low-voltage taps of the compensator to full line or running voltage, the time interval should be as near zero as posible (not more than 5 cycles) because if the rotor drops back one pole the counter emf. of the motor and the line voltage are cumulative in direction, and the action is practically that of a polyphase short circuit at double voltage on the line. This is the usual cause of tripping the overload devices during starting. The shock to the machine and to the system is severe, even with current-limiting reactance on the line, and should be avoided. The same shock is produced by changing over to line voltage with the rotor in synchronism but of wrong polarity, owing to the field excitation not being sufficiently heavy to pull the rotor into proper polarity at reduced voltage.

If the voltage change-over can be made quickly enough, there is no danger in raising the excitation to normal value for full load, after the machine has passed about three-quarters speed and before the change-over is made. If self-excited, the motor and exciter rheostats can be adjusted before starting so as to time the field current just right for the acceleration, and with a larger margin of certainty in each direction than can be attained by the best manual adjustment after starting.

Hand-operated oil circuit breakers are quick enough if properly mounted and operated, but solenoid breakers electrically interlocked will make the change-over with an interruption of not over two or three cycles. If, before changing to running voltage, the excitation is high enough to produce unity power factor on running voltage, there will be little surge of current in changing over, as then the counter-emf. and the line voltage are nearly equal and opposed (provided that the rotor does not slip back). If the rotor does slip back, it may be necessary to weaken the field circuit before changing to running voltage and to defer increasing it until the increased voltage has pulled the rotor into synchronism again, which will happen unless the load is excessive.

FIELD AMMETER INDICATES SYNCHRONISM

In this connection it is desirable to mention a highly valuable method of discovering when synchronous speed is reached in a synchronous motor or synchronous converter. Simply watch the needle of the field ammeter, which must be of the D'Arsonval or permanent-magnet type. It is necessary to have the meter in a closed circuit with the field winding, and if conditions prevent closing it through an intermittent duty discharge resistance or through the armature of the exciting generator, a continuous-duty non-inductive resistance should be placed across the field terminals. This resistance should be low enough to prevent dangerous voltage across it in starting, and also low enough to give a fair ammeter deflection when the rotor pulls into synchronism without excitatio

The field ammeter needle will remain still until the machine reaches about three-quarters speed (on a 60-cycle machine), when it will begin to tremble, with the vibrations getting slower and wider as the machine speeds up. Just as the rotor locks into step, regardless of polarity, the needle will make a violent wide swing backward and then come to zero and stay there without much surging (if the exciter circuit is open). If direct current is flowing in the field, the needle will act much the same, except that it will come to a positive steady reading instead of to zero. Before reaching synchronism the direct current does not affect the needle much, because in most machines the induced alternating current is greater than the direct current. Every synchronous motor should be provided with a field ammeter and the operator should become accustomed to watching its behavior during starting.

AUTOMATIC SWITCHING

If a normally open circuit-closing instantaneous low-voltage alternating-current relay is connected in series with a 2-mfd. or larger condenser across the field terminals, it will operate when the machine reaches synchronism (owing to the disappearance of the alternating-current voltage), and with its contact circuit in series with the contact circuit of a normally open circuit-closing instantaneous overload direct-current relay in series with the excitation circuit, will properly control the change-over to running primary voltage, and starting can be made entirely automatic. This system of only two relays is simpler and safer than that used for automatic substations at present and is independent of definite time-limit relays. The direct-current overload relay should be set so that it will not operate until the excitation is high enough to pull into step the maximum load to be started at the minimum primary running voltage.

Because of the large number of factors affecting the result it would not be practicable to outline in detail here a complete system of tests that would automatically determine for every case the best starting procedure. Among these factors are the maximum instantaneous primary current allowed by the rules or by the cut-outs of the supply company, the number of taps on the compensator, the maximum load to be started, the exciter voltage, the insulation of the field coils, the time allowed for starting (in the case of fire pumps), the amount of interlocking with other circuits, the mechanical strength of the driven equipment, whether the motor is self-excited or independently excited, whether the starting is manual or automatic, etc.

When possible the following method is desirable: Use a self-excited motor, connect the field permanently across the generator armature, adjust the field rheostats as previously described, and set the compensator leads on the lowest taps that will start the motor and pull it into synchronism. To start: Close the starting primary switch, and after the field ammeter shows that the machine has reached synchronism and that the exciter has built up to normal voltage, quickly open the starting primary switch and close the running one. To shut down: Open the latter switch. With this method there are no dangerous field voltages, no complicated starting rules, no rheostats to adjust, and no overload shock to the machine or to the system.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

REMEDYING TROUBLE MET WITH ROTOR OSCILLATOR

Failure of Device Used to Oscillate Shaft of Rotary Cured by Spring Holding Ball in Proper Position

BY GEORGE A. ILER
Superintendent of Operation Georgia Railway & Power Company

At one plant where a rotary had settled out of level trouble was experienced because the oscillating device, which was of the ball-bearing and thrust-plate type, failed to function. At heavy loads the field would pull the armature over against the ball so that the armature would oscillate for a while but not continuously. It was out of the question to relevel the machine, because the foundation had been embedded in concrete to a depth of 12 in. (30 cm.). One of the maintenance men discovered that if he held the ball of the oscillator at the bottom and normal rest position in its race, the armature would oscillate all right, so a small spring-brass pointer about 6 in. (15 cm.) long and very flexible was put alongside the ball to keep it from rocking back and forth in its race. This spring held the ball in its normal position all the time when not under pressure, causing the armature to oscillate normally.

EMERGENCY METHODS FOR USE IN INDUSTRIAL PLANTS

Methods of Quickly Providing Feeders and Motor Drives, Avoiding Long Interruptions of Service—The Plan May Be Applied Elsewhere

BY H. S. RICH

Some expedients were adopted during the rush of war work which may be advantageously applied in emergency cases that arise now provided they are not retained permanently to the exclusion of better methods. For instance, in one New York State plant where production had to be got under way immediately in a new extension delay was avoided by running open-wire feeders until conduit could be installed. Four-wire power lines were stretched the whole length of each floor by dead-ending them at each end with strain insulators and attaching them to the intermediate beams with single-wire cleats. In this way circuits were installed within a few days, whereas it took several weeks to complete the conduit system. Temporary or emergency connections were made to these feeders as required.

While waiting to install the motors and control in a permanent manner temporary drives were provided by securing the motors to any convenient foundation with lag screws and boxing in the belts with guards made of slats. Where motors for the permanent installation had not been received, large motors on hand were temporarily installed and shafting hung overnight to drive groups of machinery. The starters were set in convenient places temporarily. Later the equipment was installed in more approved fashion by bolting the starters to columns and providing for overhead mounting of the motors on the stringers. Measurements were taken to determine the spacing of bolts and the motors hoisted into place and attached during noon hour. Everything was planned carefully in advance so there would be no delay in making the changes.

In the forge shop, where new oil furnaces were installed and the blast-fan motor which had been used was inadequate for the service, an additional motor was delivered on skids, which were set on the dirt floor and braced and bolted to nearby objects. The starter was screwed to the skids and wires connected with the open-wire feeders previously mentioned. Within three weeks this gave way to a permanent installation.

As the shop was working under extra pressure it was never known when a breakdown would occur, so extra motors rated at 5, 7½, 10, 15 and 25 hp. were ordered for emergency installations. The 15-hp. motor was hardly received when power for five large grindstones was interrupted, suspending work on thousands of steel sections. The motor was immediately installed on the concrete floor, braced from the ceiling by 4-in. by 6-in. (10-cm. by 15-cm.) spruce timbers and blocked against a brick pier in such a way that it could not move. A split pulley was put on a section of the shaft driving the grindstones and connected with the newly installed motor, so that the grindstones were running again after only a few hours' interruption. Repairs were then made on the permanent drive.

Other cases like this were handled in a similar manner, while overloaded motors were assisted by installing additional motors. Where groups of machines were driven by an overloaded motor the machines were separated mechanically and driven by separate motors. Electric fans were employed to improve the ventilation of other overloaded machines that could not be shut down.

In one case, where some gears began to run hot and operations could not be interrupted, they were dosed with caster oil and powdered graphite. This treatment was costly and did not remove the cause, but it prevented shutdown. Once a starting box was completely ruined by a short circuit in the resistance coils, so a barrel of water and two iron plates were used as a water rheostat for starting.

One of the greatest advantages in making emergency installations and repairs is to have motors of one make throughout a plant, thus allowing interchangeability of pulleys, rotors, end shields, bearing linings and

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starters. Shortly after the busy times began extra pairs of bearing linings were put in stock for each motor. These cost considerable but saved money in avoiding long interruptions of service. Another necessary item was that of keeping all required sizes of fuses on hand (especially the large ones) labeled, tested and assorted. It was found to be poor practice to use wrong-size fuses because nobody ever found time to replace them.

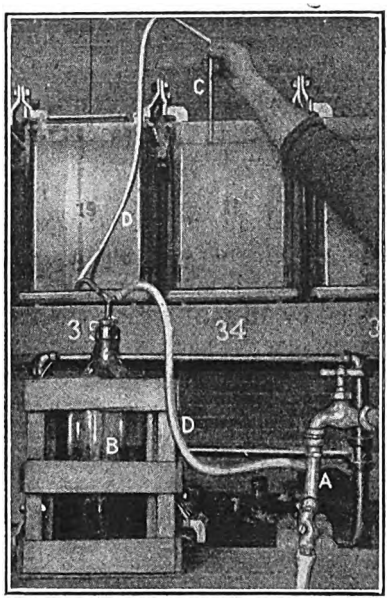
REMOVAL OF SEDIMENT FROM STORAGE CELLS

Where Cells Cannot Be Dismantled for Cleaning, Deposits in Bottom Can Be Removed by Vacuum Without Seriously Lowering Electrolyte

BY M. W. PULLEN AND F. F. SKRIVAN

After four years of rather severe service the cells of the storage battery of the Johns Hopkins University reached a point where a good cleaning out was necessary. Active material had fallen from the plates until it was within a fraction of an inch of the plate bottoms.

There are 130 cells, each of 400 amp.-hr, rating, in the set. The jars are of glass and measure approximately 12 in. (18 cm.) square and 16 in. (24 cm.) high. How to remove the old active material in the bottoms of the cells was a problem. To dismantle the cells, take them down and wash out the sediment was out of the question. Aside from the risk of breaking the jars, expense of new separators and cost, the battery could not be spared for the time required to do the work.



REMOVING DEPOSITED ACTIVE MATTER FROM BOTTOMS OF CELLS

An attempt was made to draw the material up by using a rubber pump with a long suction pipe. This worked, but it was slow and the pump finally broke. The method which was eventually used is best described in connection with the photograph showing the work of cleaning going on. The apparatus consisted of a filter pump *A*, a 5-gal. (19-l.) bottle *B*, a Z-shaped glass tube *C*, and some rubber tubing *D*. Almost any method of producing a vacuum in the bottle besides the filter pump might have been used. The latter was handy and easy to run. The bottle was provided with a cork having two glass tubes through it. To one the filter pump was connected and to the other the glass Z-tube, rubber tubes being used for the connections.

Water was turned on at the filter pump, causing a partial vacuum in the bottle. By inserting the glass Z-tube in the battery jar the sediment was drawn up. As the process went on the end of the glass tube was moved about over the bottom of the jar and the loose material thus removed. To be sure, the acid level in the jar was lowered during the cleaning process, but as the cells were not in service at the hours worked upon this made little difference. They were refilled with electrolyte before heating could take place. The mixture of electrolyte and old active material in the bottle was emptied into a spare battery jar and allowed to settle. The clear electrolyte was siphoned off and used in filling the jars.

The time required per cell was approximately half an hour. Six or eight cells were cleaned per day according to the time available from more pressing duties.

COMMON SENSE DOUBLES EFFICIENCY OF PLANT

Attention to the Ordinary Things Which Every Engineer Should Know How to Care For Saves 50 per Cent in Coal Consumption

In one plant attention to operating data brought the plant efficiency up from 32 per cent to 68 per cent, said Edward Marshall of Cincinnati, speaking before the station operating committee of the Ohio Electric Light Association. Very little attention had been paid to efficiency until instruments and stack thermometers were installed, but things became very different afterward. Readings showed stack temperatures of 800 deg. to 900 deg. Fahr. (427 deg. to 482 deg. C.). Draft readings over the fire showed 0.8 in. (20 mm.). The Venturi tube and a crude coal scale showed that 3.3 lb. of water was being evaporated per pound of coal burned. The feed-water temperature was only 130 deg. Fahr. (54 deg. C.) when enough steam was blowing through the roof to heat it to 210 deg. Fahr. (99 deg. C.).

One boiler at a time was gone over. It was found that the bottom and rear baffle was practically gone in each case. There was a large accumulation of soot on the tubes at both the front and rear headers. The tubes above the first three rows had not been bored for a period of three years. The boilers were rebaffled by using Y tile in the bottom row, taking out the vertical baffles and putting a baffle on top of the eighth and fourteenth rows, making a three-pass boiler. The Bayer soot blowers were repaired. The tubes were cleaned inside and out. The stokers were retopped and provided with new dump grates.

Then it was found that a draft of 0.35 in. (9 mm.) could be obtained over the fire, and that the stack gases were reduced to a temperature of about 600 deg. Fahr. (315 deg. C.). The amount of refuse in the ash was reduced from 40 per cent to 15 per cent. While the net result was that the efficiency of the plant was increased from 32 per cent to 69 per cent, the fuel saving was 50 per cent. Common sense made the difference.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

FIGURES AS TO METER READER'S MOVEMENTS

Analysis Shows Number of Meters Read, Time Taken, Stairs Climbed, Blocks Walked, Streets Crossed, Poles Climbed, Etc.

Some interesting figures on the movements of a meter reader are furnished by J. A. Gibson of Dunkirk, N. Y., in the accompanying table. Attention is called to the number of fuse boxes found open. All boxes were closed the previous month. Most of the open boxes were found in factories.

Days Engaged	Hours Engaged	Meters Read	Stairs Climbed	Veranda Stairs Climbed	Doors Opened	Blocks Walked	Number Streets Crossed	Poles Climbed	Rescaled Every Month	Installed on Porches	Meters Read per Hour	Fuse Boxes Found Open
1	4	171	59	36	369	40	25	1	0	0	42¾	2
	4	168	84	61	452	57	59	0	0	1	42	2
1	4	131	78	69	429	59	60	0	0	2	32¾	1
	4	121	69	46	374	51	63	1	0	1	30¼	0
1	4	124	52	46	381	41	79	1	0	1	31	1
	4	115	67	55	428	54	71	0	0	2	28¾	2
1	4	116	79	69	407	60	64	0	0	0	29	0
	4	102	76	62	388	54	62	2	0	0	25½	0
1	4	126	74	62	401	54	61	0	0	3	31½	0
	4	102	96	81	372	41	58	0	0	0	25½	1
1½	4	109	84	76	391	47	50	4	0	6	27¼	0
1	4	59	21	4	138	...	0	0	35	0	14¾	9
	4	49	19	2	101	...	0	0	33	0	12¼	5
1	4	46	22	6	112	...	0	0	28	0	11½	8
	4	13	4	1	45	...	0	1	3	0	3¼	1
7½	60	1552	884	676	4778	558	652	10	99	16	25⅞	32

CONTRACTORS INVITED TO FORMULATE SALES PLANS

Providence Lighting Company Makes Bid for Co-operation and Good Will—Letters Inviting Closer Relations Sent Out

Good will among the electrical contractors has been recognized by lighting companies as an asset. A number of companies are actively trying to increase this good will. It is doubtful, however, if many utilities have gone so far as inviting the contractors to help the company formulate sales plans. As will be seen from the following letter, this plan is being followed, at least in this instance where the contractor is especially affected, by the Narragansett Electric Lighting Company, Providence, R. I.:

NARRAGANSETT ELECTRIC LIGHTING COMPANY
EXECUTIVE OFFICES
PROVIDENCE, R. I., Feb. 4, 1919.

To Electrical Contractors:

We take great pleasure in notifying you that the customer has been relieved of financing extensions, also service connections. Those requiring consideration by the company will be handled as prior to last August by guarantees on the part of the customer.

We are one of the first of the central stations to go back to a pre-war basis in the matter of financing extensions and connections, thereby releasing a large volume of business for you which has been held up because of these restrictions. It is our intention to coöperate with you to the fullest extent at all times, and we welcome suggestions from you from time to time that will improve our mutual interests.

We have under consideration a house-wiring plan that we hope may be adopted at an early date. In the meantime will you be good enough to tell us either in writing or in person your ideas as to how it can be best handled?

Trusting that you will avail yourself of the opportunity existing to secure a large amount of business, we beg to remain.

Very truly yours,

E. R. DAVENPORT,
Sales Manager.

UTILITIES MUST ENCOURAGE SALES OF SOCKET DEVICES

Canadian New-Business Manager Points Out the Interest That the Lighting Company Has in the Development of the Appliance Market

That central stations should make every effort to encourage the sale of energy-consuming devices was emphasized by W. B. Johnson, manager of the new-business department of the Montreal Light, Heat & Power Company, Cons., before the January meeting of the Association of Municipal Electrical Engineers of Ontario. He stated that he firmly believed that should electric companies discontinue the development and sale of appliances not only would the sale of such appliances greatly decrease but that gradually the use of such appliances as are now in general use would be discontinued. This, he said, was not any reflection on the selling ability of contractors or other merchants but due to the fact that these other merchants did not have the interest in sales that a central station has. The public expects the electric company, he stated, not only to handle all the latest appliances but to handle the best at a fair price. "Should they discontinue the sale of appliances the market would be flooded by unreliable merchants with cheap, worthless and very unsatisfactory goods. This, you know, would hurt our business, the selling of electric energy, more than one would think and would also kill the sales of reliable dealers."

The pushing of appliance sales, Mr. Johnson held, should mean increased sales for all dealers. Every appliance sold, provided that it gives satisfactory service, helps sell other appliances. However, these appliances should not be sold, he felt, at a loss. To sell at a loss prevents other dealers, particularly contractors, from making a profit. He said that if utilities cut prices it meant that every merchant must discontinue selling appliances and that the utility would therefore sell more, which does not necessarily mean that there would be any more in service than the lighting company's lines. By maintaining prices the utility has that many more salesmen working for the company without being on its payroll. Mr. Johnson was not quite of the opinion

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that manufacturers' prices were fair retail prices, but thought rather that the resale price should be based on the average cost of contractor-dealers plus their margin of profit, which would, no doubt, be higher than were it based on the cost of the public utility.

He is furthermore of the opinion that every cent of net profit derived from sale of appliances, together with such addition of amounts as records will permit, should be expended in educational, sales and good-will advertising.

PROOF THAT HIGHER LIGHTING INTENSITIES PAY THEIR COST

Data on Increases in Factory Output That May Be Obtained When Good Illumination Is Properly Applied

Central-station salesmen have long asserted that increased lighting in factories will stimulate industrial production. It is only within the last few years, however, that data on actual tests have been available to prove that lighting does stimulate production, to show what percentage of increased production may be expected and to indicate to what intensities it may be wise to go.

Last week W. A. Durgin of the Commonwealth Edison Company, in the course of an address before the Chicago Section of the Illuminating Engineering Society, gave the detailed results of four completed tests which were more briefly mentioned at the New York convention of the society on Oct. 12, 1918, and reported in the ELECTRICAL WORLD of Dec. 7, 1918.

To the lighting salesman these data are important, especially at this time when the problems of reconstruction are at hand. If good lighting does mean greater output and if this fact can be substantiated by accurate data, then good lighting becomes of vital consequence to every manufacturer. Moreover, the question is of great importance to central-station executives. With the lamp engineers constantly making remarkable improvements in their product, the lighting business can remain attractive only if central stations find that the use of greatly increased quantities of light is economically justified Furthermore, electric companies, in order to advise consumers, must know actual facts. For this reason the Commonwealth Edison Company, as a beginning, has undertaken its series of tests to show the true relation between the amount of light used and the production of hand and machine workmen in various industries. The conditions to be met are: (1) The plant investigated should be able to show actual production accurately for distinct machines during definite periods; (2) the product should be so standardized that large outputs may be obtained with all conditions identical except the amount of light used, and (3) a fair proportion of the work must be done during hours of darkness, or the factory must be so placed that the daylight is negligible. These are the ideal conditions. In no case has the Chicago company been able to realize them completely, but in four instances it has interesting data.

A summary of these data is given with this article. While the figures are practically self-explanatory, it may be pointed out that two general conditions are represented by these tests. The first condition shown in test No. 1 is one in which the value of fair lighting over poor lighting is demonstrated. The second condition, illustrated in tests Nos. 2, 3 and 4, is one in which a further large improvement is made in going from fair lighting to excellent lighting. These latter results naturally raise the question as to the limits to which higher lighting intensities may be carried with commercial success, and it is in this field, where intensities may even exceed ordinary interior daylight values, Mr. Durgin stated, that opportunity for further investigation still exists.

TEST INSTALLATION NO. 1

Iron Pulley Finishing Shop.—40 ft. by 80 ft.; 13-ft. ceiling. Old equipment: Drop cords, 60-watt lamps, bare, in tin shades, 0.27 watt per square foot—0.2-ft.-candle. New equipment: "Reflecto-cap" 200-watt units, 10 ft. mounting height, 1.9 watts per square foot—4.8-ft.-candles.

Results of improved lighting in percentage of increase:

	Office Records	Test Records
Square feet of turning.....	30	35
Square inches of boring.....	34	16
Set screw holes.....	...	6
Cubic inches of key seating.....	100	..
Balancing	...	22

Average from test records, 20 per cent increased production.

Average from all records, 35 per cent increased production.

Cost—Maintenance (twenty hours per month), electricity, depreciation (15 per cent) and interest (6 per cent) = $105 per month = 5.55 per cent of payroll ($1,900 per month).

TEST INSTALLATION NO. 2

Soft-Metal-Bearing Machine Shop.—48 ft. by 50 ft. "Normal" equipment; twenty-five 100-watt vacuum Mazda lamps in deep-bowl reflectors, 1 watt per square foot—4.6-ft.-candles. "Productive" equipment: twenty-five 200-watt gas-filled Mazda lamps in deep-bowl reflectors, 2 watts per square foot—12.7-ft.-candles.

Results of productive intensity in percentage of increase: Flanging, 20; hueing, 24; rolling, 9; setting, 8; bundling, 27; second bore, 13; punching, 10; perforate and blank, 12. Average from shop records, 15 per cent increase.

TEST INSTALLATION NO. 3

Heavy Steel Machine Shop.—40 ft. by 58 ft. "Normal" equipment: Thirteen 100-watt gas-filled Mazda lamps in 23-in. eye-shield units, 0.6 watt per square foot—3-ft.-candles. "Productive" equipment: Thirteen 300-watt gas-filled Mazda lamps in same units, 1.7 watts per square foot—11.7-ft.-candles.

Results of productive intensity in percentage of increase: Drilling, 11; milling, 6; screw-machine work, 14. Average from test records, 10 per cent increase.

Cost of productive intensity: Additional electricity, additional cost of lamps, depreciation (15 per cent) and interest (6 per cent) on new units = $29 per month = 1.2 per cent of payroll.

TEST INSTALLATION NO. 4

Carburetor Assembling Shop.—50 ft. by 80 ft. Old equipment: Eighty-four 40-watt vacuum Mazda lamps in four-light clusters; two 100-watt bare gas-filled lamps; fourteen drop cords with 40-watt lamps and tin shades, 1.0 watt per square foot—2.1-ft.-candles. "Productive" equipment: Nineteen 300-watt gas-filled Mazda lamps in 23-in. eye-shield units; ten 200-watt gas-filled Mazda lamps in 16-in. eye-shield units, 1.9 watt per square foot—12.5-ft.-candles.

Result of productive intensity in percentage of increase: Carburetor A, 10.5; carburetor B, 18.6; carburetor C, 6.5. Average from test records, 12 per cent increase.

Cost maintenance (twenty hours per month), electricity, depreciation (15 per cent) and interest (6 per cent) = $57.90 per month = 0.9 per cent of payroll ($6,500).

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Mechanical Oscillation of Synchronous Machines.—C. DELLA SALDA.—In a former article (*Abstracts*, 791, 1917) the author has treated the problem of the mechanical oscillations of synchronous machines. Dina having criticised (*Abstracts*, 415, 1918) the article aforesaid and the results obtained, the author in the present article demonstrates the reliability of his calculations and results. As the demonstration deals with many points of detail it does not allow of abstraction.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Elettrotecnica*, Sept. 5, 1918.)

Parallel Connection and Voltage Regulation of Large Rectifiers.—B. B. SCHAFER.—Methods are discussed for the paralleling of large mercury-vapor rectifiers with each other and with other sources of current. By using choking coils, especially with the addition of auxiliary windings, the problem may be solved without affecting appreciably the efficiency and power factor. Various methods of voltage regulation are also described and very satisfactory results are claimed. It is a useful characteristic of mercury rectifiers that one or two sizes will cover a range of outputs and voltages which would involve twenty or thirty types of transformers. Within commercial limits, at any rate, mercury rectifiers are unaffected by frequency. The same spacing of electrodes will serve a range of pressures from 65 volts to 650 volts, and there is little practical advantage in adapting the electrodes to a number of current values. The Glarus Rectifier Company has standardized two sizes of steel-clad rectifier for 250 amp. and 500 amp. respectively and for any rectified voltage between 110 volts and 800 volts. The latest mercury-rectifier installations provide up to 16,000 amp. at 250 volts and 550 amp. at 1100 volts. Parallel operation of several rectifiers offers no special difficulty. Once the vacuum is thoroughly established, the pressure drop in the arc is nearly constant at 16 volts to 10 volts down to the lowest current values. The negative nature of the pressure-current characteristic is much less pronounced than in the ordinary arc, and a small choking coil provides suitable ballast and may also be used for purposes of voltage regulation.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Elekt. Zeits.*, Aug. 15, 1918.)

Lamps and Lighting

Electrical Changes Produced by Light.—H. S. ALLEN.—The author views the subject as one of the widest that can be studied. If all matter is built up of electric charges and light is an electromagnetic disturbance, almost any change may be considered to be connected in some way with electricity and with light. Two methods were used in the photoelectric investigation. Dr. Allen thinks it sufficient to assume photo-electrification of the substances in the rods and cones; that electrification would separate electrons in the nerve cells, and set up nervous impulses to the sensorium, and the changes in the retina would be identical in nature with those in a phosphorescent substance or in the photographic plate. He refers to the production of light by electric stimulus or by sudden pressure on the eye, to the asserted visibility of Röntgen rays to dark-adapted eyes, to the curves of the sensitiveness of the eye to rays of different wave lengths which resemble photo-electric curves for those wave lengths, and to selective absorption and color blindness.—*Engineering*, Jan. 17,

Lighting of a Middle-Class Home.—M. LUCKIESH.—The author takes up each room individually and points out what types of fixtures may be properly chosen to secure desirable illumination and the necessary artistic appearance.—*Electrical Review*, Feb. 1, 1919.

Generation, Transmission and Distribution

Boiler-Feed Water.—NEWTON HARRISON.—The writer discusses the examination of boiler-feed water and the chemical treatment involved in its purification. Quantitative data are given showing the amount of chemicals required.—*Central Station*, February, 1919.

Statistical Analysis of the Central-Station Situation of Canada.—This analysis deals with the steam as well as the hydraulic power plants. Tables of investment and operating expenses are also included.—*Electrical News*, Feb. 1, 1919.

Power Development at Drummondville.—The Southern Canada Power Company is building a concrete dam 1700 ft. (518 m.) long, extending diagonally into St. Francis River at Drummondville, Province of Quebec. It is said that the power house will have a capacity of 18,000 hp. and that the individual units will be 3500 hp. vertical units operating under 32-ft. head.—*Canadian Engineer*, Jan. 30, 1919.

Total of 2,305,310 Hp. Developed from Water in Canada.—The Dominion Census Bureau has just completed a census of the developed water power in Canada, the returns indicating a total of 2,305,310 hp. A table is given showing the geographical and industrial classification of this developed water power.—*Canadian Engineer*, Jan. 30, 1919.

Coal-Handling Appliances at Coventry Electricity Works.—GEORGE FREDERICK ZIMMER.—Special problems involved by the location of the power plant on the canal and because coal is supplied by means of barges are discussed in detail in connection with a number of illustrations. The cost of handling the coal from the barges to the bunkers by means of the conveyors is also given.—*Engineering*, Jan. 10, 1919.

Power Transmission from Bittefeld to Berlin.—Power is transmitted at 110,000 volts over a distance

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of 130 km. The line consists of three aluminum cables of 120 sq.mm. section, which are carried on iron poles. Above these is an iron earthing wire of 50 sq.mm. section. The power amounts to 20,000 kw. Three further cables can be carried. The transformers have windings of aluminum. The station in Berlin is very simple and compact, power being distributed at 6000 volts. It is calculated that this scheme dispenses with the necessity of conveying between 300 and 400 tons of coal to Berlin daily.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Elekt. Zeits.,* Aug. 1, 1918.)

Traction

The Gotthard Railway Electrification.—Much information is given concerning the history and the technical and economic features of the Gotthard Railway, with special reference to its electrification. The line, constructed in 1873-97, was taken over by the state in 1909, and the scheme for electrification was accepted about five years later. Prior to dealing with the details of the electrification this article gives full particulars concerning the gradients and general lay-out of the line. With the exception of the Brunnen-Fluelen section, the whole 151 km. from Immensee to Bellinzona is double-track. The first electrification scheme covered the 109-km. section from Erstfeld to Bellinzona, including the Gotthard tunnel; in this short distance the line rises from 475 m. above sea level to the tunnel (which is from 1100 m. to 1150 m. above sea level), and descends again to 244 m. above sea level. The sharpest curve is of 280 m. radius. A commission appointed to consider the matter concluded that electrification would save 20 to 25 per cent compared with steam costs, besides accelerating the service. It was eventually decided to equip the Amsteg and Ritom stations for the direct generation of single-phase alternating current. A summary is presented of the considerations which determined the distance apart of feeding points. Formulas and curves are given for the latter for various traffic densities and line voltages, and a number of tables are presented dealing with estimated costs on various systems of operation, traffic capacity of the electrified line, efficiency, power factor, speeds, tractive performance, regenerative braking, and so forth. It is concluded that regenerative braking offers no great advantage so far as the Gotthard line is concerned.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Elekt. Zeits.,* July 4, July 11, July 18 and July 25, 1918.)

Return of the Trolley Current in a Single-Phase Alternating-Current Network.—J. LHÉRIAUD.—Traction networks with single-phase current produce by induction very serious disturbances upon lines with feeble current running parallel to them. The author shows that the induced emf. in the latter lines becomes less in the degree that the current of traction returns through the rails. He describes experiments made by the Compagnie des Chemins de fer du Midi, both in the laboratory and on the line itself, to determine the resistance, in alternating-current systems, of fishplates, switches, etc., and the proportion of the current returning to the power house through the rails. The results of the experiments are stated, and the employment of transformers at rail joints, as well as frequent grounding of the rails, is advocated.—*Revue Générale de l'Electricité,* Jan. 18, 1919.

Transporting Freight on Electric Railways.—LUCIEN PAHIN.—An examination of what has been accomplished in this direction in America, the British Isles and France. In the Paris district especially the author thinks the practice of American railways could be imitated.—*Revue Générale de l'Electricité,* Jan. 16, 1919.

Industrial Electric Trucks, Tractors and Narrow-Gage Locomotives.—RAYMOND J. MITCHELL.—The conditions under which electric trucks are preferable to manual labor for transporting materials are given, together with a symposium of the several electric trucks now on the market. A typical charging station is shown, illustrating the simplicity and ease with which electric trucks can be recharged and pointing out how inexperienced labor may perform this duty. Advantages of electric trucks, mechanical and electrical features of industrial trucks, transmission, motors and battery equipment, steering gears and safety devices are considered briefly.—London *Electrician,* Jan. 10, 1919.

Installations, Systems and Appliances

Electric Welding.—THOMAS T. HEATON.—The author deals particularly with manufactured steel barrels, drums and tanks. Various methods of welding and cutting involved in this manufacturing work are described, and a table is given showing the time required for welds of various lengths and thicknesses.—London *Electrician,* Jan. 31, 1919.

Electricity in the Docks and Warehouses of the Port of London.—Electricity is largely used in pumping of water and for cranes, conveyors and so on at the docks. The converter substations supplying the power are described and performance curves are given for the electrically driven pumps.—London *Electrician,* Jan. 31, 1919.

New Charts for Aerial Suspension.—JOSEPH N. LECONTE.—Numerical computations involving the catenary curve are rendered troublesome by reason of the transcendental form in which the equation of the curve appears. This makes an exact algebraic solution impossible, and resort must be had to either a more or less approximate algebraic solution or a graphical solution. An attempt is made by the author to solve all cases as far as possible by algebraic equations. When this is impossible reference to tables and curves must be resorted to.—*Journal of Electricity,* Feb. 1, 1919.

Electrochemistry and Batteries

Action of Reducing Gases on Solid Copper.—N. B. PILLING.—It is well known that copper containing disseminated oxide, after heating in contact with reducing gases, becomes weak and friable. In the case of hydrogen the first mechanical effects of the deterioration appear between 400 deg. and 500 deg. C., and at temperatures above 700 deg. the action is very rapid. Deoxidation alone cannot account for this deterioration, and it is pointed out that if steam formed by the reaction is less soluble in solid copper than hydrogen is, then it will be left within the voids formed at some considerable pressure. The combination of this pressure with the intercrystalline weakness of copper at high temperatures would force the individual grains apart.

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Microscopic examination of copper after this treatment disclosed intercrystalline fractures.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Proceedings of Franklin Institute*, September, 1918.)

Operation and Chemical Control of Water-Gas Sets in Small Plants.—H. VITTINGHOFF.—This article was written primarily to aid in cases where small gas plants are operated as minor adjuncts in connection with more important electric or street-railway activities. Usually the man in charge of the gas plant who is an electrical operator will know comparatively little of the details of the operations which enter into gas manufacture. Chemical reactions are discussed in such a way as to simplify the power set.—*Stone & Webster Journal*, January, 1919.

Units, Measurements and Instruments

Testing Transformer Oils.—ARNOLD PHILIP.—The important part of a paper on this subject read by the author at the London Section of the Society of Chemical Industry is based on the method of testing for the amount of water in transformer oils. It is known that most minute quantities of water have a serious effect on the insulation resistance of oils and also on the hysteresis of the oils at high frequencies. The quantity of water producing these effects is as low as 0.02 to 0.04 per cent. Methods of testing are outlined in this paper.—London *Electrical Times*, Jan. 16, 1919.

Notes on Steam Meters.—E. CLAASSEN.—Though the mere provision of steam meters has a considerable indirect effect in securing steam economy, the meters hitherto used have conformed imperfectly to the desideratum that they should be both accurate and of rugged construction. Many types of meters yield poor accuracy, while others require skilled attention to keep them in order. One pattern of Claassen steam meter is shown and also the special type of packing employed. Great numbers of St. John steam meters are used in America. A comparison between these two types of steam meters follows.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Zeits. Vereines Deutsch. Ing.*, Aug. 10, 1918.)

Chimney Heat Losses and Their Measurement.—M. CHOPIN.—The author describes a new type of instrument for measuring heat losses in chimney gases, based upon the use of two electric currents, the intensity of one being dependent upon the temperature of the gases and of the other upon the CO_2 contents of the same. The relation between the current intensity and the CO_2 contents of the gases is obtained by measuring the electrical resistance of a solution of caustic soda of known strength and volume with which a definite volume of the chimney gases is agitated. The absorption of CO_2 by the caustic soda and formation of sodium carbonate causes an increase in the electrical resistance and therefore a diminution in the current that can be passed through the solution with a constant emf., for the conductivity of sodium carbonate solutions is only one-third that of caustic soda solutions. The temperature of the gases is obtained by a thermocouple, and the indicators of the results of the two measurements are so arranged that (1) the percentage of CO_2, (2) the temperature of the gases and (3) the loss of heat units can all be read off on one and the same dial. An illustration of the apparatus is given.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Comptes Rendus*, Aug. 26, 1918.)

The Navigational Magnetic Compass Considered as an Instrument of Precision.—M. B. FIELD.—This paper is an abstract of a lecture given before the Institution of Electrical Engineers. The construction of these compasses involved a variety of problems relating to mechanics and mechanical construction, wear and tear of material, the effect of very complex vibrations, fluid friction, viscosity and fluid motions, terrestrial magnetism and the magnetic properties of iron and steel, and complicated systems of magnetic potential and fields of force.—London *Electrician*, Jan. 31, 1919.

Telegraphy, Telephony and Signals

Optimum Secondary Capacity of an Induction Coil.—E. TAYLOR JONES.—In the use of the radio-telegraphic transmitter where an induction coil is used in conjunction with a secondary condenser, the question may arise as to the value of the capacity which connected in parallel with the spark gap yields the longest spark when the primary capacity and the primary current at "break" are given. When the oscillation of both circuits is taken into consideration, it is not obvious that the secondary potential is greatest when the secondary capacity is as small as possible. The problem is considered mathematically in this paper by regarding the oscillations as undamped.—London *Electrician*, Jan. 17, 1919.

Miscellaneous

Electric Heating as a Profitable Load.—BARRY DIBBLE.—This article contains data on the cost and revenue of electric heating on the Minidoka Project, Idaho. It is graphically pointed out that the possibilities are good for combining a heating load in winter with an irrigation demand for the summer months.—*Journal of Electricity*, Feb. 1, 1919.

An Interesting Nile Scheme.—SIR J. WILLOCKS AND JOHN WELLS.—Primarily the scheme to dispose of the waters of the Nile is one of irrigation, but reference is made to the construction of a power station between the Hillet River and Buffalo Cape. Further possibilities in Egypt are opened up by an experiment concerning the utilization of vegetable refuse as fuel. The topographical map visualizes the object aimed at—Reprint of lecture delivered at a meeting of the Sultanieh Geographical Society, Cairo, Nov. 22, 1918.

Some Characteristics of American Coals in By-Product Coking Practice.—F. W. SPERR.—The present tendency in America is to use less of the expensive semi-bituminous coals—Pocahontas, Somerset, etc.—and to use coke mixtures containing much larger percentages of bituminous coals, the volatile matter in such mixtures being from 30 to 35 per cent. The percentage of low-volatile coal runs in usual practice from 15 to 30 per cent. Very fortunately, it happens that not only do such high volatile mixtures produce larger recoveries of by-products, but the coke itself is usually found to give better results in the blast furnace, the decrease in coke consumption per ton of pig iron being in several cases quite marked. H. A. Kuhn estimated that in 1912 75 to 80 per cent of all the iron production of the United States was tributary to the coking coal of the Pittsburgh district.—*Science Abstracts, Section B*, November, 1918. (Abstracted from *Proceedings* of Franklin Institute, August, 1918.)

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

COMMONWEALTH EDISON COAL MINES OF GREAT ADVANTAGE

President Insull Estimates Saving from This Source at Not Less than $1,000,000 During 1918— Operations of Company Last Year

In his annual report to stockholders for 1918, Samuel Insull, president Commonwealth Edison Company of Chicago, said that the foresight of the company in providing its own coal mines has continued to be of great advantage. It is estimated, Mr. Insull added, that the saving from this source was not less than $1,000,000 during the year, and in addition the company was at all times reasonably assured of an adequate supply of coal. At one time there were 461,000 tons in storage as a protection against a possible shortage in the general supply.

Among the other matters mentioned by Mr. Insull were the increase in generating capacity, the conservation of capital, and taxes.

During 1918 one 50,000-hp. turbo-generator unit was installed at the Northwest station, making the total generating capacity of the company at the end of the year 1918 730,000 hp. In addition to this installation, two turbo-generator units with a total capacity of 100,000 hp. were in process of installation at the Fisk Street station at the end of the year and were about three-fourths completed. These units will be completed and ready for operation in the early part of the year 1919.

During the year there was a large demand for industrial power, requiring a considerable increase in the company's plant capacity. Whenever line extensions were necessary, however, said Mr. Insull, the customer was called upon to advance the capital therefor, and this accounts for the increase in customers' deposits over the amount shown in last year's report. These advances will be liquidated over the remaining period of the customers' contracts. Aside from such line extensions the company was able to take care of its additions to plant without increasing its permanent securities, while its notes and accounts payable were increased by only a comparatively small amount.

Throughout the year the company made strong effort to conserve capital as well as other commodities, and it issued no stocks or bonds. Mr. Insull announced that since the close of the year, however, the company has sold $4,000,000 of its first mortgage bonds and has paid its notes payable to the amount of $1,500,000.

The situation in regard to taxes was explained by Mr. Insull as follows:

In conformity with the statement made in last year's report the excess profits tax paid in 1918 on the company's business for 1917, amounting to $133,796, was charged against surplus as shown in the accompanying surplus statement.

Practically the same situation of uncertainty as to the excess profits tax exists this year as last, and the company feels it unwise to estimate the amount of the tax which it will be required to pay upon its 1918 business. When the amount of this tax is definitely determined it will in turn be charged against the company's surplus.

The income tax for 1917 was 6 per cent on the company's net income for that year. Under the tax bill just passed, and which is expected to be approved by the president, the company's income tax for 1918 will be increased to 12 per cent of its net income. Provision for this increase has already been made out of the company's income for 1918.

Reference was made to two reserves. The company has been creating a reserve over a period of years to establish a fire insurance fund. Since the date of its creation a portion of the fire risk has been carried by the company. The accumulation resulting is the amount of the premiums the company would otherwise have paid to insurance companies, plus what the fund has earned by way of income from its securities. The fire insurance fund reserve stood in the balance sheet as of Dec. 31, 1918, at $983,920. The company heretofore established a fund, called the service annuity fund, to aid faithful employees after they have served the company for a long period of years and have arrived at an advanced age. This fund stood at the close of the year at $569,095.

Operating revenue was $26,505,136, comparing with $25,351,585 in 1917. Operating expenses were $14,119,935, against $13,791,636. Charges for amortization and depreciation reserve were $2,822,090 in 1918 and $2,836,246 in 1917. The surplus available for dividends last year was $4,936,470 as compared with $4,677,077 in 1917.

GOVERNMENT LOAN TO HELP BUILD THE LORAIN PLANT

War Finance Corporation to Advance $500,000 Toward Cost of New Generating Station, Which Will Supply Shipbuilding Company

A loan of $500,000 has been made by the federal government through the War Finance Corporation to aid the Lorain County Electric Company in completing its new generating station at Lorain, Ohio. The loan is made to the Utilities Construction Company, which has a contract to build the plant. Work has been suspended on the station for some time on account of the difficulty of financing. The interest of the government lies in its desire to have sufficient energy to meet needs of the American Shipbuilding Company plant, which has contracts for the Emergency Fleet Corporation.

Efforts will be made now to finish the work in four months. The total cost of the plant, which will have a capacity of 10,000 kw., is estimated at $125,000. The Lorain company is a Doherty property.

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CHANCE FOR WATER-POWER LAW IN LAST DAYS OF CONGRESS

Agreement Reached by the Conferess—Analysis of the Bill as It Stood After Conference Between Senators and Representatives

After seven years of debate and discussion the conferees on the water-power bill now pending in Congress obtained an agreement on Feb. 26. The principal delay in reaching an agreement, as has heretofore been reported by the Washington representative of the ELECTRICAL WORLD, arose from the inability of the conferees to reach a conclusion concerning the two mooted points as to whether or not there should be a federal power commission and whether or not there should be a charge against the companies which propose to construct hydroelectric plants.

Senator Bankhead has been the acting chairman of the water-power conferees of the House and Senate in the absence from illness of Senator Shields.

As soon as President Wilson returned to the United States Senator Bankhead drew the attention of the White House to the questions in difficulty between the House and the Senate conferees, with the result that President Wilson discussed the water-power legislative situation with the conferees at the White House on Tuesday, night, Feb. 25. It is well understood in Washington that if credit for reaching an agreement among the water-power conferees is due to any one, it is due to Senator Bankhead.

ANALYSIS OF THE AMENDED PROVISIONS

An analysis of the bill now about to be reported is furnished by the Washington representative of the ELECTRICAL WORLD, who reports, after conversations with Senator Bankhead, Speaker Clark and others, that there is a very fair prospect of the adoption of the report by the House and the Senate, perhaps before this is published. At the time this is telegraphed from Washington legislative leaders there hope that the House of Representatives will find time, with its crowded calendar, to accept the report, and over on the Senate side the statement is clearly made that if the bill comes to the Senate from the House by Friday the Senate will adopt it.

Speaker Clark, in discussing the possibility of this legislation with the Washington representative of the ELECTRICAL WORLD, on Wednesday night, remarked, "Better late than never," and he added that in his belief no one on the floor of the House of Representatives would attack the report of the conferees.

It must be considered, however, that the legislative situation in Congres is such that almost any bill, no matter of how great importance it may be, is liable to be sidetracked in favor of bills of a political character which members have a pressing personal interest in having passed.

In discussing the proposed water-power legislation with the Washington representative of the ELECTRICAL WORLD, Senator Bankhead said:

"The conference had before it the so-called Shields bill, which passed Congress twice, after very thorough discussion. That bill went over to the House. The committee to which it went struck out all after the enacting clause and wrote practically a new bill. When the altered bill finally passed the House of Representatives and was ordered to a conference the preliminary situation was as follows: Both the original Shields bill and the substituted House bill, the latter being called the administration bill, were in conference. It was the duty of the conferees to harmonize the two, taking the best features of each bill and weaving them into a new one which the conferees agreed on Feb. 26 to report. When this conference report comes from the House of Representatives it will occupy the status of privileged business in the Senate. Under the Senate rules conference reports are privileged and are taken up and acted upon immediately. If the conference report comes from the House we hope in the Senate to adopt it at once.

"We regret for the country's sake that we have had difficulty in reaching an agreement all these years. The main difficulty was that the House bill created a federal power commission, composed of the Secretaries of War, Agriculture and the Interior. To this commission every applicant for a license to construct power dams would have been and is required to apply for a license to construct, and permits would have been and are required in accordance with the limitations of this bill. That difficulty was overcome by the conferees.

"One of the other sharp differences among the conferees, and one which created more controversy than any other, was the provision in the House bill that authority be given to levy what was called a reasonable charge for the permits to be issued for the privilege to construct dams and other pertinent works. The Senate conferees were opposed to the imposition of this charge, but in order to obtain the passage of the bill they yielded to the House of Representatives. The House conferees agreed to the Senate recapture clause and the net investment provision of the bill. The recapture clause means that in case the government, before or after the expiration of the license which is to be issued, desires to take the property over it may do so, by paying the licensee the amount of the net investment determined by the books of the person concerned."

OTHER AMENDMENTS AGREED UPON

The subjects outlined in Senator Bankhead's statement as above constitute, of course, the principal subjects which have hindered an agreement by the conferees, but they also have recommended many amendments, some of which are digested below:

In the conferees' report it is provided that the clerical forces of the Departments of War, the Interior and Agriculture shall so far as practicable perform the work of the water-power commission. This apparently was done for the purpose of preventing the creation of a great new government department. The bill was also amended to define the word "corporation"; also it was amended to define the term "navigable water." Some importance was attached by the conferees to the definition of the word "navigation." The conferees' report says: "It is thought that 'government dam' is a more comprehensive and clearer expression of what is intended than the expression 'navigation dam.' The words 'the improvement of navigation' are

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stricken out and the words 'government purposes' are inserted."

There are certain accounting requirements provided for in other amendments, also some specific requirements which deal with the matter of the majority of stock ownership and the question of the law under which corporations shall be organized.

One specification in the report provides that "in case the commission"—alluding, of course, to the federal power commission which it is proposed to create—"shall find that any government dam may be advantageously used by the United States for public purposes in addition to navigation, no license therefor shall be issued until two years after it shall have reported to Congress the facts and conditions relating thereto."

The conferees decided to alter the language in Section 7 of the bill, which deals with the question of licenses. The phrase "equally well" was used for the purpose of clarity of language by the conferees, and there were other alterations in wording so that the coming work of the federal power commission, in case the bill is passed, may be simplified. Other amendments by the conferees dealt with the question of mortgages and trusts on properties.

As to the amortization feature, the conference report has the following to say: "The bill as passed by the House provided that the amortization feature should be incorporated into the license from the beginning of the term of the grant. The House amendment as amended in conference provides that this amortization feature shall not become effective until after the expiration of the first twenty years of operation."

The conferees require that the proportion of charges to be paid by any licensee shall be determined by the federal power commission. The conferees suggest in their report that this provision of the law is made necessary in order to make that particular section of the law workable. The conferees declare in their report that there should be vested in the proposed federal power commission the right and authority to decide whether or not in Section 10 of the bill licenses shall be issued for a part only of a complete project, where the land of the United States required is to be used only for tranmission lines, water conduits or for storage reservoirs, of for a complete project of not more than 50-hp. capacity.

The conferees deem it proper that the proposed commission shall issue from year to year annual licenses to the then licensees under the terms and conditions of the original license until the property is taken over or a new lease entered into. They wish to amend the bill also to prevent the misunderstanding that expenditures for the construction of locks or other aids to navigation, or any other capital expenditures, were to have anything to do with the making of rates.

The method of application for constructing dams and other questions of an administrative character, which, of course, will very largely lie within the jurisdiction of the proposed federal power commission, are set forth.

Late advices from Washington, just before this issue of the ELECTRICAL WORLD went to press, were that the bill was expected to reach the House on Friday and that it was possible that the measure will reach the Senate this week.

NEW-BUSINESS OPERATIONS TO REOPEN IN NEW MEXICO

Sales Departments That Were Curtailed During War Will Be Re-established to Offset Losses Due to Daylight Saving and High Costs

The fifth annual meeting of the New Mexico Electrical Association, at Albuquerque on Feb. 17, 18 and 19, was, from all comments, the most successful convention ever held by that association. As to the prospects for the future a spirit of optimism prevailed throughout. Many of the central stations of New Mexico had discontinued practically all new-business activity during the war, but the expression of delegates at this convention indicated that all of them were returning to pre-war conditions and were reëstablishing their new-business departments. It was decided that the best plan to make up the loss of revenue caused by daylight saving was to put on extensive campaigns for socket appliances, electric ranges and motors.

A paper was read by W. C. Wurfel, Pacific Coast manager of the Westinghouse Lamp Company, on "Industrial Lighting." "Relations of Consulting Engineers to Public Utilities," by H. O. Duerr, consulting engineer of Albuquerque, N. M., brought out points in favor of employing consulting engineers in small central stations to check up operating and public policy conditions.

A paper on "Efficiency" by M. R. Buchanan, manager of the Silver City (N. M.) Power & Ice Company, contained some valuable suggestions on handling labor. "Some Considerations in the Use of Iron Wire for Alternating-Current Transmission," by Prof. R. W. Goddard of the New Mexico College of Agriculture and Mechanic Arts, contained a good deal of technical data with reference to capacity and resistance.

An interesting address with illustrated slides was given by H. L. Garbutt, manager of the line-material section of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., on the subject of "High-Voltage Pin-Type Insulators." The paper "Power Factor," by B. C. J. Wheatlake, of the General Electric Company, Denver, Col., was one of the most interesting papers of the convention.

"Prospects for the Year 1919," by W. P. Southard, manager of the Trinidad Electric Transmission Railway & Gas Company, Trinidad, Col., dealt principally with business conditions for the next year. A. C. Cornell, sales manager of the Western Electric Company of Denver, gave some interesting information relative to "Marketing Condition of Materials Used Principally in Central Stations."

"The Relation of the Manufacturer to the Utilities" was the title of a paper read by C. D. LeMoree of the Westinghouse Electric & Manufacturing Company of Los Angeles, Cal. D. W. Morgan, manager of the Las Cruces (N. M.) Light & Power Company, read an interesting paper on "Electrical Merchandising." M. E. DeFrance, manager of the Deming (N. M.) Ice & Electric Company, read a paper on "What the Electrical Association Means to Its Members and the Interest Each Individual Should Take."

J. D. Clark, professor of chemistry at the University of New Mexico, Albuquerque, read an interesting paper on "Knowledge That Pays Dividends."

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UNITE MANUFACTURERS OF MATERIAL-HANDLING MACHINERY

New Association, with Headquarters in New York, Will Study Handling of Materials at Railroad and Ocean Terminals and Other Problems

The Material Handling Machinery Manufacturers' Association has been formed with the following officers: President, Calvin Tomkins, formerly Commissioner of Docks, New York City; vice-president, J. A. Shepard; treasurer, Lucian C. Brown; directors, Mr. Shepard, Mr. Brown, R. W. Scott, F. W. Hall, William Clark, J. C. Walter, C. M. Watson and Fred Stadelman. Four additional directors are to be chosen when the charter membership is completed. The active conduct of the association work will be in the hands, as secretary and manager, of Zenas W. Carter, formerly commissioner of the Associated Metal Lath Manufacturers, and previously field secretary of the Granite Paving Block Manufacturers' Association. Officers have been opened at 35 West Thirty-ninth Street, New York.

The new organization has been formed by the following, who are a membership committee to complete the charter membership:

Watson Elevator Company, Edward F. Terry Manufacturing Company, International Conveyor Corporation, Rownsen, Drew & Clydesdale, Inc., New Jersey Foundry & Machine Company, Hayward Company, Elwell-Parker Electric Company, Sprague Electric Works, Otis Elevator Company, Manning, Maxwell & Moore, Inc., Robins Conveying Belt Company, Michener Stowage Company, New York City.

Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.

Brown Portable Conveying Machinery Cmpany, Chicago.

Karry-Lode Industrial Truck Company, Long Island City.

Whiting Foundry Equipment Company, Harvey, Ill.

Wellman-Seaver-Morgan Company, Cleveland, Ohio.

Alliance Machine Company, Alliance, Ohio.

Alfred Box & Company, Inc., Philadelphia.

Meade-Morrison Manufacturing Company, East Boston, Mass.

Alvey-Ferguson Company, Cincinnati, Ohio.

Heyl & Patterson, Inc., Pittsburgh, Penn.

American Hoist & Derrick Company, St. Paul, Minn.

Cleveland Crane & Engineering Company, Wickliffe, Ohio.

Clyde Iron Works, Duluth, Minn.

Ohio Locomotive Crane Company, Bucyrus, Ohio.

Northern Engineering Company, Detroit, Mich.

Electric Controller & Manufacturing Company, Cleveland, Ohio.

An announcement by the association says that the organization was effected following the suggestion of the Department of Commerce and the United States Shipping Board. The suggestion was made by the two government agencies because of the need for intensive study of the freight-handling methods at both railroad and ocean terminals.

While the immediate cause for organizing is the need for intensive study of the handling of materials at terminals, the body will take up the whole field of material handling and thus touch every industry.

In general the lines of work—technical, educational, promotional, etc.—will parallel those of other trade associations, but the nature of the problems will require more extensive technical committee work than is customary in such bodies. In one particular the proposed work presents an unusual phase. Since material-handling problems are found in every industry, relations will be cultivated with existing trade associations. Thus the material-handling problems of the various industries will come before broadly representative committees of material-handling experts. Already several of these coöperating committees have been arranged for, and excellent results from their work are expected.

AN INTERESTING FACTORY LIGHTING DEMONSTRATION

Simple Method of Showing Effectiveness of Different Lighting Layouts in Producing Illumination on the Working Plane

Another demonstrating model for bringing out the truth about industrial lighting was presented before the Chicago Section of the Illuminating Engineering Society on Feb. 20 by W. A. Durgin of the Commonwealth Edison Company.

This model was used in conjunction with an address in which the speaker presented data to prove the productive value of factory-lighting installations with intensities ranging up to 13 ft.-candles. Such installations, it is his belief, can best be made by the use of a general lighting system employing large lamps in industrial-type reflectors, with possibly a few shaded lamps on drop cords at machines requiring especial treatment. The model is used to show the effectiveness of such a general lighting system properly designed as against a system employing bare lamps or improperly designed reflectors. It consists of a miniature factory building in which lathes and other machine tools are mounted on the floor. Several different kinds of lighting systems are installed in the factory in miniature, including one of correct design.

This model is mounted on supports which place the factory floor at a height of about 8 ft. (2.5 m.) above the speakers' platform. In a vertical position beneath the miniature factory is mounted a white cloth which is to represent the "working plane" in the model factory. Other miniature lighting schemes behind this "imaginary working plane" are arranged to produce on the cloth effects which the audience can see that are identical with the effects that the various lighting systems in the factory would produce on the real working plane in the factory.

Operation of these systems of miniature lighting by an assistant to the speaker clearly illustrates the varying intensities that prevail in the factory under daylight conditions and under the inadequate artificial systems employing bare lamps. The even distribution that is obtained from large units in reflectors properly spaced is also shown in contrast. The whole demonstration is so simple that even the layman can understand better the technical phases of factory lighting after this model has been operated before him.

The detailed data which Mr. Durgin gave in his address are printed elsewhere in this issue in condensed form for the use of the lighting man. Discussion of his paper at the Chicago meeting was somewhat unusual in that it comprised little of the usual professional comment and that there was considerable discussion and questioning by the architects and users of industrial lighting systems. Some of these users of light insisted on discussing competitive types of equipment in defiance of the practice of the society.

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COST OF BUILDING THE DAM AT MUSCLE SHOALS, ALA.

Data Printed in an Article Contained in the "Electrical World" of Feb. 8 Referred Solely to the Dam and Not to the Nitrate Projects

The following letter has been received from Maj.-Gen. C. C. Williams, Ordnance Department, United States Army:

Your attention is invited to page 281 of the ELECTRICAL WORLD of Feb. 8, 1919, and to an item entitled "Cost of the Muscle Shoals Nitrate Plant." The subject matter of the item is the same as that of the letter addressed to Nicholas Longworth by Benedict Crowell, the Assistant Secretary of War, regarding the building of a dam at Muscle Shoals, Ala., on the Tennessee River.

The nitrate projects in that neighborhood are not related to the dam at Muscle Shoals, and many statements have been made publicly which naturally confuse the dam with the nitrate projects. The ELECTRICAL WORLD has the reputation of accuracy, of which it is undoubtedly jealous, and the Ordnance Department is also interested in trying to see that all statements concerning its work in the war are as nearly accurate as possible. You will probably wish to correct the item referred to, which is correct with the exception that reference to nitrate projects should not have been made.

GOVERNMENT LOANS TO ASSIST EXPORT TRADE

Large Scope of Plan Under Which War Finance Corporation Would Have Authority for Lending $1,000,000,000 to Aid Export Business

A report on the Victory short-term notes bill, presented on Monday of this week before the House of Representatives by Chairman Kitchin of the ways and means committee, outlines the plan for making loans to assist export trade.

A section of the bill authorizes the War Finance Corporation to make loans to exporters and to banks, bankers and trust companies until one year after the termination of the present war to assist in the exportation of domestic products. Because of exchange conditions, thereby necessitating some of the foreign governments putting restrictions upon our exports to them, as it is claimed, it is believed that this provision will materially help our industries in their production during the transition period and to maintain their export business. Other particulars regarding the plan are explained in the report as follows:

This section authorizes the War Finance Corporation to make advances for periods not exceeding five years direct to any exporter engaged in the export business in the United States, if, in the opinion of the board of directors of the corporation, he is unable to obtain funds upon reasonable terms through banking channels.

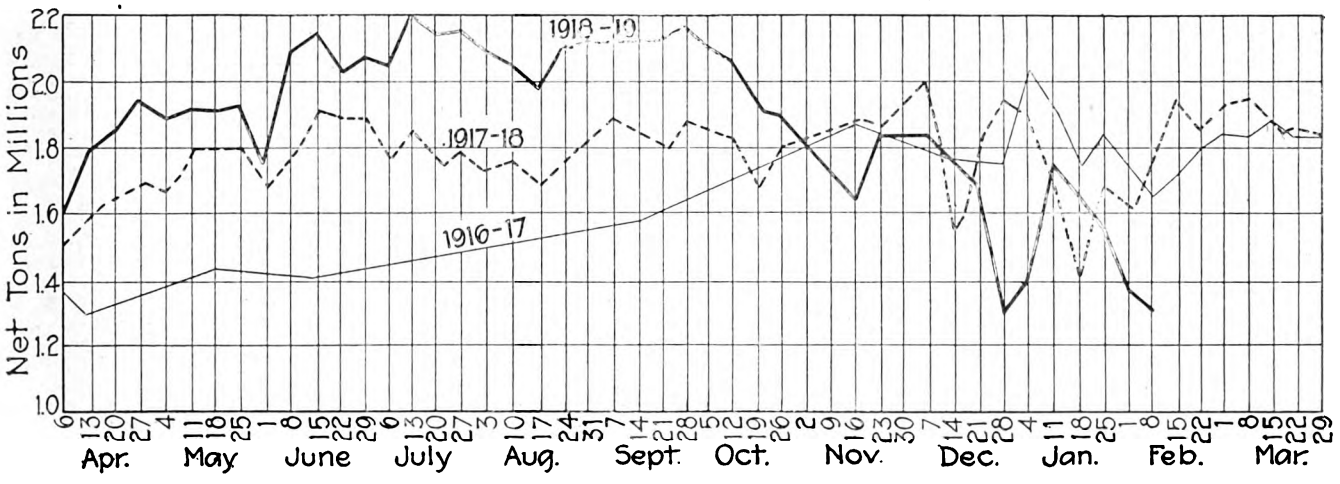
Any such advance shall be made only for the purpose of assisting in the exportation of such products, and shall be limited in amount to not more than the contract price therefor, including insurance and carrying or transportation charges to the foreign point of destination if and to the extent that such insurance and carrying or transportation charges are payable in the United States by such exporter to domestic insurers and carriers. The rate of interest charged on any such advance shall not be less than 1 per cent per annum in excess of the rate of discount for ninety-day commercial paper prevailing at the time of such advance at the Federal Reserve Bank of the district in which the borrower is located.

This section also authorizes the corporation to make advances for not to exceed five years to any bank, banker or trust company in the United States, which, after this section takes effect, makes an advance to any exporter for the purpose of assisting in the exportation of domestic products. Such advances are to be limited to not exceeding the amount remaining unpaid of the advances made by the bank, banker or trust company to the exporter for the purpose of exporting domestic products.

The corporation cannot have outstanding under this section and unpaid at any one time advances in excess of $1,000,000,000.

The corporation at the time of making any advance must require adequate security.

Declining Production of Bituminous Coal Mines in the United States



Estimates by the Geological Survey place production of bituminous coal during the week ended Feb. 8 at 8,040,000 net tons, which falls 291,000 net tons, or 3.5 per cent, below the production of the week of Feb. 1 and 2,521,000 net tons, or 24 per cent, below the corresponding week of 1918. The average production per working day during the current year is esitmated at 1,340,000 net tons, as compared with 1,860,000 net tons for the coal year to date and 1,744,000 net tons for a similar period of last year.

The production for the coal year to date, now estimated at 502,107,000 net tons, exceeds the production of last year for the same period by 31,129,000 net tons. A continuation of the low production recorded during the past few weeks for the rest of the coal year will cut this excess down approximately one-half, and production for the coal year ended March 31, 1919, will not exceed 565,000,000 net tons.

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RETURN THE WIRE LINES, SAY STATE COMMISSIONERS

Net Result of Six Months of Federal Operation, They Declare, Is Inferior Service and Substantial Increases in Charges

A letter urging the ending of federal control of telephone and telegraph lines has been addressed to President Wilson and Congress by the National Association of Railway and Utilities Commissioners. The letter, signed by Charles E. Elmquist, president of the association, recommends the return of the properties after a conference of the executive and war committees of the association, which include members from practically all states.

A resolution is included recommending to the Postmaster-General that the federal control of the lines cease "as soon as practicable and the military necessity therefor shall have ended."

Among the reasons advanced by the letter are:

The net result of six months of operation by the Postmaster-General of these wire systems is inferior service and very substantial increases in charges to the public.

We feel that these properties should be returned. No military necessity can now be pleaded in support of government control. The quality of the service has in many cases deteriorated. No rule, regulation, practice or rate increase has been adopted for military purposes. Rates and charges have been greatly increased without giving the patrons or the public an opportunity to be heard as to the reasonableness or justice thereof, although the principle was long ago settled that important changes shall be submitted for public consideration before becoming effective.

These rate changes are applicable upon state as well as interstate traffic and have thereby caused widespread dissatisfaction with federal operation. . . . This toll rate order also prescribes a new and untried system which has resulted in general confusion among operating officials and the patrons throughout the country.

Fundamental changes are being made in the operation of these systems which probably could not be legally done under private control and which upon return to private management may cause serious disturbances in the relative status of the different wire systems. Federal operation also disrupted service and resulted in interfering with many of the established practices in forty-four states.

The Postmaster-General's recent declaration that employees engaged in the public service should receive higher compensation than those engaged in private service of a similar kind, which, as a matter of fact, can be accomplished only through rate increases, has caused a demand by the employees of the wire systems for largely increased wages.

Under the provision of the law that the President fix "just compensation for government use," the Postmaster-General accepted the proposal of the Bell system, which contained provisions very satisfactory to the company with respect to guaranteed return, recognition of securities as a basis of value, reservation of property by that system, the assessment of taxes and increased expenses.

In this connection, however, it may be pointed out that corresponding contracts proposed by the Postmaster-General to other companies contain elements much more protective of the public interest and are so different that they constitute a discrimination in favor of the Bell system as against other companies or systems.

Neither the advantage accorded to the Bell system, through its agreement, nor other forms of agreement, have been offered in whole or in part to the thousands of small companies confronted by existing financial, operating and tax problems.

Census Bureau Report of Electric Light and Power Stations—1917

Preliminary figures, published herewith, of the forthcoming quinquennial report on the central electric light and power stations of several states have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics cover both commercial and municipal plants. They do not cover electrical plants operated by factories, hotels, etc., which generate for their own consumption, those operated by the federal government and state institutions, and those that were idle or in course of construction.

	Kentucky			Tennessee			Nebraska		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase* 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	125	89	40.4	106	90	17.8	297	174	70.7
Commercial	103	73	41.1	70	60	16.7	148	112	32.1
Municipal	22	16	37.5	36	30	20.0	149	62	140.3
Income	†$4,436,445	†$2,754,115	61.1	‡$4,937,285	‡$2,448,218	101.7	¶$4,860,874	¶$2,802,614	73.4
Electric service	$4,334,938	$2,683,137	61.6	$4,877,359	$2,408,762	102.5	$4,640,262	$2,678,240	73.3
All other	$101,507	$70,978	43.0	$59,926	$39,456	51.9	$220,612	$124,374	77.4
Total expenses, including salaries and wages	$3,531,547	$2,244,906	57.3	$4,436,698	$1,753,875	153.0	$3,911,923	$2,239,542	74.7
Number of persons employed	1,031	907	13.7	1,008	656	53.7	1,227	882	39.1
Salaries and wages	$759,383	$635,829	19.4	$777,922	$455,212	70.9	$979,345	$598,703	63.6
Total horsepower	98,752	81,767	20.8	201,912	68,994	192.7	112,103	52,168	114.9
Steam engines:									
Number	165	171	—3.5	129	130	—0.8	187	156	19.9
Horsepower	96,066	81,191	18.3	69,679	40,799	70.8	89,119	42,452	109.9
Internal-combustion engines:									
Number	63	6	850.0	18	4	350.0	281	91	208.8
Horsepower	2,301	576	299.5	581	445	30.6	12,480	3,832	225.7
Waterwheels:									
Number	7	.....	....	57	32	78.1	57	44	29.5
Horsepower	385	.....	....	131,652	27,750	374.4	10,504	5,884	78.5
Kilowatt capacity of dynamos	69,442	54,062	28.4	145,335	49,640	192.8	78,227	34,586	126.2
Output of stations, kilowatt-hours	122,630,433	75,593,179	62.2	564,914,272	75,544,893	647.8	129,531,131	56,299,682	130.1
Stationary motors served:									
Number	9,192	4,106	123.9	3,516	1,720	104.4	7,842	3,575	119.4
Horsepower	63,784	22,621	182.0	43,213	20,357	112.3	57,435	26,325	118.2
Number of street lamps:									
Arc	6,757	7,332	—7.8	2,861	3,938	—27.3	178	2,451	—92.7
Incandescent, etc	10,890	5,278	106.3	15,099	6,732	124.3	27,752	12,149	128.4

* A minus sign (—) denotes decrease.
† Exclusive of $153,411 in 1917, and $103,324 in 1912, reported by electric railway companies as income from sale of electric energy.
‡ Exclusive of $2,073,731 in 1917, and $1,372,745 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $469,481 in 1917 and $130,958 in 1912, reported by street and electric railway companies as income from the sale of electric energy.

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Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 459 of this number.

N. E. L. A., Philadelphia Electric Company Section.—At the Feb. 25 meeting of the commercial branch section "The Consumer's Installation" was the topic discussed by P. H. Bartlett.

Wisconsin Electrical Association.—From March 25 to March 27 the annual meeting of the Wisconsin Electrical Association will take place in Milwaukee. J. P. Pulliam, 1408 First National Bank Building, Milwaukee, is secretary of this organization.

A. S. M. E., Birmingham Section.—On March 5 the Birmingham Section of the American Society of Mechanical Engineers will hear Prof. H. L. Freeman, Mississippi Agricultural and Mechanical College, on "The Preparedness of Technical Graduates for Industrial Work."

New York Electrical Society and Institute of Radio Engineers.—In the Engineering Societies Building, New York City, on March 5, Roy A. Weagant, chief engineer of the Marconi Wireless Telegraph Company of America, will present a paper entitled "Reception Through Strays and Interference" before a joint meeting of the Institute of Radio Engineers and the New York Electrical Society.

N. E. L. A., Pacific Coast Section.—The next convention of this section is to be held in the Hotel del Coronado near San Diego, Cal., from April 30 to May 2 inclusive. At the same time and place the California Association of Electrical Contractors and Dealers and the Pacific Coast Electrical Supply Jobbers' Association will hold their regular quarterly meetings. The Westinghouse Jobbers-Agents' Association is planning to attend this meeting in addition to holding its own meeting at Del Monte the week following.

American Electrochemical Society, Pittsburgh Section.—Below is a partial list of the subjects and speakers at the March 14 meeting of the Pittsburgh Section of the American Electrochemical Society: "The Power Situation in the Pittsburgh District," G. G. Bell of the West Penn Power Company; "Commercial Aspects of the Power Situation in the Pittsburgh District," C. S. Cook, general manager Duquesne Light Company; "Electric Steel Furnaces," W. E. Moore and John Coyle, general manager Hussey-Bins Steel Company; "Manufacture of Ferro-Alloys in the Electric Furnace," A. C. Cummins, superintendent of ferro-silicon and electrode departments, Carnegie Steel Company, Duquesne Works; "Electrolytic Plants in the Pittsburgh District," Dr. C. S. Palmer; "Electrolytic Recovery of Copper and Sulphuric Acid," C. E. Skinner, head of research laboratory, Westinghouse Electric & Manufacturing Company; "Electrostatic Precipitation in the Smelting Industries," C. S. Barnham, general superintendent Pennsylvania Smelting Company, Carnegie, Pa.

New York Electrical League.—This is the new name of the organization formerly known as the New York Jovian League. The change was made at the Feb. 18 meeting of the society, at which time all connection with the Jovian Order was severed and a new constitution was adopted. It is now unnecessary for a member of the league to be a Jovian. Still further expansion is planned by the league and efforts will still be made to determine the advisability and best methods of starting a New York Electrical Board of Trade wherein all branches of the industry will be represented. For the purpose of gathering information and making suggestions to the advisory committee of the league a committee was appointed consisting of a representative from a manufacturer, an electrical contractor, a jobber and a public utility. There is some difference of opinion as to the best method of handling meetings. Some members think that electrical trade subjects should be discussed at the monthly luncheon, whereas others are of the opinion that broad subjects taken up by distinguished speakers as heretofore will be the best method of gaining a large audience and promoting good fellowship among the electrical fraternity.

American Institute of Electrical Engineers

Panama Section.—A paper on "The Influence of Modern Illuminants Upon Industrial Economy and Efficiency" was presented at a recent meeting by L. W. Lewis, electrical designer for the Panama Canal.

Washington Section.—On Feb. 11 H. A. Hornor gave a lecture on "Electric Welding in the Ship Industry." Lantern slides illustrated some recent applications of this art, and a demonstration was also given with a modern outfit.

Ithaca Section.—On Feb. 7 Prof. Frederick Bedell spoke on "Airplane Performance" and Prof. W. C. Ballard had for his subject "Some Recent Developments in Radio Communication," the latter talk being illustrated with apparatus.

Portland (Ore.) Section.—The Portland Section of the Instiute held a joint meeting with the local section of the National Electric Light Association on Feb. 4 to hear a paper on "Placing a Deep-Water Submarine Telephone Cable," by R. H. Sheppard of Seattle. Slides and moving pictures were used to show how the longest submarine cable on the Pacific Coast was laid across Puget Sound.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Use of Municipal Bonds.—A statute authorizing any city or village to issue and sell bonds for the purpose of providing necessary funds to pay the cost of acquiring by purchase or otherwise a waterworks plant and a water supply, and to construct, enlarge, extend, repair, alter and improve such plant, also to issue bonds in sufficient amount to acquire by purchase or otherwise a light and power plant, does not authorize such municipality to issue and sell bonds for the purpose of providing necessary funds to pay the cost of enlarging, extending, repairing and improving a light and power plant which it owns, the Supreme Court of Idaho held (177 P. 388).

Taxation Restrictions.—As the law forbids cities from levying any license taxes in excess of one-half of 1 per cent upon corporations furnishing water, heat, light or power, it was held by the Supreme Court of Appeals of Virginia (975 E. 780), in City of Lynchburg versus Lynchburg Traction & Light Company, that though a previous franchise ordinance accepted by the predecessor of a company engaged in transporting passengers and furnishing light reserved the power to tax the property of the company and to levy a license tax, the city could not levy a license tax on the company's street-railway business or a license tax upon its business of furnishing light etc., in excess of the amount allowed by statute, on the ground that the license charges were compensation for use of the streets.

Taxation of Utility Property.—In assessing the capital stock of an electric light and street-railway corporation under code, the indebtedness of the corporation cannot be deducted from the value of the stock, the Supreme Court of Iowa held in Marshalltown Light, Power & Railway Company versus Welker (170 N. W. 384). In assessing the capital stock of a corporation where the corporate property consisted exclusively of real estate and other tangible property, indebtedness should be taken into account in determining the value of the capital stock, even though it could not be deducted, for the market value of shares of stock would be somewhat affected by the amount of indebtedness, and, for the same reason, the dividends, etc., should be considered. As assessment of the capital stock of a gas, electric light and street-railway corporation at $150,000, pursuant to code, whose tangible property was valued by the assessor at $177,000 should be reduced to $73,000.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Success of Radio-Controlled Torpedo.—Secretary of War Baker has written to the appropriations committee of the House of Representatives that the joint Army and Navy Board has approved the device of John Hays Hammond, Jr., for radio control of surface craft to be sent laden with explosives against enemy warships. Successful results are also predicted with submerged craft on which only the wireless antennas will be above water. Mr. Hammond told the committee that he had spent ten years and $400,000 on his invention. Before deciding to purchase the patents for $750,000 the written to the appropriations committboard wants to experiment further. An appropriation for an experimental submerged boat is carried in the new appropriation bills.

Colonel Byllesby Defends Private Ownership.—Colonel H. M. Byllesby in a telegram to the Oklahoma Utilities Association in convention at Oklahoma City said: "It seems to me that only two courses are open to the utility business—first, that the laws be so adjusted as to allow these companies to make such a fair return upon their investment as will enable them to find capital continuously for the further extension of their enterprises which the growth of the community served and the improvements in the art render increasingly necessary. These laws and regulations at the hands of commissions or other properly authorized bodies should encourage in every proper way the spirit of enterprise and provide some profitable return beyond the mere bare interest on the cost of the properties in order to bring to bear the very best inventive and enterprising capacities. If the laws and regulations cannot provide for this situation, then the only alternative, it seems to me, is that the various communities should take over the properties at a fair and suitable compensation to the owners, as I am confident that at bottom no real American wishes to rob any one or to take possession of any property without making due, proper and fair payment therefor. This latter course is one which I sincerely trust will not be adopted, as it involves all the evils which years of experience have shown always attach to governmental operation of enterprises of this nature. The very best results to the community, to those who pay for the service rendered, will be found as always in private ownership, where this ownership, while being regulated along proper lines, is still allowed full scope for the exercise of ingenuity and enterprise."

American Cities Company Difficulties.—Following the appointment of receivers for the New Orleans Railway & Light Company, the Birmingham Railway Light & Power Company and the Memphis Street Railway Company, a protective committee for 5/6 per cent collateral trust bonds of the American Cities Company issued a statement saying in part: "The War Labor Board at Washington raised the wages of the various employees of several of the companies to such an extent that the net earnings were greatly reduced and the credit seriously impaired. These wages have been placed so high that it seems impossible to restore the net earnings of the companies, and thereby the credit of the companies, unless relief is obtained from the authorities controlling the rates for street railway fares, gas and electricity in cities where the several properties involved are located. The committee believes that with an earnest effort the companies will be granted an increase in income at least sufficient to meet the increase in wages authorized by the War Labor Board, and thereby further complications be avoided."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Lafayette Company May Increase Its Power Rate.—The Indiana Public Service Commission has granted the Northern Indiana Gas & Electric Company permission to increase temporarily its rates for service to large consumers of electric service. At the same time the commission denied the company's petition for a general increase in electricity rates and for increase in hot-water-heating rates. The company was granted permission to add ¼ cent per kilowatt-hour for consumption of from 400 kw.-hr. to 2500 kw.-hr. per month and ½ cent per kilowatt-hour for consumption of more than 2500 kw.-hr. per month.

Status of Competitive Company.—A decision by the New York Public Service Commission, Second District, raises again the position of the Lawrence Park Heat, Light & Power Company as a competitor of the Westchester Lighting Company in Bronxville. It says in part: "We are of the opinion that the present electric lighting business of the Lawrence company is of the nature of public service. The Public Service Commissions law was intended primarily for the protection of the patrons of companies and individuals furnishing various classes of service to the public. We do not believe that under that statute to sustain the character of public service the utility most be one which is offered to the public indiscriminately, which has been the test applied in some of the states, nor that the making of special contracts by the producer upon its own terms necessarily robs it of its public character. . . . Unless the service for which the permit is to be used is a public service, a certificate of public convenience and necessity as prayed for would be a contradiction in terms. We have determined, however, that the proposed service is of a public character, and we must next determine whether or not the certificate shall be granted. In the consideration of this question we are met with the objection that the village of Bronxville is not named in the certificate of incorporation of the Lawrence company as one of the towns, villages or cities in which the operations of the corporation are to be carried on, as required by the provisions of Section 60 of the transportation corporations law. The certificate does name the town of Eastchester within the boundaries of which the village of Bronxville lies. But every village lies within a town, and the statute requires that the village shall be named. . . . It seems clear, therefore, that the corporate rights of the Lawrence company do not extend into the village of Bronxville. . . . This objection can be overcome, however, by the petitioner amending its certificate of incorporation so as to include the village of Bronxville, and in order that this controversy may be finally disposed of we are inclined to consider the application on its merits at this time with the same effect as though that had been done, provided that the petitioner desires to so amend its certificate. It is clear that the adjudication of Oct. 9, 1917, contemplated that the Westchester company should be fully protected in the public and general commercial lighting of the village, and that the Lawrence company should be allowed to continue such lighting as it was then conducting, and with that disposition of the matter we are in full accord. The use of the permit in question will not in any way alter the adjustment thus made because it simply furnishes a more convenient way, both from the view of the company and that of the public, of conducting electric current to the Colonial Building and the Brick Row than is afforded by the two wires crossing Pondfield Road, the permit being limited to these purposes. The village authorities have expressed their preference for this method of transmission. An order will be entered denying the petition and directing the petitioner to discontinue operating under the permit described in the petition, unless within thirty days the petitioner files with the commission evidence that it has duly amended its certificate of incorporation by including the village of Bronxville in the towns, villages, cities and counties in which its operations are to be carried on, and provided that in case of such filing within thirty days the approval prayed for will be granted."

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W. F. Gilman has been made district manager for the Central Illinois Public Service Company, with headquarters at Mattoon.

H. L. Wills has been appointed engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, Ga.

Lawrence A. Coleman, who has been assistant secretary of the United Electric Light & Power Company of New York City, has recently been appointed treasurer of that company.

W. G. Lord, formerly chief electrician of the Arkansas Valley Railway Light & Power Company, Pueblo, Col., has been appointed superintendent of the Pueblo division, succeeding C. A. Orr, resigned.

H. C. Deffenbaugh, who since last summer has been a first lieutenant in the Engineer Corps, has received his discharge and returned to the Empire State Gas and Electric Association, where he is assistant to the secretary.

T. T. Parker, for the last three years manager of the Union City (Ind.) Electric Company, has been appointed manager of the Kansas Electric Utilities Company, Emporia, Kan. The latter company operates the electric and railway systems in Emporia.

Alfred C. Wilson has resigned as engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, to become associated with the Southeastern division of Lockwood, Greene & Company as assistant electrical engineer. Mr. Wilson was employed by the Georgia company for more than fifteen years, having entered the company's service following his graduation from the Georgia School of Technology.

Gardner F. Wells, who has been until recently manager of the division of transportation of the United States Housing Corporation, has resigned to enter the consulting engineering field, paying particular attention to public utilities. From 1901 to 1916 Mr. Wells was with Stone & Webster. For the first five years of this period he was engaged in property management and in engineering and construction work, and after that he was an appraisal expert, making office and field examinations and preparing reports of appraisals of public utilities. Before joining Stone & Webster he spent ten years with the Thomson-Houston and General Electric companies on engineering construction and management work in connection with electric light and other utility properties, going with the first-named company from the Massachusetts Institute of Technology, where he spent a year in engineering study. Since March, 1916, he has been head of the corporation bond-buying department of Arthur Perry & Co., Boston, and during the war period served first as major in the Ordnance Department of the army and later on the staff of Otto M. Eidlitz, head of the government Bureau of Industrial Housing and Transportation.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Louis A. Ferguson, vice-president of the Commonwealth Edison Company, Chicago, is receiving the congratulations of his friends on having completed thirty years of service with the company and its antecedent companies. Mr. Ferguson has spent his entire business career as a central-station man. Promptly after graduation from the Massachusetts Institute of Technology in 1888 he entered the employ of the Chicago Edison Company. After serving in the underground department and in the trouble department, he was assigned to the electrical engineer's office,

L. A. FERGUSON

and in 1890 he became electrical engineer for the company. In 1897 he was appointed general superintendent in charge of all the electrical engineering, construction, operating and contracting of the company. Upon the formation of the Commonwealth Electric Company Mr. Ferguson was made its general superintendent. In 1902 he was appointed second vice-president of the Commonwealth Electric Company and the Chicago Edison Company. Five years later these companies were consolidated under the name of the Commonwealth Edison Company and Mr. Ferguson was elected second vice-president. In 1914 he was elected vice-president in charge of contract, operating, construction and electrical departments, a position which he still holds. To Mr. Ferguson belongs the credit of being the first central-station engineer in the United States to recommend the system of generating three-phase alternating current for distribution over transmission lines to substations containing rotary converters to transform the energy into direct current for general distribution. He has made three trips to Europe to study engineering development there. One of these investigations of European practice resulted in recommendations to the Chicago Edison Company that it adopt the differential rates now so largely employed. Mr. Ferguson is a past-president of the Association of Edison Illuminating Companies, the National Electric Light Association and the American Institute of Electrical Engineers. During the war he has been a member of the Federal Capital Issues Committee and other war bodies.

Obituary

Charles S. Hall, aged forty-six, who was treasurer and general manager of the William Hall Electric Company, 115 East Third Street, Dayton, Ohio, died on Feb. 16. The William Hall Electric Company is well known throughout the Middle West as a retail and wholesale distributer of electrical merchandise in the Miami Valley.

Edwin Appleton Record, manager of the electrical department of the Vacuum Oil Company, Boston, Mass., died recently at his home after a short illness. He was a native of Moncton, N. B., and in early life was engaged in foundry and machine work and then in the lumber trade. He had been connected with the Vacuum Oil Company for about thirty-four years and was in charge of the company's branch office business in all parts of the world.

A. O. Dicker, district manager for the Luminous Unit Company at Chicago, died of influenza on Feb. 15 after a brief illness. Mr. Dicker was a graduate of the University of Michigan in the class of 1910. After leaving school he became illuminating engineer for the contract department of the Commonwealth Edison Company. In June, 1914, he, together with some of his business associates, formed a new company called the Electrical Sales Engineers, Inc., of which he became secretary-treasurer. Later he joined the sales staff of the Luminous Unit Company, on which he was engaged at the time of his death.

D. L. Reynolds, member of the Graham-Reynolds Electric Company, electric supply jobber of Los Angeles, Cal., died recently from pneumonia following influenza. Mr. Reynolds was born at Pasadena, Cal., and when only seventeen years old came East to study dentistry, graduating in 1901 from the Baltimore Dental College. After four years of practice at Pasadena his health required him to give up his profession, and he became interested in the electrical business through his brother, Robert L. Reynolds, and soon after became a member of the Holabird-Reynolds Electric Company, now the Graham-Reynolds Electric Company, in which for fifteen years he had been associated with N. W. Graham.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FARM-LIGHTING DISTRIBUTERS ARE NOW BEING STOCKED UP

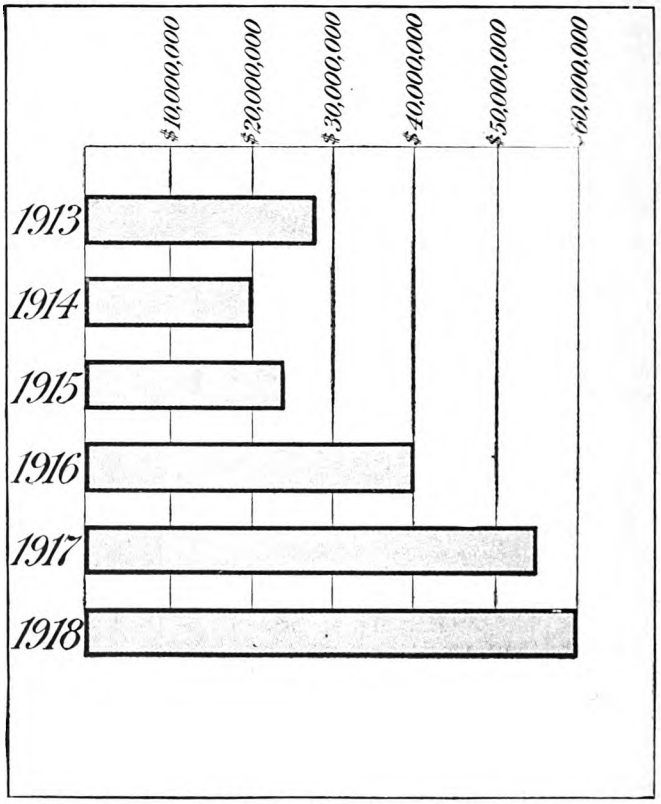
Reports State that Farmers Are Holding Back, Waiting for Lower Prices, of Which There Is No Present Indication

It is the opinion in some quarters that many of the farm-lighting plants which are apparently sold are not going to farmers. They are being used to load up wholesale distributers and dealers with stock which they can ill afford to carry. Meanwhile the farmers are waiting for decreased prices. There is, of course, no logical reason based on costs of material and labor to expect a decrease in price of farm-lighting plants at a reasonably near future date. If quantity production is maintained and if the farmers continue to hold off, the overproduction may create a market in which there will be reduced prices. It is reported that certain distributers of farm-lighting plants among the automobile trade have gone into bankruptcy on account of the overstock of farm-lighting plants which they were carrying. The cause of this is thought to lie in the method of doing business along lines usually followed by automobile manufacturers; that is, of shipping goods sight draft, bill of lading attached.

1918 SETS NEW RECORD FOR ELECTRICAL EXPORTS

Equipment Valued at $59,982,526 Shipped During the Year—Doubtful, However, if Volume of Goods Equals That for 1917

Exports for the last calendar year 1918 amounted to $59,982,526, which is larger than the value of electrical goods exported during any previous year. With the exception of batteries, insulated wire and cable, arc lamps, carbon lamps and telegraph apparatus, all of the items listed were exported in greater value last year than in 1917. It must not be forgotten, however, that the average price of copper wire was considerably less in 1918 than it was in 1917. Other items increased in price considerably during the year, and if this is taken into consideration when comparing 1918 figures with 1917, it seems doubtful that the volume of goods exported in 1918, therefore, was as great as that in 1917. The total value for 1918 was but 10 per cent greater than the total for the year before, but it is probably true that the average increase in price of



SIX YEARS OF ELECTRICAL EXPORTS

electrical goods during 1918 was considerably more than 10 per cent.

The figures as here reported also include the figures for December, 1918, which amounted to $5,187,981, or a little more than $500,000 below December of the previous year. In view, however, of the signing of the armistice in November, this figure for last December is especially good.

Articles	December, 1917	December, 1918	1913	1914	1915	1916	1917	1918
Batteries	$370,486	$233,321.	$359,123	$635,522	$1,364,999	$2,025,250	$3,624,222	$3,178,437
Carbons	178,567	139,347	.....	.....	.....	.....	*736,717	1,600,920
Dynamos or generators	138,450	344,034	2,374,122	2,372,816	1,872,191	1,867,565	2,356,780	3,363,349
Fans	73,106	88,678	415,774	295,966	374,113	313,771	622,731	847,327
Heating and cooking apparatus	58,701	74,794	.....	.....	.....	.....	1,256,533	686,339
Insulated wire and cable	676,651	465,688	*1,256,865	1,321,451	2,761,609	4,943,577	7,187,951	5,604,114
Interior wiring supply, including fixtures	134,398	100,270	*408,253	591,136	882,981	901,657	1,405,772	1,428,615
Arc lamps	1,534	128	134,053	42,782	23,968	15,467	16,418	14,139
Carbon-filament lamps	27,172	13,809	254,893	88,025	150,111	124,776	187,876	102,872
Metal-filament lamps	341,086	229,903	301,791	278,061	873,862	1,420,309	2,884,675	3,369,192
Magnetos, spark plugs, etc.	328,527	318,005	.....	.....	.....	.....	*1,757,848	2,749,705
Meters and measuring instruments	191,539	122,311	.....	*157,386	657,129	884,241	1,213,278	1,887,925
Motors	730,585	663,216	4,886,508	3,300,839	3,279,174	4,932,831	6,484,972	8,225,197
Rheostats and controllers	21,641	27,850	.....	.....	.....	.....	*93,612	288,757
Switches and accessories	221,022	151,786	.....	.....	.....	.....	*1,025,003	2,195,300
Telegraph apparatus, including wireless	44,644	68,090	147,233	93,563	136,890	209,343	555,703	378,806
Telephones	278,162	121,935	1,659,326	1,251,788	910,562	1,813,969	2,212,237	2,687,483
Transformers	213,243	195,180	872,661	934,312	704,373	1,051,168	1,747,884	3,528,673
All others	1,696,862	1,829,636	15,126,761	8,599,468	10,316,548	19,740,151	21,107,867	17,845,376
Total	$5,726,376	$5,187,981	$28,197,363	$19,963,115	$24,308,510	$40,244,075	$55,478,079	$59,982,526

* Figures begin with July.

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Numbers of American manufacturers of electrical goods received cancellation orders from abroad almost immediately upon the signing of the armistice, and consequently December shipments were considerably below what they would have been had the war continued. While it is true that export embargoes were generally lifted, still Europe had not entirely lifted its embargo on imports, and, moreover, there was not sufficient time after the signing of the armistice for business to develop in any volume. The exports in individual items ran along about average for the year, and there is nothing of especial interest to point out in the December figures.

The figures in the accompanying table were originally compiled by the Bureau of Foreign and Domestic Commerce and have here been brought together in order that comparisons may be made over a period of years. The totals for the last six years are graphically represented in the accompanying chart.

METAL MARKET SITUATION

Prices Generally Lower—Government Expects to Return Its Metals to Market for Easy Absorption

The tone of the whole market has undergone little change. Although the prices of many metals have continued in a steady downward trend, this has, as a rule, meant little to the trade because there were so few buyers and so few orders that the asked prices would have given way to almost any reasonable offer.

The War Department authorized a statement to the effect that, although details of the arrangement have not yet been worked out, it was practically agreed that some arrangement could be made between the War Department and producers of copper, lead and brass which would permit of a gradual feeding into the market of the surplus supply of these metals in possession of the War Department in such a manner as to obtain fair prices for the government without upsetting the market.

The 1,000,000,000 lb. of copper stocks in the United States comprises copper in the crude form and in the processes of refinement. Normal stock is 500,000,000 lb. Electrolytic copper quotations have declined about 1½ cents from a week ago to 15.37 cents. Smaller producers, however, have made sales as low as 15 cents, but even this price has attracted little buying.

Lead has advanced from 5 to 5.25 cents per pound, and outside dealers have received as much as 5.30 cents.

American brass has dropped its base price for finished goods to a 17-cent copper level.

The used metals have continued to decline, and although orders are small, nevertheless the trade seems to be enjoying a better feeling.

NEW YORK METAL MARKET PRICES

	Feb. 18	Feb. 25
Copper:	£ s d	£ s d
London, standard spot	74 10 0	75 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	17.50 to 18.00	16.50
Electrolytic	16.75	15.37½
Casting	16.50	15.25
Wire base	20.75	18.75 to 19.00
Lead, trust price	5.00	5.25
Antimony	7.25	7.12½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.72½	6.65
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent.	31.50	31.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.50 to 14.75	13.50 to 14.00
Brass, heavy	7.75 to 8.00	7.50 to 7.75
Brass, light	6.50 to 6.75	6.00 to 6.50
Lead, heavy	4.00 to 4.25	4.25 to 4.50
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

THE WEEK
IN TRADE

IN THE Far West stocks are getting pretty sizable, but elsewhere they are being kept pretty low. In fact, in some lines in certain localities stocks have been allowed to become too low.

Business of a small kind is keeping the trade fairly well engaged. Until prices have hit pretty near their low level it is doubtful if orders will be placed for large quantities of supplies except where immediate consumption is assured.

Prices generally are steady. Local prices show changes not registered elsewhere. Wire appears to be the only product from jobbers' stocks that is dropping in price everywhere.

It is announced from the office of the director of sales, War Department, that, as of Dec. 31 inventories, it has on hand $200,000 worth of miscellaneous electrical equipment exclusive of machinery.

Labor is still in a very uncertain state. Higher wages are being paid in spite of the surplus of labor. In fact, it would not be surprising to find labor prices increase for some time.

Collections appear to be in good shape—much better in fact than could reasonably be expected under the circumstances.

The General Electric Pittsfield works on Monday reduced the working week from fifty to forty-five hours, or five days of nine hours each. About 4000 hands are affected. This is the first time since August, 1914, that slack business has caused curtailment of working hours.

NEW YORK

The real estate market has shown no decided improvement this week. Plans suggested for writing off the present abnormal cost in building construction and encouraging private owners to make investments comprise temporary exemption of improvements from taxation, government aid on long-term loans and assistance for experiments in quantity production. A cessation of price fixing as a means to the return of normal conditions and the construction of public buildings the cost of which has already been appropriated have been advocated. The building during January, however, showed an improvement over December, and operations projected in January show an advance over that month of 1918.

Regardless of the new building field, jobbers report a very fair amount of work on hand, the business in January being better than that of the previous January. Stocks have moved down to a very satisfactory level so that overstocking has practically disappeared. Jobbers are not restocking to any considerable amount in the ordinary run of schedule and wiring material, but are keeping well up for the class of work that has been coming through.

Prices on rubber-covered wire base have eased off slightly, while transformers and regulators are lower.

Manufacturers' and jobbers' collections have been reported exceptionally good for the month of January. Credit is very satisfactory. Collections have been running well under sixty days, and some have been reported averaging forty-five days.

RUBBER-COVERED WIRE.—The average base has decreased about three-fourths of a cent, from 23.8 cents to 23.1 cents. One manufacturer quotes on 25-cent base this week as against two last week, and seven on 23-cent base against four last week. One is on 24-cent base, two on 22 cents, and one on cost.

TRANSFORMERS.—Two large manufacturers have quoted lower prices since the middle of February on trans-

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formers of 200-kva. capacity and larger. The reduction was from 10 to 15 per cent in one case and 10 per cent in the other. Deliveries about ten weeks.

VOLTAGE REGULATORS.—About Feb. 1 prices of two manufacturers were reduced 5 per cent.

LAMPS.—While the 100-watt vacuum-type Mazda has been standardized with an unskirted medium through base with the same over-all dimensions as before, it will be possible for a considerable period of time to secure the skirted-base lamps in this size, owing to stocks on hand. The unskirted base, however, will become standard upon the disappearance of lamps of the other type now in stock. Both styles are listed at the same price.

CONDUIT.—Carload lots are coming through to the jobbers in good shape. Half-inch continues the favorite, but one jobber reports good 2½-in. sales, presumably indicating larger-size work, under way.

FLEXIBLE METALLIC CONDUIT.—A good movement is reported with no evident expectation of an early easier price. Considerable remodeling and recircuiting is providing a good part of the push for this material.

HEATER CORD.—Deliveries are much better, and stocks are in good condition.

SCHEDULE MATERIAL.—Surplus stocks have been reduced so that now they are in general very satisfactory to handle the fair amount of business coming through.

LAMP CORD.—A good market is reported with good local stocks and satisfactory deliveries from factories.

SOCKET DEVICES.—One large jobber reports very good sales of small-motor devices and table utensils.

FANS.—Jobbers are receiving their fan information. Some dealers have already placed their orders, and from inquiries and orders received one jobber predicts no decrease in fan business due to the higher prices for this year.

BOSTON

Trade is rather quiet this week. Washington's Birthday and the debarkation of President Wilson at Boston protracted the week-end. Inquiries are still in good volume, but buyers continue to play a waiting game. Labor conditions are very unsettled in the textile field. The danger of a telephone strike is lessened for the moment. Jobbers' stocks are being gradually reduced, and some scarcity in weatherproof wire is reported. Wire softened about 2 cents a pound last week in sympathy with the weakening of copper prices. The demand for appliances is healthy. Building operations look a little more promising. There will be a school to cost $150,000 erected soon at Quincy Point, and at Springfield it is estimated that about $2,000,000 of additional construction will be put through in 1919. Reduction of orders has led to a curtailment of the hours of labor at the Pittsfield (Mass.) works of the General Electric Company from 50 to 45 per week, with the exception of the fan-motor department, which will run on full time for the present. Collections are fair, especially when watched carefully. One jobber who pays personal attention to credits and whose invested capital is relatively small has reported good collections for many months past. It is rumored that storage-battery prices are likely to show further declines in the not distant future. Central stations have not as yet begun expansion on any considerable scale.

FANS.—Jobbers are stocking up somewhat, and the opinion is expressed that prices will hold firm for the remainder of the 1919 production season. There are signs of an excellent demand.

WIRE.—Base prices about 2 cents below the figures of week before last are noted. Rubber-covered and weatherproof wire are quoted around a 24-cent base and bare copper wire at 20 cents. The demand is very light.

POLE-LINE MATERIAL.—Stocks are well prepared to meet a rapid expansion of business, but as yet the lid is down pretty tight on central-station developments. Some of this material is about due to move, however, and lower prices on wire may help.

MOTORS.—Stocks are still rather spotty in the larger sizes. The demand is light at present, but prices hold remarkably steady. Distributers are building up more representative stocks every week.

STARTING AND LIGHTING SETS.—All signs point to a big year in automobile production. The pleasure car market is most promising, and while stocks of electrical accessories are at present in fairly good shape, there is some question how long this condition can be maintained. Prices are firm and distributers extremely active preparing for work at the automobile shows, some of which have already opened.

STORAGE BATTERIES.—The outlook for a remarkable year's business is good. Stocks are being gradually built up in the face of a heavy demand from the automobile industry. Government business has fallen off to modest proportions of the total volume. Prices are still pretty firm, but it is likely that reductions will be in evidence before long, though it is any man's guess when the recession will occur. Deliveries are improving as the result of vigorous work by the factories. The need of throwing open the steam railroad market for signal, car-lighting and other batteries is emphasized among the trade.

ELECTRIC LOADING MACHINERY.—Inquiries are improving and a renewal of ordering is beginning to be noted. Prices are not likely to increase, and deliveries from stock can be made readily. Some special machinery is now on order.

WASHING MACHINES.—Jobbers are buying on a fair scale, and the domestic labor situation seems unlikely to improve to a point where this business will be seriously affected, at least for the present.

PORTABLE LAMPS.—A fair turnover continues despite the increasing length of days. The removal of all lighting restrictions has unquestionably been a very helpful psychological factor in stimulating this class of business.

DRY BATTERIES.—Business is quiet and stocks are in reasonably good shape for the most part. It is believed that prices will show some recession before many weeks.

ATLANTA

Some stimulation is noted in building activity this week. Reports state that Mississippi lumber dealers are enjoying so great a business that many yards have received more orders than they can conveniently fill at present. Repairs and remodeling on a large scale are taking place. Architects of the Southeast are confident that better weather in the spring will bring a large amount of construction work. Reports from various Southern states show that the supply of labor in general is about equal to the demand. Labor conditions at Atlanta are somewhat unsettled because of the declaration by the Builders' Trade Association for an open shop in order that returning soldiers may not be deprived of an opportunity to secure work.

A tentative agreement between the electrical contractors and electrical workers was reached this week, whereby the men will go back to work pending a settlement on the open-shop proposal, which has been put in the hands of Mayor Key for mediation. Presaging building construction, real estate appears to be becoming more active.

The War Department has not definitely decided to discontinue all work at Camp Benning, Columbus, Ga. The Georgia-Alabama Power Company, Albany, Ga., recently organized, will take over the Albany Power & Manufacturing Company and the Columbia Power Company, Columbia, Ala., and construct combined hydroelectric and steam plants on the Flint River, Ga., for the development of approximately 15,000 kw.

Manufacturers report business from small central stations and municipalities as being excellent for meters, transformers and general supplies.

MOTORS.—Inquiries seem to be increasing, and business shows considerable improvement over last week. Shipment promises are much shorter and local stocks are accumlating. One manufacturer has reduced prices about

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10 per cent, claiming increased factory efficiency as the result. Inquiries among other motor representatives, however, failed to produce any concrete evidence of a general cut in motor prices.

LIGHTNING ARRESTERS.—Prices remain firm, but buying has dropped off unexpectedly.

GENERATORS.—Activity is increasing in the small alternating-current sizes, and orders booked show a decided improvement. A slight decrease in price generally was recorded this week. Factory shipments are getting much better.

TRANSFORMERS.—The demand for the large-power type is dull and comparatively little business is being done. It is rumored that a 10 per cent reduction in price is coming very soon.

METERS.—The small central stations continue their steady buying of the residential type. No change in price is noted and deliveries are excellent.

FEEDER AND GENERATOR VOLTAGE REGULATORS.—Manufacturers state that inquiries are growing, with a corresponding increase in the volume of sales compared with the earlier weeks of February. The recent drop of 5 per cent in price has no doubt tended to stimulate sales. Shipment promises are more encouraging.

CHICAGO

Only 3000 buildings were erected in Chicago during 1918, as against 10,000 buildings of about the same average value in 1916. The Chicago Association of Commerce and other civic organizations realize the necessity of a widespread inauguration of building activities and are using their influence to get new buildings started without further delay.

Work was started this week on the new Union Depot. Morris Gest, a New York theatrical manager, announced that he will build a new theater in the "loop." John S., Henry C. and Howard Phipps of New York have agreed to build a burlap-bag factory to cost $175,000 in the Kenwood manufacturing district for Marshall Field & Company. The suburb of Winnetka plans to place all lighting and telephone wires underground and to make a number of other public improvements.

The agricultural districts of the Middle West and South are expected to be productive of good business. The agricultural sections will be less severely hurt by taxation than industrial sections. The farmer is only subject to the taxes of an individual.

WIRE.—The base on both rubber-covered and weatherproof wire is down to 23 cents. Bare wire has a spread of from 19 to 22 cents, but there is little call for it.

CONDUIT.—Conduit remains firm.

IRONING MACHINES.—There is a shortage in jobbers' stocks.

DISHWASHERS.—Some manufacturers have been unable to keep up with their orders.

SEATTLE—PORTLAND

Contrary to expectations, strikers in Seattle and Tacoma did not return to work on Feb. 19. In fact, shipyards and shops did not attempt to open gates. This change of program on the part of shipyard owners came as a complete surprise and was probably because employers concluded that sufficient men would not return to justify the endeavor. Up to date the strike is as far from or further from settlement than it has been at any time since it began. The Pacific Coast district metal trades conference, which concluded a week's session in Portland on Feb. 22, was apparently fruitless of result as regards early settlement of difficulties.

The strike is having an exceedingly detrimental effect on all lines of business. Electrical jobbers report that sales, aside from those to shipyards and industrial plants, are fairly satisfactory. However, the major portion of jobbers' business is with shipyards Dealers report a marked decrease in sales of fixtures and domestic appliances. There is no further change in prices, and the likelihood of early decreases is considered as purely a matter of personal opinion. The larger jobbers believe that lowering of wages is absolutely essential before prices drop. Stocks are in excellent shape owing to the improvement in the freight situation, cessation of hostilities and the government's being out of the market. Smaller concerns which are unable to shift stocks to branch houses and which since the strike have no outlet for merchandise are in many cases overstocked along some lines.

The Portland district reports the industrial situation somewhat improved. The recent action of the Emergency Fleet Corporation in reinstatement of six steel vessel contracts at three large Portland yards previously put on the suspended list has caused a material improvement temporarily. Award of contract for the Astoria Flouring Mills is followed by information that the industry will be entirely motor-driven, utilizing 1000 hp. The mills will be the largest in Oregon. The construction of a five-mile transmission line for supplying three-phase, 2200-volt power to farmers in the McMinnville (Ore.) district is reported. Small sales of electrical supplies continue good. There are, however, no particularly large sales to report nor no particular movement of any one line of merchandise. The spruce production division has opened sale bids on approximately 200 motors ranging from 5 hp. to 75 hp. The bids ranged from 30 to 40 per cent of cost to government new and were appreciably below what had been hoped for.

SAN FRANCISCO

Rains have been plentiful. Farmers and fruit men are everywhere jubilant over the prospects for 1919. Further, live stock is in good condition and feed plentiful. The heavy late snows on the Sierras will fill the reservoirs of the hydroelectric systems. The Pacific Coast is getting good shipments from the factories. The breakdown of the Seattle strike has given a salutary lesson to California labor radicals. The recent Oakland strike in defiance of the national unions was broken by most of the strikers themselves returning to work. The labor situation at San Francisco and Los Angeles is quiet.

POLE-LINE HARDWARE.—New state and power line construction is being planned by three companies—the San Joaquin Light & Power Corporation, in the vicinity of Chowchilla; the Sierra & San Francisco Power Company, in the district north of Modesto, and the Western States Gas & Electric Company for the city railroad system in Eureka. Prices on lag screws, carriage bolts, double-arm bolts, etc., have decreased about 10 per cent and cross-arm braces about 15 per cent. Hopes are expressed that there will be a lot of necessary construction this season, especially for isolated farms that are not on the main distribution lines.

WIRING DEVICES.—There is a steady call for schedule material such as sockets, switches, etc., but in hand-to-mouth quantities. As a result of a recent debate at one of the San Francisco organizations, the local underwriters intend to investigate the reported misuse of two-way and three-way plugs inserted in one socket. A certain faction wishes to discontinue their use.

WIRE.—For the third time this year rubber-covered wire has dropped, although No. 14 single-braid solid is still constant at about $14.25 per 1000 ft. in carload lots. Other sizes have dropped about 5 per cent, except the heavy circular-mil sizes, which have decreased 15 per cent. Asbestos-covered magnet wire base is quoted at $0.54 per pound, a drop of about 5 per cent. Telephone wires have dropped nearly 25 per cent, and office annunciator wires at one bound decreased 15 cents per pound. Plenty of rubber-covered wire is being sold, and local stocks are good.

CONDUIT.—Certain sizes show a very small decrease, but more as the result of new methods of figuring than as the result of price change, the drop being more noticeable on the smaller quantities. Local stocks are better than they have been for many months.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
1/8	250	$5.00
¼	250	7.50
⅜	100	10.00
½	50	13.00
¾	50	21.00
1	50	26.00
1¼	25–50	35.00
1½	25–50	45.00
2	25–50	52.00
2½	25–50	

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
1/8	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
¾	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
¼-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00–26.50
¼-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08¼
⅜	.08¼
½	.08¼
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.00—$36.00
Coil to 1000 ft.	25.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 —N.C.
Less than 1/5 std. pkg.	$16.00	$26.00
1/5 to std. pkg.	13.60	21.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 —N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.46–$0.66
No. 18, full spools	.44– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.60 to $0.90
No. 18, full spools	.53 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00–$25.00	$11.00–$17.00	$11.00–$15.00
12	21.40– 27.09	19.26– 23.22	16.05– 23.22
10	28.94– 32.40	26.06– 32.40	20.83– 27.45
8	35.82– 45.72	32.84– 45.72	28.66– 38.10
6	56.70– 72.36	51.98– 60.30	45.36– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$19.50–$20.00	$14.50–$15.00	$13.00–$14.50
12	17.50– 24.57	17.55– 24.57	17.55– 21.06
10	24.05– 32.97	24.05– 32.97	21.16– 28.26
8	33.35– 46.69	33.35– 46.69	29.35– 40.02
6	52.95– 73.71	46.60– 63.18	46.60– 52.65

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$29.75 to $34.75
25 to 50 lb.	29.75 to 34.75
50 to 100 lb.	28.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$32.75 to $35.75
25 to 50 lb.	31.75 to 34.75
50 to 100 lb	30.75 to 37.35

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NEW APPARATUS & APPLIANCES

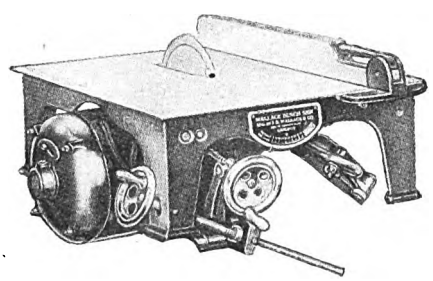
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Portable Bench Wood Saw

The time usually wasted in walking to and from stationary sawing machines may be saved through using the portable bench saw recently developed by J. D. Wallace & Company, 1401 West Jackson Boulevard, Chicago. While designed to operate from an ordinary incandescent socket, it is said to have ample power to cut through the hardest wood, making its use possible for a majority of the work customarily done by hand or on large saws in pattern, cabinet, jobbing and contracting carpenter shops or in woodworking plants.

A number of useful features are pointed out, among these being that in order to cut at an angle the saw is tilted instead of the table. This, it is claimed, makes it possible to cut long stock without fear of breaking it by coming in contact with the floor as sometimes happens when tilting tables are employed. Other advantages accruing from the tilting-saw design are that the operator always works at a table in a horizontal position and the exact angle at which the wood is to be cut may be set by spinning a hand wheel until the desired angle is registered on a dial. This tilting mechanism swings a cradle containing the saw, the driving mechanism and a ½-hp. General Electric motor. The motor is equipped with a ball bearing that acts as a thrust bearing when the motor is tilted for angle cutting. The saw can be raised and lowered to cut or groove stock any depth up to 2 in. (5 cm.), the mechanism for this operation being controlled by another conveniently located hand wheel.

The cross-cut fence is built into the machine and therefore, while it may

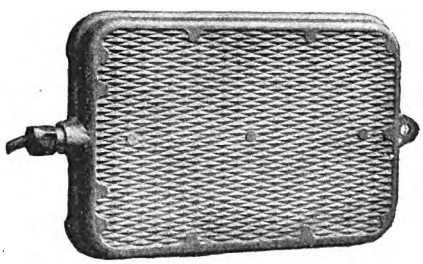


SAW, NOT TABLE, IS TILTED FOR ANGLE CUTTING

be turned under the table when not needed, is yet never off the machine or misplaced. A box-type rip fence is clamped to both sides of the table and is finished on both sides so that it can be used on either side of the saw. A factor in the safe operation of the saw is the shuttle saw guard which is built into the machine and constantly acts as a shield. As the saw goes through the stock this guard slips back and so does not interfere with the saw's efficient operation. Not only does this guard protect the operator's hands, but, the maker points out, it also prevents two other causes for accidents — the catching of the tail end of the stock in the back of the saw and the catching of the waste stock in the saw's teeth.

Outdoor-Service Electric Foot Warmer

Among the applications to which the outdoor-service foot warmers being made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., may be put are warming the feet of watchmen at industrial plants and those of motormen and conductors on railway cars. Three heats for moderately cold, cold and extremely cold weather are provided, in this way obviating the possibility of harm resulting from the feet becoming too warm. The casing of the heater is

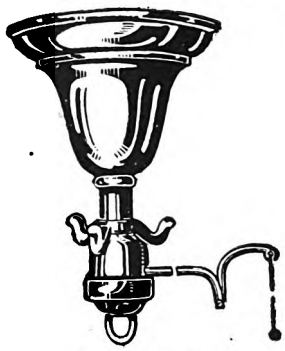


UPPER SIDE OF WATERPROOF HEATER

made in one piece of either cast iron or copper and is 20 in. (51 cm.) long, 14 in. (36 cm.) wide and 2½ in. (6 cm.) high. To prevent the foot from slipping, the top surface is diamond treaded and to raise it 1 in. (2.5 cm.) above the ground supports are provided at the corners of the under side. The heating unit is clamped against the under side of the main casting by a sheet-steel clamping plate and is made waterproof by means of a bottom sheet-steel plate sealed with waterproof gum. The slotted ribbon-type resistance is distributed uniformly over the entire surface, the ribbons being assembled between two thin plates of built-up mica cemented together to form a unit. By means of the three-heat control snap switch 200 watts are obtained when two equal circuits of 100 watts each are connected in parallel; 100 watts are produced on medium by using one circuit only, and 50 watts may be obtained by connecting the two circuits in series. The rubber-insulated triple conductor enters the warmer through a bell-mouth waterproof fitting mounted in the middle of one 14-in. (36-cm.) edge.

Chandelier Pull Switch

What is known as the "In-B-Tween" chandelier pull switch has recently been placed on the market by the Peerless



STYLE THAT IS USED WITH THREE-CHAIN FIXTURE

Light Company, Halsted, Adams and Green Streets, Chicago. It is said to eliminate the necessity of a side-wall switch and to form a neat appearance. The stem of the new switch, which may be obtained either with or without a canopy, is 6 in. (15 cm.) long. Cast armor covers the mechanism, and the switch, ornamental in appearance and having a finish of brushed brass, may be applied to single or three-chain lighting fixtures. The bottom part of the armor has a large square pin that engages a bayonet slot in the upper portion of the armor so that by a quarter turn it will lock into place and will not work loose. The manufacturer claims that the device has sufficient strength and capacity to support and control any lighting fixture or commercial unit with a mogul lamp base.

Forced-Draft Chain-Grate Stoker

A traveling grate stoker which can be readily converted to use either natural or forced draft has been developed by the James A. Brady Foundry Company of Chicago. It consists of cast-iron side frames carrying the driving gear, hopper front, shaft and feed gate in the usual manner. The side girders are formed of structural steel members built like a truss, permitting stokers 20 ft. (6 m.) in length to be built.

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Transverse members of structural steel support a series of tracks on which semi-steel chains operate. These tracks carry and support the grate surface, take up the stress and tension of the chain, and are provided with V-rollers to insure alignment both horizontally and vertically and to reduce the power required for driving the stoker. Attached to the chains is a series of transverse racks or beams on which the clips or grate bars forming the grate surface are attached. These grate bars are sufficiently loose to slide over the ends of the racks readily. This is said to prevent any rusting together of adjacent parts. Each row is held in place by a single cotter pin, and any one bar can be readily replaced without stopping the stoker. The straight under-surface of these racks makes possible a practically air-tight diaphragm or seal between the adjacent draft compartments.

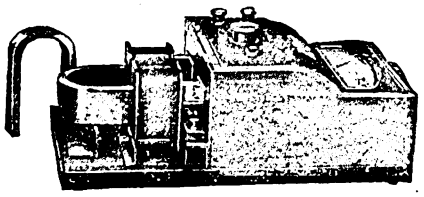
A simple form of adjustable damper controls the air pressure in each respective compartment, so that the proper draft can be maintained under each section of the stoker. Each communicating passage through the side wall terminates in a removable door, which, when taken off, allows free access to the chambers. The closing of the damper and the removal of this door puts the stoker on a natural-draft basis.

The non-sifting grate surface is considered by the manufacturers to be one of the novel features of the stoker. The grate bars fit so closely together that in passing through an arrangement of air passages the air makes two right-angle turns and the lower shoulder at the joint prevents the flow of fuel through the grate. Projections hold the adjacent surfaces apart so that an air space of approximately 15 per cent is assured.

Joseph A. Harrington, designer of the stoker, considers it feasible to develop combustion rates exceeding 75 lb. of coal per square foot (756 kg. per sq.cm.) of grate area per hour from these stokers.

Magnet-Testing Instrument

To facilitate the inspection and testing of shaped or horseshoe permanent magnets by comparative measurements



SHOWING COMPACTNESS AND POSITION OF INSERTED MAGNET

of flux which determine their initial strength and their stability or coercive force—that is, their power to retain the flux under use—Herman A. Holz, of 1 Madison Avenue, New York City, is marketing the illustrated magnet-meter. This device is also said to be well adapted for determining by means of flux tests carried out at intervals whether magnets are properly aged, such tests being particularly desirable where magnets are in use in electrical measuring instruments.

In this instrument a coil capable of rotary movement, to which is attached a pointer traversing a calibrated scale, is supported between two iron pole pieces. This movable system and scale are inclosed in an air-tight housing. The pole pieces are extended through the housing into contact faces or plates, to which the polar portions of the magnet under test are applied. When a definite current is allowed to flow in the moving coil a deflection of the pointer occurs which is proportional to the flux in the magnet applied to the contact faces.

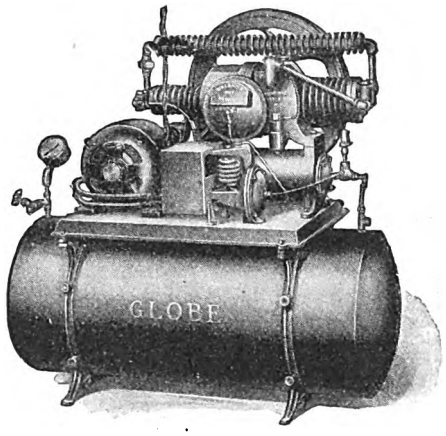
In measuring the magnetic stability of the magnet two adjustable solenoids are employed, being placed in front of the contact faces so as to encircle the respective legs of the test magnet. If current is allowed to flow in the proper direction through the windings of these solenoids when the pointer is deflected in reading the flux, such deflection may be reduced to zero by regulation of the current. The value of this current indicates directly the stability of the magnet.

It is pointed out that the measurement of flux does not affect the magnetization and the state of the magnet remains unchanged. The measurement of stability involves a demagnetizing operation, and the magnet must be remagnetized after such a test. Therefore the flux test may be carried out on each magnet, while it may be found advisable, except in special cases or in investigation work, to test for stability only a few magnets selected as samples from the lot.

Contact shoes are provided to permit of ample contact between the polar portions of the test magnet and the contact plates in cases where the ends of the magnet are not finished. No bushings of any kind are required to adjust the instrument for testing different sizes of magnets. The complete equipment includes the magnet-meter, a milliammeter, an ammeter, three rheostats and two switches.

Motor-Driven Air Compressor Equipment

For garages, vulcanizing shops and other places requiring compressed air at all times the Globe Manufacturing Company of Battle Creek, Mich., has recently developed the "Victory" model two-stage air compressor driven by an electric motor and equipped with an air storage tank. The compressor used is of two-stage construction and is said to be very efficient and economical. It has a capacity sufficient for the average garage, tire shop or free-air station and a maximum pressure of 300 lb. (21 kg. per sq.cm.). The 30-gal. (113-l.) horizontal cylindrical steel tank upon which the machinery is mounted has a guaranteed working pressure of 150 lb. (11 kg. per sq.cm.). Motors of ½ hp. to 1 hp. are supplied for use on all kinds of circuits. Because the outfit is equipped with an automatic pressure unloader, protection is afforded



CAN BE CONVERTED INTO A PORTABLE OUTFIT

against motor troubles and the blowing of fuses. When starting the outfit there is no compression until the normal working speed of the motor is reached, at which time the release valve is opened. The fittings of the new unit include a pressure gage with a needle valve, 25 ft. (7.6 m.) of air hose with an air chuck, and a brass taper connection with an air needle attached. The height of the outfit is 38 in. (0.96 m.); it occupies a floor space 19 in. by 40 in. (0.79 m. by 1.02 m.) and has shipping weight of 475 lb. (215.4 kg.).

NOTES ON RECENT APPLIANCES

Demagnetizer

To make possible the use of magnetic chucks for grinding and similar operations without the disadvantage of having the work magnetized, the William F. Davis Machine Tool Company, 149 Broadway, New York City, is manufacturing a device which will demagnetize small metal pieces passed through it.

Steel Etching Device

An outfit for etching numbers or names on machine parts, steel tools and other similar objects is being manufactured by the Gibb Instrument Company of Detroit, Mich., and is known as the "electrograph." The apparatus can be used with either 110 volts or 220 volts, 60 cycles, alternating current.

Portable Lamps

An adjustable portable electric lamp constructed of metal with mahogany, brushed brass and etched finishes and for use as a stand or wall lamp or clamped to chair backs and beds has been placed on the market by the Faries Manufacturing Company of Decatur, Ill.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of manufacturers in Switzerland (No. 28,407) wishes to purchase electrical outfits, lighting and starting equipments for motor cars, and particularly a combined dynamo and starter for four-cylinder engine, 80 in. by 130 in. and 90 in. by 150 in. Terms, cash. Correspondence may be in English.

Literature regarding the third Bordeaux fair, which is to be held from May 31 to June 15, has been received by the Bureau of Foreign and Domestic Commerce in the form of (a) application blanks for participation in the fair; (b) sample contracts for advertising space in the official catalog, and (c) pamphlets describing the plan of the buildings and their location on the Place des Quinconcs, presenting the advantages from buyers and sellers meeting at this point and giving information in regard to the date of subscriptions, accommodations offered in the way of customs, furnishings, lodgings, etc. John M. Chapman, president of the Lamontagne, Chapman Company, Inc., 101 Park Avenue, New York, is the official representative of the fair in this country, and those desiring further information are advised to get in touch with him. Copies of the literature referred to may be obtained from the Bureau of Foreign and Domestic Commerce or its district or coöperative offices by referring to file No. 110,760a.

A company in Italy (No. 28,368) desires to purchase 50,000-volt insulators; transformers of from 1000 kw. to 3000 kw. and higher, with the following capacities; 55,000/10,000 volts and 55,000/2000 volts, frequency 42 cycles; cabin insulators, 55,000 volts; copper cables, seven wires, 65 mm. E; copper ropes, seven wires, 52 mm. E, and wire, diameter 60/10, 45/10, and 38/10. Quotations should be f.o.b. New York. Payment through bank in New York.

A man in Belgium (No. 28,388) desires to secure an agency for the sale of electrical supplies. Correspondence may be in English.

THE PULVERIZED FUEL EQUIPMENT CORPORATION has recently been organized for the purpose of taking over the business of the Locomotive Pulverized Fuel Company and to broaden the activities of the latter to cover the central power station, metallurgical and industrial fields. The head offices are at 30 Church Street, New York City, with a Canadian office in the Transportation Building, Montreal. The officers of the new company will be J. S. Coffin, chairman; J. E. Muhlfeld, president; H. F. Ball, vice-president, executive; H. D. Savage, vice-president, in charge of sales; V. Z. Caracristi, vice-president, in charge of engineering, and Samuel G. Allen, secretary-treasurer.

THE AMERICAN APPLIANCE COMPANY, INC., lamp and specialty manufacturer and distributer, announces that it has recently opened an additional branch at 318 West Washington Street, Chicago, in charge of Roy L. Schaulin, who was formerly the Franklin Electric Manufacturing Company's representative in charge of the New York office, and before that associated with the ELECTRICAL WORLD. The company has also opened up a Cleveland branch at 419 Prospect Building in charge of E. L. Wohlfeld, who was formerly in charge of the Evansville branch. This gives the company branches at Indianapolis, New York, Chicago, Atlanta, Detroit and Cleveland, and it is contemplating opening up one additional branch within the next thirty days and probably two more before the end of the year. The Western Agencies Company, at 285 Minna Street, San Francisco, has been appointed as the company's representative for the State of California. N. Abrams, the proprietor of the Western Agencies Company, was formerly connected with the United States Incandescent Lamp Company in St. Louis as its San Francisco representative, previously to which he was associated with the Interstate Electric Novelty Company on the coast.

PAUL J. WILLIAMS, formerly with the Electric Appliance Company, has severed his connection with that company and established an illuminating engineering office at 1188 Oak Street, Columbus, Ohio.

WILLIAM H. FERNHOLZ, Mack Building, Milwaukee, Wis., has been appointed the exclusive representative in the Wisconsin territory for the Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago.

THE BADENHAUSEN COMPANY, boiler and engine manufacturer, announces the opening of a Pittsburgh office at 5030 Jenkins Arcade, in charge of A. D. Neeld, Jr. This office will control the sales in the Ohio, West Virginia and western Pennsylvania territory.

THE UNDERFEED STOKER COMPANY of America has moved its general offices from Chicago to the Book Building in Detroit. This will not interfere with the sales work of the Chicago district sales offices in the Harris Trust Building, nor any of the other district offices.

B. J. ALPIN, for a number of years with the New York Edison Company and more recently general agent of the Yonkers (N. Y.) Electric Light & Power Company, has opened an office at 30 Church Street, New York City, as representative of the Chelten Electric Company, manufacturer of switches and cut-outs.

THE BLACK & DECKER MANUFACTURING COMPANY of Baltimore, Md., announces that R. G. Ames has joined the organization as branch manager in charge of the Chicago office. Mr. Ames was well known in the automobile accessories trade and for the past ten years has been associated with the Edward A. Cassidy Company of New York.

R. L. M. STANDARD REFLECTORS.—Arrangements have been made with the following manufacturers to fabricate the R. L. M. standard reflector: Adams-Bagnall Electric Company, Cleveland, Ohio; Benjamin Electric Manufacturing Company, Chicago; Central Electric Company, Chicago; George Cutter Company, South Bend, Ind.; Harvey Hubbell, Inc., Bridgeport, Conn.; Ivanhoe-Regent Works, Cleveland, Ohio; Wheeler Reflector Company, Boston, Mass.

THE ST. PAUL ELECTRIC COMPANY, electric supply jobber of St. Paul, Minn., begins with the February issue the distribution of its *Monthly Service Bulletin*. The most important feature of the bulletin is the space devoted to current net prices of electrical goods. It is particularly stated, however, that should prices decline the customer will be charged only prevailing price, irrespective of the price quoted in the bulletin. The bulletin also, the company states, will include in each issue articles of an instructive nature. The bulletin is published for the customers of the company solely.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of Frank R. Ryan to the sales force of its Chicago office at 740 Monadnock Block. Mr. Ryan graduated from the electrical engineering course of Notre Dame University, spent over a year in the testing department of the Commonwealth Edison Company, about the same time in the testing and operating department of the Sanitary District of Chicago, and was subsequently connected with the Krehbiel Company, consulting engineers of Chicago. For the past six months he has been in the Signal Corps. Mr. Ryan takes the position which was held by Charles H. Nicholson before the latter entered the service and subsequently took charge of the company's Detroit office.

R. E. S. GEARE HEADS NEW COMPANY.—R. E. S. Geare has been elected president of the Mid-West Manufacturing Company, recently incorporated. Mr. Geare is well known to the construction and power-plant field in Chicago and the Middle West because of his active representation of the T. L. Smith Company, Manistee Iron Works Company, Geare & Company and others, which work he will still continue. The Mid-West Manufacturing Company has located its factory in Chicago, with general offices in the Old Colony Building. It has acquired the sales and manufacturing rights of the "Continental" chain-grate stoker from the Manistee Iron Works and of the "Chaingrip" pipe vise and tools from the Gerolo Manufacturing Company. In addition to this the manufacture of special machines, tools and dies, rebuilding of construction and power plant machinery, together with the installation of such machinery, will constitute an important part of the new company's activity.

Trade Publications

REFLECTOR GUARDS.—Bulletin No. 16-6 from Harvey Hubbell, Inc., of Bridgeport, Conn., has for its topic "Locking Guards for Reflectors."

PLUG.—A large folder telling about the Benjamin "two-way" plug is being distributed by the Benjamin Electric Manufacturing Company, Chicago. The folder can be used as a window poster.

METERS.—The "magnet-meter," an apparatus for investigating the magnetic qualities of permanent magnets, is described in a leaflet issued by Herman A. Haltz, Metropolitan Tower, New York City.

COPPER.—A leaflet called "Copper History," which gives the monthly average prices of copper from 1887 to 1918, has been compiled by the Rome Wire Company of Rome, N. Y. Copies may be obtained from this company upon request.

ELECTRIC VEHICLES.—A sixteen-page booklet called "Increasing Income by Reducing Delivery Expense" and two folders descriptive of the "Ward Special" electric vehicle for commercial use have been prepared by the Ward Motor Vehicle Company of Mount Vernon, N. Y.

WELDING.—An interesting booklet entitled "Repair of the German Ships" has been prepared by the Wilson Welder & Metals Company of 2 Rector Street, New York City, and tells of how the damaged interned German vessels were put back into service through the use of plastic-arc welding.

INDUSTRIAL TRUCKS.—"Flat-Wheel Haulage Systems," bulletin No. 25, just issued by the Lakewood Engineering Company, Cleveland, Ohio, shows the Lakewood line of storage-battery tractors and trucks for all kinds of industrial haulage. A table is included which gives the types of trailers recommended for different classes of work.

BELT FASTENING.—The service department of the Crescent Belt Fastener Company, 381 Fourth Avenue, New York City, has just issued a bulletin covering "The Crescent Principle of Belt Joining" which summarizes the reasons why many large industrial plants are standardizing Crescent belt fasteners. This bulletin also contains a ready reference "service chart" by means of which it is claimed that a superintendent, a belt man or a machinist can quickly determine the correct type of belt fastener to use for any condition of work.

New Incorporations

THE BOYLE ELECTRIC COMPANY of Gettysburg, S. D., has been chartered with a capital stock of $100,000 by Frank H. Boyle and others.

THE NOVA (OHIO) ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $5,000 by W. M. Thiedman and others.

THE IRON & STEEL EQUIPMENT COMPANY of Philadelphia, Pa., has been incorporated by J. Vernon Pimm and F. R. Hansell of Philadelphia. The company is capitalized at $50,000 and proposes to manufacture electrical devices of various kinds.

THE REID ELECTRIC & SUPPLY COMPANY of Elkhart, Ind., has been incorporated by Brice H. Reid, L. P. Reid and A. F. Warren. The company is capitalized at $10,000 and proposes to engage in electrical contracting and supply work.

EARLE & PARCELLS, 299 Central Avenue, Newark, N. J., has filed articles of incorporation with a capital stock of $25,000 and proposes to deal in electrical appliances, etc. The incorporators are M. P. and F. H. Earle of East Orange, and W. W. and A. J. Parcells of Newark.

THE CENTRAL NEW JERSEY POWER COMPANY of Morristown, N. J., has been incorporated by John W. Melick and Arthur S. Pierson of Morristown, and Edward Wegman of Yonkers, N. Y. The company is capitalized at $15,000 and proposes to construct and operate an electric power plant with distributing system in Morristown.

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New England States

EASTHAMPTON, MASS.—The Hampton Company is contemplating improvements to its power plant, including raising boilers, the installation of stoker and coal-handling equipment.

BOSTON, MASS.—Three petitions have been presented to the Gas and Electric Light Commissioners by the Edison Electric Illuminating of Boston asking for authority to erect an electric transmission line from Boston to Southboro, through Dedham, Dover, Natick, Sherborn, Ashland and Framingham. The first petition asks the commission to determine the line is necessary, the second for authority to take lands and rights-of-way, and the third is for permission to erect the line and for approval of voltage. The voltage will be 25,000 between Forest Hills and the Dedham substation and 69,000 from a substation to be erected at Baker Street and to connect at Sudbury dam with the New England Power Company.

HOLYOKE, MASS.—John J. Kirkpatrick, manager of the municipal gas and electric light plant, has petitioned the Board of Aldermen for an appropriation of $200,000 for extensions and improvements, including the purchase of new machinery for both the gas and electric plants. One-half of the amount asked for is to be used for the electriq plant and the other portion for the gas plant.

MILFORD, MASS.—The Milford Pink Granite Company is considering rebuilding its local plant, destroyed by fire on Jan. 31. The buildings destroyed include the main cutting plant, machine shop, forge shop and electric power plant, with equipment consisting of electrically operated traveling cranes, air compressors, etc.

MILLIS, MASS. — Contract has been awarded by the Clicquot Club Company, manufacturers of Clicquot ginger ale, to the Aberthaw Construction Company of Boston for the construction of an extension to its plant at Millis, to include a new bottling building, power house, the removal and re-erection of a storage building. The cost of the work is estimated at about $150,000.

SPRINGFIELD, MASS.—The Turners Falls (Mass.) Power & Electric Company has acquired from the Agawam (Mass.) Electric Company large tracts of land in West Springfield and Agawam, to be used in connection with its electric transmission lines.

STOCKBRIDGE, MASS. — The Lenox Electric Company and the Stockbridge Lighting Company have been consolidated under the name of the South Berkshire Power & Electric Company.

WORCESTER, MASS.—The Board of Gas and Electric Light Commissioners has granted the Worcester Electric Light Company permission to issue $400,000 in capital stock, the proceeds to be used for an extension to its generating system.

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received by Lindley M. Garrison, receiver of the New York Municipal Railway Corporation, 85 Clinton Street, Brooklyn, until March 4 for the installation of electrically driven, automatically controlled seepage and emergency pumps, etc., in the pump rooms of the Sixtieth Street and Montague Street tunnels. Plans and further information may be obtained at Room 412, 85 Clinton Street, Brooklyn.

GENESEO, N. Y.—The Board of Trustees has awarded contract to the Livingston-Niagara Power Company of Avon for the installation of two electrically driven pumping units in the power house at Conesus Lake. It is also proposed to erect an electric transmission line from the vicinity of Lakeville to the plant. The company has also been authorized to install two Gould triplex pumps with induction motors at the pumping station. Energy to operate the pumps will be furnished by the company at $4,764 per year.

HUDSON, N. Y.—Bids will be received by Mrs. Annie Winsor Allen, president of board of managers, New York State Training School for Girls, Hudson, until March 14 for electrical work including the installation of electric fixtures, additional lamps, in cottages 5, 7 and 10, at the New York Training School for Girls at Hudson. Drawings and specifications may be consulted at the above institution, at the New York office of the Department of Architecture, 1715 Tribune Building, and at the Department of Architecture, Capitol, Albany. L. F. Pilcher is state architect.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—The United Machine Works, 57 West Third Street, New York City, is reported to be in the market for three 300-kw., 250-volt direct-current generators, directly connected to compound condensing engines, three 500-hp. high-pressure water-tube boilers, chain-grate stokers and one steel stack, 84 in. in diameter, 175 ft. high; open feed-water heater, Cochrane type preferred, of approximately 3000 hp. capacity.

SANBORN, N. Y.—Arrangements are being made by the Sanborn-Pekin Power Company for the extension of its transmisssion line to Pekin, a distance of 2 miles.

SANGERFIELD, N. Y.—Application has been made to the Public Service Commission by the Waterville (N. Y.) Gas & Electric Company for permission to construct and operate an electric light plant in Sangerfield and for approval of franchise granted by the town.

UTICA, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until March 4, for construction of mortuary and laboratory, including heating, plumbing and electric work, at the Utica State Hospital. L. F. Pilcher, Capitol, Albany, is state architect.

WEST HAVERSTRAW, N. Y.—The board of managers of the New State Hospital for the Care of Crippled and Deformed Children has requisitioned an appropriation of $2,000 to provide for the installation of a new electric lighting system for the grounds at the institution.

BORDENTOWN, N. J. — Considerable electrical equipment will be required in connection with the construction of the proposed new building at the Manual Training and Industrial School at Bordentown. Francis H. Bent is state architect.

DOVER, N. J.—The Morristown Cracked Stone Company has requested the New Jersey Power & Light Company to erect a short extension to its plant near Millington.

NEWARK, N. J.—The capital stock of the Public Service Corporation has been increased from $50,000,000. Arrangements will be made by the company for an issuance of a portion of the increase, including $2,500,000 in notes and preferred stock to the amount of $10,000,000, the proceeds to be used in part for extensions and improvements to its electric plants and system.

PEQUANNOCK, N. J.—The Pequannock Township Committee has made arrangements with the Board of Public Works of Pompton Lakes for furnishing electricty from the new power plant now in course of construction at the foot of Pompton Lake for lighting purposes in Pequannock.

BETHLEHEM, PA. — Plans have been prepared for the erection of a power plant, about 50 ft. by 75 ft., in connection with the proposed new local plant of the Traveler Tire & Rubber Company, 819 Broad Street, Philadelphia. The cost of the entire works is estimated at about $250,000.

McKEE'S ROCKS, PA.—The Pittsburgh Railway Company contemplates building an addition to its local power house and also a new station at Castle Shannon and new tracks at various points.

OIL CITY, PA.—Plans are under consideration by the city for the erection of an addition to the municipal boiler plant, to cost about $45,000. H. B. Weber is engineer.

PHILADELPHIA, PA.—Plans have been prepared for the construction of a three-story brick tower at Thirty-fourth and Pine Streets, and the installation of two electric elevators for the Philadelphia General Hospital.

PHILADELPHIA, PA. — Considerable new electrical equipment will be required in connection with the construction of the refrigerator and ice plant by Jacob Hornung, 2125 West Clearfield Street, contract for which has been awarded to the P. Haibach Contracting Company, Twenty-sixth and Thompson Streets.

PITTSBURGH, PA.—Contract has been awarded by the Hein Company, 34 Isabella Street, for the erection of an addition to its power house to the George Enzian Company, 8022 Madison Avenue, to cost about $25,000.

SCRANTON, PA.—The Delaware & Hudson Company is contemplating the construction of a new coal breaker to replace the building recently destroyed by fire, causing a loss of about $300,000.

YORK HAVEN, PA.—A portion of the power plant of the York Haven Water & Power Company was destroyed by fire on Feb. 12.

NEW CASTLE, DEL.—The City Council is considering a bond issue for $150,000, part of the proceeds to be used for improvements to lighting and water systems.

WILMINGTON, DEL.—The Standard Kid Manufacturing Company, Fourth and Monroe Streets, is contemplating the construction of a new steam-driven power plant unit at its works.

BALTIMORE, MD.—The City Electrical Commission is planning to extend the electric conduit system in the new annex of the city. The first work to be done is in the Highlandtown and Canton districts. Trunk lines will also be built from the old city line on Belair and Harford Roads and Greenmount Avenue, Falls Road to Mount Washington Avenue, Park Heights Avenue from Mount Washington to Park Heights Avenue, Liberty Heights, Edmondson and Wilkena Avenue and Washington Road. The cost is estimated between $150,000 and $300,000. P. G. Ligon is chief engineer.

CLAY, W. VA.—The Clay Utility Company contemplates the construction of an electric transmission system, including the erection of a substation. Charles and Oscar Hall are interested in the company.

NORFOLK, VA.—Plans are being prepared for the erection of a garage for B. Gray Tunsta and W. C. Cobb, to cost about $250,000. The building will have a capacity of 500 automobiles and trucks and will be equipped with electric elevators.

NORFOLK, VA.—Plans are under consideration by the Treasury Department, James A. Wetmore, acting supervising architect, Washington, D. C., for construction of a quarantine station on Craney Island, including the erection and remodeling of group of twenty-one buildings, sterilizing plant, heating plant, telephone and lighting systems, coal dock, water supply, etc. The cost of the buildings is estimated at about $200,000 and the equipment, $100,000. Captain J. J. Cosgrove, constructing quartermaster, 330 Law Building, Norfolk, is in charge.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 10 (Specification 3797) for delivering at the various navy yards condensers, after-coolers and pumps. The cost is estimated at $388,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until March 11 at Washington, D. C., Schedule 3745—3000 lb. electric furnace chrome-nickel steel. Puget Sound, Wash., Schedule 3746—two switchboards complete Brooklyn, N. Y., Schedule 3738—2000 ft. 10,400-circ. mil two-conductor, braided and leaded, common-type wire. Norfolk, Va., Schedule 3738—miscellaneous nickel-chromium, bare resistance wire. Until March 18, various, Schedule 3773—376 doors, dome and glass for seachlights. Puget Sound, Wash., Schedule 3752—90 storage batteries. Brooklyn, N. Y., Schedule 3771—190,000 ft. hard-drawn copper wire; Schedule 3777—30,000 ft. duplex rubber-covered wire.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until March 18 for delivering at Washington, D. C., under Schedule 3748—fifty-four disconnecting switches, eight oil circuit breakers, twenty constant-current transformers, dry type; 1800 lb. busbar copper, eight potential transformers, dry type; 100 busbar supports and twelve reverse power relays. Until March 25—Schedule 3827—for Brooklyn Navy Yard, three switch sets and mates. Until March 28, f.o.b., Schedule 3832—ten aircraft transmitter test sets. Until March 7 at Norfolk, Va., Schedule 7813½—miscellaneous copper wire and cable. Mare Island, Cal., Schedule 7815½—one motor-generator set; Schedule 7820½—thirty-four storage batteries. Alexandria, Va., Schedule 7817½—two constant-duty motors and two exhausters. Boston, Mass., Schedule 7821½—one 5-ton trolley with one 5-ton auxiliary hoist. For further information address the above bureau.

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North Central States

JACKSON, MICH.—The chair factory building at the Michigan State Prison was recently destroyed by fire, causing a loss of about $450,000.

SUNFIELD, MICH.—The Commonwealth Power Company of Jackson has notified the committee appointed to investigate the feasibility of installing an electric lighting system that it will erect a transmission line to Sunfield, providing the residents will purchase sufficient stock of the company to pay for construction of the line. The cost is estimated at about $35,000.

HAMILTON, OHIO—F. J. Sloat, service director, has recommended to the Council the purchase of electric energy from power plants outside of the city. Mayor Smith and several of the Councilmen are said to be in favor of erecting a new plant to meet the increasing demand for electrical service.

LORAIN, OHIO—The United States government has advanced $500,000 for the completion of the new power plant of the Lorain County Power Company on Second Street. The Utilities Construction Company has the contract for the work. The plant when completed will cost about $1,250,000 and will supply electricity in large quantities to the American Shipbuilding Company.

NEW PHILADELPHIA, OHIO.—Owing to the unsatisfactory service furnished by the Ohio Service Company the City Council is considering the installation of a municipal electric light plant.

DAYTON, KY.—Bids will be received by the Board of Councilmen of Dayton, Ky., until March 17 for the sale of franchise, right and privilege of constructing and operating an electric light and power plant to supply the city and inhabitants with electricity for lamps and motors for a period of nineteen years from Sept. 1, 1919. Further information may be obtained upon application to Will C. Martin, city clerk.

FORT WAYNE, IND.—Preparations are being made by the city of Fort Wayne for the construction of a new filtration plant on the St. Joe River, to cost about $500,000. Considerable mechanical and electrical equipment will be required for the proposed plant.

AURORA, ILL.—The Western United Gas & Electric Company has been granted permission by the Public Utilities Commission to issue $155,000 general mortage bonds and $1,500,000 guarantee debenture notes.

BYRON, ILL.—Plans are under consideration to secure electrical service for Byron, following the failure of the Byron Electric Light Company. It was hoped to secure energy from the Rockford (Ill.) Electric Company, but the company decided that it could not afford to erect a transmission line to Byron. Arrangements may be worked out to secure a combined service for Byron, Stillman Valley and Davis Junction. Albert Johnson is Mayor of Byron.

CAIRO, ILL.—Contract, it is reported, has been placed by the Cairo Railway & Light Company with the General Electric Company for a 2000-kw. turbo-generator.

CHAMPAIGN, ILL.—The Caldwell Electric Company has recently purchased a factory building, into which it proposes to move. It is also planning to erect a large warehouse. The company manufactures general electrical supplies.

CHICAGO, ILL.—The Ilg Electric Ventilating Company has purchased a site at Crawford Avenue and George Street, on which it proposes to erect a factory. The cost of the first unit is estimated at $250,000. If conditions are favorable construction work will start this year.

HILLSDALE, ILL.—The Rock River Valley Light & Power Company, which is planning to install an electric power plant here, will supply electrical service in Silvis and other communities as well as in Hillsdale. The company is capitalized at $15,000. Clarence Britzer, Frank Wake and Fred Frels are among the incorporators.

QUINCY, ILL.—The City Council has adopted a resolution to submit to the voters the proposal to establish a municipal electric plant in Quincy at the April election.

ROCKFORD, ILL.—The Public Utilities Commission has granted the Rockford Electric Company permission to issue $164,000 in refunding bonds and $66,000 in capital stock.

WOODSTOCK, ILL.—The proppsal to issue $25,000 light and power bonds will be submitted to the voters.

MINOCQUA, WIS.—An election will soon be held to submit the proposal to purchase electricity to operate the municipal electric lighting system from the Rhinelander (Wis.) Light & Power Company. E. A. Forbes is president of the Rhinelander company.

HIBBING, MINN.—Preliminary plans are being prepared by Holstead & Sullivan, architects, Paladia Building, Duluth, for the construction of a three-story power power plant, 100 ft. by 150 ft. Charles Foster is general superintendent.

GETTYSBURG, S. D.—Arrangements are being made by the Gettysburg Electric Light Company to extend its transmission lines to the towns in this territory, including Onida, Agar, Labanon, Tolstoy, Seneca and Haven. The cost of the main line is estimated at about $25,000.

CHADRON, NEB.—Application has been made to the City Council by the Chadron Electric Company for a franchise to construct and operate an electric light plant in Chadron for a period of 25 years.

HOOPER, NEB.—The local electric plant of the Nebraska Light & Power Company of Norfolk was recently destroyed by fire, causing a loss of about $15,000.

O'NEILL, NEB.—The local electric light and power plant, owned by the McGinness Creamery & Produce Company, has been purchased by the Hanford Produce Company of Sioux City. Improvements are being made to the plant, including the installation of a new engine and generator. The Hanford company is planning to erect a new creamery, power for which will be supplied from the electric plant.

BAXTER SPRINGS, KAN.—Preparations, it is reported, are being made by E. S. McCombs for the installation of a new electric light plant, work on which will begin in the near future.

Southern States

ASHEVILLE, N. C.—The Asheville Power & Light Company is contemplating the installation of additional machinery.

CHARLESTON, S. C.—A special meeting of the stockholders of the Charleston Consolidated Railway, Gas & Electric Company will be held March 19 to vote on an increase in capital stock of $1,500,000, part of the proceeds to be used for proposed extensions and improvements. Work is under way on an addition to the electric power station of the company and the completion of a transmission system to Port Terminal, North Charleston.

SPARTANBURG, S. C.—Contract, it is understood, has been awarded by the City Council for the installation of an ornamental lighting system on Main, South, Liberty, North Church and other streets.

ALBANY, GA.—The property of the Albany Power & Manufacturing Company has been purchased by Foy & Shemwell & Foy Company, capitalists, who will operate the plant in Albany under the name of the Georgia-Alabama Power Company. The latter company already operates two large hydroelectric plants on the branches of the Chattahoochee River, near Columbia, Ala. It is the purpose of the company to connect its plant, making available 50,000 hp. for the three plants, with its steam auxiliary plants. The Georgia-Alabama Power Company contemplates the construction of a large dam and power plant on the Flint River, work on which will begin in the near future. Mr. Shemwell is president of the company, and W. J. Vestal is secretary-treasurer and general manager, both of Lexington, N. C.

BRUNSWICK, GA.—Plans are under consideration by the Mutual Light & Water Company for improvements to its electric plant.

SAVANNAH, GA.—The city of Savannah is contemplating the installation of an electrically-driven pump at well No. 10, and also drilling a well in the southern section of the city, which will be equipped with an electrically-driven pump.

BLOUNTSVILLE, FLA.—The Council is considering calling an election to vote on a bond issue to provide funds for municipal improvements, including an electric light plant and waterworks system. W. P. Fields is city attorney.

TALLAHASSEE, FLA.—The Board of Public Works would like to receive prices on the following equipment: One 200 or 250-kva., two-phase, 60-cycle, 2300-volt generator directly connected to Corliss, or other economical type, engine; one 200-kva., two-phase, 60-cycle, 2300-volt generator, belt driven; both units to be equipped with exciters and switchboard panel, containing main switch, exciter switch, alternating-current and direct-current ammeters and alternating-current voltmeter, synchronous indicator, plug receptacles and all necessary transformers. W. H. Phillips, 54 North Monroe Street, is secretary of board.

CHATTANOOGA, TENN.—The Chattanooga Electro-Metals Company has contracted with the Tennessee Power Company for electricity to operate its plant for the manufacture of ferro-silicon.

MOBILE, ALA.—The entire boiler room of the plant of the Mobile Electric Company was recently destroyed by fire.

MONTGOMERY, ALA.—Improvements and extensions are under consideration by the Montgomery Light & Traction Company. Ray Rushton is receiver.

CLARKSDALE, MISS.—The Crawley Ice Company is contemplating improvements to its ice factory, including the installation of new machinery, to cost about $40,000.

WESTLAKE, LA.—The Lock-Moore Lumber Company, it is reported, would like to receive prices on a 14-in. by 20-in. twin engine, a 35-kw., 125-volt generator, directly connected to engine, one 15-hp. slide valve engine, 48-in. by 96-in. vertical, and a 75-100-hp. marine boiler.

BRISTOW, OKLA.—The Bristow Ice & Light Company is contemplating extensions and improvements to its electric light plant and ice factory, including the installation of new machinery.

COOPER, TEX.—The Cooper Light & Ice Company, recently incorporated with a capital stock of $50,000, proposes to install an electric light plant and ice factory in Cooper. E. Hendricks is interested in the company.

Pacific and Mountain States

PROSSER, WASH.—Plans are being prepared by the Pacific Power & Light Company for practically rebuilding its entire system in Prosser.

PILOT ROCK, ORE.—The city of Pilot Rock has secured a site on which it proposes to erect an electric light plant.

FRESNO, CAL.—The San Joaquin Light & Power Company contemplates the construction of a 15,000-kw. hydroelectric power plant on the San Joaquin River, and also improvements to its transmision line and distribution system. The cost of the work is estimated at about $3,000,000.

SAN DIEGO, CAL.—Plans have been prepared by the Navy Department for the installation of a new floodlighting system at the naval coaling station at La Playa. The system, it is understood, will consist of high-power projectors with wires running to the lamps from the local power plant in submerged concrete conduits.

SAN PEDRO, CAL.—The Southern California Edison Company is contemplating extensions to its service in Los Angeles harbor.

LEWISTON, IDAHO.—Plans have been outlined by F. S. Rice, mining engineer, for a hydroelectric development on the Salmon River, 35 miles from Lewiston. Water rights have been secured by Mr. Rice at Horseshoe Bend in the Salmon River, and also authority from the government to tunnel through the bend and to construct a dam to divert the flow of the river.

FLORENCE, ARIZ.—Bonds to the amount of $20,000 have been voted for improvements to the municipal electric light plant and $60,000 for waterworks system.

CUTBANK, MONT.—Preliminary plans have been completed by Joseph Seal & Son for the installation of an electric light plant in Cutbank. If the franchise is approved by the Council, work will soon begin on the proposed plant.

MILES CITY, MONT.—In the report recently submitted to the City Council by J. J. McGill, superintendent of the municipal electric light plant, an expenditure of about $45,000 for improvements to the electric plant is recommended. New equipment, including an ash-conveyor, two new boilers with stokers or self-feeding apparatus and a 500-kw. generator with turbine engine, is necessary to meet the requirements for additional service.

LAMAR, COL.—The town officials have petitioned the State Public Utilities Commission for permission to establish a municipal electric light plant.

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Canada

NIAGARA FALLS, ONT.—Plans have been prepared by the American Cyanamid Company, 511 Fifth Avenue, New York City, for the erection of two additional one-story buildings, 100 ft. by 180 ft. and 50 ft. by 120 ft., at its plant on the Canadian side of Niagara Falls. The cost of the entire plant, it is stated, will amount to approximately $4,500,000.

TORONTO, ONT.—The estimates of the Ontario Hydro-Electric Power Commission, it is expected, will call for $9,000,000, as the Chippewa extension scheme will be carried on, as well as the development at Nepigon, High Falls and other places.

CAP DE LA MADELEINE, QUE.—An extension to its mills, to cost about $375,000, is reported to be under consideration by the St. Maurice Paper Company of Cap de la Madeleine. J. Louthood is manager.

MOOSE JAW, SASK.—The electrical superintendent has recommended to the City Commissioners extensive improvements to the municipal electric light plant, including the installation of a 3000-kw. turbo-generator. This together with proposed line extensions is estimated at $223,370.

MOOSOMIN, SASK.—The installation of an electric light plant, to cost about $50,000, is reported to be under consideration by the town officials.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom, 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City. Annual meeting, New York, March 20.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 110 West 40th St., New York City.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB, Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

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ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

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MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, L. D. Gordon, Jackson Light & Traction Co., Jackson, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City. Annual convention, Atlantic City, N. J., May 19.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, March 25-27.

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Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 10, 1918)

1,287,304. ELECTRIC STARTER AND GENERATOR; John O. Heinze, Detroit, Mich. App. filed March 22, 1915. Easily connected to engine of motor vehicles.

1,287,322. POWER-TRANSMISSION CONTROL; Edwin E. Huffman, St. Louis, Mo. App. filed May 9, 1916. Electromagnetic transmission of motor vehicles.

(Issued Jan. 7, 1919)

1,290,229. SWIVEL ATTACHMENT PLUG; John J. Kenney, Pittsburgh, Pa. App. filed April 25, 1917. Simplified form of electrical terminals employed.

1,290,241. ART OF PURIFYING FIRE CLAYS; Henry L. Kohler, St. Louis, Mo. App. filed July 31, 1918. For removing such impurities as feldspar, silica, magnetic minerals and the like.

1,290,269. PRODUCTION OF ALUMINA; Ralph H. McKee, Ridgefield Park, N. J. App. filed June 9, 1917. Process is electrolytic, and in preferred embodiment is cyclical in character, the acid solvent being to a large extent regenerated in the course of the operation.

1,290,289. ELECTRIC FLATIRON; William Morgan, Los Angeles, Cal. App. filed Jan. 28, 1918. Has an automatic circuit breaker to prevent overheating of the iron when not in use and so that the circuit may be broken at any time during the operation.

1,290,344. DYNAMO-ELECTRIC MACHINE; William H. Powell, Milwaukee, Wis. App. filed Feb. 27, 1915. Invention has particular relation to the windings of such machines and to supporting and retaining means therefor.

1,290,362. ELECTRIC SWITCH; Joseph H. Rusby, Nutley, N. J. App. filed June 13, 1917. Means provided coacting with a longitudinally slotted hinged lug for universally adjusting the switch relative to a wall.

1,290,366. COMBINATION HORN AND LIGHT; Wayne D. Schaaf, Aurora, Col. App. filed Aug. 10, 1916. The horn proper serves also as part of the lamp, and the reflector serves as part of the horn.

1,290,367. ELECTRIC WELDING MACHINE; Gustave H. Schkommodau, Cincinnati, Ohio. App. filed Feb. 24, 1917. Enables sections of the work to be readily welded in perfect alignment with each other so that the completed article will be free from distortion.

1,290,369. PROCESS OF AND APPARATUS FOR TREATING OIL; Frank M. Seibert and John D. Brady, Houston, Tex. App. filed Jan. 11, 1918. Comprises a method of separating or breaking the permanent emulsions of oil, watery liquid and mineral matter occurring in the crude oil from petroleum wells.

1,290,382. ELECTRICAL CONDENSER; Nugent H. Slaughter, Queens, N. Y. App. filed March 16, 1917. Fine adjustment, to the precise capacity value desired, may be easily obtained.

1,290,394. CORNER IRON FOR PANELBOARD FRAMES; Henry F. Starrett, Chicago, Ill. App. filed Oct. 27, 1916. Different sides of the frame may be adjusted relatively to the panelboard to fit steel cabinets of varying depths.

1,290,438. WIRELESS SIGNALING APPARATUS; Roy A. Weagant, Roselle, N. J. App. filed April 5, 1915. An improvement on the Fleming vacuum valve.

1,290,443. SPEEDOMETER; Augustus W. Wessoleck, New Britain, Conn. App. filed May 9, 1918. Automatically shuts off the power of a motor or internal-combustion engine when the speed reaches a predetermined point.

1,290,449. CIRCUIT INTERRUPTER; Adolph M. Widerberg, Worcester, Mass. App. filed Nov. 17, 1917. Will sound an alarm when motor vehicle or automobile on which it is mounted is being operated or driven away by an unauthorized person.

1,290,471. SIGNAL LANTERN; Alfred A. Ziegler, Boston, Mass. App. filed Nov. 6, 1915. The lamp block, with its associated members, may be assembled as a unit and applied to or removed from the base block.

1,290,472. STARTER FOR ENGINES; Thomas Zimmerman, Niagara Falls, N. Y. App. filed March 4, 1915. Invention relates to devices having normally incomplete or interruptable transmissions.

1,290,487. BATTERY TRAY; Martin Mella, Philadelphia, Pa. App. filed Sept. 21, 1918. Prevents stresses which cause cracking and breakage of storage-battery jars.

1,290,492. ELECTRICAL MEASURING INSTRUMENT; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 23, 1915. Motor meter operates through wide range of load.

1,290,499. ELECTRICAL MEASURING INSTRUMENT; William M. Bradshaw, Wilkinsburg, Pa. App. filed May 25, 1914. Motor meter operates on a wide range of applied voltage.

1,290,500. ELECTRICAL MEASURING INSTRUMENT; William M. Bradshaw, Wilkinsburg, and Clarence A. Boddie, Pittsburgh, Pa. App. filed June 13, 1917. Magnetic circuit of motor meter deflects large part of main magnetic flux through armature at predetermined times.

1,290,504. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES; William C. Brinton, Jr., Kennett Square, Pa. App. filed April 10, 1917. Insures simultaneous production of sparks of equal intensity.

1,290,540. KNOB INSULATOR; Gustave Glocker, North East, Md. App. filed March 6, 1918. Porcelain cap and knob can be fired at same time.

1,290,584. PROCESS FOR THE PRODUCTION OF REACTIONS IN GASES IN CLOSED SYSTEMS; Jens L. La Cour, Christiania, Norway. App. filed Nov. 17, 1915. Composition of gas passing through reaction compartment maintained constant.

1,290,594. SYSTEM OF MOTOR CONTROL; Niles D. Levin, Columbus, Ohio. App. filed March 8, 1917. For use in operating a motor-propelled vehicle and a mining mechanism attached thereto.

1,290,598. ENGINE-STARTING DEVICE; Paul M. Lincoln, Pittsburgh, Pa. App. filed Feb. 3, 1913. Electric motor used.

1,290,604. ELECTRICAL APPARATUS; Antonio Longoria, Cleveland, Ohio. App. filed July 7, 1918. Designed for therapeutical use, though not limited to this purpose.

1,290,616. AUTOMATIC SWITCHING APPARATUS FOR TELEPHONE-EXCHANGE SYSTEMS; James L. McQuarrie, Montclair, N. J. App. filed March 30, 1917. Compact, efficient and low in cost of production and maintenance.

1,290,621. RECORDING TELEPHONE; John F. Malthaner, Atlanta, Ga. App. filed Aug. 3, 1915. Receives direct dictation and records telephone messages from ordinary receiver.

1,290,623. ELECTRIC TAP; Orlando R. Marsh, Chicago, Ill. App. filed Nov. 23, 1915. Can be installed without altering present devices.

1,290,624. INTERRUPTER FOR IGNITION DYNAMOS; Charles T. Mason, Sumter, S. C. App. filed April 29, 1918. Break primary circuit of high-tension ignition system to produce current in secondary circuit for sparking purposes.

1,290,628. APPARATUS FOR MEDICAL TREATMENT BY ELECTRICITY; Louis Mayor, Chateau de Montagny sur Lutry, Switzerland. App. filed Sept. 15, 1916. Transformer provided with divided secondary windings, one arranged to light small lamp for endoscopic work and other for producing weak current of high voltage.

1,290,644. BURGLAR-ALARM SYSTEM AND APPARATUS THEREFOR; Theodore H. Nelson, Chicago, Ill. App. filed Jan. 29, 1916. Protects outer doorway which must be used for access to the system.

1,290,645. SWITCHING MECHANISM FOR INTERCOMMUNICATING TELEPHONE SYSTEMS; Theodore H. Nelson, Chicago, Ill. App. filed May 7, 1917. Has two directions of motion, one for selecting line to be connected to the talking line and other for connecting these lines.

1,290,653. FUSING MECHANISM; Carl Pfanstiehl, Highland Park, Ill. App. filed July 14, 1917. Produces puppet valves for internal-combustion engines.

1,290,658. CIRCUIT-CONTROLLING APPARATUS; Walter C. Reed, Dalton, Mass. App. filed Nov. 23, 1916. Can operate expression appliances in electrically operated piano-players and pipe organs using perforated music sheets.

1,290,673. SECTIONAL-PIN INSULATOR; Sol S. Sonneborn, Brooklyn, N. Y. App. filed June 27, 1917. Constructed like condenser so that dielectric strength against puncture is approximately proportional to combined minimum thickness of insulating wall.

1,290,691. TELEPHONE LOCK-OUT RELAY; Frank W. Adsit, Chicago, Ill. App. filed July 29, 1916. Armature may be drawn up with one coil and held by weaker coil.

1,290,700. AUXILIARY ALARM SYSTEM; Clarence E. Beach, Binghamton, N. Y. App. filed Sept. 24, 1914. For fire-alarm systems.

1,290,701. CIRCUIT CLOSER FOR AUTOMOBILE SIGNALS; Joseph Berger, Detroit, Mich. App. filed Sept. 12, 1917. Headlights furnished with electric signals, controlled by the steering apparatus, to indicate direction of travel.

1,290,710. MAGNETO; John B. Bushnell, Vacaville, Cal. App. filed Dec. 14, 1917. Intensity of electromotive force generated by high-tension magnets generally constant.

1,290,711. SOUND RECORDING AND REPRODUCING MACHINE; Manuel Calderon, New York, N. Y. App. filed March 10, 1917. For moving-picture machines.

1,290,749. ADVERTISING LAMP AND RADIOMETER; Edward J. Hunt, West Orange, N. J. App. filed Nov. 8, 1917. Light from lamp filament causes rotation of motor vanes in bulb.

1,290,755. WIRELESS DETECTOR; Samuel S. Jones, Brooklyn, N. Y. App. filed Feb. 28, 1917. Removing crystal from holder to test for sensitive surface or other purposes unnecessary.

1,290,806. X-RAY APPARATUS FOR DENTAL USE; William H. Thwaites, Grand Rapids, Mich. App. filed July 2, 1917. Taking X-ray photographs facilitated and rendered harmless.

1,290,808. COMPOSITE RINGING APPARATUS; John F. Tommey, New York, N. Y. App. filed Oct. 30, 1917. For composite telephone and telegraph lines.

1,290,822. AUTOMATIC TELEPHONE SYSTEM; Charles S. Winston, Chicago, Ill. App. filed Dec. 26, 1911. Improved circuit arrangements of selector switches and improved line switch provided.

1,290,837. TELEPHONE SYSTEM; Alexander E. Keith, Chicago, Ill. App. filed Oct. 21, 1904. Of automatic type.

1,290,860. ELECTRIC FUSE; Allan P. Bender, Wilkinsburg, Pa. App. filed Dec. 5, 1914. Self-contained cartridge in which fuse element is mounted may be slipped into ordinary fuse casing and locked therein.

(Issued Jan. 14, 1919)

14,585 (reissue). POWER-LIMITING DEVICE; Harold D. Arnold, East Orange, N. J. App. filed Oct. 10, 1916. Polarized valve used in signaling systems.

1,290,863. TRIP-COIL-ADJUSTING MEANS; Chester D. Ainsworth, Wollaston, Mass. App. filed Jan. 4, 1918. Coils simultaneously adjusted for predetermined current flow.

1,290,868. MAGNETIC CHUCK; William Arter, Worcester, Mass. App. filed June 15, 1916. Requires few stock parts for different chucks.

1,290,881. ELECTRICAL GROUNDING DEVICE; Robert A. Becker, Poughkeepsie, N. Y. App. filed Nov. 27, 1916. Easily installed.

1,290,895. APPARATUS FOR SEPARATING AND RECOVERING DOMESTIC REFUSE; Daniel R. Bryan, Chatham, N. J. App. filed Nov. 21, 1916. Metallic particles removed.

1,290,899. ELECTRIC SWITCH; George A. Burnham, Saugus, Mass. App. filed Feb. 5, 1916. Handle detachable for use in manholes.

1,290,901. WATER-TIGHT ELECTRIC BELL MECHANISM; Paul C. Butte and Charles F. Butte, San Francisco, Cal. App. filed Jan. 17, 1918. Simple and compact.

1,290,902. ELECTRIC FURNACE; Charles A. Cadwell, Cleveland, Ohio. App. filed May 1, 1915. Operates on high-voltage current.

1,290,903. ELECTRIC WELDING APPARATUS; Charles A. Cadwell, Cleveland, Ohio. App. filed Nov. 25, 1916. In electric railway repairing uses energy directly from trolley wire.

1,290,908. VOLTAGE-REGULATING SYSTEM; Robert M. Carothers, Schenectady, N. Y. App. filed Feb. 14, 1917. Control dynamo is connected in series between load circuit and main source of energy.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Passing the Obligation

CONGRESS ended the allotted number of its days without taking the responsibility for crystallizing a policy for or against permanent government operation of the great utilities still controlled by the administration as a war measure. That it did nothing on this large question is attributed to several causes. People will differ about the relative weight of each, but it is well to restate them. Among them we rank first the changed attitude of the authorities after the armistice was signed. There was the plain, positive end of the war. Yet we see no action looking to the assured early return of these vast properties to their owners. Another contributing cause was the outcome of the November elections and the swing in the balance in Congress to the opposition party. While the administration party was in actual power in the legislative branch and could have forced legislation through, a new alignment has been voted by the people for the next Congress. This meant uncertainty as to how far legislation could be carried with any assurance against repeal. As another cause there is the promulgation of higher telephone rates. The state commissions saw their authority overriden in this step, and undoubtedly they contributed a powerful voice against the destruction of states' rights. This was naturally reflected in the attitude of the Representatives and Senators in Congress.

It will be observed that the causes named—together with others of similar character which had less bearing—are not economic factors. By some they might be called public policy, but others would say that they are more political in nature. The Washington authorities have not advanced economic reasons to justify continuation of their control. Such incomplete data as to economy and efficiency under their direction as are open for consideration weigh against an extension of government control. Certainly the only real grounds on which the country ought to embark on a revolutionary program of public ownership or operation or both are economic. Those who now have their capital tied up in these properties and those who favor government operation or ownership or both should be called before the bar by the public and have opportunity given them to prove their case before any radical departure from our historic policy is encouraged. That policy is in general the development of individual initiative and through the accepted principle of regulation a restricted return on the capital used in furnishing needed public service. Important cases of public ownership in this country are mainly those where a municipal government built a plant which in part or in whole duplicated the investment of a competing system of a private company; in other words, cases of uneconomic competition. There has been no great movement except as the present government control of railroads and wire lines constitutes such a movement or the possibility of an overturn of the old policy. Present conditions, of course, do not rest on any theory of uneconomic competition; they are the aftermath of the war.

The only process through which government operation or ownership on a giant scale can be permanently incorporated into our national policy as a result of the present curious conditions is by failure to carry out the clear intent of Congress as expressed in the war measures. An opportunity was open to the same Congress which enacted those measures to repeal them or to pass new laws suitable to the conditions of peace. That opportunity Congress lost when it did not act. It is not entirely blameless for it could have proceeded on its own initiative without waiting for the development of a definite administrative policy. Its failure to act leaves a burden of obligation unshouldered at this juncture. It cannot be passed on perpetually as a disregarded problem. It appears that legislation is vitally necessary to solution, and legislation is the duty of the next Congress.

The electric fan is ready in summer because some one got ready before summer. Breezes cool the air for the tired customer because the manufacturer gaged his market long in advance, the jobber figured his probable sales, the distributers gave their orders. Look ahead!

Failure of the Water-Power Bill

NEVER in American history has there been a Congress like the Sixty-fifth, just ended. Its achievements transcended those of any of its predecessors, and it passed into history with credit to itself and to the nation. For two arduous and anxious years it served the country faithfully. The greatest tax laws and bond issues ever attempted by any nation form part of its record. It appropriated approximately sixty billion dollars and created agencies to control transportation, communication, food, fuel, finance and shipping. Stupendous was its record of accomplishment during the war, despite the controversies which beset it toward the end of its career. For these accomplishments it deserves the thanks of the American people. Our only regret is that it did not make its career more resplendent by passing the water-power

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bill and by making an honest and diligent attempt to grapple with the reconstruction problems confronting the nation.

The electrical industry need not be discouraged, however, for had time not fought against it the water-power bill would have become law. Enough votes were pledged in the Senate to pass the measure, which had already been favorably acted on by the House of Representatives, but the eleventh-hour filibuster in the Senate which killed the effort against daylight saving also prevented a vote on the water-power bill. Thus the bill died. But there is every assurance that the water-power bill will be reintroduced in the next Congress and speedily passed. The country needs water-power development, the people are determined to have it, and no legislature wishes to withstand the will of the American people.

Now is no time to waste capital by plunging recklessly into uncertain developments, but let us remember that both waste and uncertainty are relative terms. Where an enterprise bids fair to realize a surplus above cost, let us break away from the idea that the maximum possible profit determines the launching of the undertaking.

Radio Direction-Finding Apparatus

A REMARKABLE and characteristic property of a simple, straight, vertical-mast antenna is that it is entirely devoid of directive action in the emission of signals and likewise entirely devoid of directive indication in the reception of signals. Because it stands straight upright, it sends out electromagnetic waves with equal impartiality to all points of the compass, and likewise signals coming from various quarters are all treated with the calm impartiality of blind-eyed justice, so that there is no means of ascertaining whence they come or whither they go.

As soon as the antenna abandons its simple vertical symmetry of structure and inclines more to one direction than to another it begins to exert selective properties with respect to that direction, both in sending and in receiving. Finally, if the antenna takes the form of a closed loop standing in one and the same vertical plane, the wave it tends to emit will have maximum intensity in that plane and zero intensity in the transverse direction. In the same manner, it will give maximum attention to incoming signals advancing in its plane and will be electrically deaf to signals that come in exactly transverse. Such a transverse wave would strike all four sides of the loop simultaneously, and the emfs. thereby generated in the sides would annul each other and cancel.

By taking a simple vertical loop or set of loops and rotating it about a vertical central axis, it thus becomes theoretically possible to orient any particular set of incoming electromagnetic waves to which the loop is attuned.

It may surprise some of our readers to learn from Capt. A. S. Blatterman's article in this number that a simple vertical frame of about 2.7 sq.m. area and containing in, say, twenty-five turns an aggregate area of 67.5 sq.m. will enable a radio observer, when equipped with suitable receiving apparatus, to hear on the eastern coast of America the high-power radio stations of Europe. Within certain limits of precision the true bearings of these stations may also be determined with such a frame. However, the distance of these European stations is so great from an observer situated, say, in New Jersey that their bearings are nearly all alike. On the other hand, the bearings of various high-power American stations will be correspondingly widened out to an American observer.

Two saliently valuable applications of the gonio-loop direction finder in peace times are to the establishment of the map position in bad weather of aircraft and of seacraft. It should ultimately become almost impossible for a careful navigator to lose his map position, either in the air or on the sea, if equipped with a good radio direction finder and with beacon stations at work in the neighborhood.

The simple loop, as described in Captain Blatterman's interesting article, is a direction finder and no more. That is to say, a simple vertical loop would be incapable of indicating whether the incoming signals arrived from, say, the northeast or the southwest. By the use of a pancake loop, however, the Signal Corps has utilized the dissymmetry of structure with respect to the inner and outer ends in such a way that the apparatus becomes a radio compass, or can show whether the signals are coming from the northeast or from the northwest. In many cases, of course, with well-known power stations, it becomes superfluous to inquire on which side their signals come in if their direction is known. In particular cases, however, the ambiguity of indication might be embarrassing.

A great deal of good may be accomplished just now by doing work at a modest rate of return in preference to standing idly and fearfully on the brink of enterprises which the country sorely needs in order to go forward to stable prosperity.

The Economy of Duplicate Lines

THERE have been many discussions of the most economical size of line wire for use under various conditions as regards the cost of copper, cost of construction and cost of energy. The factors entering into the problem when definite values can be assigned to them lead to formulas which with reasonable precision give the required answer. The fault of all such computations is that the factors assumed to be constant in the formulas vary from time to time in the most annoying manner, so that a line correctly laid out on a certain date may seriously violate the conditions of economy a few years later. The real solution of the problem requires therefore the eye of the prophet as well as the skill of the engineer. In our current issue P. O. Reyneau, who has already contributed valuable suggestions concerning distribution, takes up a practical phase of the matter which is somewhat out of the ordinary.

The question he raises concerns the relative economy of using one or two circuits for such service as feeders of large capacity, assuming that a certain maximum size of single conductor, in this case taken as No. 4/0, is not to be exceeded. Granted this, it is clear that

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with increasing load a point will be reached where the energy loss over a single line will more than counterbalance the investment required for two lines. Mr. Reyneau's previous careful studies of the general economics of feeders and the probable increased distribution of load give him special facility for attacking a problem of this kind, and our readers will be interested in his form of computation to serve the purpose in hand. In the long run he so simplifies the working method as to reduce the tangible variables to a rather simple pair, the maximum load in amperes and the ratio of the cost of copper to the cost of energy. These can be estimated with at least an approximation to the truth from data at hand in any well-organized central station, and consequently a closely approximate solution of the whole problem can be reached. Perhaps the most interesting conclusion brought out by Mr. Reyneau's investigation is that under ordinary conditions of central-station use the economical loading of power wires is much below their reputed safe carrying capacity, and often very much lower than the general conditions would at first sight suggest. In other words, as a general rule a liberal investment in copper is in the long run a good policy. As a corollary to this proposition one may add that with the information here placed at our disposal it is a comparatively easy matter to find the maximum economical load for any given system of feeders. Knowing this, it is clearly good endeavor to secure intensive service on existing lines up to this point.

If Edison had struck for an eight-hour day, what would have been his percentage of achievement in scientific investigation? Clock watching may be necessary in train dispatching, but in constructive thinking it is an absurdity to cramp mental activity within narrow time limits.

Discrepancies in Power Interchange Prices

THE publication of contract prices for energy interchanged between adjacent utilities is a feature of commission work which sometimes leads the public to erroneous conclusions regarding the relations between buyer and seller. The layman, for example, finds it hard to understand why one central station should not buy electricity from another at the price at which it sells it on its own account to the other utility concerned, and it is important to explain the reasons for marked differences where such are brought forward in hearings or other public proceedings. Take the case of an actual contract where one company within a few miles of another buys energy at 1⅜ cents per kilowatt-hour and sells it at ½ cent to the same concern. The companies involved have each hydroelectric plants, steam auxiliary equipment and transmission lines interconnected for the interchange of energy under the most favorable circumstances. Despite the fact that the hydroelectric stations are all located on the same river or its immediate tributaries within a very few miles of one another and that the load centers of the two systems are certainly not more than 20 miles (32 km.) apart, it is apparent after a very short investigation that the costs of delivering energy by one company to the other may vary materially. One company serves a large manufacturing district, with important textile and shoemaking plants; the other supplies a residential and mercantile city which happens to be the state capital. When the latter utility needs additional energy it buys in preference to starting its own relatively inefficient auxiliary steam plant and paying a still higher price per unit of energy secured. The other company, on the other hand, seldom buys unless a measure of surplus output is available in the other system. The plant designs are naturally different, the loads vary considerably, and the system geography is diversified.

The real test of a fair price is regarded by each company as one which will save it money in the delivery of electricity to its customers, and the fact that the intercompany price is virtually three times in one case what it is in the other is without meaning from the standpoint of equitable intercorporate relationships.

Real interest in the immediate task and some appreciation of the well-nigh infinite possibilities that border the problems of our wonderful industry are more necessary to the common welfare of thoughtful workers in electricity than speculation as to the best methods of obtaining more pay for less work.

The Poor Coal Question

THE same necessity that requires the utmost diligence in improving station operation conditions makes attention to fuel and furnaces of much importance. One of the points about burning all poor coals, and some good ones, particularly if smokeless combustion is desired, is to allow a very ample furnace space for the ignition and the proper combustion of the fuel and its gaseous products. Besides this, the grate areas must be big, on account of the relatively low calorific value of the fuel. In other words, the furnace, as contradistinguished from the boiler itself, must be unusually large in order to consume low-grade fuel at a fair degree of efficiency. Long, high-pitched igniting arches are recommended with a grate area having a ratio to heating surface of not less than one to forty and a volume of furnace space of not less than 12 cubic feet per square foot of grate. Even this large allowance can often be advantageously increased, while the older furnaces show often less than half the figure just given for volume. It is therefore something of a task to reequip boilers originally planned for high-grade fuel so as to deal successfully with real low-grade coals. The stokers which are fitted for using the old fuel must very often be changed to handle the new without undue trouble from clinkers, and above all the furnace space needs to be increased to a very considerable degree. In many instances there is hesitancy about going to the trouble and expense of making the necessary changes. In the long run, however, the plant manager must make up his mind to the use of grades of coal somewhat lower than has been his practice. Sufficient results have now been obtained from low-grade fuel burned under proper conditions to give a very good line on what performance may be expected, and it is the part of wisdom to investigate the conditions of fuel supply thoroughly so that when a judgment can finally be formed as to the most desirable grade of fuel to use suitable equipment for burning that particular grade can be promptly procured.

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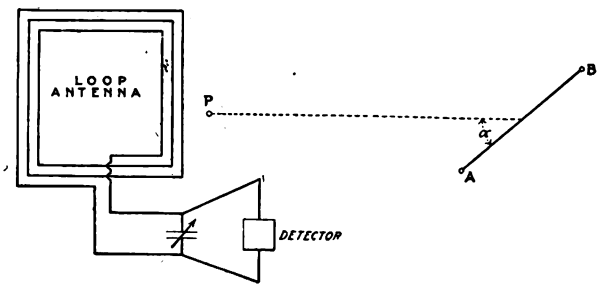
Radio Direction-Finding Apparatus

Airplane Flight May Be Guided at Night or in Bad Weather by the Use of Direction-Finding Devices—Sources from Which Radio Signals Emanate Are Located by the Use of Movable Coils and Detector

BY CAPT. A. S. BLATTERMAN, SIGNAL CORPS, U. S. A.

THERE are two important uses of direction-finding apparatus. A listening station on the ground intercepts enemy radio communications and determines by radio measurements their origin. This is known as ground goniometry. Again, a listening station on a flying machine determines by radio measurements the direction of a fixed ground transmitting station or of several such ground stations. Through the bearings thus obtained the airplane pilot is able to steer a course accurately to his home station or to navigate his ship by radio in a manner entirely analogous to methods involving the readings of a



FIGS. 1 AND 2—COMMON ARRANGEMENT OF LOOP RECEIVER AND DETECTOR; TOP VIEW OF LOOP RECEIVING WAVES FROM SOURCE AT *P*

magnetic compass, and thus avoid the possibility of getting lost in fogs or darkness.

The requirements of apparatus for these two kinds of service are essentially similar in their fundamental aspects. The directional settings must be capable of being made quickly and with a high degree of accuracy. The antenna must be small, because in the one case of the necessarily restricted space available on an airplane, and in the other—that is, the ground set—because of the requirements of low visibility, portability and general mechanical wieldiness. Very careful electrical design is necessary to secure the over-all high efficiency and strength of signal required of apparatus using small aërials and operated in the midst of noisy surroundings.

The ability to focus or project electromagnetic wave energy in a given predetermined direction or to exclude the reception of such energy from undesired sources, such, for instance, as may be easily accomplished in optics, has been studied for years. None of the devices based on these principles was successful in practical application to the problem of locating the direction of a transmitting station from a receiving station or to that of establishing, by radio, from a distance the exact location of a transmitter, and it was not until the observation had been made that the reception quality (as well as the radiation) of a vertical loop or closed antenna was not symmetrical, and that such a loop, if properly designed, could be effectively used in place of the usual antenna and ground connection, that practical direction-finding apparatus came into existence.

USE OF THE LOOP ANTENNA

The loop, as it is commonly used for directional receiving and as developed for military use in the present emergency, consists of a vertical closed coil of several turns of wire which can be tuned to incoming waves by means of a variable condenser connected across its terminals. A detector is connected either directly or inductively to the oscillating circuit so formed, the most common arrangement being that shown in Fig. 1. Such a system, when properly designed and used in connection with a sensitive multi-stage vacuum-tube amplifier detector device, may be effectively employed for receiving radio signals over very long distances. For instance, it is easily possible to hear the high-power stations of Europe in this country using a loop frame 5 ft. or 6 ft. (1.5 m. or 1.8 m.) square with twenty or thirty turns of wire on it.

The use of this type of antenna as an apparatus for locating the direction of a transmitting station depends on the fact that a vertically placed coil such as that described receives electromagnetic wave energy best when its plane coincides with the direction from which the waves are arriving, and practically not at all when placed at right angles to the direction of wave travel. Thus, in the practical use of the apparatus it is only necessary to be able to orient the loop about a vertical

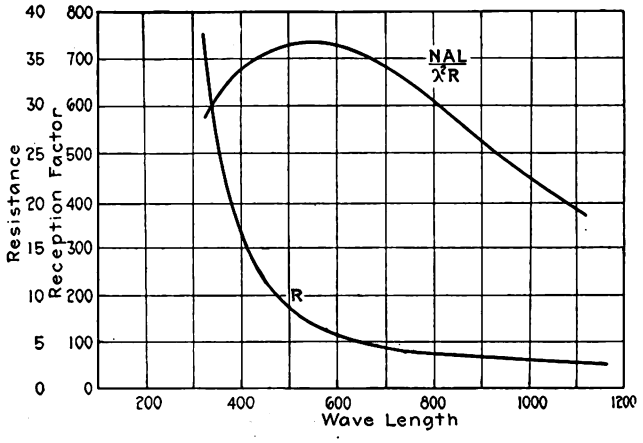


FIG. 3—VARIATION OF RESISTANCE AND RECEPTION FACTOR OF LOOP WITH WAVE LENGTH

axis, noting the strength of signals at different settings, in order to locate the direction of the origin or source of any radio that may be picked up. If two receivers equipped with this kind of apparatus are set up a known distance apart and both determine from their respective locations the direction of a certain transmitting station with respect to the geographic north

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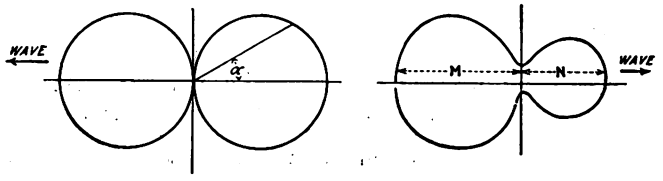
and south meridian, it becomes a simple matter of triangulation on the known base line joining the receivers to fix definitely the exact position of the transmitter.

The direction-finder problem of the Air Service involves additional considerations. In an airship in flight



FIGS. 4 AND 5—THEORETICAL DIRECTIONAL CHARACTERISTIC OF LOOP RECEIVER; ACTUAL DIRECTIONAL CHARACTERISTIC OF LOOP OBTAINED IN PRACTICE

the magnetic compass is not accurate. For instance, it is quite impossible to allow for drift in steering by the compass unless observations can be made by eye from the air of known landmarks or the location otherwise determined, as, for instance, by solar observations with suitable instruments, as is done on ships at sea. As a consequence of this the aërial navigator easily becomes lost at night or above the clouds and in fogs. A means was desired whereby a long-distance bombing airplane could go out after nightfall into enemy territory, drop its bombs, and be able to return accurately to its home station after completing its mission. The airplane radio direction finder has supplied this want in a remarkably satisfactory way, and has even been applied to the broader use of general aërial navigation by radio, so that it has become possible to fly any desired circuitous course simply by taking successive radio bearings on different ground transmitting stations and making calculations similar to those made by mariners at sea.

General Principles Affecting Design of Receiving Loops

In order to get the best results from the loop receiver it is necessary to proportion the size of loop properly, the number of turns, their spacing, the size and kind of wire, etc., to the wave lengths to be employed. The Signal Corps has worked out charts from which it is possible to design these coils quickly for any desired wave length so as to get maximum receiving efficiency.

The effective value of emf. induced in a coil or loop of wire of N turns and threaded by a harmonic flux ϕ, such as produced by sustained oscillations in a distant radio antenna, $E = \sqrt{2}\pi fNAH$, where f = frequency, A = area inclosed by loop, H = field intensity.

If the loop is tuned to the frequency of the field in which it is placed by means of a condenser across its terminals, the impedance of the circuit so formed becomes equal to the resistance of the circuit and the r.m.s. current flowing will be

$$I = \sqrt{2}fNAH\pi/R.$$

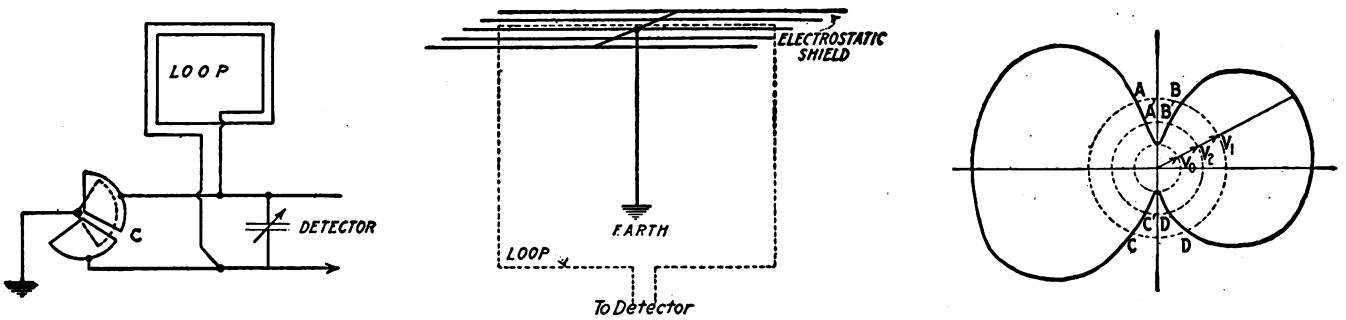
This current produces a voltage across the tuning condenser which is used to actuate the detector of the radio receiving set (see Fig. 1). The value of this voltage is given by the expression $E_c = kNAL/\lambda^2R$, where k = a constant, L = inductance of loop, λ = wave length, R = effective resistance of loop circuit.

A casual inspection of this formula indicates an advantage in the use of large area, many turns, high inductance and small tuning condenser for given wave length. Apparently also short wave lengths would be expected to give the loudest signals, and the resistance should always be kept low. Upon closer investigation, however, it is found that none of the factors N, A, L or λ can be varied without materially affecting the value of R, and most important of all is the very marked effect of changing wave length on the effective resistance. In fact, this circumstance gives rise to the existence of a critical optimum wave length for any given loop at which signals have their maximum strength, as indicated in Fig. 3.

The Directional Characteristic

As has been stated above, the loop antenna has very pronounced directional characteristics. If AB (Fig. 2) represents the top view of the loop which is receiving waves sent out from P, the flux threading the loop is proportional to cos α. Hence the received current will vary for different angular displacements in a manner which can be represented by a polar curve characteristic consisting of two tangent circles (Fig. 4). This would indicate that when the plane of the loop is at right angles to the direction of propagation no energy will be received, while strongest signals will occur when the plane of the loop coincides with the direction of wave travel. For direction finding the loop would be oriented until no sound was heard in the receiving telephones. Theoretically, a very accurate setting could be made owing to the great sensibility of the polar curves near the point of tangency, but in practice conditions are found to be less favorable, and conclusions based on the general theory must be somewhat modified.

In general, the polar curves are not circles but are



FIGS. 6, 7 AND 8—CONDENSER COMPENSATOR FOR IMPROVING DIRECTIONAL ACCURACY OF LOOP; ARRANGEMENT OF ELECTROSTATIC SHIELD ABOVE LOOP; EFFECT OF DETECTOR SENSITIVENESS ON DIRECTIONAL ACCURACY

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changed according to the shape and dimensions of the loop, the manner of winding, proximity to the earth's surface or nearby conductors, the nature of the ground and the arrangement and disposition of the receiving apparatus. Thus a typical characteristic obtained by measurement of received signal at different angular

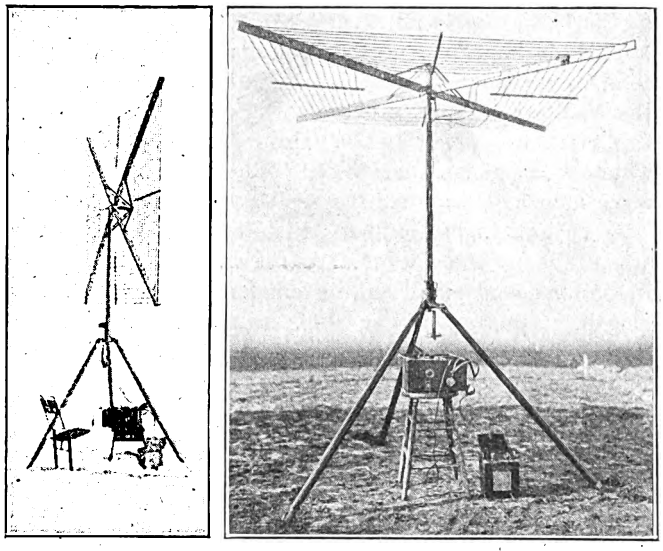

FIG. 9—DIRECTION-FINDING POSITION OF LOOP (LEFT) AND "INTERCEPT" POSITION (RIGHT)

positions of the loop is similar to that shown in Fig. 5. It will be noted that the two maxima and the two minima are unequal and the curve is distorted. Investigation of this distortion effect led to the development of methods for controlling it, either increasing it principally to augment the asymmetry of the maxima and thus secure a device which would indicate not only the line of the transmitting station but its sense or absolute direction, or else decreasing the dissymmetry in such a way that a very sharp minimum is decured and thus gain directional accuracy.

There are several ways of increasing the sharpness and symmetry of the minima of the polar curve. The solenoidal type of winding is better in this respect than the flat pancake loop. A small condenser C (Fig. 6) by means of which the capacity to earth of the two loop terminals may be equalized is helpful. Another method is to use an electrostatic shield consisting of a harp of parallel wires placed horizontally just above the loop and grounded (see Fig. 7).

Flat pancake loops with unequal maxima and minima have been used by the Signal Corps for finding absolute direction, since after finding the line by means of right-angle settings as usual it is only necessary to swing the loop into the position for maximum signals and compare the strengths M and N (Fig. 5) by reversing the loop through 180 deg. or by interchanging the connections to the tuning condenser by means of a switch.

When a loop is placed with its winding plane parallel to earth it becomes non-directional and receives signals equally well from all directions. This arrangement is therefore valuable for intercept work.

Effect of Receiver Sensitiveness.—The accuracy of the direction finder and the speed with which settings can be made depend on the sharpness of the minimum points in the directional polar characteristic. Some of the factors that effect this have just been discussed, but there is in addition to these another very important one, namely, the sensitiveness of the detecting apparatus.

If the sensitiveness is made very great, it is often difficult to find an absolute zero as the loop is rotated. Nevertheless, it is generally desirable to have the detection sensitiveness as great as possible for the following reason. If the polar curve is as shown in Fig. 8 and the sensitiveness of the detecting apparatus is such that it just responds to potentials of value V_1 and voltages less than this cannot be detected, then as the loop is rotated zero response will be obtained throughout the regions AB and CD. If, however, the detector sensitiveness is greater so that smaller voltages down to the value V_2 can be detected, the zero regions are narrowed down to $A'B'$ and $C'D'$ and the apparatus becomes more accurate. By further increasing the sensitiveness still greater accuracy is obtained as the zero regions are further narrowed, and, in the case shown, an increase in sensitiveness to correspond to the potential V_0 would give a single point or position where there would be zero response.

It is very desirable to produce this condition, but to do so requires extremely sensitive detecting apparatus as well as a very sharp antenna (loop) characteristic. If the zero regions are wider than a few degrees so that they cannot be accurately and quickly bisected experimentally, the average of the four readings A, B, C, D, where the signal becomes inaudible, must be taken as an indication of the true minimum. This requires time. It has, however, been found to give good accuracy provided the regions of silence do not exceed about 30 deg.

With the uncompensated loop the midpoints of the regions AB and CD are not 180 deg. apart, which

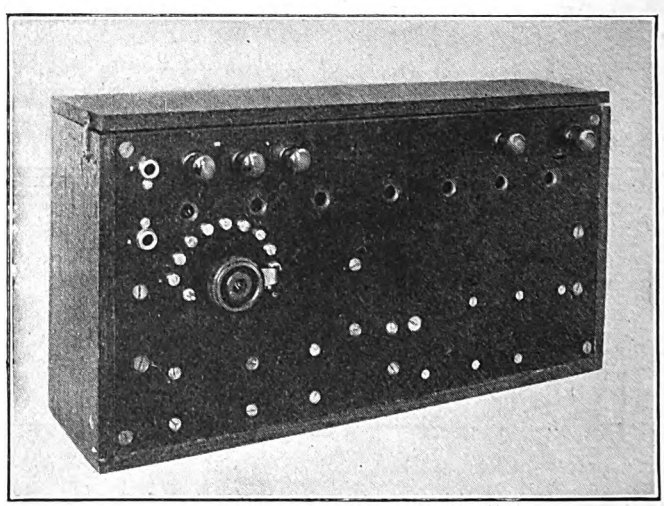

FIG. 10—ARRANGEMENT OF SEVEN VACUUM TUBES FOR AMPLIFYING PURPOSES

makes it necessary to average all four readings as just described. The electrostatic shield effectively removes this dissymmetry.

Development of Amplifier

On account of the exponential relation between current passed and applied potential all the usual radio detectors respond much more effectively to large im-

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pressed voltages—that is, strong signals—than they do to weak ones. In order to get the desired sensitiveness, therefore, it is necessary to amplify the radio-frequency energy in the receiving antenna loop system before passing it to the detector. This requirement has led to the development and use of radio-frequency vacuum-tube amplifiers.

The problem of building vacuum-tube amplifiers for radio frequencies is not essentially different from that where audio frequencies are involved. Fig. 10 shows a photograph of one of these instruments. The Signal Corps VT-1 vacuum tube is used.

The coupling between both the radio and audio frequency stages is provided by iron-core transformers whose impedances are adjusted to match the internal output tube impedance and whose turn ratios are approximately one to ten.

DIRECTION FINDERS

Several different types of direction finders have been built by the Signal Corps. One has already been shown in Fig. 9. In working out a small portable outfit for field use the size was limited to 5 ft. (1.5 m.) on a side in order to meet the requirement of portability. The stipulated wave-length range was 300 m. to 800 m.

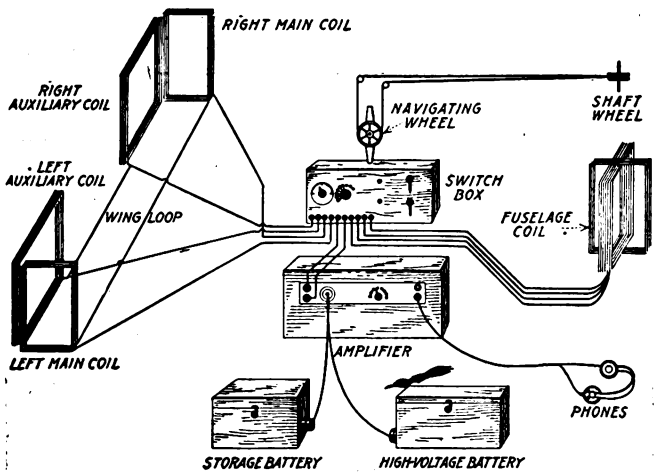

FIG. 11—ASSEMBLY OF AIRPLANE DIRECTION-FINDING SET

Extreme directional sensitiveness was required, together with the highest efficiency obtainable, in order to permit setting up as far as possible back from the battle front and shelled areas.

The equipment furnished comprises a vertical collapsible loop surmounted by an electrostatic shield consisting of a harp of wires 5 ft. long by 2 ft. wide (1.5 m. by 0.6 m.). The loop itself contains five turns of No. 18 wire sewed in a canvas strip. A collapsible table, measuring 5 ft. by 3 ft. (1.5 m. by 0.9 m.) on top and approximately 30 in. (0.75 m.) high, is furnished and supports the loop and its shield. Electrical connections to the loop are permanently made with the necessary lead wires fastened to the table top. A wheel with shaft and gear arrangement is provided and permanently fixed to the table for rotating the loop, and the whole structure folds together, forming a comparatively flat package for transit. A multi-stage combination radio-frequency and audio-frequency amplifier similar to that described above is used.

The requirements for airplane use of direction-finding radio apparatus are rather different from those for use on the ground. As has been explained, apparatus for ground direction-finding utilizes setting on a minimum or zero signal, but in an airplane the noise of the engine and rush of air drown out all save the very strongest radio signals and the ordinary direction finder methods are therefore of no use at all. Setting must be made "on the signal" rather than on the zero. This involves the use of a new method, credit for the application of which is due the British. The method used allows setting to the required direction with maximum strength of signal, while at the same time it retains the directional sensitiveness.

The apparatus is designed for use on the large Handley-Page bombing planes. High-power land stations send out prearranged signals and thus serve as beacons or radio lighthouses for the airplane, which is able to steer a course by radio in a manner quite analogous to navigation with the magnetic compass.

Two distinct sets of loops are provided. One is mounted rigidly on the struts and wings of the plane, a main coil fore and aft and an auxiliary coil athwartships. These coils have their turns sewed into a canvas band or strip about 6 in. (15 cm.) wide which is cemented on to the struts and the entering edges of the planes. They are used for straight homing flying. Another smaller set, about 3 ft. (0.9 m.) square, is mounted inside the fuselage of the airplane and arranged so that it can be rotated about a vertical axis by the navigator by means of a disk, cords and pulley device. By means of this second set of coils and a graduated dial the line of one of the beacon stations can be set, and if two such readings are taken quickly on different beacon stations the location of the plane may be determined. When the fixed wing coils are used it is necessary to alter the course of the ship in order to make the direction setting. The accuracy obtainable is about plus or minus one degree in making the radio setting. The general arrangement of the apparatus is shown in Fig. 11.

PEACE-TIME USE OF THE RADIO GONIOMETER

While the war has given great impetus to study of the radio direction finder and has without doubt been responsible for development of apparatus that in the ordinary course of events during peace times would not have appeared for several years to come, yet it has required the direction of effort entirely along lines that were narrowed by military requirements and which led only to the two developments that have been described above. The principles worked out, however, relating to the design of this type of apparatus and the methods evolved for their application will without doubt find application in the near future to numerous other fields. Already ships at sea have been equipped with directional apparatus, and the Post Office Department at Washington has now begun investigating the question of using direction-finding radio compasses on planes in the aerial mail service. With a set of direction-finding loops on the plane and a ground transmitting station sending prearranged signals from the landing fields of each of the designated stopping places, the pilot could venture forth at practically any time with the assurance that prompt arrival at his destination would depend only upon the performance of his motor and the mechanical soundness of his ship.

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Electrical Competition in Foreign Markets

An Exposition of the Manner in Which the Allgemeine Elektrizitaets-Gesellschaft of Berlin Has Dominated the World—How the Industry of the United States May Compete Successfully with This Powerful Organization

BY DR. JOSEPH M. GOLDSTEIN
Professor of Political Economy at the Moscow High Institute of Commerce and Industry and of the University of Moscow

LONG before the war the electrical industry of Germany, having brought to a very low factor the foreign competition in German markets, began to play an important rôle in the world's trade. In this respect it suffices to give the following data from German official statistics on Germany's foreign trade in some important electrical articles during the five-year period before the war:

Year	Electrical Appliances for Light and Power Transmission, Marks	Electrical Machinery, Marks	Incandescent Lamps, Marks
1909	20,600,000	30,200,000	36,400,000
1910	28,400,000	38,700,000	49,500,000
1911	32,300,000	47,000,000	45,800,000
1912	42,300,000	51,300,000	50,400,000
1913	74,000,000	56,500,000	48,100,000

From 1909 to 1913 the exports of above-mentioned goods increased from 87,200,000 marks to 178,600,000 marks[1], while the total imports amounted in 1913 to the unimportant sum of only about 7,000,000 marks[2].

The exports of all kinds of electrical products from Germany were directed to the European countries as well as to other parts of the world, and special attention was paid to the Russian market, which was by a reputed agreement or understanding between the Allgemeine Elektrizitäts-Gesellschaft of Berlin and the General Electric Company of America completely turned over to the above-mentioned German concern.

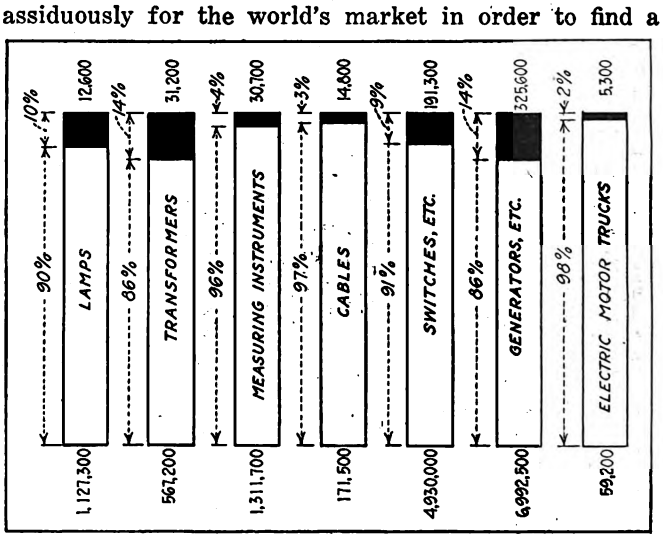
To show clearly the importance of the Russian market for American capital, investment and exports, it may be stated that Russia has many millions of horsepower in her streams and waterfalls which are awaiting exploitation. Taking into consideration that the construction of electrical power stations demands an average, including dynamos, cables, etc., of about $100 to $120 per horsepower, the electrification of Russia's water resources would demand in the next five or ten years an expenditure of at least $500,000,000 for machinery, cables, lamps and other electric supplies.

In what manner Germany understood long before the war the importance of Russia from that point of view is sufficiently shown by her rôle in Russian imports of electrical products, as it can be seen from the diagram on this page.

In this diagram the white part of the columns represents Germany's imports to Russia, while the black portion shows the imports from all other countries of the world. German imports of electrical apparatus and appliances into Russia amounted from 86 to 96 per cent of the total electrical imports of Russia, showing clearly to what extent Germany has had in Russia almost a complete monopoly.

The most influential factor of the electrical industry in Germany, as well as the most important in gaining the world's market for German products, has been the Allgemeine Elektrizitäts-Gesellschaft of Berlin, which by merciless competition and shrewd policy has compelled the electrical industry of the United States to enter into all kinds of disadvantageous agreements.

The war has destroyed all the old agreements, so disadvantageous for America, and the electrical industry of the United States, which has vastly developed its resources during the period of the war, will have to work assiduously for the world's market in order to find a suitable field for the application of American labor and accumulated capital.



IMPORTS OF ELECTRICAL PRODUCTS INTO RUSSIA IN THE YEARS 1912 AND 1913 (AVERAGE FOR TWO YEARS)[3]

In order to solve this problem properly the American electrical industry must, in the first place, be backed by American capital, inasmuch as without the most generous aid of the latter it will hardly be possible to compete with the Allgemeine Elektrizitäts-Gesellschaft, which, like a monster octopus with thousands of tentacles, has encircled the whole universe and, assisted by the powerful German banks and in alliance with two or three other electric concerns more or less closely united with these banks, has created a monopoly which permits to it the exploitation, with very few exceptions, of all the nations of the globe.

[1] About $42,000,000.

[2] It is not possible to compare the data of German foreign trade statistics for separate articles with those of the United States. All that can be stated in that direction is that the value of exports of the above-mentioned three groups of articles only was in 1913 about one and a half times larger than the total value of exports of the products of electric industry from the United States of America.

[3] The numbers above the columns represent Russia's imports from all countries in poods (1 pood equals about 37 lb.). The percentage figures show the relation of the imports of each article obtained from Germany to the total imports. The numbers below the columns show the total value of the imports from Germany in rubles (1 ruble equals about 51 cents).

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The writer has in his possession an interesting official document belonging to the "A. E. G." of Berlin. In this document are enumerated all the plants, installation bureaus, agencies, electrical stations, railroads and street-car companies which belonged to this German corporation. In the twelfth and last section of this document are mentioned fifty-nine enterprises which, according to the information of the "A. E. G.," were more or less closely associated or had entered into agreements with it.

From this official list prepared by the "A. E. G." one can readily see, first, that this company, which before the war controlled a capital of at least half a billion dollars, manufactured at its numerous plants in Berlin, Frankfort-on-Maine, Hennigsdorf, Vienna, Riga, Milan, etc., the following products: railroad supplies, high-tension wire, apparatus and supplies, small and large dynamos and other electric machinery, electric locomotives, arc lamps, supply materials, circuit breakers and switches, integrating meters, typewriters, fans and ventilators, measuring instruments, electric clocks, electric naval instruments and apparatus, turbo-generators, wires and cables, incandescent lamps, various porcelain insulatory materials, varnishes, heating apparatus, flying machines, nuts, all kinds of instruments, railroad signaling devices, machinery for printing of railroad tickets, electric welding outfits, machinery for tempering of steel and other metals, ozonating plants, searchlamps, etc.[4]

Second, this document shows that the "A. E. G.," irrespective of the fact that in almost all the large towns of Germany it had possession of various plants, installation bureaus, bureaus of sales, stations, etc. (in all, about 180 German towns), had also numerous branches in the commercial centers of the following countries:

Europe.—Austria-Hungary, in thirty cities; Italy, in ten cities; England, in seven cities; Spain, in seven cities; Belgium, in six cities; Sweden, in six cities; France, in five cities, Norway, in five cities; Switzerland, in four cities; Roumania, in three cities; Holland, in two cities; Portugal, in two cities; Denmark, in one city; Turkey (European), in one city; Greece, in one city.

Asia. — China (including Manchuria), in twelve cities; Japan (including Korea and Formosa), in ten cities; Singapore, one office; Java, two offices; India, in two cities; Siam, in one city; Turkey (Asiatic), in one city.

Australia.—In four cities.

North America.—In one city.

Mexico.—In one city.

Cuba.—In one city.

In South and Central America.—Brazil, in three cities; Argentina, in one city; Chile, in one city; Peru, in one city; Uruguay, in one city; Ecuador, in one city; Guatemala, in one city; Costa Rica, in one city.

Egypt.—In two cities.

Transvaal.—In two cities.

The same may be said with regard to Russia, where the "A. E. G." of Berlin maintained its branches, plants, installation bureaus, electrical stations, etc., in the following cities: Petrograd, Moscow, Riga, Kharkoff, Kieff, Odessa, Warsaw, Lodz, Sosnovitzi, Samara, Rostov-on-Don, Ekaterinoslav, Baku, Ekaterinburg, Irkutsk, Omsk, Vladivostok, Tashkent, Helsingfors, Viborg and Abo[5].

In this manner, as can be seen in the diagram on page 469, with the exception of North America, where by agreement or understanding the field was left free to the General Electric Company of America, there existed practically no important city or large commercial and industrial center in the whole world in which the "A. E. G." of Berlin had no branch.

With regard to the various other enterprises with which the "A. E. G." of Berlin, according to its own statements, was in close contact, besides the Bank für Elektrische Unternehmungen in Zürich (see footnote 5)[6], the following concerns must be especially mentioned: (1) A. E. G. Lahmeyer Werke, with a capital of 50,000,000 marks; (2) Deutsch-Ueberseeische Elektrizitäts-Gesellschaft, with a capital up till 1913 of 230,000,000 marks; (3) Gesellschaft für Elektrische Unternehmungen, in Berlin, with a capital in 1912 of 105,000,000 marks; (4) British Thomson-Houston Company, in London; (5) Compagnie Française Thomson-Houston, in Paris; (6) Société Financière de Transport et d'Enterprises Industrielles, in Brussels; (7) Société Générale Belge d'Enterprises Electriques, in Brussels, etc.

With the assistance of the above-named companies, the "A. E. G.," having created for itself a monopoly in innumerable countries, and irrespective of vast amortization and reserve funds, etc., had paid before the war very high dividends, as can be seen from the following data:

Year	Paid-up Capital[7] of the "A.E.G." Marks	Dividends, Per Cent.
1897–1898	25,000,000	15
1898–1899	47,000,000	15
1899–1900	47,000,000	15
1900–1901	60,000,000	12
1901–1902	60,000,000	8
1902–1903	60,000,000	8
1903–1904	82,500,000	9
1904–1905	86,000,000	10
1905–1906	93,000,000	11
1906–1907	100,000,000	12
1907–1908	100,000,000	12
1908–1909	100,000,000	13
1909–1910	100,000,000	14
1910–1911	100,000,000	14
1911–1912	130,000,000	14
1912–1913	155,000,000	14

Just before the war broke out the paid-up capital of the "A. E. G." of Berlin amounted to 155,000,000 marks, the reserve and other funds to 93,000,000 marks and the bond issues to 108,000,000 marks.

To compete successfully with such a powerful organization, backed by the most prominent and best organ-

[4]After the declaration of war this company was one of Germany's principal sources of military supplies.

[5]In addition to corporations with which the "A.E.G." of Berlin was closely associated, the following factories were established in Russia with her direct help: (1) a branch of the Berlin firm of A. Guttman; (2) a branch of the German concern of Koerting Brothers; (3) an electrical company in Warsaw; (4) the Associated Cable Works in Petrograd; (5) the so-called company of the year 1886, in Moscow. The last-mentioned organization was under the auspices of the "A.E.G." through the intermediary of the Bank für Elektrische Unternehmungen in Zürich, which, according to the official information of the "A.E.G.," was closely affiliated with that company but in reality was completely in its hands. In order to create for itself a lasting monopoly in the Russian market, the "A.E.G." eliminated all competition among the retail dealers, dividing Russia into separate districts. For instance, in placing orders, the retail dealers of north Russia were compelled to apply to Petrograd, the retail dealers of Moscow to the main branch of the "A.E.G." in Moscow, the retail dealers of Poland to the main branch of the "A.E.G." in Warsaw, etc. In view of the absence of competition, owing to the international agreements, the whole of Russia's market was in this manner under complete domination of the "A.E.G."

[6]This bank helped the "A.E.G." to borrow money from Switzerland, France, Belgium and other countries.

[7]Not including companies under control of the "A.E.G."

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ized banks in the world, such as the Deutsche Bank, Discontogesellschaft, Dresdner Bank, Darmstädter Bank, Schaafhausenscher Bankverein, National Bank für Deutschland, Berliner Handelsgesellschaft, Bleichröder, Delbrück, Leo & Company, etc., with a paid-up capital of over $300,000,000 reserve and other funds of about $120,000,000 and deposits of more than $1,250,000,000,[5] the American electrical industry must be backed by a consortium of the biggest banks in the United States.

Should the latter not back the American electric industry the old world domination of the "A. E. G." will return in greater force than before the war, and the tremendous work that the electrical industry of America has accomplished for the development of its exporting trade in increasing exports from $26,800,000 in 1913 to $51,900,000 in 1917 will be frustrated.

Determination of Economical Power Circuits

Method of Deriving Curves Showing When Two Circuits Become More Economical than One as Load Increases—Fixed Charges Are Balanced Against Saving of Line Loss When New Conductors Are Added

BY P. O. REYNEAU
Distribution Engineer the Detroit Edison Company

IN AN article previously published under the same title* it was shown how to determine the relative economies of the various sizes of wire used for three-phase power circuits when the cost of copper wire, the cost of energy at the point of loss, the equivalent hours during which the load is on the circuit and the maximum current are known. The equivalent hours are taken as meaning the time of maximum loading that would produce the same daily energy loss as the actual load does. The largest size of wire used was No. 4/0, and it was considered the largest size that could be installed on average pole lines without special reinforcements and devices. For reference, one of the curve sheets printed with the previous article (Fig. 1) is reproduced, showing the economical size of conductor for three-phase power circuits with any ratio between copper and energy cost when the equivalent hours equal 9.69.

DEDUCTIONS FROM CURVES IN FIG. 1

It is obvious from a study of these curves that a minimum load, under various conditions of the other variables involved, at which a No. 4/0 line is economical was shown. On the other hand, the other limit—that is, the maximum load that is economical under the same conditions—was not determined. In other words, the field beyond the line at which the economy changed from one No. 3/0 to one No. 4/0 line was not explored. It is here desired to point out the method of finding when it is economical to operate two circuits in the place of one and to draw some conclusions regarding the results obtained. As the load is increased it is evident that a point will be arrived at when the additional energy loss by using one line will be greater than the additional investment charge for using two lines.

Obviously any size of line with the same required spacing occupies the same amount of pole space, so that in the study referred to above it was not necessary to take into consideration the pole-space rental in order to get a comparison between various sizes of wire. On the other hand, if a second line is strung on the same poles as the first line, or strung by another route of approximately the same length, to carry a load that previously was handled by only one line, the pole space rental becomes chargeable to the second line and must be taken into account in the economics of the proposition.

To simplify matters here we have considered a simple case as an example—that is, taking one No. 4/0 line and two No. 4/0 lines. There could naturally be a number of possible combinations of two lines of the same size of wire or different sizes of wire. It has also been assumed here that the equivalent hours of loading are 9.69, which agrees with the first curve submitted. The equivalent hours chosen represent an average obtained from the study of actual conditions on a large number of power circuits and should be applicable to such circuits in many localities with a fair chance of accuracy.

DERIVATION OF EQUATIONS

If K_1 = the annual fixed charge per 1000 ft. of line,
K_2 = the annual charge on energy consumption per 1000 ft. of line,
k = multiplication factor,
D = distance of transmission in thousands of feet,
g = per cent interest and depreciation,
W = weight per foot of wire,
C_c = price of copper wire per pound,
H = cost of stringing 1000 ft. of line,
ρ = resistivity of wire in ohms per mil-foot,
A = area of wire in circular mils,
t = equivalent hours per day peak load is on,
C_e = cost of energy per kilowatt-hour,
C_{ins} = cost of insulators,
C_{ps} = cost of pole space,

we can proceed to formulate equations for K_1 and K_2.

K_1 = annual charge on copper + insulators + pole space + stringing per 1000 ft. of line.

[5] In these sums are not included the paid-up capital, reserve funds and deposits of smaller but often very important banking corporations controlled by the above-mentioned principal German banks. For instance, the Deutsche Bank controls the following banking corporations: Deutsch-Ueberseeische Bank, Deutsch Ostafricanische Bank, Deutsche Vereinsbank in Frankfort-on-Main, Essener Kredit-Anstalt, Hannoversche Bank, Mecklenburger Hypothek- und Wechselbank, Nieder-Lausitzer Bank, Oldenburger Spar- und Leihbank, Pfälzische Bank, Privatbank in Gotha, Rheinische Kreditbank, Schlesischer Bankverein, Württembergische Vereinsbank, Deutsche Treuhandels-Gesellschaft, Märkische Bank, etc.

*See ELECTRICAL WORLD, May 25, 1918, page 1072.

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Considering spacing of 100 ft., then

$$K_1 = \frac{g}{100}(3000 \times W \times C_c + 30\,C_{ins} + 10C_{ps} + H).$$

Letting $k = 1 + \left(\frac{30\,C_{ins} + 10\,C_{ps} + H}{3000 \times W \times C_c}\right)$,

then $K_1 = \frac{g}{100}(k3000 \times W \times C_c)$.

K_2 = annual charge on energy consumption per 1000 ft. of line.

$$K_2 = I^2\frac{\rho}{A} \times 3000 \times t \times 300 \times \frac{C_e}{1000}$$

$$= 900\frac{\rho}{A}I^2 \times t \times C_e.$$

Having obtained expressions for K_1 and K_2, the next step is to determine the annual charges for a single line and for two lines.

Single line $= (K_1 + K_2)D$

$$= \left[\frac{g}{100}(k3000 \times W \times C_c) + 900\frac{\rho}{A}I^2 \times t \times C_e\right]D \quad (1)$$

Two lines $= (2K_1 + \tfrac{1}{2}K_2)D$

$$= \left[\frac{2g}{100}(k3000 \times W \times C_c) + 450\frac{\rho}{A}I^2 \times t \times C_e\right]D \quad (2)$$

(The investment is double, the load is half in each line, the energy loss quarter in each line, therefore the total energy loss is half that of a single line.)

When the annual charges (1) equal the annual charges (2), then it is as economical to use either a single or a double line.

Hence

$$\left[\frac{g}{100}(k3000 \times W \times C_c) + 900\frac{\rho}{A}I^2 \times t \times C_e\right]D$$

$$= \left[\frac{2g}{100}(k3000 \times W \times C_c) + 450\frac{\rho}{A}I^2 \times t \times C_e\right]D \quad (3)$$

Since C_c and C_e are not constant and I and t depend on the load, it is advisable in order to make the equation

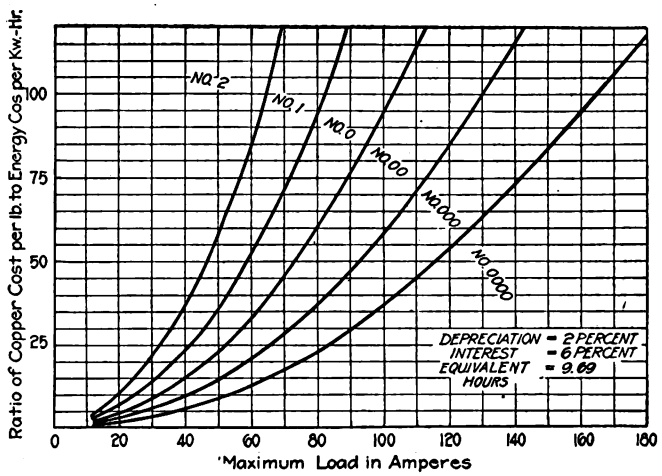

FIG. 1—ECONOMICAL SIZE OF WIRE FOR ANY RATIO OF COPPER COST TO ENERGY COST FOR THREE-PHASE POWER CIRCUITS

most usable to solve equation (3) for the ratio of C_c/C_e. This leaves these two variables in a convenient form for handling.

Therefore

$$30gkWC_c - 450I^2t(\rho/A) \times C_e = 0$$

and

$$\frac{C_c}{C_e} = \frac{450(\rho/A) \times I^2t}{30gkw} \quad (4)$$

Substituting in general equation (4),

ρ = 10.8 ohms per mil foot.

t = 9.69 equivalent hours per day peak load is on (see above-mentioned report).

g = 10 (6 per cent interest and 4 per cent depreciation).

W = 0.6405 lb.-ft. (using No. 4/0 wire).

A = 211,600 circ.mil (using No. 4/0 wire).

$$k = \frac{1 + 30C_{ins} + 10C_{ps} + H}{3000 \times W \times C_c}.$$

POLE-SPACE RENTAL

Fig. 2 shows how the pole-space rental was arrived at. A survey of the lines under consideration indicated that the conditions shown on the sketch represented

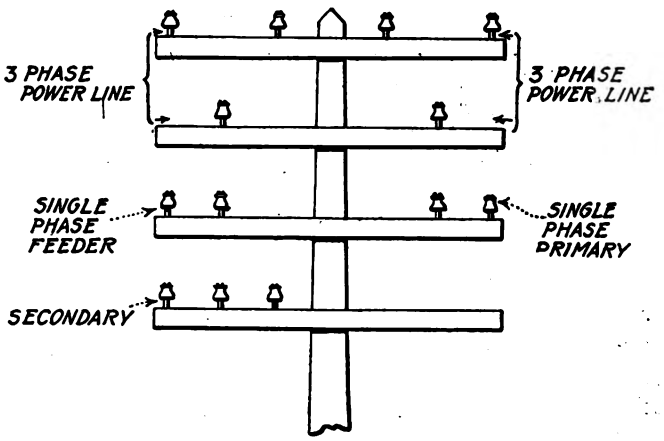

FIG. 2—ARRANGEMENT CONSIDERED IN FINDING POLE RENTAL

the average conditions on the pole lines carrying three-phase circuits. On the sketch there are four cross-arms used and twenty-four pins are possible. In a power circuit with standard 28-in. (71-cm.) spacing between wires and also with a minimum of 28 in. between these power wires and any other wires, it is necessary to charge the power circuit with six pin positions; in other words, the pole-space rental of one power circuit on the average pole line will be six-twenty-fourths, or one-quarter, of the cost of the pole plus the cost of the arms—both of these installed.

Using costs obtained as shown above we find that

$$k = 1 + \frac{30 \times 0.4949 + 10 \times 8.61 + 59.42}{3000 \times 0.6405 \times C_c} \quad (5)$$

$= 1 + (0.0832/C_c)$. Solving for k, using values of \$0.20, \$0.30 and \$0.40 for C_c, it is found that

$$k_{0.20} = 1 + 0.0832\ (1/0.20) = 1.416,$$

$$k_{0.30} = 1 + 0.0832\ (1/0.20) = 1.277,$$

$$k_{0.40} = 1 + 0.0832\ (1/0.20) = 1.208.$$

It should be noted here that in the derivation of the equation (4) the cost of insulators, pole space and stringing was carried through as a percentage of the copper costs as shown in equation (5) for k. This was found necessary in order to express this equation in the form above, giving it as the quotient of the two most important variables. This percentage is variable with the cost of copper, and its effect on curves is shown by drawing them for \$0.40, \$0.30 and \$0.20 copper.

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It is now possible to put the actual values in general equation (4) and obtain the following:

$$C_c/C_e = 0.00082\,I^2 \quad (C_c = \$0.20),$$
$$C_c/C_e = 0.00091\,I^2 \quad (C_c = \$0.30),$$
$$C_c/C_e = 0.00096\,I^2 \quad (C_c = \$0.40).$$

DISCUSSION OF CURVES

Fig. 3 shows equation (4) plotted for three values of C_c ($0.20, $0.30 and $0.40) and also shows the equation determining the points at which a No. 3/0 and a No. 4/0 line are equally economical. This was reproduced from Fig. 1 as a means of comparison and for the sake of limiting the field of economy of a single No. 4/0 line both as to minimum current and as to maximum current.

The areas as indicated represent the conditions under which it would be most economical to use a single No. 3/0, single No. 4/0 line or two No. 4/0 lines.

The economical design is brought down to two tangible variables—the maximum load in amperes and the ratio of copper cost to energy cost per kilowatt-hour. It is therefore only necessary to substitute in the equation values that are in most cases quite easy to secure. It should be noted that the method of obtaining economical circuits is limited only by matters of regulation. In other words, having determined the length of the line, the available voltage at the station and the voltage desired at the receiver end, it must first be determined whether the voltage loss is not too great under the most economical design, thus making it necessary to increase the size of the line or provide some other means of getting satisfactory service.

Further, in many cases physical conditions and matter of right-of-way may come in to force alteration of the conditions prescribed by the curves as the most economical. In all cases, however, the curves can be

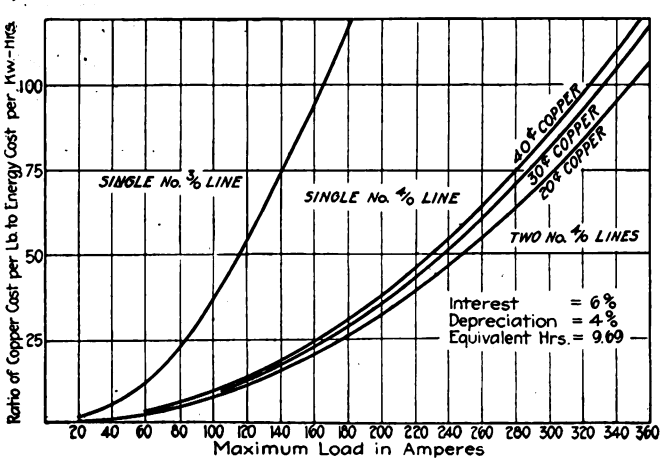

FIG. 3—ECONOMICAL CIRCUITS FOR ANY RATIO OF COPPER COST TO ENERGY COST FOR THREE-PHASE POWER LINES

used as a guide and should be of service in obtaining the best design.

Finally, it should be pointed out that the various factors entering into the equation and substituted numerically to obtain the curves submitted represent approximately existing conditions and that other existing conditions at other places would probably not in most cases change the location of the curves to a great extent.

If such is the case, with equivalent hours of 9.69 representing a fair load factor and an average condition on industrial power circuits, it is quite apparent that the economical loading of power wire is considerably below the so-called safe carrying capacity of the wire, and at first sight, under certain conditions of the ordinate, surprisingly low.

INSURING PROTECTION OF CURRENT TRANSFORMERS

Series Resistors or Reactors and Shunt Resistors, Condensers or Vacuum Gaps Assist When Used Separately or in Combination

BY V. KARAPETOFF

ONE of the troubles with which operating companies are confronted is the burning out of current transformers connected to long cables or overhead lines. A frequent cause of such failure is a steep-front electric surge coming to the station from the line. The opening of a remote oil switch, a short circuit or flash-over somewhere on the line, a sudden change in the load—all such occurrences produce an instantaneous change in the electrical conditions and give rise to a surge. Such a surge upon entering a station or substation suddenly meets with a high concentrated inductance of a current transformer and is forced to undergo a partial reflection. This reflection is accompanied by a transformation of magnetic energy into electrostatic, and consequently the voltage at the transformer suddenly rises and sometimes exceeds the safe limit. The reflected surge may not be absorbed at the other end of the line and may return several times, giving repeated "blows" to the current transformer.

The phenomenon is somewhat similar to a water hammer in a water-supply system. A sudden closing of a valve causes an instantaneous local rise in pressure, and the pressure wave is propagated along the system, undergoing reflections at the closed end until the whole energy has been dissipated in friction and vibrations.

In many cases the electrical line itself and the generators are sufficiently well insulated to stand considerable overvoltages, but the series transformer is the weakest link in the chain. The problem is therefore a threefold one:

1. To flatten the steep wave front of the incoming surge so as to reduce the first shock against the transformer.

2. To absorb gradually the energy of the surge by converting it into heat.

3. To provide a by-pass shunt for the surge around the transformer, in order that the shock of overvoltage may be received by some other piece of apparatus more capable of withstanding it.

Some possible solutions may be briefly summarized as follows:

1. The wave front may be flattened by having small reactance coils along the line. A condenser connected across the line just ahead of the transformer absorbs part of the surge and relieves the transformer of the first shock. A spark gap or an electrolytic arrester

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across the line accomplishes the same result, though less effectively on account of the time lag.

2. The energy of the surge may be gradually dissipated in resistances. Carborundum rods have been used for this purpose. A proper resistance shunted across the series transformer offers an easier path for the steep wave front than the highly inductive coil, and while the front end of the surge is passing through the resistance its energy is partly converted into heat.

3. If meters are connected to the series transformer, then the by-pass shunt must possess a very high or even infinite resistance under normal conditions, in order not to impair the accuracy of the ratio of transformation. At the same time the by-pass must break down readily and without an appreciable time lag.

The vacuum-gap arrester has been found very helpful for such protection, according to reports. It consists of a small closed copper tube from which the air has been exhausted and which is provided with a spark gap inside. A comparatively large gap in vacuo is equivalent to a small gap in the air, so that the device is well adapted for low potentials. When a considerable difference of potential is established across the transformer terminals owing to a surge, the gap is broken down and the surge passes through it. A resistance, such as a carborundum rod, in series with the gap, helps to absorb the energy of the surge and adds to the protective value of the spark gap. The successful use of such vacuum gaps has been reported by the Public Service Company of Northern Illinois and by the Georgia Railway & Power Company. An aluminum cell and a sphere gap have also been recommended as suitable shunts around a series transformer, and it would be of interest to investigate their value as such.

These three aspects of the problem offer a fruitful field for research, both theoretical and experimental. A steep-front electric wave is readily produced in a laboratory on a comparatively short stretch of single-phase line or cable. The line is connected to a source of direct-current voltage at one end, while the other end is kept open. If now this latter end be suddenly short-circuited, a steep-front wave starts from the generator and travels along the line. A series transformer and any protective devices under test connected to the line will then be subjected to this surge. Its effect may be studied, using a spark gap or some other more delicate measuring device for recording transient phenomena.

An investigator will find some information on the subject scattered in various European electrical periodicals, though the problem has not been solved by any means. The Swiss recommendations for the protection of station apparatus against surges deserve particular mention. They will be found translated into English in the *Electrician* (London) of Oct. 27, 1916.

Pulverized Coal Burners Versus Stokers

Relative Efficiencies—Conditions Under Which Powdered Coal Is Preferable—Comparative Freight Charges on Low and High-Grade Fuel—Price That Can Be Paid for Fuel

BY JOSEPH T. FOSTER
Engineering Department Public Service Electric Company of New Jersey

CONSIDERABLE attention has been devoted during the past year to the subject of burning pulverized fuel. The results of numerous tests have been reported, and in most cases these have been considerably higher than the corresponding efficiencies from mechanically operated stokers. The number of plants burning pulverized coal is quite large, and it has been estimated that 10,000,000 tons of coal is burned annually in this manner. It should be noted, however, that electric central-station companies, which as a class are usually the leaders in all attempts to secure greater fuel economy, have not adopted this method to any great extent.

The chief reason seems to be the fact that the mechanical stoker has been brought to a high degree of perfection as regards both fuel economy and ease and reliability of operation. It is therefore evident that central stations have been far more advanced than other coal consumers and that the latter in burning their coal in the pulverized form are merely adopting a substitute for the stoker.

Published test results indicate an efficiency of approximately 80 per cent, but there appears to be no reason to believe that such a figure could be maintained under conditions of continuous operation, and it is probable that no better than 75 per cent will be realized under these conditions. A well-designed stoker will show an efficiency of 70 per cent or better continuously, and it will therefore be difficult if not impossible for the pulverized fuel burner to displace the mechanical stoker.

There are no doubt special cases in which pulverized coal will receive consideration in determining what type of combustion apparatus will best meet a given set of conditions. For example, pulverized coal would be preferred in the following cases:

1. Where a large supply of low-grade coal is available at an attractive price.

2. Where the supply of fuel for gas or oil burning furnaces has been cut off or materially advanced in price.

3. Where the moisture content of the raw fuel already in use is so high as to require special treatment in the way of drying.

In comparing low-grade fuel with the quality of fuel ordinarily supplied to mechanical stokers it must be borne in mind that a greater tonnage of the low-grade fuel will have to be handled. For example, assuming 10,000-B.t.u. (1140 cal.) pulverized coal can be burned with 75 per cent efficiency compared with 70 per cent for

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14,000-B.t.u. (1596-cal.) stoker coal, then it will be necessary to consume about 30 per cent more of the lower-grade coal for a given output.

To determine the maximum price which could be paid for low-grade coal to place it on a basis comparable with good coal the following formula may be used:

$$P_1/P_2 = (H_1/H_2)\ (E_1/E_2),$$

where

P = price per ton delivered,
H = B.t.u. content per pound,
E = combined boiler efficiency,

and the subscripts 1 and 2 refer to the low-grade and high-grade fuels respectively.

To show the use of this formula, assume a price of $5.50 for 14,000-B.t.u. coal delivered to stations on the Atlantic seaboard, the freight charge making up $2.50 of this total. Required the amount which could be paid for 10,000-B.t.u. coal.

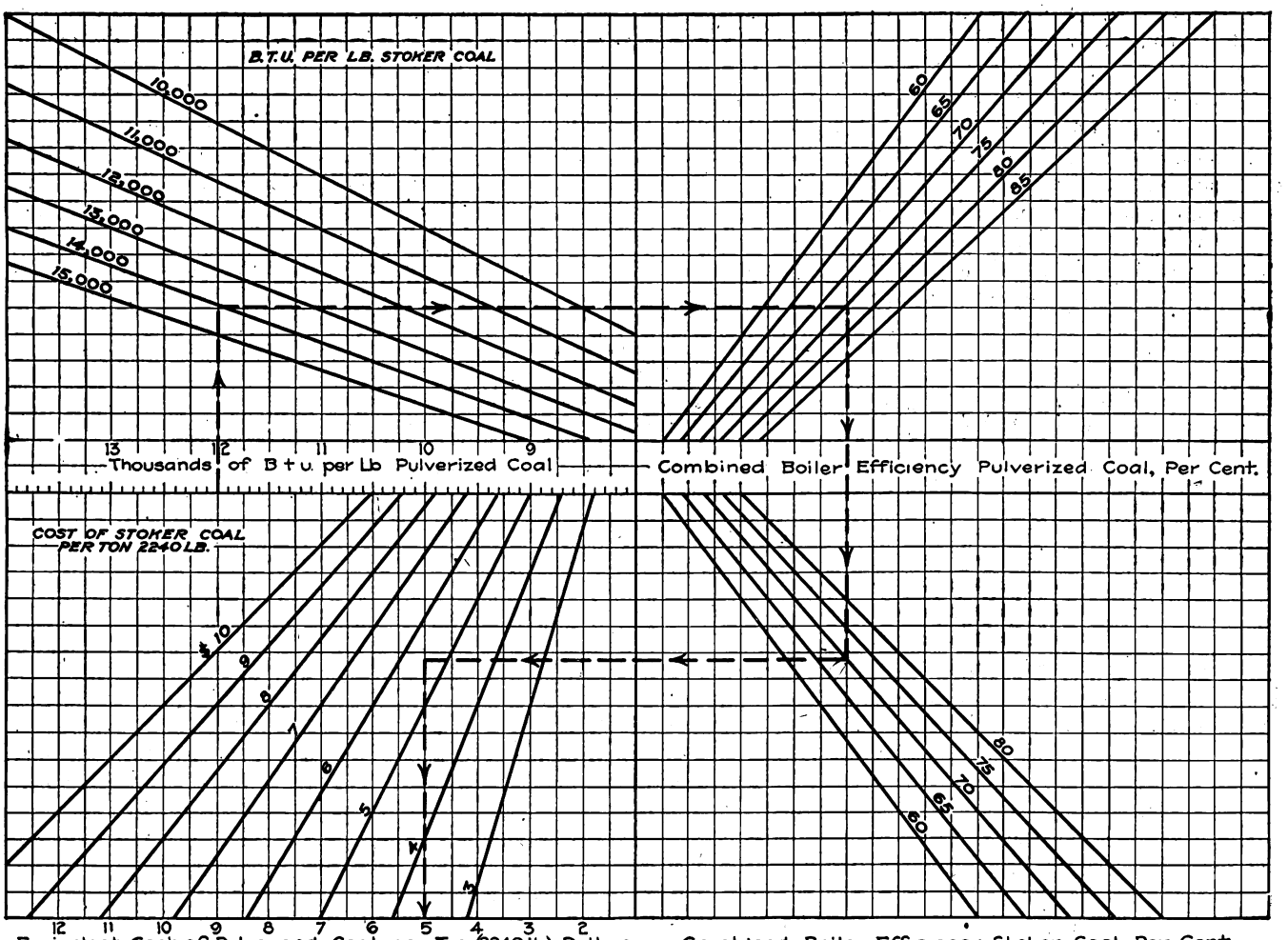
$P_1 = \$5.50 \times (10{,}000/14{,}000) \times (75/70) = \$4.20.$

Deducting freight to the amount of $2.50 per ton leaves $1.70 as the cost at the mines, and unless the fuel could be obtained at this price or less there would be no advantage in pulverizing. No account has been taken of the cost of pulverizing and drying, and this amount, which will be 30 cents or more per ton, would require that coal be obtainable at the mines for $1.40 per ton.

The foregoing example is worked out for a given set of conditions, but by means of the accompanying chart a comparison can be obtained for fuels of various grades under different combustion efficiencies. The use of the chart will be illustrated by the following example:

Problem.—A supply of 12,000-B.t.u. coal is available. What is the maximum amount (exclusive of cost of drying and pulverizing) which could be paid for the low-grade coal delivered to make it comparable with 14,000-B.t.u. coal at $5.50 per ton? Combined efficiency assumed at 75 per cent for the pulverized fuel and 70 per cent for raw fuel fired on stokers.

Solution.—From 12,000 B.t.u. on the pulverized coal scale project upward to the 14,000-B.t.u. line for stoker coal, then horizontally to the right to the 75 per cent efficiency line, vertically downward to the 70 per cent line, horizontally to the right to the line representing $5.50 coal, then vertically downward. Read on the scale



MAXIMUM AMOUNT THAT CAN BE PAID FOR PULVERIZED COAL TO MAKE IT COMPARABLE WITH A GIVEN STOKER COAL

the equivalent cost for low-grade fuel as $5 per ton delivered. The five-dollar price, of course, includes freight but does not include the cost of drying and pulverizing the fuel, which will vary from 20 to 50 cents per ton.

The foregoing views are confined entirely to the consideration of a new installation. It is probable, however, that in changing over an existing plant from hand firing or old-type stokers to a more modern arrangement capable of higher forcing rates the pulverized fuel equipment would cost less than a stoker installation.

This phase of the subject, with estimates of comparative costs, the author will cover in a later article.

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Statistics in Accident Prevention

Analysis of 1172 Cases During Two-Year Period, Giving Data on Days Lost and Division of Cost, Points to Need of Guards, Inspection Service and Education of Employees in the Promotion of Safe Working Conditions

BY EVELYN M. DAVIS
Statistician Utilities Mutual Insurance Company

AN INTELLIGENT approach to the study of industrial accident prevention must of necessity be made through a careful record and examination of the statistics on the cases, and it was with this thought, and in the belief that such study would tend to indicate where the more serious accidents might be eliminated, that the Utilities Mutual Insurance Company undertook such a survey. This company was organized in 1914 by the public utility interests when the compensation act became operative in New York State, and it has confined itself exclusively to that class of business, so that to-day there are about 150 New York properties insured by it in respect to their compensation needs. The consequence of this restriction makes its record peculiarly valuable to the public utility man, as it may act as a guide to show where he should go to prevent accidents to his employees.

Delay Necessary in Arriving at Cost of Accidents

It is a peculiarity of the compensation business that the exact cost of an accident cannot be immediately known, as in the case of a fire loss, since the injured employee must receive compensation until he is able to return to work, and this is always an indefinite period, because no one is in a position to know just when the return to work will occur. As a consequence, it necessitates the study of the accidents that have occurred in a more or less remote period, and the Utilities Mutual Insurance Company has therefore only recently made this study of its first two years' experience.

This survey involved 1172 accidents occurring between June 30, 1914, and June 30, 1916, and is a complete record of the accidents incurred by those public utility companies insuring with the Utilities Mutual. Most of these companies were electric companies, although there were numerous gas companies and a few street railways. Of these 1172 cases, full payment had been made on all but ten and the cases had been closed, but these ten involve continuing disability or continuing dependency, so that their actual and final cost could not be absolutely determined, although estimates could be made which would very closely approximate the actual cost.

The study, as is indicated by the charts, attempts to segregate the accidents with respect to occupation, both as to the percentage of total days lost time and the percentage of total cost chargeable against each occupation. The accidents are also analyzed as to causes with respect to the percentage assignable to each cause, percentage of total days lost and percentage of total cost assignable to each cause.

The total number of days lost per accident is certainly a very fair indicator of the seriousness of the accident; but from a purely business basis the more satisfactory figure, and the one harder to obtain, is the cost of each accident.

It is self-evident that these two chart classifications, first as to occupation and then as to cause, will develop in a very different way where the serious accidents are occurring.

Theoretically the curves of days lost and cost should parallel each other, but there is a difference, for the very good reason that in some fatal cases, figured on a basis of twenty-five years' lost time, there will be no dependents, whereupon the state prescribes that the insurance carrier is liable for only $100 burial fees and $100 to be paid into the state fund. The time element is, therefore, very much overburdened, while the cost factor is a minimum.

The percentage of total days lost chargeable to each accident according to occupation shows that over 94 per cent of the lost time among public utilities is assignable to seven different occupations—linemen, laborers, firemen, switchboard operators, groundmen, carpenters, painters and masons (these three being grouped together) and locomotive engineers—and it is noticeable in this regard that these seven classifications each include one or more fatalities, as indicated by the figures in the circle. It may, therefore, be quite positively stated that in public utility operations fatalities are the ones to guard against, particularly when the last three classifications—linemen, laborers and firemen—where a total of twelve deaths is recorded out of sixteen and where the total days lost amount to 72.8 per cent of the entire lost time, are considered.

Proceeding to the chart on costs, it is seen that there is a slightly different rearrangement of the schedule, as shown by the following: Days lost—linemen, laborers, firemen, switchboard operators, groundmen; cost — linemen, laborers, carpenters, etc., firemen, groundmen.

This may be finally boiled down to a bare statement that in public utilities laborers and linemen account for 58.62 per cent of the total time lost due to accidents, while they account for 49.05 per cent in respect to the cost.

Five Classifications Cover Causes

The analysis of these 1172 accidents as to cause shows that explosives, electricity, fires and hot and corrosive substances; falls of persons; boilers and steam-pressure apparatus, machinery and handling objects account for more than 95.85 per cent of the total time lost, and it is found that these five classifications contain all of the fatalities reported in the two-year period.

In respect to the total cost, there is a slight rearrangement of the classifications again, as shown by the following: Days lost—explosives, electricity, etc.,

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falls of persons, boilers and steam pressure apparatus, machinery, handling objects; cost—falls of persons, explosives, electricity, etc., boilers, and steam-pressure apparatus, handling objects, machinery.

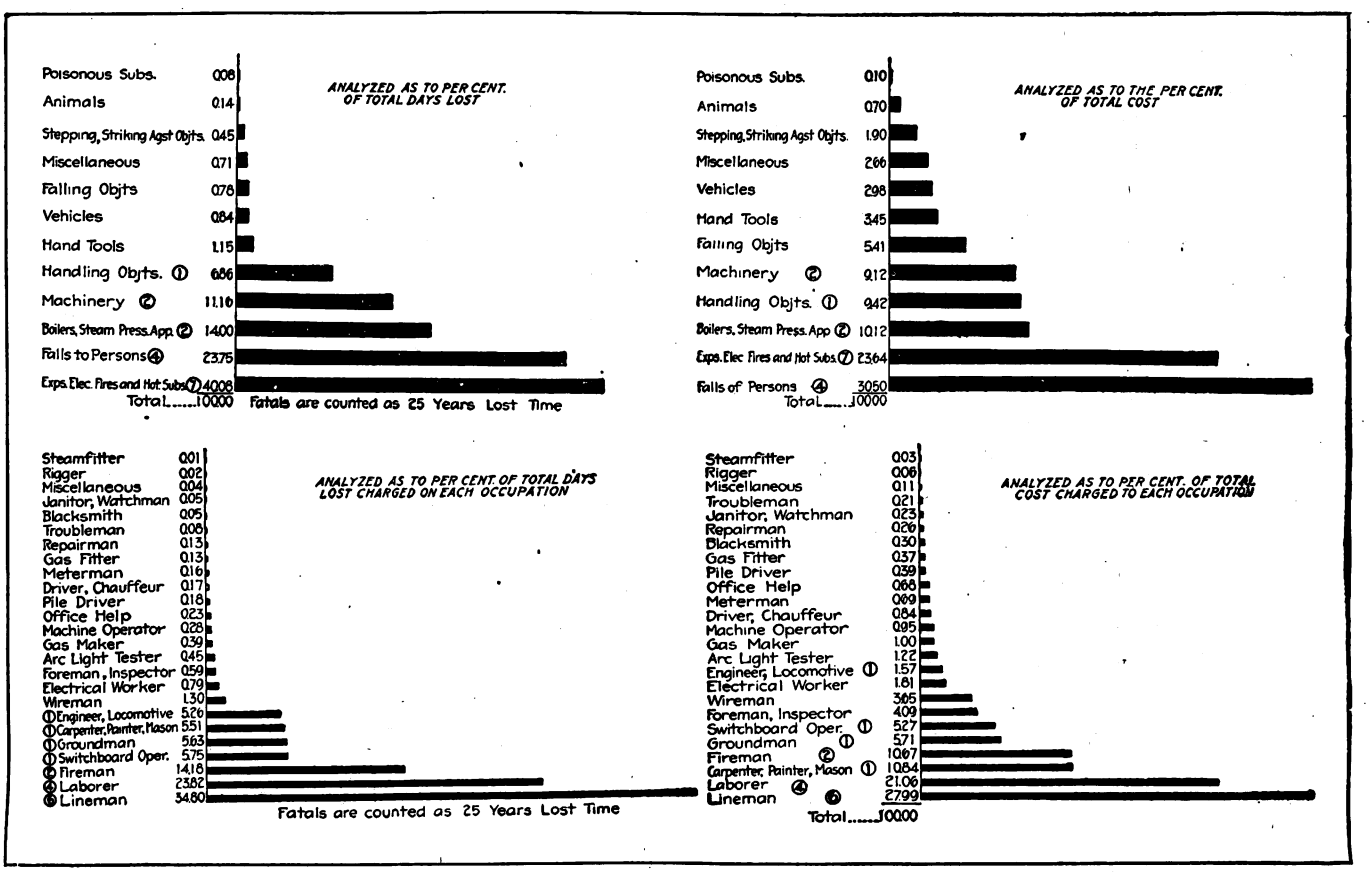
These five classifications account for 82.80 per cent of the cost of accidents, and aside perhaps from the classification "falling objects," which contributed 5.41 per cent of the cost, it may be said that these five classifications are the ones that should receive the greatest attention.

Summarizing, therefore, it may be definitely stated that the public utilities should exercise their greatest care for the protection of their employees, first, where linemen are concerned; second, among laborers; third, firemen; fourth, switchboard operators; fifth, groundmen; sixth, carpenters, painters and masons; seventh, locomotive engineers. They should particularly guard against accidents arising from the operation of, first, falls of persons; second, explosions, electricity, etc.; third, operation of boilers, steam, etc.; fourth, handling of objects; fifth, machinery. If conditions are still further analyzed, it may be positively stated that electric current and the boiler room are two of the three principal contributors to accidents among public utilities.

Such an analysis as the above should be the first study in accident prevention, and the second should be to provide the guards, the inspection service and the education to the employees needed to prevent these accidents. It is unquestionably true that the education is the very much more difficult portion of the work, but it cannot be intelligently undertaken unless such statistics as presented above have been accumulated.

As an indication of what the above facts mean, falls account for 13 per cent of the 1172 accidents, or an actual number of 148; 24 per cent of the total lost time, or 33,000 working days, is assignable to this one cause, while 31 per cent of the total cost, or $23,800, is contributed by falls alone. Again, linemen alone fell often enough to absorb 73 per cent of these 33,000 lost working days and 53 per cent of the cost, $23,800. The moral of this is "Watch your step."

On the other hand, electricity contributed 11 per cent of the total number of cases, or 119 accidents: 40 per cent of the lost time, or 55,300 working days, and 24 per cent of the total cost, or $18,400. Under the heading "electricity" linemen absorbed 23,000 days lost, at a cost of $4,497; laborers in the plant 15,000 days lost, at a cost of $5,200; switchboard operators, 7900 days lost, at a cost of $4,017, and wiremen 1735 days lost, at a cost of $2,722. If, therefore, accidents to these four classes of workmen about public utility plants are eliminated, 85 per cent of these lost working days and 87 per cent of this accident cost will be saved.



GRAPHICAL ANALYSIS OF 1172 ACCIDENTS OCCURRING IN TWO-YEAR PERIOD

FIRST of all, the hand of friendship for that new American, the voice of a friend who shall be an unselfish adviser, a guide in this strange land of troubles, small and large, but equally incomprehensible. Then the school, the night school, or if not that, the shop school. And with these the community center, the gathering place that represents all America. —*Secretary of the Interior Franklin K. Lane.*

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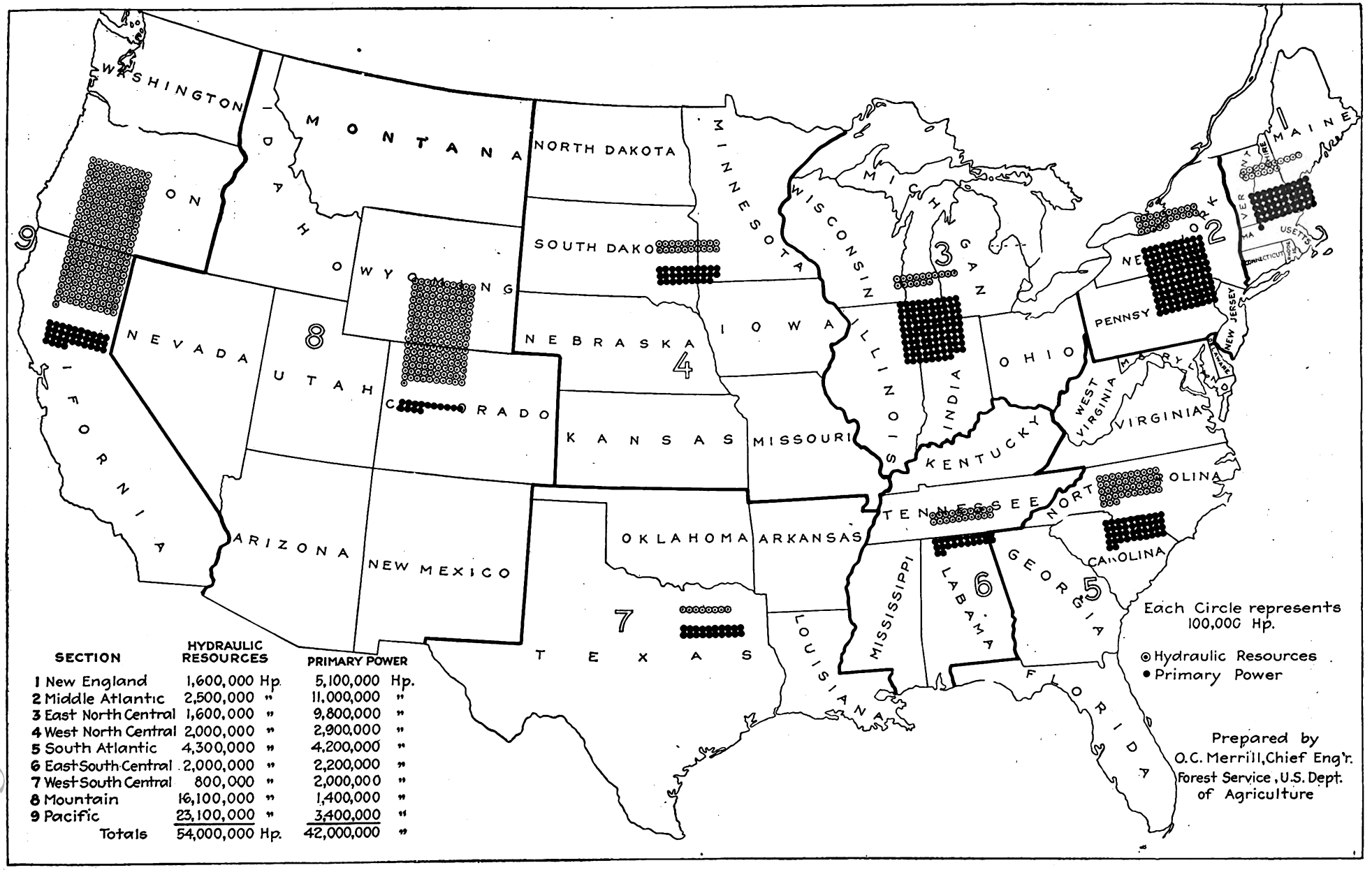

SECTION	HYDRAULIC RESOURCES	PRIMARY POWER
1 New England	1,600,000 Hp.	5,100,000 Hp.
2 Middle Atlantic	2,500,000 "	11,000,000 "
3 East North Central	1,600,000 "	9,800,000 "
4 West North Central	2,000,000 "	2,900,000 "
5 South Atlantic	4,300,000 "	4,200,000 "
6 East South Central	2,000,000 "	2,200,000 "
7 West South Central	800,000 "	2,000,000 "
8 Mountain	16,100,000 "	1,400,000 "
9 Pacific	23,100,000 "	3,400,000 "
Totals	54,000,000 Hp.	42,000,000 "

DISTRIBUTION OF HYDRAULIC RESOURCES AND PRIMARY POWER BY SECTIONS, 1918

Hydraulic resources from Table No. 2, Part II, Senate Document No. 316, Sixty-fourth Congress, first session. Primary power, which consists of the installed capacity of water-wheels, steam engines and gas engines in commercial and municipal central stations, street and electric railways and manufacturing plants, has been estimated for 1918 by assuming a rate of increase in each state from 1912 to 1918 corresponding to the rate of increase for such state from 1902 to 1912, as indicated by the data given in Table No. 4, Part II of the above-named Senate document. The figures given do not include the horsepower of railroad locomotives.

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Market for Electrical Goods in South America—II

Brief Notes on Bolivia, Ecuador and British Guiana, Together with a Resume of South American Conditions as a Whole—List of Central Stations in Chile, Uruguay, Ecuador and Peru

BY PHILIP S. SMITH
Trade Commissioner, Bureau of Foreign and Domestic Commerce

WHILE the account of conditions and opportunities in Brazil, Argentina and other countries printed in the ELECTRICAL WORLD for Feb. 22 covered all the principal commercial territory in South America, the following notes, omitted from that issue, will tend to make the record complete and a condensed view of the whole field is given in the résumé that follows.

BOLIVIA

The only users of electrical material in quantity in Bolivia are the mining companies, and as those have been enjoying several years of prosperity, they will probably purchase more heavily than ever in the near future. Each has its own generating plant, operated by water power or petroleum engines. The number of motors installed is being increased constantly. Personal representation is necessary to obtain this business.

For domestic purposes electric devices are confined to three or four towns, since the greater portion of the population consists of Indians and halfbreeds, who will never become users of this material.

Under present conditions there is little opportunity for the sale of anything but lamps and wiring material.

ECUADOR

Ecuador is one of the least developed of the South American republics. Its population is largely scattered throughout the country, there being only three cities of any importance. It is essentially an agricultural country, deriving most of its revenue from cocoa, ivory nuts, and hats made from the fiber of certain palm trees.

There are some twenty central stations, and outside of Guayaquil, where there are a few small industries using power, the electrical goods that can be sold are confined to lamps and wire and wiring devices. The purchasing population, as will be seen from the table, is extremely small.

BRITISH GUIANA

A small amount of electric material is consumed in Georgetown, where there is a central station and a street-railway system. In the interior there is practically no civilization other than a few towns situated at some distance from the capital.

A tremendous quantity of water power is available, including the famous Kaiteur Falls, where the power is estimated at two to three times that of Niagara Falls. Here again, however, it is too far removed from civilization to be of any value at present.

RESUME

It was previously pointed out that the population census does not afford a true criterion of the value of the South American market. Mention has been made also of the lower purchasing power of the average individual, in consequence of which the cheaper goods have a greater acceptance than those of higher cost.

The climate, too, must be taken into consideration, especially in regard to articles such as fans and heating devices. Nearly all the continent lies within the tropics, but this does not mean that it is hot the year round. The altitude makes a great difference, and much of the inhabited land reaches an elevation of 1000 ft. to 12,000 ft.; so that even in places as near the equator as Quito or Bogota overcoats and blankets are not out of place at certain times of the year. At sea level the temperature on the west coast is not excessively high.

The natural tendency of the people as a whole is toward conservatism; consequently new devices are adopted very slowly. This is shown in a striking manner by the fact that even in such cities as Santiago and Buenos Aires, where the temperature falls to freezing point occasionally and for two or three months hovers around 50 degrees Fahrenheit, no provision is made for warming the houses. By many it is considered unhealthful to have any artificial heat in homes and offices. This feeling is disappearing gradually, however, and an example is being set by hotels, office buildings and modern apartments, which are now installing either some central-heating system or means for local heating.

Such wiring rules as there are permit the use of European designs, which in many things, particularly wiring devices, are much cheaper than American. There is little prospect of a radical change in this situation at an early date, though there is a strong movement toward an elevation of standards. That this condition exists is not at all surprising, since for many years European factories and merchants have had agents and representatives on the ground advertising and pushing their goods. It was part of their propaganda to secure the adoption of specifications and regulations favoring their own products, and as Americans offered little or no resistance, the European representatives soon had everything on a basis as advantageous to themselves as it was disadvantageous to us. In addition, they have established strong banks and commercial houses in large and small cities and have earned through hard work the trade that is theirs.

During the last three years American banks have been established in a number of cities, so that to-day there is no considerable importing center without one. Any manufacturer, therefore, who does wish to enter this field will find that he is able to secure credit information through them, as well as much other assistance, including the handling of documents, with the result that if care is used in the selection of persons to whom credit is extended, the loss on accounts will be practically nothing.

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LIST OF CENTRAL STATIONS IN CHILE, URUGUAY, ECUADOR AND PERU

CENTRAL STATIONS IN CHILE

Location and Nature of Plant	Motive Power	Total Capacity, Kw.	Characteristics of House and Power Circuits	Make of Machinery
ANCUD				
Luz Eléctrica Ancud	Steam	25	230-volt D.C.	German
ARICA				
Cia. Alumbrado de Arica	Petroleum	200	220/440-volt D.C.	American
ANTOFAGASTA				
Cia. de Electricidad Antofagasta.	Petroleum	1000	220/440-volt D.C.	English
BUIN				
Luz i Fuerza Electrica de Buin	Pet., steam and water	590	110 and 220-volt A.C. 1 Ph., 50 Cy.	German
CALERA				
Cia. Luz Electrica de Calera	Water	40	220/440-volt D.C.	German
CHILLAN				
Cia. General de Electricidad Industrial	Water	510	250/500-volt D.C.	German
CONCEPCION				
Cia. de Luz Electrica de Concepción	Steam	1,350	230/460-volt D.C.	German
Cia. Electrica de Concepción	Steam	600	550-volt D.C.	American
COQUIMBO				
Empresa Electrica de Coquimbo.	Pet. and gas	280	220/440 volt D.C.	American and German
CORONEL				
Cia. de Luz Electrica de Coronel.	Steam and gas	175	220-volt D.C.	German
COYA				
Braden Copper Company	Water	13,000	2300-volt A.C. 3-Ph., 60 Cy.	American
CRUZ GRANDE				
Bethlehem Chile Iron Mines Company	Steam	7,300	2300-volt A.C. 3-Ph., 60-Cy.	American
(Railway voltage, 1200 volts and 2400 volts, D.C., power voltage, 220/440 or 2300-volt A.C., three-phase, 60 cycles.)				
CURICO				
Cia. Electrica de Curicó	Water	350	220-volt A.C. 3 Ph., 50 Cy.	German
Cia. General de Electricidad Industrial	Pet. and water	200	220/440-volt D.C.	German
IQUIQUE				
Cia. de Alumbrado	Pet. and gas	1,300	110-volt A.C. 1 & 2-Ph., 60 Cy.	American and English
LINARES				
Empresa Eléctrica	Water	35	220/440-volt D.C.	English
LLAILLAI				
Empresa Eléctrica	Pet. and water	275	220/440-volt D.C.	German
LONCOCHE				
Luz Eléctrica de Loncoche	Steam	55	250-volt D.C.	German
LA SERENA				
Empresa Eléctrica	Pet, steam and water	400	220/440-volt D.C.	English and German
LA UNION				
Empresa Eléctrica	Water	250	220-volt A.C. 1-Ph., 50 Cy.	German
LOS ANDES				
Cia. Eléctrica de Los Andes	Steam and water	600	210-volt A.C. 1-Ph., 50 Cy.	German
LOS ANJELES				
Empresa Eléctrica	Water	125	115/230-volt D.C.	German
LO BRAVO				
Cia. General de Electricidad Industrial	Steam and water	175	110/220-volt A.C. 1-Ph., 50 Cy.	English
MEJILLONES				
Antofagasta & Bolivia Railway Company	Steam	570	250/500-volt D.C.	English
OSORNO				
Empresa Eléctrica	Steam	450	220/440-volt D.C.	German
OVALLE				
Empresa Eléctrica	Petroleum	45	220/440-volt D.C.	German
PANGAL				
Braden Copper Co	Water	15,000	.....	.....
PUERTO MONTT				
Luz Eléctrica de Puerto Montt	Steam	14	230-volt D.C. 1 and 3 Ph., 60 Cy.	German
PUNTA ARENAS				
Cia. de Alumbrado Eléctrico de Punta Arenas	Pet. and steam	1,350	100 and 220-volt A.C. 1 and 3-Ph., 60 Cy.	English
QUILLOTA				
Empresa Eléctrica	Petroleum	250	220/440-volt D.C.	English and German
RANCAGUA				
Cia. General de Electricidad Industrial	Steam and water	100	220/440-volt D.C.	German
SANTIAGO				
Chilian Electric Tramway & Light Company, Ltd	Steam and water	15,300-water 14,000-steam	220/440 D.C.	German
SAN BERNARDO				
Ferro Carril Eléctrico de San Bernardo a Santiago	Steam, gas and water	500	220-volt A.C. lights, 550-volt D.C. street ry.	American and German
SAN FELIPE				
Cia. Luz Eléctrica de San Felipe	Gas and water	200	220/440-volt D.C.	English and German
SAN FERNANDO				
Cia. General de Electricidad Industrial	Gas and water	100	220/440-volt D.C.	English
TACNA				
Empresa Eléctrica de Tacna	Petroleum	280	220/440-volt D.C.	American
TALCA				
Empresa Eléctrica	Water	200	220/440-volt D.C.	German
TADCAHUANO				
Cia. de Luz Eléctrica	Gas	170	220/440 volt D.C.	English
TALTAL				
Taltal Electric Light Co	Petroleum	90	250-volt D.C.	American
TEMUCO				
Cia. Genral de Electricidad Industrial	Water	460	220/440-volt D.C.	Amer. and German
TOCOPILLA				
Empresa Eléctrica	Petroleum	50	220-volt D.C.	German
Chilian Exploration Company	Steam	40,000	.....	German
(Transmission to the mines at Chuquicamata at 110,000 volts, three-phase 60 cycles.)				
TOME				
Cia. de Luz Eléctrica	Steam	100	230/460-volt D.C.	German
VALDIVIA				
Cia. de Luz Eléctrica de Valdivia.	Steam	780	220/440-volt D.C.	German
VALLENAR				
Cia. Eléctrica de Vallenar	Gas	40	230-volt D.C.	German
VALPARAISO				
Cia. Tranvias Eléctricas de Valparaiso	Steam and water	3,600-water 2,000-steam	220/440-volt D.C.	German
VICTORIA				
Empresa Eléctrica	Steam	82	220-volt D.C.	German
VIN VINA DEL MAR				
Empresa Eléctrica	Steam and gas	700	220/440-volt D.C.	English
YUMBEL				
Empresa Eléctrica	Water	32	220-volt D.C.	German

CENTRAL STATIONS IN URUGUAY

Location and Nature of Plant	Motive Power	Total Capacity, Kw.	Characteristics of House and Power Circuits	Make of Machinery
CANELONES				
Usinas Eléctricas del Estado	Petroleum	55	220-volt D.C.	American
CARMELO				
Empresa Eléctrica de Carmela	Petroleum	118	220-volt D.C.	.....
COLONIA				
Usinas Eléctricas del Estado	Steam	495	220-volt A.C. 3-Ph., 50 Cy.	German
DURAZNO				
Empresa Eléctrica de Durazno	Producer gas	163	220-volt D.C.	German
FLORIDA				
Empresa Eléctrica de Florida	Petroleum and producer gas	191	150-volt D.C.	.....
FRAY BENTOS				
Municipalidad de Fray Bentos	Steam	80	110-volt D.C.	.....
LA PAZ				
Usinas Eléctricas del Estado	Substation fed from Montevideo	...	220-volt A.C. 3-Ph., 50 Cy.	.....
LAS PIEDRAS				
Usinas Eléctricas del Estado	Substation fed from Montevideo	...	220-volt A.C. 3-Ph., 50 Cy.	.....
MALDONADO				
Usinas Eléctricas del Estado	Petroleum	160	220-volt A.C. 3-Ph., 50 Cy.	Swiss
MELO				
Empresa Eléctrica de Melo	Steam	190	220-volt D.C.	.....
MERCEDES				
Empresa Eléctrica de Mercedes	.....	....	135-volt A.C. 1-Ph., 50 Cy.	.....
MINAS				
Empresa Eléctrica de Minas	.....	....	135-volt A.C. 1-Ph., 50 Cy.	
MONTEVIDEO				
Usinas Eléctricas del Estado	Steam	17,000	220-volt A.C. 3-Ph., 50 Cy.	.....
(To be increased to 27,000 kw., with the installation of the new turbo-generator unit bought in the United States—General Electric Co.—in 1918.)				
PANDO				
Usinas Eléctricas del Estado	Petroleum	160	220-volt A.C. 3-Ph., 50 Cy.	Swiss
PAYSANDU				
Empresa Eléctrica de Paysandú	.....	....	220-volt D.C.	.....
PUNTA DEL ESTE				
Usinas Eléctricas del Estado	Substation fed from Maldonado	...	220-volt A.C. 3-Ph., 50 Cy.	.....

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LIST OF CENTRAL STATIONS IN CHILE, URUGUAY, ECUADOR AND PERU *(Continued)*

Location and Nature of Plant	Motive Power	Total Capacity, Kw.	Characteristics of House and Power Circuits	Make of Machinery
RIVERA				
Empresa Eléctrica de Rivera		....	220-volt D.C.	.....
ROCHA				
Empresa Eléctrica de Rocha		....	220-volt D.C.	.....
SALTO				
Empresa Eléctrica de Salto		...	220-volt D.C.	.....
SAN CARLOS				
Usinas del Estado	Substation fed from Maldonado	...	220-volt A.C. 3-Ph., 50 Cy.	.....
SAN JOSE				
Empresa Eléctrica de San José		...	220-volt D.C.	.....
TACUAREMBO				
Usinas del Estado	Steam	150	220-volt D.C.	.....
TRINIDAD				
Empresa Eléctrica de Trinidad	Petroleum	219	220-volt D.C.	German

The Administration General of the Usinas Eléctricas del Estado is ready to undertake the establishment of plants in the following places as soon as the conditions are more favorable: Artigas, Dolores, José Battalle y Ordoñez, Nueva Palmira, Rosario, San Eugenio, Santa Lucia, Sarandi del Yi, Trinta y Tres.

CENTRAL STATIONS IN ECUADOR

Location and Nature of Plant	Motive Power	Total Capacity, Kw.	Characteristics of House and Power Circuits	Make of Machinery
AMBATO				
Municipalidad de Ambato	Water	200	110-volt A.C. 1-Ph., 60 Cy.	American
AZOGUES				
Cía. Trifásica de los Rios	Petroleum	30	120-volt A.C. 1-Ph., 60 Cy.	American
BABAHOYA				
Cía. Trifásica de los Rios	Petroleum	100	120-volt A.C. 1-Ph., 60 Cy.	American
CAJABAMBA				
Municipalidad de Cajabamba	Water	40	110-volt A.C. 1 Ph., 60 Cy.	American
CAYAMBO				
Municipalidad de Cayambo	Water	40	110-volt A.C. 1 Ph., 60 Cy.	American
CUENCA				
Municipalidad de Cuenca	Water	375	110-volt A.C. 1 Ph., 60 Cy.	American
Roberto Crespo O	Water	100	110 volt A.C. 1 Ph., 60 Cy.	American
CHONE				
Municipalidad de Chone	Steam	50	110-volt A.C. 1Ph., 60 Cy.	American
GUANO				
Cía. Trifásica de los Rios	Water	50	110-volt A.C. 1 Ph., 60 Cy.	American
GUARANDA				
Cía. Trifásica de los Rios	Water	120	110-volt A.C. 1 Ph., 60 Cy.	American
GUAYAQUIL				
Empresa Luz y Fuerza Eléctrica	Steam and pet.	1000	110-volt A.C. 1 Ph., 42 Cy.	French
HUIGRA				
Guayaquil & Quito Railway	Water	20	120-volt D.C.	American
IBARRA				
Municipalidad de Ibarra	Water	50	220-volt D.C.	American
LATACUNGA				
Municipalidad de Latacunga	Water	50	110-volt A.C. 1 Ph., 60 Cy.	American
LOJA				
Empresa Luz Eléctrica de Loja	Water	40	220-volt D.C.	American
MACHACHI				
Cía. Trifásica de los Rios	Water	60	120-volt A.C. 1 Ph., 60 Cy.	American
MILAGRO				
E. Morgner & Co	Steam	2	120-volt D.C.	.....
OTOVALO				
Compañía Pinto	Water	30	110-volt A.C. 1 Ph., 60 Cy.	American
PUJILI				
Municipalidad de Pujilí	Water	30	110-volt A.C. 1 Ph., 60 Cy.	American
QUITO				
Quito Electric Light & Power Co.	Water	600	110-volt A.C. 1 Ph., 60 Cy.	American
RIOBAMBA				
Granize & Falconi	Water	250	110-volt A.C. 1 Ph., 60 Cy.	American
VINCES				
Cía. Trifásica de los Rios	Petroleum	50	120-volt A.C. 1 Ph., 60 Cy.	American

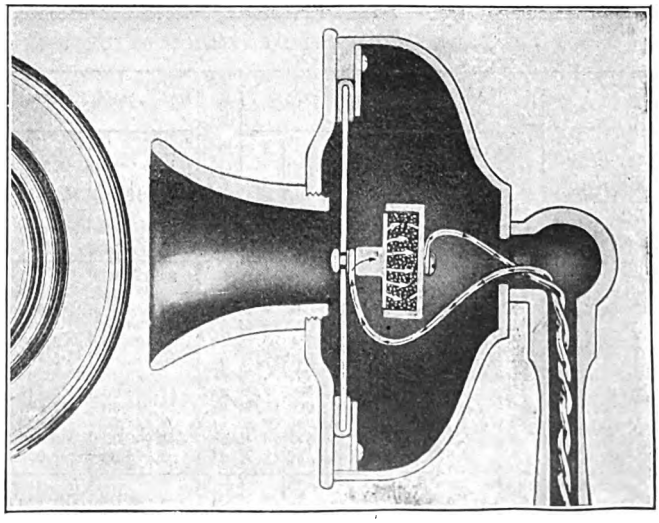
CENTRAL STATIONS IN PERU

Location and Nature of Plant	Motive Power	Total Capacity, Kw.	Characteristics of House and Power Circuits	Make of Machinery
AREQUIPA				
Sociedad Eléctrica de Arequipa	Water	1,760	220-volt A.C. 3-Ph., 50 Cy.	German
CASAPALCA				
Backus & Johnson	Water	2,300	110/440-volt A.C.	German
Ricardo Bentin	Water	500	110/220-volt A.C.	American and German
CUZCO				
Compañía Eléctrica Cuzco	Water	1,000	220-volt A.C. 3-Ph., 60 Cy.	Italian
CHICHA ALTA				
Empresa Eléctrica de Chicha Alta	Gas	50	110-volt D.C.	American
CHICLAYO				
Empresa Eléctrica de Chiclayo	Steam and gas	275	110-volt A.C. 3-Ph., 60 Cy.	Amer. and German
HUACHO				
Empresa Eléctrica de Huacho	Water	50	110-volt A.C. 3-Ph., 60 Cy.	American
HUANCAYO				
Martinelli Hermanos	Water	25	220-volt A.C. 1-Ph., 50 Cy.	German
HUARON				
Compañía Mina de Huaron	Water	200	220-volt A.C. 3-Ph., 50 Cy.	Amer. and German
ICA				
Empresa Eléctrica de Ica	Water	30	220-volt A.C. 1-Ph., 50 Cy.	German
JUNIN				
Eulogio Fernandini	Water	500	220-volt A.C. 3-Ph., 50 Cy.	German
LIMA				
Empresas Eléctricas Asociadas	Water and steam	12,000	220-volt A.C. 3-Ph., 60 Cy.	American
MOLLENDO				
Empresa Eléctrica de Mollendo	Petroleum	25	110-volt A.C. 1-Ph., 60 Cy.	American
OROYA				
Cerro de Pasco Mining Company	Water	20,000	220/550-volt A.C. 3-Ph., 60 Cy.	American
PISCO				
Empresa Eléctrica de Pisco	Petroleum	40	240/480-volt D. C.	American
PUNO				
Empresa Eléctrica de Puno	Steam	55	110 A.C. 3-Ph., 60 Cy.	American
TALARA				
London & Pacific Petroleum Co.	Petroleum	700	110/440-volt A.C. 3-Ph., 60 Cy.	American
TARMA				
Empresa Eléctrica de Tarma	Water	40	220-volt A.C. 1-Ph., 50 Cy.	German
TRUJILLO				
Empresa Eléctrica de Trujillo	Water	60	220-volt A.C. 1-Ph., 50 Cy.	German

MOTION PICTURE SHOWS WHY TELEPHONE TALKS

A Visualization of What Happens Scientifically When This Instrument Is Used Interests Audience of Engineres

On Wednesday evening of last week, at the session of the American Institute of Electrical Engineers' mid-winter convention, the Bray Studios, Inc., New York, presented a motion picture that visualized what happens in a telephone. The spherical sound wave vibrates the diaphragm, which in turn varies the resistance of the carbon particles and causes the variation of current in the connecting wires. The picture was animated by E. Dean Parmelee and Max Fleisner.



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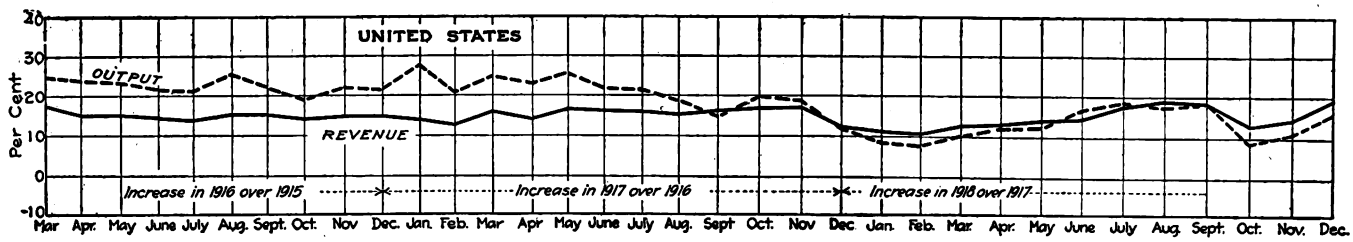
Central Station December Operations



THOUGH CONVERSION OF INDUSTRIES WAS UNDER WAY, DECEMBER SHOWED LARGE INCREASES

DECEMBER, 1918, operations of the central stations reporting to the ELECTRICAL WORLD show the large increase of 19.1 per cent in revenue and 15.6 per cent in kilowatt-hour output over December, 1917. The preliminary statistics are from 45 per cent of the industry and of course are subject to change when the returns are in from the 60 per cent of the industry usually represented in the compilation. This is a very favorable showing, and it reflects industrial activity of tremendous scope. The more striking item is the gain reported in revenue, which exceeds any other of the high rates of increase generally reported during the months of 1918. August showed 18.5 per cent gain, and July and September were not far from that figure, but the other months were substantially lower in percentage of gain. Output gains fluctuated to a greater extent during the months of 1918, and the December record of increase was below the returns of the four months from June to September inclusive. The December record, however, carries much encouragement.

The first month after the signing of the armistice, December was a time of partial transition. The manufacture of war munitions and supplies was continued to some extent, and where that policy was followed it meant sustained demand for electrical energy. Other influences, however, developed, among them the very sharp cancellation of contracts in many instances, the maintenance of production in certain cases with the object of lessening labor non-employment, and the rapid steps to restore normal peace-time industries. All of these factors are represented in the returns and it is to be expected that such influences will be reflected in the figures until the national and international situation has a greater measure of stability.

Based on the statistics from 45 per cent of the industry, the ELECTRICAL WORLD estimates for December for the entire industry are: Revenue, $51,651,000; output, 2,367,633,000 kw.-hr.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Per-centage of In-dustry Repre-sented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent In-crease	1918	1917	Per Cent In-crease
Jan.	62	$27,035,000	$24,977,000	8.2	1,508,353,000	1,422,121,000	6.3
Feb.	60	24,690,000	22,307,000	10.6	1,254,217,000	1,168,288,000	7.1
Mar.	60	25,396,000	22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct..	56	26,254,000	23,228,000	13.0	1,517,866,000	1,392,359,000	9.0
Nov.	53	25,149,000	21,873,000	14.1	1,251,805,000	1,119,929,000	10.9
Dec..	45	23,243,000	19,513,000	19.1	1,065,435,000	921,634,000	15.6

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and Mountain States		
			1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase
REVENUE	Jan.	63	$3,393,000	$2,990,000	13.8	64	$9,677,000	$9,517,000	1.6	53	$8,862,000	$7,639,000	16.8	86	$5,113,000	$4,831,000	5.8
	Feb.	62	2,995,000	2,272,000	8.0	57	9,473,000	8,658,000	8.6	53	7,779,000	6,746,000	15.3	84	4,443,000	4,131,000	9.5
	March.	62	2,985,000	2,724,000	9.2	59	9,904,000	8,922,000	11.0	53	7,947,000	6,735,000	18.0	84	4,560,000	4,321,000	5.5
	April	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824,000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug.	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sept.	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct.	63	3,360,000	3,036,000	10.6	51	8,822,000	7,924,000	11.3	50	9,218,000	7,848,000	17.4	81	4,854,000	4,420,000	9.8
	Nov.	64	3,695,000	3,238,000	14.1	54	10,092,000	8,883,000	13.6	39	6,328,000	5,200,000	21.7	81	5,034,000	4,552,000	10.6
	Dec.	64	4,097,000	3,449,000	18.7	44	9,406,000	8,038,000	17.0	34	6,621,000	5,318,000	24.5	62	3,119,000	2,787,000	15.2
KW.-HR. OUTPUT	Jan.	63	125,212,000	111,339,000	12.4	64	477,200,000	466,158,000	2.3	53	486,291,000	453,009,000	7.3	86	419,651,000	391,624,000	7.3
	Feb.	62	110,454,000	102,562,000	7.7	57	438,721,000	403,122,000	8.3	53	358,276,000	342,257,000	4.5	84	346,766,000	320,025,000	8.4
	March.	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug.	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept.	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct.	63	139,784,000	128,970,000	8.3	51	481,222,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov.	64	138,559,000	123,033,000	12.6	54	450,210,000	406,725,000	10.6	39	259,470,000	221,934,000	16.9	81	403,566,000	368,237,000	9.6
	Dec.	64	145,543,000	129,838,000	12.1	44	373,150,000	327,539,000	13.9	34	268,213,000	231,530,000	15.8	62	278,529,000	232,727,000	19.6

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

PENETRATION AND OVERLAP INDICATE WELD QUALITY

Easily Observed by Visual Inspection When Moving Arc Terminal Over Plate with Uniform Velocity

Penetration of deposit metal into the plate metal and overlap of the edge of the deposit layer on the plate are two good indications of the quality of a weld, said O. H. Eschholz in a paper presented before the American Institute of Electrical Engineers recently. Both of these can be observed by visual examination. The penetration ought to be at least $\frac{1}{16}$ in. (1.6 mm.).

Extreme overlap is sometimes due to a low-melting-point electrode or too great speed of arc travel. For a given arc current it has been the author's experience that fusion is not improved with increase in arc length, that the best weld characteristics are obtained when holding a short arc, not longer than $\frac{1}{8}$ in. (3.2 mm.) and preferably about $\frac{1}{16}$ (1.6 mm.). With a given arc length the ease of securing complete fusion increases with arc current until a maximum value is reached beyond which further increase results in a weakened weld structure.

When the molten material passes through a short arc it is quite completely enveloped by hot gases and suffers but a slight loss in temperature before being deposited. Upon drawing a long arc the air currents in its vicinity blow the arc stream and arc flame about violently, so that it is difficult to maintain the plate terminal of the arc in a given position long enough to effect sufficient penetration. Moreover, the energy absorbed from the arc stream and electrode terminal becomes practically negligible, owing to the greater diffusion of the radiation in the region of the arc plate terminal, while the energy absorbed from the molten metal is decreased because of the loss in temperature the deposit has sustained in transition.

Slight Overlap Often Permissible

For most purposes a slight overlap is permissible in single layers as a simple procedure of depositing the subsequent layers will fuse the overlapped areas. If the width of a layer is increased by weaving the electrode back and forth the percentage overlap will be decreased. However, it may be eliminated by the simple expedient of always overlapping adjacent layers.

To minimize the occurrence of unfused areas, the melting point of the electrode metal should exceed that of the plate metal. The melting point of most weldable steels may be gaged with sufficient accuracy by their carbon content.

While pure iron possesses the highest melting point, its use is not advisable since excessive oxidation of the vaporized metal occurs. However, a commercially pure iron alloyed with about 0.18 per cent carbon and 0.5 per cent manganese greatly reduces the oxidation and improves the ease of manipulation without an appreciable sacrifice in melting point. For most purposes the use of this electrode gives a reasonable minimum overlap.

Preheating Is a Good Practice

Under exceptional conditions, such as high thermal capacity of weld or overheat welding with a low current, it is advisable to preheat the object to be welded or to adopt a welding procedure which utilizes the thermal energy from preliminary welding operations to raise the temperature of the object welded, in order to prevent excessive overlap.

For a given plate thickness the welding current will vary with the type of weld scarf, cleanliness of surface, thermal capacity and conductivity of the metal, and position of plate with respect to the welder. Excessive overlap and unsatisfactory penetration may be caused by applying too small an amount of energy at the arc crater, whereas the excessive energy consumption at the plate arc thermal produces excessive penetration. Further increase in current causes cutting. Unskilled workers using full arc current can obtain about 85 per cent weld strength, whereas if the current drop to 80 per cent normal value only 40 per cent strength will be had.

For miscellaneous direct-current welding the densities usually fall within a range of 7000 amp. to 10,000 amp. per square inch, if an 0.18 per cent carbon-steel electrode is used. However, whenever practicable, the author prefers a closer range of 8000 amp. to 9000 amp. per square inch. With too great an electrode diameter for a given current, the arc becomes more unstable, increasing the manipulative skill required and decreasing the rate of depositing electrode material. Too small a diameter causes a deposition of electrode materail before the plate has been properly liquefied; it also results in overheating and softening of electrode, which increases the skill required to prevent the electrode "freezing" to the plate.

In butt welding $\frac{1}{2}$-in. (1.27-cm.) low-carbon steel plates $\frac{5}{32}$ in. (4 mm.) in diameter, welding electrodes containing approximately 0.18 per cent carbon and 0.5 per cent manganese, would preferably be used with an arc current of approximately 150 amp. With moderate skill the strength of weld should approximate 90 per cent that of the plate. If the same current and electrode diameter are used in welding a lap joint formed from $\frac{1}{2}$-in. plates, poor fusion will be obtained owing to the increased thermal capacity of the abutting sections. To secure complete fusion on both faces of a lap joint it is necessary to increase the arc current and with it the electrode diameter.

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METER TERMINAL BLOCK THAT FACILITATES TESTING

Found Possible by Its Use to Double Number of Meters Tested by the Scranton Electric Company's Laboratory

BY JOS. N. MC CLURG, SOUTHERN ELECTRIC COMPANY

By using the terminal block shown in the accompanying illustration in testing meters it is unnecessary to remove the terminal covers of the meters. Thus the time ordinarily consumed in performing this operation as well as connecting the leads to the meters is saved. The

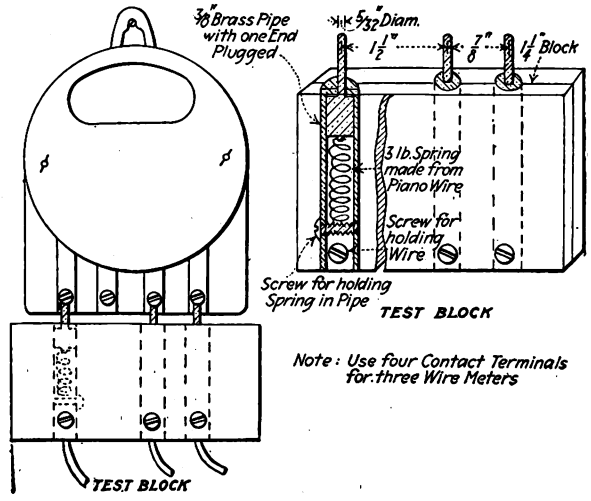

FIG. 1—METER-TESTING TERMINAL BLOCK

block is being used in the laboratory of the Scranton, (Pa.) Electric Company, where it has doubled the number of meters that can be tested per day.

The terminal is made from a piece of ¼-in. (6-mm.) brass pipe with one end plugged. In the center of this plug is an 11/64-in. (4-mm.) hole, in which the contact rod works freely. The end of the contact rod inside the pipe is fitted with a sort of piston which presses

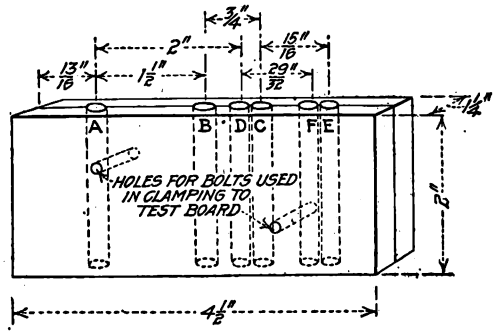

FIG. 2—TESTING BLOCK ADAPTED TO THREE MAKES OF METERS

against a spring made of steel piano wire. The latter exerts a force of 3 lb. (1.4 kg.) and thus insures good contact with the meter terminals without raising the meter from the supporting screws.

The particular terminal block shown is suitable only for testing meters the terminals of which are the same distance apart as those on the block. The principle shown can be applied, however, in making a terminal block which will be adaptable to several different types of meters. For instance. if G. E. types I14 and K5, Westinghouse type OA and Sangamo type H meters are to be tested, split terminal blocks 4½ in. (11.4 cm.) wide by 1½ in. (3.8 cm.) combined thickness can be provided with receptacles spaced as shown in Fig. 2. For testing the G. E. meters the terminals can be placed in holes *A*, *B* and *C;* for Westinghouse meters they can be placed in holes *A*, *D* and *E*, while for Sangamo meters the terminals can be inserted in holes *A*, *D* and *F*. The block is split to facilitate changing the positions of the terminals.

For holding the blocks securely against the test board bolts may be run through the blocks and test board and drawn up tight with wing nuts. To use the block with Westinghouse meters a ¼-in. (6-mm.) strip has to be inserted between the blocks and the test board to bring the terminals into the proper position.

The springs have been tested for heating, and it has been found that 25-amp. test current can be easily employed without overheating them.

FAILURES PROVE TO BE FEW IN REINSTALLED CABLE

Experience Shows the 9000-Volt and 12,000-Volt Lead-Covered Cable Can Be Pulled Out of Ducts, Reinstalled and Operated at Rated Potentials

The Commonwealth Edison Company, Chicago, began removing and reinstalling transmission cable on a large scale in the spring of 1917. On Sept. 8, 1917, after about 75 miles of the cable had been moved, the ELECTRICAL WORLD published an article showing something of the methods used in doing the work and stating that the approximate saving made at that time by reusing the old cable was about $200,000. The company has now moved 107 miles out of a total of 726 miles of 9000-volt and 12,000-volt cable which it owns. Hence the cable which has been moved amounts to 15 per cent of the total.

With such a large percentage of total cable transferred from one location to another a comparison of the annual records covering cost of repairing burn-outs is interesting.

Data on the cost of repairing burn-outs for 1914 and 1915 represent fairly well what the normal conditions were before reinstalled cable was used. In those years the expense of repairing burn-outs averaged about $13,800. Since the reinstalled cable has been operating (in 1917 and 1918) the cost of burn-outs has averaged $10,500. By these data it is not intended to prove that the simple act of reinstalling cable improves the quality of the cable, but it is a fact that when the cable is pulled out and inspected places are discovered in it which would have sooner or later resulted in failures. Such weak places can be removed from the cable before it is replaced in the ducts. This fact has been partly responsible for the good service record. Thus, while it cannot be said that moving the cables was the cause of the lessened expense of repairing burn-outs in the last two years, the figures do indicate that the amount of cable trouble has not increased on account of the transfer. The few burn-outs which have occurred on the reinstalled cable bear out this general idea, as they are not attributed to causes associated with reinstallation. Insulation tests also bear out the belief that the reinstalled cable is in good shape.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

EFFECT OF WAR ON 1918 CENTRAL-STATION BUSINESS

Increase in the Sales to the Smaller Factories Was Less than the Average, but to Large Factories and Residences It Was Greater

An interesting sidelight on the effect of the war on central-station business in 1918 is given by Alex Dow, president of the Detroit Edison Company, in his annual report. He said in part:

Our sales of power to the smaller factories showed less than the average increase. On the other hand, our sales of power to the larger factories, and particularly to those which promptly undertook war work, increased beyond the average for the year. Residence lighting, which is an important part of our business (175,967 residences were served in December and $3,188,512.65 earned by that service in the twelve months), likewise showed more than the year's average increase. This is due to an increase in the number of residences connected, and not to a commensurate increase in use by the average residence customer, who in 1918 was likewise asked by the government to practice economy of light and fuel.

The increase in sales of power to large factories was the result in a measure of their working night shifts and of overtime and Sunday work. The stoppage of overtime, etc., by government instructions after the signing of the armistice coincided with the removal of the Fuel Administration's restrictions on display lighting, so that there was no net resultant effect upon our December earnings, although the effect of each official order is clearly recognizable in the daily load curves.

EXPERIENCE WITH BONUS SYSTEM FOR METER READING

Found Unsatisfactory in Cleveland Owing to Human Element and Unequal Density of Meters in Different Districts

Experience with a bonus system of paying for meter reading was told of by J. T. Kermode before the recent meter conference of the Ohio Electric Light Association. As an experiment, beginning Jan. 1, 1918, a bonus system was adopted in Cleveland by which the meter readers were paid a certain rate per month with a bonus for all readings turned in in excess of an average number per day. It was considered that the bonus system would act as an incentive for men to work harder and that the amount earned would be proportionate to the amount of energy that a man would spend on his work. Unfortunately, Mr. Kermode stated, there were not sufficient data to know how just how a bonus system should be applied so that all readers would receive equal opportunities. Theoretically, a bonus system should overcome the difficulty of securing men as there are excellent opportunities to gain a good bonus. As a matter of fact, the speaker said that the bonus system caused considerable dissatisfaction for two reasons—first, the human element and, second, the unequal density of meters in different districts.

On the human-element side it was quite natural, the speaker said, for a reader to pass by individual meters in out-of-way places so that he could get to groups of meters readily accessible. Besides, it was quite common for readers to enter readings without visiting the customer's premises. But it is well known that pick-up readings or check readings due to errors are very expensive. The speaker said that the bonus system no doubt lowered the unit cost of meter reading, but the total cost of reading, pick-up readings and errors was considerably higher than the total cost of operation under a salary system.

Mr. Kermode stated that the density of meters in some districts permitted a reader to earn a fairly good bonus without much effort, while in another district the same reader could not earn a bonus no matter how hard he worked. To make conditions fairly equal, therefore, it would have been necessary to rotate the readers to different districts. Where there are a large number of districts, the readers, it was pointed out, could not become well enough acquainted in any particular district to read with sufficient speed to permit them to make a satisfactory rate of pay. Perhaps some sort of bonus can be successfully applied, Mr. Kermode stated, but he was of the opinion that it is a question if the cost of keeping track of the work performed by each man would not offset any advantage gained in the reading cost. While the unit cost of meter reading on a bonus system may be lower, the speaker was of the opinion that the total cost is higher.

WAY IN WHICH TO TACKLE AN ELECTRIC HEATING JOB

Information Which Power Salesmen Must Secure, Reasons Why It Is Needed, and Suggestions as How Best to Use It

In the determination of the amount of power required in any electric industrial heating process there is a certain amount of general information to be secured before an intelligent calculation can be made as to the kilowatt-hours of energy that will be required and the kilowatt demand necessary for a satisfactory application. It is the power salesman's job to get this information and to make use of it. Some of the points to be remembered in connection with this work which were outlined by Wirt S. Scott before the new-business committee of the Ohio Electric Light Association are presented below.

The material or work to be heated must first be considered. A given kind of material requires a definite amount of power to raise its temperature 1 deg. Fahr.,

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which is referred to as specific heat and which has been determined for nearly all materials in use.

The initial maximum and final temperatures to which the material will be heated constitute the second group of factors. By initial temperature is meant the temperature at which the material is placed in the oven, furnace or container. This may or may not be room temperature, depending upon whether or not the material has previously been heated and has had an opportunity to cool off completely. The maximum temperature is that required to produce a certain chemical change or a certain result in the heating of the material. The final temperature, while often, is not necessarily the maximum temperature. A piece of work will enter a continuous oven or furnace at some initial temperature, be heated to a maximum temperature, then before leaving the oven or furnace be subjected to cooling by entering a chamber in which no heat is applied or by blowing cold air over the work. In either case a certain amount of heat which the material previously has absorbed when subjected to the full force of the heat will be given off in the oven or furnace and utilized in preheating the work entering the oven or furnace, or may be used in supplying part of the heat required to maintain the necessary temperature. In such cases, so far as heating the material is concerned, the power required will depend upon the initial and the final temperatures.

The size of the oven, furnace or container is a third consideration, owing to radiation losses.

The kind of material of which the container is made is also important because radiation losses depend upon the rapidity with which heat is conducted from the interior to the exterior. Steel produces heat 1000 times as fast as a high-grade magnesia or diatomaceous earth, hence, 1 sq.in. of steel extending from the inside to the outside of the container will conduct as much heat as 7 sq.ft. of high-grade insulation. The importance of eliminating bolts, rods, etc., extending through the container walls is apparent.

Thickness of container walls is another factor. With the heating done within the interior of the container, the rate at which the heat will flow through the walls will be inversely proportional to their thickness.

Weight of movable and immovable racks, trays or trucks within an oven or other container and their initial temperature are the sixth factor for determination. These accessories absorb heat just as much as the work does, and the power to heat them must be determined. It is desirable to have racks and trucks as light as can safely be used, also to maintain them at a temperature as high as possible by keeping them in the oven with the doors closed when not in use, or by returning them to the oven as quickly as possible.

The length of time the oven, furnace or container is out of operation between heats is a point to note. All substances absorb heat, even the walls of the oven. The amount of heat initially absorbed by an oven may easily be three or four times that required for the work. If the oven is allowed to cool off completely after each operation, an enormous amount of heat is lost in proportion to that utilized.

The eighth point is the amount of ventilation required. In many baking and drying processes a certain amount of ventilation is necessary, either to supply the oxygen required by the chemical change undergone in the heat treatment or to hasten the evaporation of moisture. The air usually enters at room temperature and is discharged at the maximum oven temperature. Seldom does the customer know the amount of ventilation he is using or the amount required to produce the best results.

The amount of moisture to be evaporated in the process is a particularly important factor. In a drying process the work may be partly saturated with water. In other instances a thin film may cover the surface of the work.

RATE INCREASES ARE MADE EASY IN HOME-RULE CITIES

Colorado Company Made Appeal First to Local Officials, After Which the Public Service Commission Acted Quickly

When the Western Light & Power Company of Boulder, Col., which furnishes service to thirty-two towns in northern Colorado and Cheyenne, Wyo., had to secure increased rates recently, it became apparent that owing to the inclusion of the "home-rule" cities of Boulder and Fort Collins in the territory the company served, special procedure would have to be employed. Home-rule cities have rate regulation under their supervision, and the Supreme Court has repeatedly handed down decisions justifying the contention of such cities denying the right of the Public Utilities Commission to fix rates for them. For that reason the company was careful that its application for the increase in rates should first be made to the city authorities in all of the towns served by the company, and their indorsement was secured before taking the matter up with the Public Service Commission.

In carrying out this campaign, D. A. Hegarty, vice-president, and C. A. Semrad, general manager of the company, appeared before the governing bodies in each of the cities and towns and explained to them carefully the situation which necessitated the increase in rates. By laying the cards face down on the table and meeting the public on a fair and open basis, they received the consent of the governing bodies of each of the towns and also the support of the newspapers throughout the territory. The applications for increases were filed simultaneously with the Public Utilities Commissions of Colorado and Wyoming, together with the resolutions approving the increase in rates from the governing bodies of the cities and towns affected and the favorable press notices.

The commissions immediately set dates for hearings on the applications fifteen days after the applications were filed. As there were no protestants against the increase at the hearings, the applications were granted, effective thirty days after filing.

In such cases it will frequently be found that the cities block rate increases not so much because the city officials believe that higher rates are not justified but because they are exceedingly jealous of their rights. In many instances in the last year it has been proved that to get the consent and backing of the local community is really simple, provided always, of course, that the utility begins at that place.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Performance of Motor-Generator Sets.—F. T. HAGUE.—The writer deals particularly with the performance of high-voltage motor-generator sets for the Chicago, Milwaukee & St. Paul Railway system. The service requirements for these sets differ from those of motor-generator sets operating at lower railway voltages in that great care must be exercised to prevent the flash-over of machines built for high voltage and large power. The necessity for improving the commutating performance of these machines involves a considerable revision of the standards of operating characteristics acceptable on low-voltage installations.—*Electric Journal,* February, 1919.

Operating Conditions in Transformer Practice.—E. G. REED.—The writer states that about 80 per cent of the distributing transformers which burn out are below 7.5 kva. in capacity, and of these about 65 per cent fail from overload, thus pointing out the necessity of properly fusing pole-line transformers. One of the very serious causes of short circuits and grounds in transformers is shown to be the presence of moisture in the oil, principally because of the fact that the oil and transformer may be stored in damp places. The trouble from moisture is noticeable principally where the voltage is higher than the usual 2300 volts on distribution systems. The author emphasizes the importance of drying out the transformers and of properly caring for the insulating oil. In addition to properly fusing transformers, the winding should be mechanically braced so that in case of heavy short circuits it will not be mechanically distorted, thus impairing the insulation.—*Electric Journal,* February, 1919.

Some Characteristics of Transformer Oils.—O. H. ESCHHOLZ.—In discussing the possibility of explosions due to high temperatures in transformer oils the writer states that the temperature required for the disintegration of the oil is very great. It follows therefore that slight differences in flash or fire points of oils used for transformers do not materially influence the ease with which such disruption is produced. No appreciable protection is therefore obtained by substituting a high-flash for a low-flash oil. He says that it has been observed that, owing to the lower vapor pressure and consequent decreased dilution of hydrogen by the less active hydrocarbon vapors, explosions in the higher flash oils are occasionally more violent. It is pointed out that every effort is being made to eliminate prolonged arcing near the oil surface and the prevention of the leakage of moisture through joints and terminal leads. There is also the danger from a low level of oil due to the uncovering of the primary terminal board.—*Electric Journal,* February, 1919.

Neutral Point on a Delta-Connected Set of Three-Phase Transformers.—E. E. STARK.—This describes a scheme of obtaining an artificial neutral on a three-phase system with a delta method of lighting distribution by using a star-wound induction motor and earthing its neutral. The regulation of the system will be governed by the capacity of the motor, which transfers energy from one phase to the other.—*Science Abstracts, Section B,* Dec. 31, 1918. (Abstracted from *New Zealand Journal of Science,* July, 1918.)

Lamps and Lighting

Measurement of Transmission Factor.—M. LUCKIESH and L. L. MELLOR.—The transmission factors have been obtained for several representative slightly diffusive glasses for two kinds of illumination—(1) for a narrow beam of light directed perpendicularly to the surface of the specimen, and (2) for uniformly diffused light reaching the specimen from all directions above its plane. It has been shown that the transmission factor of such glasses depends upon the position of the glass with respect to the light source for a narrow beam of light directed perpendicularly to the specimen. The transmission factors are generally greater when the rough surface faces the light source than when the smooth side is toward it. This difference is very apparent in the case of ribbed glasses, but it has been found to exist even for so-called "frosted" or etched glasses.—*Journal of the Franklin Institute,* November, 1918.

Generation, Transmission and Distribution

Substation Short Circuits.—R. F. GOODING.—When a substation derives its power from several parallel feeders a short circuit in the feeders may develop considerable power. This is particularly true when the feeders are in reality tie lines between two generating plants. In cases where there is very great generating capacity at either end or both ends considerable care must be exercised in the selection of reactances to limit short-circuit currents at different parts of the systems. In this article the writer deals particularly with the location of reactances for certain assumed conditions of generating equipment and feeders, reactances at the generating-station buses, reactances in the feeders and also at substations. He also deals with the magnetic forces involved in such short circuits and the necessary and mechanical constructions to return them.—*Electric Journal,* February, 1919.

New Maximum-Current Time Relay.—K. TROTT.—A new maximum cut-out with inverse time element is described which is made by Siemens & Halske, Berlin. The adjustments may be made without opening the relay circuits. The relay contacts are capable of interrupting 150 volt-amp., maximum current 3 amp., maximum pressure 220 volts direct or alternating current. On heavier overload the relay operates more rapidly than on ordinary interruptions, the law being roughly quadratic with a two-second to fifteen-second relay. The heav-

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iest short circuit will not, however, operate the relay in less than three-fourths of a second to one second, when set to fifteen seconds on the time scale, unless an instantaneous release is added to operate at a predetermined overload.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elektrot. u. Maschinenbau*, June 16, 1918.)

The "Sandwich" System of Fuel Blending.—E. W. L. NICOL.—It is said that in many important steam plants the use of bituminous coal has now been entirely eliminated by the substitution of coke. The adaptation of certain types of existing mechanical stokers to the users of coke or admixtures of coke and coal, although a difficult problem, has now been accomplished satisfactorily. The sandwich system of blending and feeding fuel to steam boiler furnaces, which incidentally permits a material increase in national wealth through by-product recovery, enjoys the distinction of having been accorded official encouragement by the coal mines department of the Board of Trade. Efficiency tests indicated about 80 per cent efficiency using a mixture of coke and coal compared to 60 per cent efficiency with coal alone.—London *Electrician*, Jan. 24, 1919.

Selecting Coal for Power-Plant Use.—ROBERT JUNE.—The writer takes up the question of the classification of coal, the question of size and the purchase of coal on the specifications. Curves are offered to show the effect on efficiency and rating of boilers of the size of screen used and also the relation between combustion space and grate area to the volatile matter in coal.—*Electrical Review*, Jan. 18, 1919.

Phase Transformation.—E. G. REED.—The following important transformer connections for phase transformations are taken up by the aid of diagrams: (1) three-phase to single-phase; (2) three-phase to two-phase; (3) two-phase to six-phase; (4) three-phase to six-phase.—*Electric Journal*, January, 1919.

Construction of Steam Boilers.—The American Society of Mechanical Engineers has just issued a bulletin covering the rules for the construction of stationary boilers and other pressure vessels, indicating allowable working pressures as well as the care and service of the same. Specifications for the construction of the boilers and related apparatus are taken up in considerable detail.—Paper read before the American Society of Mechanical Engineers, 1918.

Installations, Systems and Appliances

Electrically Driven Plate Mills.—G. E. STOLTZ.—The writer states that the three most important problems in selection of apparatus to drive a plate mill are the type of motor, the control and flywheel. These three factors are interrelated. The writer takes up specific plate-mill installations to show how the selection of apparatus was made.—*Electric Journal*, February, 1919.

The Electric Furnace in the Development of the Norwegian Iron Industry.—H. STYRI.—This is mainly a brief history of the electric furnace in the Norwegian iron industry. In referring to the Rennerfelt furnace the author states that there is very little advantage in the special feature of this furnace, namely, the arrangement of electrodes for throwing the arc against the bath, as this can be obtained with single or polyphase currents when the electrodes are placed at an angle to the charge. —*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Transactions A. E. S.*, 32, pp. 129-140, 1917.)

Elevator Code.—The elevator code issued by the Industrial Commission of Wisconsin, 1918, deals particularly with the safety of employees. The code covers the use of electric brakes and circuit breakers for high-speed elevators and also limit switches and reverse-phase relays and specifies the wiring and signal systems for electric elevators.

Wires, Wiring and Conduits

Resistance and Reactance of Commercial Steel Conductors.—H. B. DWIGHT.—In discussing the usefulness of iron and steel conductors in transmission-line service the author presents a considerable series of curves showing the change in resistance of the steel conductor with current density. The grades EBB, BB and ordinary steel grade Siemens-Martin high-strength cable are considered.—*Electric Journal*, January, 1919.

Electrophysics and Magnetism

Maximum Primary Potential in an Induction Coil.—E. TAYLOR JONES.—A discussion of whether the maximum primary potential of an induction coil should be calculated on the basis of ratio of turn or in accordance with the oscillation transformer theory which allows both the secondary and primary potential to be calculated.—London *Electrician*, Jan. 24, 1919.

Ionization and Excitation of Radiation by Electron Impact in Nitrogen.—BERGEN DAVIS and F. S. GOUCHER.—The experiments show that: Radiation can be stimulated in nitrogen molecules by electron bombardment without any appreciable ionization; the value 7.5 volts, heretofore accepted as the value of the ionizing potential, really corresponds to the least energy an electron must have in order that it may excite radiation by the bombarded molecules (there is an indication of a more intense type of radiation setting in at about 9 volts); that ionization sets in at about 18 volts. —*Physical Review*, January, 1919.

On the Mechanical and Electrodynamical Properties of the Electron.—MECH NAD SAHA.—The physics concepts of absolute independence of time and space and constancy of mass are abandoned in this investigation, which is an extension of Minkowski's method of four-dimensional analysis.—*Physical Review*, January, 1919.

A New Experimental Determination of the Brightness of a Black Body and of the Mechanical Equivalent of Light.—E. P. HYDE, W. E. FORSYTHE and F. E. CADY. —A new set of experimentally determined values of the brightness of a black body from 1700 deg. to 2600 deg. K. are given on the assumption of a temperature scale based upon Planck's equation taking the gold point as 1336 deg. K. and the constant C_2 as 14,350 μ deg. These values, as plotted in a curve obtained by a least-square solution, are compared with the relative computed values on the assumption of the visibility curve recently published by the authors. A value of 70.2 candles per square centimeter as the brightness of a black body at a temperature of 2077 deg. K. (color match with 4-watts-per-candle standard carbon lamps) is proposed tentatively as an absolute standard of light. The mechanical equivalent of light for the wave-length of maximum visibility ($\lambda = 0.566\mu$) is computed to be 0.00150 ± 0.00005 watts per lumen.—*Physical Review*, January, 1919.

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Electrochemistry and Batteries

Function of Barium Sulphate in Accumulators.—O. SCARPA.—Some large batteries of accumulators constructed by one of the best known firms in Italy showed the unexpected phenomenon that their capacity, which should have remained constant for at least 200 discharges, rapidly diminished, so that after 100 discharges they had a capacity of only 40 per cent of the initial value. The author found that this had to be attributed to the physical properties of the barium sulphate mixed with the lead oxides of the negative plates in order to render the mass more porous. Microscopic observations showed that the function of the barium sulphate was to prevent the "soldering" of the lead particles of the negative paste. This purpose is more or less effected according to the physical properties of the barium sulphate.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elettrotecnica*, Sept. 25, 1918.)

Units, Measurements and Instruments

New Method of Meter Calibration.—H. GEWECKE and W. V. KRUKOWSKI.—A new means is described for recording accurately the regular speed of rotating parts without affecting this speed in any way. The accuracy obtainable in meter tests depends primarily on the accuracy with which the time for a given number of revolutions can be determined, since there is no difficulty in measuring the corresponding load to a high degree of accuracy. The authors' arrangement uses a ray of light as transmitting medium between a mirror on the meter spindle and a selenium cell or bolometer. This method is convenient and cannot influence the meter speed in any way; the meter casing may be closed during the test. (This is frequently an important factor.) A battery is connected across one axis of a bridge and a recording chronograph across the other. The second element is connected to a seconds pendulum. The chronograph is used without relays, and a deflection is obtained once a second on one line and once per meter revolution (*i.e.*, each time the selenium cell is illuminated) on the other line.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elektrot. Zeits.*, Sept 5, 1918.)

Miscellaneous

Electrolysis and Its Mitigation.—E. B. ROSA and BURTON MCCOLLUM.—The Bureau of Standards, which has been engaged for some time past in a general investigation of the subject of electrolysis and its mitigation, has issued a bulletin which gives results of its investigations thus far. Some of the outstanding features of the report are given below. Remedial measures that are applicable to pipe systems should be regarded as secondary means of mitigation of electrolysis trouble, the best method being to provide proper construction and maintenance of the railway return circuit. The two most commonly applied mitigating measures are the insulation of the insulating joints and the use of pipe drainage. Both of these methods are valuable under certain conditions, the former particularly where new pipes are being laid and the latter for application to isolated pipe systems without insulating joints. Of the methods applicable to railways the most important are the adequate maintenance of track bonding, the use of a proper number and location of power houses or substations and the use of insulated negative feeders where the capacity of the rails is insufficient. Remedial measures adopted in this country have been less effective than the measures used in certain foreign countries where regulations limiting voltage drops in the negative return have been in effect. In defining the voltage limitations either the all-day average value or the average value for a period not less than one-half hour may be used. The former is preferable. The voltage drops either in the tracks or in pipes and earth may be used as the basis of fixing limitation, but in general the latter is to be preferred. Under most conditions over-all voltages in railway tracks should be limited to about 2 volts to 4 volts and the potential gradients should in general be restricted to about 0.3 volt to 0.4 volt per 1000 ft. (1.3 volts per 1000 m.) Potential wires should be installed running from some central point to selected points on the railway or pipe networks for the ready determination of these drops. Any regulations governing electrolysis mitigation should be made not alone to apply to the railway system but also to define the responsibilities of the owners of underground utilities.—*Technologic Paper No. 52*, Bureau of Standards, March, 1918.

Testing of Switch and Transformer Oils.—G. SCHENDELL.—The author describes methods of testing commercial oils. These tests are considered to be specially necessary at the present time in Germany in consequence of the fact that raw materials, often of unsuitable kind, are used in emergencies. The tests are described in various sections under the following headings: (1) The kind of oil—*i.e.*, whether resinous or mineral; (2) the color—the oil should in any case be translucent; (3) consistency; (4) mechanical impurities—the oil should contain neither straw, fibrous particles nor sand; (5) specific gravity—transformer oils between 0.85 and 0.92, switch oils between 0.88 and 0.9; (6) viscosity—on Engler's viscometer transformer oils should not be above 8 and switch oils not below 10, as compared with water at 20 deg. C. (a description of this test is given); (7) inflammability—for transformer oils the vapor should not inflame below 160 deg. C. and for switch oil not below 170 deg. C.; (8) the burning point, about 20 deg. C. higher; (9) the freezing point—in transformer oils not above —20 deg. C. and in switch oils not below —20 deg.; (10) the tendency of the oil to deposit resinous particles—this test is very important and fully described; the oil is put in a flask and heated electrically by an external spiral to 120 deg. C. for seventy hours; a strip of clean copper and a cotton bandage are suspended in the oil; the cotton bandage should not lose its strength and the oil should not become cloudy, but these conditions are very difficult with present commercial samples; (11) the oil should not tend to deposit tarry substances; (12) the volatility of the oil; (13) its water content; (14) its acid content; (15) its content of free alkali; (16) its sulphur content; (17) its resinous content; (18) its asphalt content; (19) its content of oils of an inadmissible character—mixtures of mineral and resinous oils must not be used in transformers, and it is therefore in this case necessary to determine whether any such admixture is present.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Elekt. Zeits.*, June 20, 1918.)

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

AUTOMATIC OPERATION IS DISCUSSED AT SCHENECTADY

High Speed Favorable to Induction Generator—Synchronous Condenser Unit Automatically Responds to Voltage Conditions

The increasing tendency toward the use of attendantless stations and substations was traced by H. R. Summerhayes, C. M. Davis and L. B. Bonnett at a meeting of the Schenectady Section of the American Institute of Electrical Engineers held Feb. 28. The speakers pointed out the great saving in operating expense which is realized without sacrifice in the matter of reliability. Typical installations of automatic and remote-controlled generating plants and substations were also described with the aid of lantern slides.

Mr. Summerhayes pointed out that the wages of operators in any station, no matter what the capacity, would amount to at least $2,400 to $3,600 per year, assuming twenty-four-hour operation. On the other hand, control equipment for a single-unit automatic plant costs from $3,000 to $4,000 more than the corresponding equipment for the simplest hand-controlled plant. It is thus apparent that the saving due to automatic operation will pay for the extra equipment in about two years. While these stations require some maintenance and occasional inspection, this is a small matter compared to the saving of operators' wages. Buildings for attendants, moreover, are dispensed with, and a great saving is also effected by not heating the plants.

In the matter of reliability, which is the most important consideration in the design of attendantless stations and substations, Mr. Summerhayes stated that results had measured up to expectations. The human element is largely removed, and even the operation of synchronizing may be very satisfactorily accomplished by the use of reactance. In the case of one plant it was said that no one had entered the station for eight or ten weeks.

As to the induction generator which has been advocated for small automatic plants, Mr. Summerhayes said that for high speeds induction generators are cheaper than synchronous machines. For slow speeds, however, the induction machines are more expensive, and at medium speeds the costs of the two types may be about equal. The large magnetizing current drawn by the induction machines may be a serious consideration and may even require the use of synchronous condensers.

It was said that the General Electric Company is willing to undertake the construction of out-door generators; so there appears to be no reason why generating stations may not be built with little or no housing or heating required. He advised caution in the adoption of automatic operation for large plants.

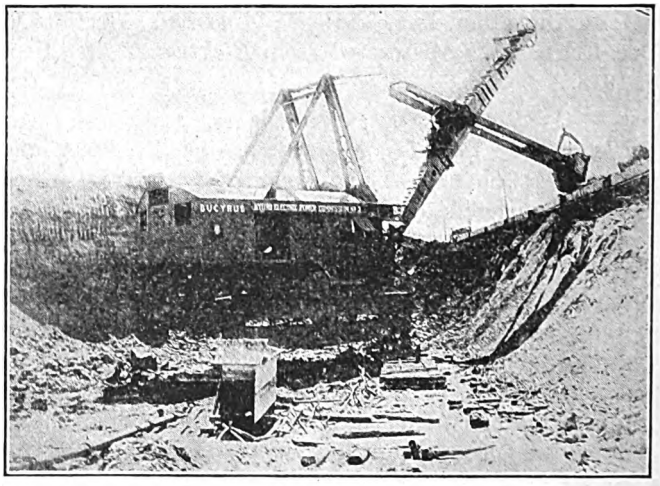
Mr. Davis dealt particularly with the railway substations, of which there are twenty or thirty in operation. He showed the great saving in losses in substation apparatus due to automatic operation whereby machines are running at full load or are shut down. It may often prove economical to install an automatic substation where a manually operated one would not be justified.

A remote-controlled generating plant will shortly be put into service by the Ontario Power Company, California. The operation is to be performed by remote control at the main station now in service. This plant was described by the aid of slides by Mr. Bonnett, who also showed how power factor and voltage regulation had been improved at Hazel Green, Wis., by the installation of a 3000-kva. synchronous condenser which is automatically started and stopped according to voltage conditions.

In discussing the papers other speakers agreed that automatic operation offers great possibilities of development and that reliability and simplification of control and protective devices should be the present aims of designers.

In the absence of the chairman the meeting was presided over by T. A. Worcester.

Electric Shovels Dig Niagara Power Canal



Electric shovels are being used exclusively to dig this canal, which is to deliver not less than 10,000 cu.ft. (280 cu.m.) of water per second from the Welland Canal above Niagara Falls to a new 300,000-hp. hydroelectric power plant at the end of the last rapids below the falls. This canal is over 8 miles (12.8 km.) long, and to dig it the five electric shovels now in use and others to come will have to remove 19,000,000 cu.yd. (14,500.000 cu.m.) of material. One of the largest electric shovels is shown here.

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MEASURES THAT FAILED WHEN CONGRESS ADJOURNED

Proposed Repeal of Daylight-Saving Law, Bill to Extend Government Control Over Wire Lines and Tests of Commodities

Among the bills which Congress did not pass before adjournment on Tuesday were several which were of direct interest to the electrical industry. Reference to failure of the water-power measure is made elsewhere in this issue.

An amendment to repeal the daylight-saving act was attached to the agricultural appropriation bill. As that bill was not passed, the daylight saving law remains in force.

The Moon bill to extend government control over telephone and telegraph systems was not passed.

Another measure, the Fletcher bill, providing for tests of qualities of commodities by the Bureau of Standards, which had been attached as an amendment to another bill, was, it appears, eliminated by the conferees of the House and Senate.

WATER-POWER BILL DIES WITH END OF CONGRESS

Act Which Had Been Approved by Conferees and Passed by House of Representatives Falls Under Senators' Filibuster

The proposed water-power legislation which has been before Congress for the six years of the present administration failed of passage when Congress expired *sine die* March 4. After lengthy debate in committee and on the floor of both houses, conferees on the part of the House and Senate agreed to report the bill favorably, and it would undoubtedly have been passed by both houses if it could have been reached on the calendar before the expiration of the Congress. The proposed legislation was passed by the House of Representatives a few days before the end of Congress by a vote of 264 to 65.

The proposed legislation failed in the Senate, however, because it became entangled in the meshes of the filibuster which was conducted by senators who are opposed to the President's policy in foreign affairs. Although there were informal assurances to senators who had charge of the proposed legislation that at least eighty votes were in favor of the measure in case it could be brought before the Senate, the bill did not obtain a hearing.

It will now be necessary for the advocates of water-power legislation, according to the Washington representative of the ELECTRICAL WORLD, to open a campaign of education for the benefit of the new members of the House of Representatives and the Senate who will take their seats in any extra session of Congress which the President may call.

Committee assignments which will have to do with water-power legislation will be altered under the organization of the coming Congress. The legislation, which has been in the hands of Democratic leaders in the House in the past, will now be committed to the hands of Republican leaders, inasmuch as the Republicans have control of the new House.

Many of the legislators on both the House and the Senate side who have been earnest students of the subject of advisable water-power legislation and have acquired a knowledge of it will not be in the new Congress.

It is too soon to say who will be in charge of water-power bills in the coming Congress, and it is not possible at this writing even to say who will be the members of the new committees which will deal with it. It is reported, however, in Washington that new bills will be introduced in both houses as soon as the expected extra session of Congress is convened.

GREAT INTEREST IN THE N. E. L. A. CONVENTION EXHIBITS

Exhibition Committee Finds that New Conditions Will Mean Either a Change in 1917 Layout or Increased Space, or Both

The exhibition committee of the National Electric Light Association announces that almost all manufacturers who were assigned space in 1917 have not only sent their acceptance for a reassignment of the same space, but in many cases have asked the committee for increased space to show their new lines or to care for the new conditions that have come up during the last two years.

The committee states this will mean either a change in the space as laid out in 1917 or increased space, or both. Consequently the committee urges the manufacturers who intend making an exhibit and who have not already applied for space to do so at once, giving details as to the amount of space required and as to what they intend exhibiting, so that some arrangement can be made to meet the new conditions and give all the manufacturers who desire it an opportunity to exhibit this year at Atlantic City during the week of the convention, beginning on May 19.

H. G. McConnaughy, secretary of the exhibition committee, can be reached at 1111 Munsey Building, Washington, D. C., or at 29 West Thirty-ninth Street, New York City.

SEEKS INFORMATION ON EARLY N. E. L. A. OFFICIALS

Association Wants to Know Addresses of Every One Who Has Served as President or Vice-President or on Executive Committee

In connection with the annual convention to be held at Atlantic City during the week beginning May 19 the National Electric Light Association is trying to get the address of every one who has served as president or vice-president or as member of the executive committee at any time in its history. Some of those who have been in the association in these capacities are not now active in the electrical industry and connection with them has been lost by the association. The ELECTRICAL WORLD has been asked to give publicity to the desire of the association. Information on the subject should be sent to T. C. Martin, executive secretary of the association, 29 West Thirty-ninth Street, New York City.

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ELECTRICAL SUPPLY JOBBERS ARE TO MEET IN CONVENTION

General Gathering Will Be Held at Hot Springs, Va., Early in June—Dates for Atlantic and Central Divisions

The next general meeting of the Electrical Supply Jobbers' Association will be held at Hot Springs, Va., in the early part of June. The quarterly meeting of the Atlantic Division is to take place in New York on March 11 and that of the Central Division in Chicago on the day following.

ASSOCIATED MANUFACTURERS' ANNUAL MEETING PLANS

Meetings of Various Sections Are to Precede Annual Convention on Thursday, March 20—Schedule for the Week.

All arrangements have now been completed for the fourth annual meeting and banquet of the Associated Manufacturers of Electrical Supplies, which is to be held at Delmonico's, in New York City, on Thursday, March 20.

Charles E. Dustin, the general secretary, announces that, as in previous years, the business session will be held in the afternoon, commencing promptly at 2 o'clock, for the presentation of reports of officers and the review of the work of the several committees, including that of the international trade and the general war service committees, reports of section progress, election of governors, and for other matters of interest to the association members. The social session with banquet will be held in the grand ballroom of Delmonico's at 7.30 p.m., and for this an interesting program has been arranged with good speakers and other attractive features and a musical program by the manufacturers' chorus as last year.

Tables seating from six to twelve persons may be reserved for members and guests, and as a large attendance is assured, it is desirable that members advise Mr. Dustin at the earliest moment in order that proper seating provisions may be made. Members have the privilege of inviting guests and additional tickets will be sent on request or will be delivered at the door of the hall as desired.

Herewith is a revised schedule of meetings to be held in New York in connection with the annual meeting of the Associated Manufacturers of Electrical Supplies, from March 17 to 21. Some changes have been made since the first list was printed in the issue of the ELECTRICAL WORLD of Feb. 22.

Monday, March 17, 1919.—Industrial and Street-Lighting Fixture Section, 10 a.m.; Signaling Apparatus Section, 2 p.m.

Tuesday, March 18, 1919.—Snap-Switch Section, 10 a.m.; Molded or Formed Insulation Section, 10 a.m.; Lamp Receptacle and Socket Section, 2 p.m.; Outlet-Box Section, 2 p.m.; Attachment-Plug Section, 4 p.m.; Heating-Appliance Section, 10 a.m.; Line-Material Section, 2 p.m.; Air-Circuit-Breaker Section, 10 a.m.

Wednesday, March 19, 1919.—Panelboard and Switchboard Section, 10 a.m.; Fuse Section, 10 a.m.; Knife-Switch Section, 3 p.m.; Insulating Materials, 2 p.m.; Fan-Motor Section, 10 a.m.; Electrical Porcelain, 11:30 a.m.; joint meeting conduit industry, 10 a.m.; Rigid-Conduit Section, 10:30 a.m.; Non-metallic Conduit Section, 2 p.m.; Armored Conductor and Metallic Flexible Conduit Section, 4 p.m.

Thursday, March 20, 1919.—Board of governors, association offices, 11 a.m.; business session, Delmonico's, 2 p.m.; social session and banquet, Delmonico's, 7:30 p.m.

Friday, March 21, 1919.—Magnet wire committee of the Wire and Cable Section, association offices, 10:30 a.m.

Special attention is called to the congested condition of New York hotels at this time, and members are urged to make hotel reservations well in advance of the date of their arrival in the city.

PROPOSAL TO ABOLISH ILLINOIS COMMISSION

Hearing by Committee of the Legislature Does Not Reveal Sentiment for Abolition of Commission, but Changes Are Asked

The Senate committee on public utilities of the Illinois Legislature held a public hearing on Tuesday of this week on Senate bill No. 38 proposing to abolish the state public utilities commission.

No demand was made for the abolishment of the commission. Only one speaker, from the Greenville Commercial Club, asked that the act be repealed, and for no specific reason other than that he was opposed to that form of government. Representatives of the Chicago, Peoria and Decatur associations of commerce asked the General Assembly not to favor any measure abolishing the commission or limiting its powers in any way.

Representatives of several cities spoke in favor of the retention of the commission but urged amendments that would prevent the commission from increasing rates in excess of those provided by franchise ordinance. The Home Rule Municipal League of Illinois, representing 175 Illinois cities, asked that the commission be retained and asserted that they were fostering a bill which would be introduced on the following day amending the public utilities law by permitting cities by referendum vote to elect whether they should come under the jurisdiction of the commission. Several bills have been introduced to amend various sections of the law which would prohibit the commission from authorizing increases in rates in excess of those provided by ordinances.

The committee adjourned to meet on March 18, when a public hearing will be held on all bills affecting public utilities, which will include the bill to be introduced by the Home Rule Municipal League.

At the public hearing before the House committee on Wednesday on a similar bill no one appeared, and the matter was continued for two weeks, at which time a general hearing on all public utilities bills will be held, as well as on the Home Rule Municipal League of Illinois bill, which was introduced Wednesday. This bill provides that cities by means of ordinances, these to be voted upon and receive a majority of the votes cast at regular or special election, may go out from under the jurisdiction of the commission. It provides that they may establish a municipal utilities commission for the regulation of utilities within the corporate limits and that they may go back under the commission when the ordinance is approved by vote of the people at a regular or special election.

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NO MATERIAL DIFFERENCE FROM NATIONAL PROHIBITION

Samuel Insull Expresses Belief that Public Service Company of Northern Illinois Will Not Be Affected—Past Experiences

The results of war measures on service and costs and the possible effect of national prohibition are discussed by Samuel Insull in his annual report as president of the Public Service Company of Northern Illinois for 1918.

During the year the company took on a number of large users of electric power. Mr. Insull says that this added service, together with the service of other new customers, more than offset the losses brought about by the "heatless days" during the early months of the year, by the "lightless nights" and the "daylight-saving" law.

High prices established for labor and for oil and other materials prior to the beginning of 1918, Mr. Insull adds, continued throughout the year, and substantial increases were made in freight rates. The high price of coal was also maintained, but the company's interests in coal mines proved to be a benefit effecting a considerable saving in the cost of operation.

Referring to the fact that some study has been given to the possible effect upon the business of the company of national prohibition, Mr. Insull comments as follows: "It is believed this will make no material difference in the company's income. A large proportion of the territory served by the company has been 'dry' for some time past, and it has been the experience of the company that where communities have 'gone dry' the resulting loss in certain kinds of business has been offset by increases in other lines brought about by the changed conditions."

Owing to the war the company's policy in 1918 was merely to complete additions already started to its plants but not to make other additions except as absolutely necessary. Even with this restricted policy the company was compelled to make considerable plant increases, owing to the demands for its service.

ELECTRIC FURNACES FOR THE MELTING OF BRASS

Bureau of Mines Comments on Operation of Furnace Built After Its Design by the Detroit Edison Company

In the annual report of Dr. Van H. Manning, director of the Bureau of Mines, covering the fiscal year ended June 30, 1918, reference is made to the development of electric furnaces for melting brass. An account is given of the operations of a furnace built after the bureau's design by the Detroit Edison Company, which has been described in the ELECTRICAL WORLD. Dr. Manning says:

During the fiscal year work was continued at Ithaca, N. Y., on electric brass melting. A rocking furnace of about 1300 lb. capacity, built after the bureau's design by the Detroit Edison Company under a coöperative agreement, was thoroughly tested by the bureau at the plant of the Michigan Smelting & Refining Company, Detroit. The metallurgical results were good, the metal losses of a wide range of alloys being markedly below those obtained by melting the same charges in coke-fired crucibles. The power consumption was low, comparing favorably with that of other electric brass furnaces of equal flexibility. If the metal savings be considered, the over-all cost of melting brass and bronze in the rocking furnace at the Michigan plant was not more than a third of the over-all cost shown by the coke fires under present crucible, fuel and metal prices, and the furnace can seemingly compete under pre-war conditions.

While the furnace is, of course, most efficient in continuous operation, it is particularly adapted for use at foundries that are idle at night and melt many different alloys, as it is without many of the drawbacks other types of electric furnaces show in such service.

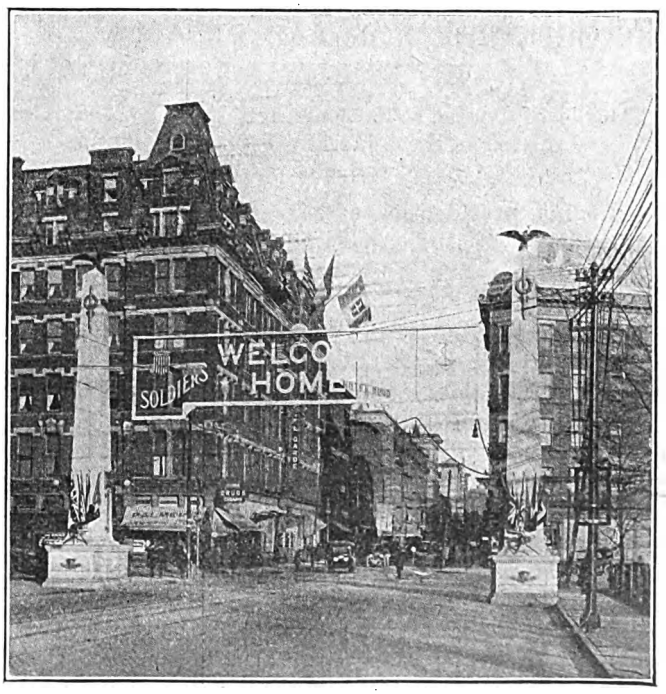
At first some difficulty was found in melting alloys high in zinc, those in which much metallic zinc is added, because zinc condensed about the electrodes, causing them to stick and break, but by suitable changes in design and operation this trouble seems to be overcome. However, the rocking furnace has not had an extended test under rolling-mill conditions, where large amounts of zinc are normally charged, but probably the furnace will work satisfactorily.

After the bureau's tests were completed, the Michigan Smelting & Refining Company put the experimental furnace into commercial use, and construction of four 1-ton furnaces for that firm was begun at once. Two other Detroit firms are each having four 1-ton furnaces built. These twelve furnaces will soon be running, and the results obtained should give fairly definite data on their possibilities.

The results of the tests have been published as Bulletin 171 of the Bureau of Mines, and a short digest of the tests has appeared in several technical journals. One firm is considering the use of a furnace of this type for calcining grains of artificial corundum.

The collection of data on the performance of other commercial electric brass furnaces has been continued, and a comprehensive report covering all types will soon be made.

Floodlamps Saved $600 in Illumination of "Welcome Home" Sign



By providing eight 200-watt floodlamps to illuminate the "Welcome Home" sign at Hartford, Conn., shown herewith about $600 was saved in comparison with the use of electric letters, and the display was not injured. The sign, facing the railroad station at Hartford, is the first object that strikes the eye of the returning service man. Four 150-watt bracket lights are provided in translucent globes to heighten the illumination.

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Back to Business!

This is the way the Society for Electrical Development views it. Uncle Sam is on the job and has taken his coat off to tackle the pile of work. Optimism is in the smile and the greeting.

PROCEDURE FOR AMERICAN ENGINEERING STANDARDS

Details of Course to Be Followed by the Main Committee as Explained by President Adams of the A. I. E. E.

In his presidential address before the midwinter convention of the American Institute of Electrical Engineers in New York on Feb. 19, Prof. Comfort A. Adams outlined the proposed work of the American Engineering Standards Committee. In addition to the details printed in the ELECTRICAL WORLD of March 1, page 421, President Adams gave the following information on the procedure to be followed:

"When the development of a particular group of standards is proposed the main committee assigns the work to the appropriate organization as 'sponsor,' or, if the situation seems to indicate that more than one organization is equally interested, to these organizations as 'joint sponsors.'

"The sponsor then appoints the sectional committee subject to the approval of the main committee. The purpose of this approval is merely to assure the comprehensive representation of all the interests involved. Complete records of all interested organizations and of their standardization work and connection will be kept on file and properly classified in the office of the main committee. The main committee or its secretary will thus be able either promptly to suggest the proper representation to a sponsor on request or to approve or amplify the representation as provisionally proposed by the sponsor.

"After a group of standards has been prepared and accepted by a sectional committee it is submitted to the sponsor body for its approval and then to the main committee with a full report of its history. When approved by both the sponsor body and the main committee the standards in question become American standards.

"When the report of any sectional committee is being considered by the main committee three members of that sectional committee are invited to sit with the main committee to report, discuss and vote on the standards in question as if they were regular members of the committee. Thus each sectional committee, and therefore usually each sponsor body, will be represented on the main committee when standards in which they are interested are being discussed.

"The scrutiny of a standard by the main committee is to make sure that the proper procedure was pursued, that it was prepared by a comprehensively representative sectional committee, that the vote of acceptance was nearly enough unanimous, and that the standard is consistent with other related standards. Consideration is also given to international relations, but the main committee is not supposed to pass upon the details as it is obviously impossible for a moderate-sized workable committee to cover the details of all parts of the field.

"After approval by the main committee the standard is published by the sponsor body with the statement that it has been approved by the A. E. S. committee and labeled 'American standard' with the appropriate descriptive title."

GREAT WESTERN POWER PLAN TO SPEND $6,000,000

Outline of the Arrangement of California Company with Bankers for Raising Large Sum of Capital to Develop Its Resources

The financial plan under which the Great Western Power Company, San Francisco, as announced by President Mortimer Fleishhacker a few days ago, intends to develop its resources through the expenditure of $6,000,000, has been submitted to the California Railroad Commission in the shape of a petition asking the commission to issue the orders required to bring about the consummation of the big deal. Accompanying the petition is a copy of the agreement entered into by the power company, E. H. Rollins & Sons, Bonbright & Company and Lee, Higginson & Company, which takes care of the financial details of the development plan.

The financial plan provides for the organization of a new company, to be known as the Great Western Power Company of California, which is to take over the holdings of the Great Western Power Company, the City Electric Company and the Consolidated Electric Company. The new company plans to execute a first and refunding mortgage to secure an issue of $150,000,000 bonds, or an unlimited issue as may be determined. The immediate issue is to be for $6,000,000 of series A six per cent bonds, dated March 1, 1919, due on March 1, 1949. The bonds are to be sold at 88, and

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$1,650,000 of the total of $5,280,000 is to be advanced to the Great Western Power Company and by that company expended in carrying out the developments and extensions planned; $350,000 is to discharge indebtedness of the new company to the Bankers' Trust Company, and the balance is for the purchase and acquirement of necessary lands and rights in the Butte Valley, the scene of the greatest construction program. There is also provision for the immediate issue of $1,500,000 of 7 per cent cumulative preferred stock of the new company, Bonbright & Company having agreed to take the entire issue at 90, delivery to be made within two years in five installments of $300,000 each.

The construction program calls for the immediate construction of a hydroelectric plant, to be known as the "Caribou plant," on the north fork of the Feather River, a development designed to enable the power company to meet demands for power and energy and to minimize the danger of power shortage.

The plant is to be erected in the main canyon of the North Fork about 6 miles (9.6 km.) from Belden station on the transcontinental line of the Western Pacific Railway. The spillway at Big Meadows Dam (Lake Almanor) will be raised 9 ft. (2.7 m.) and the capacity of the reservoir thereby increased by 80,000 acre-feet (9830 hect.-m.), making it 380,000 acre-feet (46,700 hect.-m.). Water from the lake will be diverted through a large intake tower and through a concrete-lined tunnel, 7 ft. (2.1 m.) in inside diameter and 2 miles (3.2 km.) in length, to the Butte Valley watershed, and there spilled into the channel of Butte Creek, where, together with the natural waters of Butte Creek, it will flow down the valley to a small dam at the lower end of the canyon, which will serve as the plant's forebay. A second tower will receive the waters at this point, which, after passing through a series of three tunnels of an inside diameter of 9 ft. (2.7 m.) and an aggregate length of about 2 miles, 1400 ft. (420 m.) of which has already been excavated, will drop to the power house below through steel penstocks embedded in concrete in solid rock tunnels.

The power plant will consist of two 20,000-kw. units, together with necessary electrical apparatus for switching and stepping up the electrical energy to the transmission voltage, all housed in a monolithic reinforced-concrete structure. Ultimately the plant will be increased to a capacity of 136,000 kw.

From the power house a 150,000-volt steel-tower transmission line will convey the power to Big Bend, and thence to Valona substation, a distribution network center on the shore of San Francisco Bay south of Carquinez Straits.

A 9-mile (14-km.) standard-gage railroad will be built from the Western Pacific Railway to the plant site so that machinery and material may be economically handled. The lands, water rights and the major part of the easements necessary to the consummation of the project are already in hand, being the property of the Great Western Power Company. It is thought that the plan can be put in operation within from one to two years, according to the speed at which the work is pushed.

The cost of the entire project, including the transmission line, is estimated to amount to something over $6,000,000.

GOVERNMENT TRAINING OF DISABLED SOLDIERS

Electrical Training Offered Free by Federal Board for Vocational Education to Disabled Discharged Men of the Forces

The following information is made public by the Federal Board for Vocational Education, Washington, D. C.:

Electricity in all its branches is proving very attractive to the disabled soldiers, sailors and marines who are taking the free trade and professional education placed at their disposal by the United States government through the Federal Board for Vocational Education. Men who had a smattering of electrical information before the war are now given the opportunity to perfect themselves and become really skilled in the particular branches which they have chosen. This training embraces both practical and theoretical work, such as may be obtained in the Massachusetts Institute of Technology, the Case School of Applied Science, the Georgia School of Technology and the Alabama Agricultural and Mechanical College, in addition to practical training with the General Electric Company and other concerns and in plants of some of the great power companies.

One development of the war is the opening of a brand new and well-paid skilled occupation—that of oxy-acetylene welding. This and the general handling of the wonderful oxy-acetylene torch in other lines afford opportunities for many men disabled by war. The course is one of the most popular among the 400 trades, occupations and callings in which free education is offered. Competent handlers of the oxy-acetylene torch are readily hired at good wages by railway shops, electric street railways, in shipyards, in the automobile industry and in repair garages, for gas, sewer and water-pipe work, in sheet-metal work and in metal-furniture making, in foundries and general machine repair shops.

A disabled soldier of thirty whose previous occupation required the handling of logs and heavy machinery, but who had read books on engines and electricity, is taking a course in electrical station operation, because an injury to his back from shrapnel makes heavy work impossible. The government will give any handicapped man who needs and desires it the kind of training indicated above, provided, of course, that his claims are reasonable and that his previous training and the nature of his handicap are such as to make further training profitable. Men taking the courses are, if unmarried, supported by an allowance of $65 per month from the federal board. More is given if the man has dependents. There is no set time in which a course must be finished. The sole criterion is the ability of the man to "carry on" under commercial conditions. If it is a wage-earning branch of the trade he is qualifying for, a position is ready for him when he is ready for it, the placement division of the board having arranged for his employment. The Federal Board for Vocational Education is anxious to hear from any war-disabled soldiers who are interested in this free training provided by the government, not as a charity but as a matter of justice to disabled men who have been impaired in the nation's service.

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CONTEST OVER TELEPHONE RATES IN THE OHIO COURTS

Injunction Issued in Columbus Against New Schedule Announced by the Postmaster-General—Finding of the Court

Judge E. B. Kinkead of the Franklin County Common Pleas Court, Columbus, Ohio, issued a permanent injunction against the Ohio State Telephone Company on Feb. 27 to prevent it from putting into force the rates announced by Postmaster-General Burleson recently. A temporary restraining order was issued by Judge Kinkead some weeks ago. J. E. Todd, counsel for the company, stated that the case will be carried to a higher court. General Manager Gould Williams said that the new rates had never been given a fair trial in Ohio, although they have been used by some of the Bell companies.

Suits are now pending in Ohio against the American Telephone & Telegraph Company and the Cincinnati & Suburban Bell Telephone Company. All of them were filed by Attorney-General Price in behalf of the Public Utilities Commission.

The injunction is based on the ground that the announced rates are not such an act of control as was contemplated by the federal law which gave control of the telephone lines to the President for war purposes and that the federal statute specifically provides that the federal control exercised shall not operate against state police regulations, which include, according to Judge Kinkead, the Ohio public utilities act prohibiting the increase of telephone rates without receiving the consent of the Public Utilities Commission of the state.

The court holds that the federal act gave the President control of the lines for war purposes only and that Congress did not contemplate such control as would allow the change of rates or anything else that would affect the use of the lines by the public. Until peace is proclaimed that control still exists, but only so far as the lines are used for distinctly war purposes. The court said he had scant patience with fictitious questions based upon the laws enacted for the purpose of aiding the President in transacting the business of the war. Such control as was given is only temporary and was not given to allow sweeping changes that would affect the private business of the companies. It has not been shown that the rates were promulgated to raise funds for war purposes, and he does not believe that the federal law was intended to give the companies power to override the state laws.

According to Attorney-General John G. Price of Ohio, federal and state officials throughout the country will coöperate to secure from the United States Supreme Court a decision as to whether Postmaster-General A. S. Burleson acted according to law when he promulgated an order for a change in long-distance telephone rates, which, it is claimed, has resulted in an increase in most instances. Mr. Price recently spent some time in Washington in conference with the authorities.

Suits bearing upon this order have been filed in a number of states, but it has not been determined which one of them will be carried to the United States Supreme Court.

Census Bureau Report of Electric Light and Power Stations—1917

Preliminary figures, published herewith, of the forthcoming quinquennial report on the central electric light and power stations of several states have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics cover both commercial and municipal plants. They do not cover electrical plants operated by factories, hotels, etc., which generate for their own consumption, those operated by the federal government and state institutions, and those that were idle or in course of construction.

	West Virginia			Oklahoma			Massachusetts		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	72	58	.....	201	130	54.6	120	117	2.6
Commercial	63	52	.....	95	67	41.8	81	87	—6.9
Municipal	9	6	.....	106	63	68.3	39	30	30.0
Income	†$3,583,492	†$1,167,583	206.9	‡$4,306,782	‡$2,357,950	82.6	¶$30,392,893	¶$16,306,909	86.4
Electric service	$3,508,995	$1,148,089	205.6	4,212,933	2,287,329	84.2	$29,636,879	$15,996,463	85.3
All other	$74,497	$19,494	282.2	93,849	70,621	32.9	$756,014	$310,446	143.5
Total expenses, including salaries and wages	$2,975,345	$897,843	231.4	$3,541,443	$1,888,706	87.5	$23,577,844	$11,651,739	102.4
Number of persons employed	753	439	71.5	1,112	785	41.6	5,482	3,954	38.6
Salaries and wages	$675,121	$255,471	164.3	$885,880	$581,580	52.3	$4,557,883	$2,981,043	52.9
Total horsepower	130,693	43,185	202.6	80,997	53,922	50.2	680,485	350,780	94.0
Steam engines:									
Number	84	88	.....	223	194	14.9	239	270	—11.5
Horsepower	114,094	34,064	234.9	66,769	45,821	45.7	55,212	323,128	71.8
Internal-combustion engines:									
Number	32	24	.....	133	38	250.0	24	22	9.1
Horsepower	10,100	3,085	227.4	12,860	5,966	115.6	6,287	3,172	98.2
Waterwheels:									
Number	15	14	.....	5	7	—28.6	78	58	34.5
Horsepower	6,499	6,036	7.7	1,368	2,135	—35.9	118,986	24,480	386.1
Kilowatt capacity of dynamos	103,611	29,772	248.0	57,783	38,301	50.9	478,933	252,732	89.5
Output of stations, kilowatt-hours	204,107,945	42,344,796	382.0	100,737,632	48,824,097	106.3	937,124,653	386,254,294	142.6
Stationary motors served:									
Number	3,883	1,279	203.6	6,375	3,470	83.7	65,218	37,191	75.4
Horsepower	98,573	22,925	330.0	61,268	23,056	165.7	446,025	228,868	94.9
Number of street lamps:									
Arc	2,151	2,096	2.6	1,925	3,303	—41.7	16,375	17,601	—7.0
Incandescent, etc	5,996	2,922	105.2	13,763	8,334	65.1	100,394	67,372	49.0

* A minus sign (—) denotes decrease. Percentages omitted where base is less than 100.
† Exclusive of $713,008 in 1917, and $386,598 in 1912, reported by electric railway companies as income from sale of electric energy.
‡ Exclusive of $11,669 in 1917 and $130,096 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $578,283 in 1917 and $396,124 in 1912, reported by street and electric railway companies as income from sale of electric energy.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

N. E. L. A., Manila Section.—The Manila Section of the National Electric Light Association will have C. H. Van Hoven as its president and J. G. Hess, Jr., as its secretary for the ensuing year.

Jovian Club of Cincinnati.—Through its war labor committee the Jovian Club of Cincinnati has arranged a campaign for the reëmployment of all soldiers, sailors and marines who were engaged in electrical work as fast as they return home.

New Mexico Electrical Association.—D. W. Morgan of Las Cruces was elected president and Charles E. Twogood of Albuquerque was elected secretary-treasurer of the New Mexico Electrical Association for the coming year at the meeting reported in the ELECTRICAL WORLD for March 1.

American Association of Engineers.—A. A. Mathews has been elected president and S. J. Treadway secretary of the Dallas Chapter, American Association of Engineers. The Pittsburgh Chapter of this association also announces its officers for the coming year, they being C. K. Harvey, president, and H. Gellin, secretary.

Association of Operating Engineers of the Thomas A. Edison Interests.—An address was given to the Association of Operating Engineers of the Thomas A. Edison interests on Feb. 19 by Prof. L. A. Belding, Stevens Institute of Technology, his subject being "The Use of Alternating Current in Manufacturing Processes."

Engineers at Akron to Organize.—Dean Fred Ayer of the engineering school of the University of Akron is at the head of a movement to organize a general association of engineers which will absorb the Jovian League, the Aëronautical Engineers' Society, the Mechanical Engineers' Society and all other organizations, including both local societies and branches of national organizations.

Electrical Supply Jobbers' Association, Pacific Division.—The annual meeting of this division was held at Del Monte, Cal., Feb. 13, 14 and 15. R. M. Alvord, General Electric Company, presented as a topic for discussion the desirability of making an analysis of electrical jobbing methods for the purpose of reducing expense of operation and increasing economy generally A paper was also read by W. M. Deming, publisher of the *Journal of Electricity*, on the subject of the probable trend of prices and the business outlook. T. E. Bibbins, president Pacific States Electric Company, was elected as chairman of the Pacific Division of the association for 1919

A. S. M. E., New York Section.—"The Application of Electrical Control to Gate Valves" was the subject of a paper presented before the society by Peter P. Dean, engineer of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., in which he emphasized the point that electricity for this purpose is so reliable that it may often eliminate a loss of life in handling superheated steam lines.

Illinois Association of Electrical Contractor-Dealers.—John F. Gilchrist, E. W. Lloyd and W. A. Durgin, all of the Commonwealth Edison Company, were among the speakers at the annual convention of the Illinois Association of Electrical Contractor-Dealers held on Feb. 14 and 15 in Chicago, their message being that the Commonwealth Edison Company stood ready to discuss with a committee from the contractor-dealers any of the company's policies which might be construed as harmful to the local electrical retail trade. Other speakers at the convention were George A. Hughes, president of the Edison Electric Appliance Company; C. E. Brown, Central Electric Company; John R. Smith, Electrical Estimators' Association of Chicago; Louis Kalischer, Brooklyn, N. Y.; Fred R. Farmer, Beardslee Chandelier Manufacturing Company; Albert Uhl, Henry Newguard Company; A. L. Swanson, Evansville, Ind., and L. T. Block, St. Louis. The officers elected for the coming year are R. W. Poelma, chairman, and N. M. Blumenthal, secretary.

American Institute of Electrical Engineers

Cleveland Section.—Harry L. Bradley of the Allen-Bradley Company, Milwaukee, presented a paper on "The Application of Graphite to Battery Charging and Motor Control" on Feb. 17.

Toronto Section.—J. F. Heffron presented a paper entitled "Recent Advances in Illumination" at the Jan. 31 meeting, and Hugo J. Lund of the Canadian General Electric Company read one on "The Manufacture of Electric Porcelain" at the Feb. 7 meeting.

Madison Section.—At the Feb. 11 meeting Prof. E. M. Terry gave an outline of the uses of tubes in radio-telephony. Connections were made so that the audience heard the Arlington station send out the time and the weather reports and also listened to music in another part of the building.

Erie Section.—Members of the Engineers' Society of Northwestern Pennsylvania and the Erie Sections of the American Society of Mechanical Engineers and the A. I. E. E. heard Prof. Comfort A. Adams on Feb. 11 speak on "Electric Welding in Shipbuilding." James Burke of the Burke Electric Company, Frank Geary, builder of the first electrically welded tugboat, and Herman Lemp of the General Electric Company also spoke.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Service Charge.—The Ohio Public Utilities Commission has denied the application of the Toledo Railways & Light Company for permission to collect a service charge of 50 cents per month from each consumer. The City Council has, by ordinance, fixed a rate of 7 cents per kilowatt-hour, which took effect on Feb. 6. The commission suggested that the company take an appeal from this ordinance, if it is not satisfied with the rate, and this course will probably be followed.

Discounts and Minimum Charges.—In a decision allowing the Public Electric Light Company, St. Albans, to make a horizontal increase of 10 per cent in its electric rates, the Vermont Public Service Commission holds that a single rate of discounts for payment of bills within a specified date is preferable to two rates of discount varying with specified lengths of time within which bills may be paid. It also held that a utility company should not be allowed to make an additional minimum charge to consumers having two meters where the second meter is required in order to enable consumers to obtain the needed service at the lowest price made by the company's classification of service.

Justifying Rate Increase.—The Maine Public Utilities Commission has announced its policy in regard to higher rates sought by the Milo Electric Light & Power Company, substantially as follows: "Our engineering and accounting departments have been engaged in this investigation, prosecuting it as fast as circumstances would permit. They have not yet been able to complete the work; and, while it was understood and agreed by both parties that this should be done, neither their inability to complete it nor this agreement as to procedure relieves the proponent from the burden of justifying the increases. This has not been done within the suspension period originally fixed. Neither party should suffer from this fault, because the procedure was agreed upon. Upon the other hand, the rates should not become effective until such proof is presented. The situation presented to the commission the alternative of extending the suspension period or of disallowing the proposed rates for lack of proof sustaining their reasonableness, saving to the proponent the right to prosecute its case further without prejudice. The latter course appears to be preferable under the circumstances, and it will be so ordered. A date will be fixed as soon as the above reports are completed on which the parties may be heard further if they desire."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Storm Damages Wire System at Cincinnati.—A 44-mile gale, accompanied by rain, swept over Cincinnati (Ohio) on the evening of Feb. 28, and many of the transmission lines were put out of service for four or five hours. Poles blown down caused the greater part of the damage. Walnut Hills, the eastern and northeastern sections of the city were in darkness for some time and cars stopped running.

Engineers of Illinois State Institutions Meet.—Since the recent consolidation, effected by the present Governor of Illinois under the civil administrative code, the various state institutions are tied together closely under common supervision. All mechanical work, including operation, maintenance, repair and new construction, is subject to the supervision of Fred J. Postel, a state officer, bearing the title of supervising engineer. The chief engineers of the various institutions having charge of mechanical work are now in a way units of the organization, and as there are many operating features of common interest to these men, they were called together at state expense to hold their first annual convention at Dunning, one of the state's largest institutions, on Feb. 14 and 15. The program consisted of addresses by prominent engineers, including Joseph Harrington, Prof. H. H. Stoek and Prof. S. S. Parr of the University of Illinois. The discussion of boiler-room problems which the engineers meet in their daily work was continued at a lively pace throughout the two days.

J. E. Aldred Lectures at Johns Hopkins.—The department of engineering of Johns Hopkins University, Baltimore, has announced the complete list of the J. E. Aldred lectures on engineering practice for this year. The course of lectures is one feature of a general plan, made possible by Mr. Aldred's gift, for furthering and improving undergraduate instruction in the methods and problems of the practice of engineering. Three lectures each will be given on the general subjects, civil, electrical and mechanical engineering. They will be given on Wednesday afternoons at 4.45 o'clock in the auditorium of the Mechanical and Electrical Engineering Building of the university, at Homewood. The lectures are open to the general public, and tickets of admission are not required. The complete program, including the lectures already given, follows: Feb. 5, "The Public Service Electric Power System," Percy H. Thomas; March 5, "The Human Element in the Machine Shop," James Hartness; March 12, "Berthing and repair Docks for Shipping," Rear Admiral Frederic R. Harris, U. S. N., retired; March 26, "Safety from the Standpoint of Industrial Efficiency," C. W. Price; April 2, "The Modern Steel Freight Ship," D D. Thomas; April 9, "The Duties of the Young Engineer in the Construction of a Hydroelectric Plant," H. S. Slocum: April 30, "The Production of 50 per Cent Ferro-Silicon in the Electric Furnace," P. H. Falter; May 7, "Ore Docks on the Great Lakes," John E. Greiner; May 14, "Disturbing Currents in Telephone Systems," John B. Taylor.

Test for Municipal Operation.—Light Commissioner W. E. Davis of Cleveland, Ohio, states that the new addition to the municipal light plant will begin operation in June of this year. The delay in construction caused by labor shortage and lack of materials, he said, cost the city $300,000. This added to the cost of construction will bring the outlay for the plant to about $2,000,000, instead of $1,750,000 as originally estimated. As soon as the plant extension is opened there will be fixed charges of 15 per cent., or $300,000 per year, including interest, depreciation and sinking-fund charges, which will become part of the operating expenses. A considerable period will be required to acquire business and collect on it to pay the additional charges, he said, and this will be the crucial time for the municipal plant.

Electrically Operated Dredges Increase Load of California Company.—Work has been begun on the new substation of the Southern Sierras Power Company at the Hanlon heading. This station is to be within a few hundred yards of the international boundary line, on the California side, and service will be given by it to the Imperial Irrigation District for the operation of dredges. These dredges are used in freeing the main canal of the silt that is carried in such quantities by the waters of the Colorado River. Electrical energy has been furnished from a temporary substation for several months, and two new dredges, each with a total connected load of 850 hp., have been in service for some time. The irrigation district is changing over a third dredge from steam to electric drive and will within a short time put a fourth one in operation which will increase the total connected dredge load to 2750 hp. An additional 500-hp. motor will be installed this spring for driving a centrifugal pump at the headgates. This irrigation project supplies water to some 600,000 acres in Imperial Valley through a main canal into which water from the Colorado River is diverted by the Hanlon heading. The Southern Sierras is installing an additional 900 kva. in transformer capacity, which will bring the station capacity up to 2400 kva. This substation is at a point 455 miles from the center of generation on Bishop Creek, and voltage regulation is effected by means of synchronous-condensers which are installed at intermediate points.

Union Gas & Electric Company Can Supply Hamilton.—President W. W. Freeman of the Union Gas & Electric Company, Cincinnati, Ohio, recently announced that his company is now in position to furnish service to Hamilton in case that city desires it. A committee was recently appointed by Mayor Smith of Hamilton to look into the matter. The Ohio Gas & Electric Company, which has been supplying Hamilton utilities, owns a transmission line between Cincinnati and Hamilton. The power was furnished by the Union Gas & Electric Company.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Contracts Required for Municipal Plants.—A city is not liable for coal furnished under a written order from the superintendent of a light and power plant operated by the city, as there is no contract such as the law requires, the Springfield (Mo.) Court of Appeals held (208 S.W. 109).

City Ordinance Application.—Where a city ordinance made the price of gas a certain amount, with the privilege of a 10 per cent discount if paid before a certain date, a later ordinance, omitting the privilege of a discount and providing an additional 10 per cent for delay in payment, could not be applied retrospectively under law, even though the discount feature were considered a mere inchoate right or privilege, according to the Civil Court of Appeals of Texas (208 S.W. 239). A city ordinance which granted a gas company the right to a minimum charge on meters could not, under the law, take effect for the month in the middle of which the ordinance went into effect.

Rates Fixed by Legislature Cannot Be Changed by Commission.—When the Legislature has fixed the maximum price for gas, the Public Service Commission has no power to allow the charging of a greater rate, even though the statutory rate be confiscatory, according to the Supreme Court of New York, Kings County (173 N. Y. S. 789). Though enforcement of a rate for gas had been enjoined pending trial and the company was charging the rate it had been charging prior to the enactment of the statute, the Public Service Commission may, under the Public Service Commissions law, require the gas company to file a schedule of its rates, the filing of the schedule giving the commission no greater control over the rate than it would have possessed had none been filed.

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Paul Cloke has been elected to a professorship in electrical engineering at the University of Arizona, Tucson.

Andrew Gaul of Bergen County, N. J., has been appointed a member of the State Board of Public Utility Commissioners.

J. Hall Truman, Jr., has been appointed district superintendent of the Ohio Service Company at New Philadelphia, Ohio.

Ernst Hutchens, formerly city electrician of Bluffton, Ind., has become superintendent of the Linn Grove Light & Power Company.

Harry L. Knight has been appointed to succeed Ralph W. Donges as a member of the Board of Public Utility Commissioners in the State of New Jersey.

C. C. Slater has been appointed general manager and general superintendent of the Columbus Railway, Power & Light Company, Columbus, Ohio. Mr. Slater was in charge of the construction work of the old Public Service Company and acted as its general superintendent for eight years. In recent years he has been interested in the coal-mining business.

R. J. Dearborn has recently withdrawn from the patent-law firm of Marshall & Dearborn, New York City, to take up work with the Texas Company as patent attorney. Mr. Dearborn was associated with Mr. Marshall for six years. Prior to that he was connected with the Westinghouse Electric & Manufacturing Company for nine years, during the last seven of which he was engaged as one of the assistant attorneys in the patent department.

Thomas F. Kelly, commercial manager of the Dayton (Ohio) Power & Light Company, has resigned to become sales manager for the Dominion of Canada for the Hoover Suction Sweeper company. Mr. Kelly prior to going to Dayton nine years ago was contract agent for the Dominion Power & Transmission Company of Hamilton, Ontario, with which company he began in 1900 as a junior clerk. Mr. Kelly is particularly well known among central-station men for his committee work in the Commercial Section, N. E. L. A., being at the time of his resignation a member of the executive committee of the section and chairman of the executive committee of the lighting sales bureau. In both Hamilton and Dayton Mr. Kelly was active in civic work.

Hartley Le H. Smith, former chief of the testing bureau of the Brooklyn (N. Y.) Rapid Transit System, has resigned to take charge of the steam engineering department of the New England Power Company, Worcester, Mass. Mr. Smith was with the Brooklyn company for more than sixteen years. The testing bureau was organized soon after he joined the staff and under his direction has grown to be a large department with mechanical, electrical and chemical subdivisions. He secured his elementary education in Camden, N. J., later attending Drexel Institute in Philadelphia. Upon graduation he became connected with the Camden & Suburban Railway, where he spent one and one-half years as assistant electrical engineer, resigning to join the Brooklyn company's staff.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Edward B. Meyer, assistant to the chief engineer Public Service Electric Company of New Jersey, who was recently appointed chairman of the committee on transmission and distribution of the American Institute of Electrical Engineers, has been a member of the National Electric Light Association committee on underground construction for the past eight years, the last part of that period as chairman.

E. B. MEYER

He is also a member of the sub-committee on wires and cables of the Institute. This committee was appointed at the request of the chief of the Bureau of Steam Engineering to assist the Navy Department in the solution of problems relating to wire cables with special reference to the high-tension cable to be used on the new electrically driven warships. Mr. Meyer was born in Newark, N. J., in 1882, where he received his early education. Upon graduation in 1903 from Pratt Institute, Brooklyn, he entered the engineering department of the Public Service Electric Company, and three years later he became field engineer in charge of installation of underground transmission and distribution systems. In 1909 he became assistant engineer, and in 1912 assistant to chief engineer, which position he now holds. Mr. Meyer has written for the engineering press and is the author of a book on "Underground Transmission and Distribution."

Brig.-Gen. George H. Harries, the first American officer in Berlin as the American member of the Inter-Allied Commission on the Repatriation of Prisoners of War, formerly vice-president of H. M. Byllesby & Company, has finished the task of evacuating not only American prisoners but those of Greece, Serbia and Rumania as well. For some weeks he has been engaged in a much greater and more difficult task, namely, the return to non-Bolshevik Russia of the 600,000 to 700,000 nationals of that country.

Charles E. Michel, who has been appointed sales manager of the Union Electric Light & Power Company, St. Louis, Mo., joined the Union company organization in 1907 as manager of the electric vehicle department. That department was later combined with the office sales department under his management. Finally those two departments were consolidated with the sales department and he now presides over them all. He is a graduate of the engineering department of the Virginia Military Institute and is lieutenant-colonel of the First Regiment of Infantry, Provisional National Guards of Missouri.

J. A. Whitlow, who was recently appointed general manager of the Pine Bluff (Ark.) Company, was previously administrative engineer and state director of conservation for the United States Fuel Administration of Missouri, while at the same time he was chief of the department of gas, electricity, heat and water of the Public Service Commission of Missouri. Mr. Whitlow was three and one-half years with the commission, three years chief engineer for the Board of Education, St. Louis, Mo., and three years with the Union Electric Light & Power Company, St. Louis, Mo. He is a graduate electrical engineer of the University of Missouri, and has also been assistant professor of electrical engineering at his alma mater.

Obituary

Alva W. Bernard, local manager of the Western Light & Power Company at Boulder, Col., died on Feb. 23 from pneumonia following an attack of influenza. Mr. Bernard was born in Leadville, Col., July 16, 1884, and was educated in Boulder, entering the employ of the Western Light & Power Company in 1904 as electrician. He rose to various positions and finally to the post of local manager at Boulder, which position he had held since 1917.

James E. Cole, wire commissioner of Boston, Mass., died at Needham Feb. 22. He was born at Roxbury, Mass., fifty-seven years ago and was educated in the local schools. Mr. Cole had been commissioner of wires since the administration of Mayor Hibbard, having been reappointed by each successive mayor. He was highly regarded in electrical and insurance circles, and his knowledge of the National Electric Code was of a really professional description.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

SOME SALIENT FEATURES OF FARM-LIGHTING MARKET

Distribution Program of Prominent Producers Calls for Agents Who Virtually Form a New Set of Electric Supply Jobbers

An interesting development in the electric supply jobbing field is taking place in connection with the farm-lighting market. This market has grown to a considerable size in the last two or three years, and the development of special 32-volt appliances has opened up a line of goods with a rapidly growing demand.

There are a number of manufacturers of farm-lighting plants each with a more or less different distribution policy. One plant is being distributed exclusively through electrical contractors. Other plants are being placed in customers' hands through local implement dealers. The electrical jobber is acting as agent in many cases. There are a couple of the largest producers, however, who are using their own agents exclusively. In one case the agent handles everything even to the wiring of the customer's premises, while in the other case this work is left to the local electrical contractor. In both instances, however, these agents are virtually becoming electrical supply jobbers, specializing on 32-volt installations. They are carrying more and more of an electrical stock, such as socket devices, motors, lamps, batteries, repair parts, etc. In fact, this has really become a necessity in order to get good agents to handle the proposition. There is not sufficient profit, it has been claimed, to entice one to distribute lighting plants alone. Once a plant is sold, however, there is at once provided a new outlet for the sale of additional labor-saving equipment.

CURRENT HIGH PRICES UNFAVORABLE TO FIXED LIST

General Electric Company Doubles List on Wiring Devices in Order to Get Away From Unsatisfactory Condition

Up to the time that the prices of materials began to skyrocket it was very satisfactory to make a fixed list price and to change discounts as market conditions warranted. Catalogs on this basis did not have to be changed every time the price changed. It was simply necessary to change the discount sheet.

Lately, however, the margin between list and net has become very small, and not infrequently the net selling price is greater than the list price. A good deal of confusion has been created, and some concerns have gone so far as to abolish the practice of quoting on a list basis and now quote on a net basis altogether.

This week an announcement was made by the General Electric Company relative to a new price schedule affecting its entire line of wiring devices, except inclosed fuses and some similar material, effective March 1, whereby all lists are doubled.

"During the active period of the war," the statement reads, "when costs advanced very rapidly, the easiest way to accomplish each advance in prices was to reduce discounts. This resulted in a most unsatisfactory method of figuring net prices on many lines, necessitating as it did in many instances selling wiring devices on a list-plus basis. There is no indication that costs will be sufficiently reduced for some time to come to warrant the continuing of this present unsatisfactory method of pricing.

"The company decided that the only way immediately to remedy this, without making present catalogs obsolete, was to declare practically all list prices doubled and establish a new schedule of discounts from these doubled lists which gives the same net prices as are now in effect."

BETTER MARKETING OF CONTROL EQUIPMENT NEEDED

Hasty Decisions in Cases Where War Demands Required Quick Installations Have Caused No End of Dissatisfaction

Although controlling apparatus has been widely standardized for some time, it is important that adequate engineering consideration be given to motor-driving problems involving severe service conditions. Perfunctory selection of equipment may lead to trouble. Under the stress of war conditions many installations were hastily made. Cost was of little consequence and early industrial production of the utmost importance. The specification or selection of controlling equipment ill adapted to the required service was necessary in some cases in order that the motors could be set at work quickly. These hasty installations have led in some instances to expensive replacements of motors, sweeping rearrangements of drives, interrupted production, damages to the original layout of machinery, and dissatisfaction with products substitutes for which would have given admirable service had there been a suitable preliminary engineering study. In addition, the cancellation of orders, throwing of motors upon the second-hand market after but a few weeks' service, loss of time in making betterments and an increased cost of plant beyond necessary limits would have been avoided or at least reduced.

Deliveries of control apparatus by the manufacturers of better reputation are so good now that there is little excuse for hasty work in motor applications. Even during the war in some sections of the country controller deliveries compared favorably with those promised on motors, but sometimes the equipment put in was unequal to the conditions. Vibration and rough handling by very unskilled labor led to disaster, and sometimes the pressure upon the motor users to get out war material was so great that the controlling apparatus could not be kept in order sufficiently to permit the use of the original motor installation.

One case occurred where 500 5-hp. induction motors were installed for turret-lathe individual driving. The labor available was so poor in quality that fuses were blown literally by the bushel. The original control equipment would not "stand the gaff," and when the employees replaced the fuses with solid copper wire the situation showed no improvement. Designs were prepared for an automatic control which when tested promised to solve the problem; but it was impossible to get suitable deliveries and so great was the importance of the plant output from the military standpoint that it became necessary to substitute eight 50-hp. motors for the 500 units. This was a war-time experience, but it points a moral in the careful selection of control for future installations under conditions of peace operation. More analysis of the mechanical fitness of controllers for duty under conditions of severe vibration, moisture, poor ventilation, neglected supervision, deferred

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inspection and postponed maintenance efforts will save many an installation from getting an undeserved "black eye" from some minor but none the less important feature which good sales engineering would avoid.

In the machinery trade as a whole, no less than in electrical circles, the failure to pay sufficient attention to the selection of auxiliary appliances is felt to be a prolific cause of dissatisfaction, and forward-looking observers expect a reformation in this practice. Repeat orders unquestionably have been canceled because of inadequate controller selection after earlier installations of different control gave excellent results. Certainly a closer coöperation is desirable between distributers of machinery, motors and control equipment than has often heretofore been feasible.

METAL MARKET SITUATION

War Department Not to Dump Surplus Copper on the Market at Low Price

There has been much interest shown in the policy of the War Department as to the method of disposal of its stock of copper. Articles appearing in newspapers have stated that this surplus stock would be sold back to the producers at 11 cents to 12 cents per pound. The War Department on Feb. 28 issued a statement refuting these press articles and upholding a policy of selling, through the director of sales, surplus property at market prices, allowing the trade only the actual cost of handling. The government surplus is about 14 per cent of the total copper supply of the country. Electrolytic dropped ½ cent over last week to 14.87½ cents, and London standard is reported off £1. Large producers have made sales at 15 cents and small producers have gone to 14.75 cents.

Estimated sales of refined copper for the past week were given as 20,000,000 lb., and sales for the month of February at 50,000,000 lb. to 60,000,00 lb., domestic and foreign.

Negotiations between French interests and the committee representing the Export Association are reported to have reached a state where the only bar to the closing of the contract is a question of price. It is expected that the association price of 23 cents for export copper will be lowered, possibly to 17 cents. This French delivery would be for the third quarter of the year.

The other metals are finding a very quiet market and prices are steady.

The old-metal market is demoralized and prices have shrunk. The stock of scrap copper in this country has been estimated at 10,000 tons. If this scrap yields 70 per cent copper, it means about 7000 tons of secondary copper. Stocks in Great Britain have been estimated at twice this figure, and France has considerable.

NEW YORK METAL MARKET PRICES

	Feb. 25	March 4
Copper:	£ s d	£ s d
London, standard spot	75 0 0	74 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	16.50	16.00
Electrolytic	15.37½	14.87½
Casting	15.25	14.75
Wire base	18.75 to 19.00	18.75 to 19.00
Lead, trust price	5.25	5.25
Antimony	7.12½	7.00 to 7.12½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.65	6.62½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	31.50	31.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 14.00	12.75 to 13.25
Brass, heavy	7.50 to 7.75	7.25 to 7.50
Brass, light	6.00 to 6.50	6.00 to 6.25
Lead, heavy	4.25 to 4.50	4.75 to 4.87½
Zinc, old scrap	4.75 to 5.00	4.50 to 4.75

THE WEEK
IN TRADE

EVIDENCES of increased activity in building are seen on almost every hand. With an early spring predicted, business in this line should develop soon. Lighting utilities are planning to make numerous developments shortly.

Prices are slowly weakening. Present firmness, however, is not necessarily an indication of the future. At present a slash in the price of fine sheet goods would probably not cause any great volume of buying, except perhaps for speculation. When, however, it is time for buying to commence there will be a better reason for manufacturers to consider offering better prices. This time, however, is still three or four weeks off.

Collections appear to be coming in satisfactorily. Because of income-tax payments this month might show somewhat slower payments.

The material-disposal section of the Bureau of Aircraft Production, under the direction of Lieut. Charles S. Shotwell, will issue bulletins on materials as soon as they are established as a surplus. Electrical machinery is classified as 6-2. Sales negotiations will be handled by salesmen in each of eight district branches, to be established in Boston, Buffalo, Chicago, Dayton, Detroit, New York, Pittsburgh and San Francisco.

Labor conditions continue to show increasing non-employment. There are numerous local disturbances, and wage rates are tending higher. All this was to be expected, but the situation is much easier than was anticipated. An early spring would, of course, help the situation consideraly, not only by furnishing more outlets for labor, but also by quickening the seasons of vegetable and other farm supplies.

NEW YORK

Despite the unrest manifest in the labor situation, building activities show a decided increase over the first two months of last year. In the third week of February more than $3,000,000 worth of contracts for buildings in the metropolitan district were let, nearly three-quarters of which were for private purposes, the remainder being state, municipal and government. With the United States Department of Labor backing it, the nation-wide "build-your-own-home" campaign is gaining headway, according to reports.

The amount of new line extensions continues small, and the new buildings for which contracts have been let are not yet ready for the electrical trade. Still, several steam plants have been reported changed over to electric drive for industrial and refrigerating purposes.

Rubber-covered wire is continuing down with the decline in price of copper. Knob, cleat and tube porcelain is off, and wood cross-arms have dropped slightly.

LAMPS.—The new small-sized bulb for the 23-watt and 25-watt low-voltage lamps, according to a statement by the Westinghouse Lamp Company, will not be available until some time in April or possibly later. It was anticipated that the bulbs would be available about Jan. 1, but owing to war conditions there were unforeseen delays in getting the molds.

VACUUM CLEANERS.—The inability of some manufacturers to keep up with their orders shows the trend of the market.

PORCELAIN.—Knob, cleat and tube porcelain has been reported as off 40 per cent in price.

CONTROL EQUIPMENT.—A very satisfactory market is reported in both automatic and manually operated equipment, with deliveries much improved.

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WOOD CROSS-ARMS.—A drop of 5 per cent is reported on carload lots at the mill, with deliveries around two weeks.

WOOD POLES.—Stock deliveries can be made on cedar poles, while two to three weeks is necessary on chestnut. This is much better than former deliveries on chestnut, as hauling and cutting facilities are now available.

ATTACHMENT PLUGS.—Plugs and switches are finding a very active market with manufacturers of socket devices.

METERS.—Little activity is reported in this field, owing to the small number of extensions by lighting and power companies.

KNIFE SWITCHES.—A considerable market is found for switches, both exposed and incased in an iron box for safety and fire-protection purposes. No drop in price is predicted.

RUBBER-COVERED WIRE.—Average base is just under 23 cents. The majority of manufacturers quote on 23 cents, as was the case last week. A couple of manufacturers are a cent or two lower than last week, one quoting as low as 20 cents.

BOSTON

Trade still moves along conservative lines, with cautious buying and few commitments to new electrical projects. Inquiries are demanding much attention, however, and a moderate amount of building construction is reported. The Worcester (Mass.) Electric Light Company has inaugurated a house-wiring campaign, and the falling price of wire bids fair to see a good deal of work hitherto delayed by war conditions resumed. Spring is almost upon the industry, even in New England, and a reasonable amount of central-station activity along new-business lines will soon have its effect on stocks. Prices show tendencies toward weakness in motors of the smaller sizes, and wire is off about 2 cents compared with a week ago. Two makes of motors are quoted about 10 per cent lower this week than recently. Collections show little change from week to week. Stocks are in substantial volume, and the high prices represented in the jobber's investment are being held up pretty firmly. No shortages of moment are reported. Great interest is being shown by the public in automobiles, and at the Hartford show last week three of the latest models of electric passenger coupés were sold off the floor before the week was half gone.

APPLIANCES.—The demand is well maintained, with firm prices. A prominent manufacturer reports that he cannot fill orders now in hand for irons, grills and heating pads. Factory stocks are low. The high price of labor is a decided deterrent of lower prices on these outfits. Raw materials are plentiful. There is a feeling that unless the jobbers in many cases begin to stock up faster on appliances there is a fair chance of their being obliged to face a shortage later in the year. All signs point to a big year in electric labor-saving devices and household conveniences.

ELECTRIC PASSENGER VEHICLES.—Prices of one leading make rose $250 Feb. 15, making the current selling price for a popular model $2,450. Dealers report a very active market and announce that it is becoming more and more difficult to obtain prompt deliveries. The Detroit Electric Car Company is planning to build a service station and agency quarters soon in New Haven, Conn.

WIRE.—Bare copper wire is quoted at 18 cents base this week, weatherproof at 21 cents, and rubber-covered at 22 cents. The demand is still very moderate, but the opinion is being advanced that as soon as buying sets in on a considerable scale prices will spurt upward again.

PORTABLE TESTING COILS.—The demand is increasing somewhat, although the market for testing panels is rather quiet just now. Prices are firm on account of high labor costs.

SWITCHES AND SOCKETS.—Business from the manufacturer's viewpoint begins to show some improvement. Apparently a low point was reached about three weeks ago. Jobbers are less timid in buying, and some ordering is noted for fixture work. Factory stocks are well built up for prompt delivery, and prices are still firm. Raw material is now plentiful. Short-time running is being carried out to some extent. Service men are being taken back as a uniform policy.

GENERATORS.—Interest is well maintained in small alternating-current generators for water-power services. Prices are still steady, and inquiries well maintained.

MOTORS.—Ten per cent price reductions are reported in the cases of two prominent makes of small motors. Motors are not moving very fast, and some dealers hope to stimulate activity by making concessions.

CONDUIT.—Pipe is in good supply and in comparatively small demand. The release of conduit by war plants is affording an opportunity for some buyers to obtain material of the slightly used variety for stock at prices somewhat below the manufacturers' quotations.

RADIATORS.—Stocks are fair as to size. A revival of business is expected during the next few weeks, with later sales for summer home use.

CHICAGO

Business in the Chicago district has been greatly stimulated by the action of Congress in validating informal war contracts, of which there are about 640 in this district. The claim board of the United States Army Ordnance Department is adjusting claims with dispatch, and the claimants are receiving checks in full settlement about ten days after the adjustment figure has been agreed upon. Claims for stocks of material purchased at abnormal prices are usually adjusted by paying the contractor the difference between present prices and what was actually paid for the material. Even on this basis of settlement, Chicago manufacturers will probably receive about $150,000,000 from the government. When the government fulfills its obligations to the manufacturers the latter will be in a position to proceed with their plans for extensions requiring both labor and materials.

Chicago manufacturers are looking for business abroad. The Bates Expanded Steel Truss Company intends to manufacture steel poles in Italy and has shipped all the equipment required for its Italian factory.

Building is still being held back by high prices of building materials, but there will be a flood of orders when prices weaken.

APPLIANCES.—These have developed into a stronger line with the jobbers than ever before. Prices are firm and deliveries are good.

SCHEDULE MATERIAL.—There is little demand owing to the lack of building.

LAMP GUARDS.—Manufacturers report increasing requirements from the trade, especially for those guards which prevent theft of lamps.

WIRE.—The base on rubber-covered wire is from 20 cents to 23 cents. Bare wire is around 18 cents, and weatherproof ranges from 18 cents to 21.75 cents. The demand is light.

FARM-LIGHTING OUTFITS.—There is a steady increase in sales, and one manufacturer is unable to keep up with orders.

ATLANTA

The undertone of trade in general is strong, and while the sagging price of copper has tended to retard heavy buying, the volume of sales this week compares favorably with the last two weeks of February. Manufacturers report continued activity on the part of the smaller central stations in their purchases of supplies and especially for meters and distributing-type transformers. On the whole, the jobbing field maintains a healthy condition. Sales vary in the several Southeastern states, depending on circumstances. One jobber, however, claims that his sales for the first two months of this year are approximately 40 per cent greater than for the corresponding period in 1918. A few jobbers are very active and are leaving no stone

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unturned in their efforts to open up new channels of trade.

Reports from Charleston indicate that the Standard Oil Company will spend $10,000,000 for the erection of a refinery, 127 acres having been bought for this purpose.

The labor situation is quiet this week. Although the electrical workers have returned to the shops not in agreement with the employers' association, quite a number are still out. The contractors assert that the labor situation, so far as they are concerned, is rapidly reaching normal.

LAMPS.—Manufacturers and distributers state that trade is very active, and the outlook is so good that selling and distributing facilities are being extended to meet coming conditions. The average wattage per lamp is slowly increasing. Local stocks are accumulating. The demand for miniatures exceeds the supply, and incoming shipments are not yet sufficient to keep down the insistent pressure from dealers.

LEAD-BURNING TRANSFORMERS.—While this device has been on the market for some time, it has not been pushed on account of crowded factory conditions and long shipments. There is a big market for this outfit in the battery-repairing field, and dealers are beginning to go after this business actively. This transformer is not expected to displace the present gas-burning equipments, but merely to supplement these for finishing and trimming purposes. Shipments are promised for one month.

STREET LIGHTING.—The number of inquiries appears to be increasing each week. These are exclusive of maintenance. Manufacturers are looking forward to a good business as the warmer months approach. No change is noted in prices lately.

CHARGING OUTFITS.—These equipments are enjoying an ever-increasing market. Factory shipments, while showing some improvement, are still bad, and the manufacturers are having difficulty in satisfying jobber and dealer pressure for better deliveries. Jobbers expect a big sale in the larger-type rectifier now being brought out. Prices remain firm.

WIRE.—Weatherproof base has dropped to 18 cents. Rubber-covered and lamp cord remain around a 23-cent base. Buying is affected somewhat by the unsettled copper market, but the demand is fairly steady. Orders are increasing, but the volume per order is less than recorded for several weeks past. Stocks and shipments satisfactory.

WIRING DEVICES.—No change in price has been recorded for this week. Local stocks are in pretty good shape. The demand is well maintained, but buyers are not stocking up.

LAMP CORD.—Movement is rather slow at this time. Stocks are ample to take care of current requirements.

SEATTLE—PORTLAND

It is believed that only a few days will elapse before the workers in the Northwest will begin voting to call off the strike which has paralyzed shipbuilding since Jan. 21. A conditional agreement to submit the question of calling off the strike to a referendum vote of labor was reached at a joint meeting of the Seattle and Tacoma Metal Trades Councils recently. The Gray's Harbor Metal Trades Council has issued orders to unions of which it is composed to begin at once a referendum vote on the return to work of telephone operators, linemen and other electrical workers in Washington, Oregon, California and Nevada. Representatives of employees who would be most directly affected by labor unrest and any tendency toward Bolshevism are showing much confidence in the present outlook.

The Portland district reports wholesale jobbing business as good during the past week with collections at normal. Retail trade is active, considering the season. The Spokane district reports wholesale trade as continuing fair and retail business as good with collections satisfactory. Both wholesale and retail business in Tacoma is very quiet, principally owing to the strike. Approximately forty wooden vessels in the Portland district will be affected by the latest order of the Emergency Fleet Corporation that machinery installation be halted. An almost wholesale rejection of recent bids for the $10,000,000 of equipment of the United States Spruce Corporation opened in Portland is announced. The sales board has adopted a policy whereby prices commensurate with the ruling market will be fixed on most of the major equipment. All bids save those that were clearly coincident with the contemporary market were rejected. The lumber market continues strong, and Northwest lumbermen report new business developing in considerable volume in the past week. Orders received by 119 representative mills in Oregon and Washington were nearly 15 per cent above shipment and 13 per cent above production.

FIXTURES.—A decrease in demand for medium-priced fixtures is noticed, particularly by the Seattle trade. Inclement weather and the labor situation are retarding building. Stocks of both jobbers and dealers are in excellent shape. It is believed that the fixture business will be heavy during coming spring and summer.

SAN FRANCISCO

Weather conditions continue to be ideal. Business is very fair and along the same lines. House-wiring devices are still a little slow, but there are signs of an almost feverish activity in the booming of electrical household devices.

An unusual amount of large building has been reported during the past week, a great deal of it coming from the Central Valley. For instance, Sacramento reports a new million-dollar department store and a project to cost $2,500,000 in West Sacramento for a gigantic stockyard and packing house, to be supplemented later by a fruit and vegetable cannery. The Great Western Power Company, with power houses about 50 miles north of Sacramento, reports two new projects, one of $7,500,000 at Caribou Lake, to be begun immediately, and another project even larger, aggregating $10,000,000, to be constructed in the near future near the head of the Feather River. As signs of the new prohibition law, there have been several permits taken for the conversion of California wineries to canneries, and several Los Angeles contractors report jobs for breweries over the border. Recent meetings of California commercial bodies have predicted that this year will begin a new movement whereby the state will become more and more a manufacturing and industrial center.

TAPE.—This staple has fluctuated several times during the year, the latest having been a 5 per cent increase after a 10 per cent decrease. In looking over prevailing prices it is noticed that rubber and friction tape seem to have reversed their 1917 prices. Several large orders for friction tape are reported from the street railways, and a big shipment of rubber tape has been received by one of the Bay City shipyards.

RANGES.—During the past two weeks electric ranges seem to have usurped the previous position of washing machines as the device showing the greatest activity. A big range demonstration is being planned for Richmond, and dealers over the state are finally undertaking the sale of electric ranges and are beseeching the power companies for rates, power and permission to make extensions. The range rate in San Francisco has been increased to 3 cents per kilowatt-hour with a monthly minimum of $1.

FARM PLANTS.—There has been a greatly increased activity in 32-volt plants, and many sales are reported by agents, especially in the southern part of the great central valley. It is significant that regularly appointed agents make the greater part of these sales.

MEDICAL DEVICES.—Heating pads have been in the greatest demand during the past season, and there is practically no local stock, new shipments being ordered before their arrival. Vibrators have also been very difficult to secure and have been sold out continuously for the past three months.

LAMPS.—The price of carbon lamps has decreased about 15 per cent over prices prevailing during last season. The demand has considerably decreased. Deliveries on tungsten lamps are very good in practically all sizes, voltages and styles.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00 — 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25 to $78.75	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05½	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
1/4-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$60.00	$30.00	$26.00–26.50
1/4-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08½
3/8	.08½
1/2	.08½
3/4	.11½
1	.17
1 1/4	.23
1 1/2	.27½
2	.37½
2 1/2	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb	7% to 7.1%	9% to 9.1%
2500 to 5000 lb	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3¼-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4⅝-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.00—$36.00
Coil to 1000 ft.	25.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%-32%	10%-27%
$10.00 to $50.00 list	30%-40%	20%-35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00-$24.15
1/5 to std. pkg.	17.85- 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.—Nail-it—N.C.
Less than 1/5 std. pkg.	$16.00	$26.00
1/5 to std. pkg.	13.60	21.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$13.00-$18.40	$32.00-$36.80
1/5 to std. pkg.	11.50- 16.00	27.20- 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41-$0.66
No. 18, full spools	.39- .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.60 to $0.90
No. 18, full spools	.53 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.50-$25.00	$10.50-$17.00	$10.50-$15.00
12	20.20- 27.09	18.18- 23.22	15.15- 23.22
10	27.00- 32.40	24.30- 32.40	19.44- 27.45
8	33.12- 45.72	30.36- 45.72	26.50- 38.10
6	52.50- 72.36	48.13- 60.30	42.00- 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$19.50-$20.00	$14.50-$15.00	$13.00-$14.50
12	17.50- 24.57	17.55- 24.57	17.55- 21.06
10	24.05- 32.97	24.05- 32.97	21.16- 28.26
8	33.35- 46.69	33.35- 46.69	29.35- 40.02
6	52.95- 73.71	46.60- 63.18	46.60- 52.65

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$26.75 to $34.75
25 to 50 lb	26.75 to 34.75
50 to 100 lb	25.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$32.75 to $35.75
25 to 50 lb	31.75 to 34.75
50 to 100 lb	30.75 to 33.35

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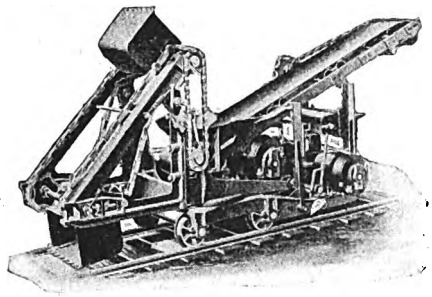
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Continuous Twin-Scoop Loading Machine

A mine loading machine known as the McDermott continuous twin-scoop loader has been placed on the market by the Wellman-Seaver-Morgan Company of Cleveland, Ohio. As its name implies, this machine digs loose ore, dirt or muck by a continuous scooping process, the material being taken up by scoops or buckets on an endless chain, elevated and dropped in a hopper which feeds to a conveyor belt that in turn loads into a car. The scooping mechanism is so pivoted that it can dig to the side as well as in front of the machine. However, the ore, being delivered to the conveyor through the hopper, reaches the car behind the loader no matter at what angle the scoop is working. The movement of the scoop is continuous, not reciprocating. The machine is self-propelled and is so dimensioned that it can easily be transferred around the mine. It is said to load at the rate of more than a ton a minute and may be operated by unskilled labor. While especially designed for underground work, the loader, according to its maker, is not limited to this application, but can also be used on the surface for loading coal from piles to cars, removing piles of rock and sand and similar operations.

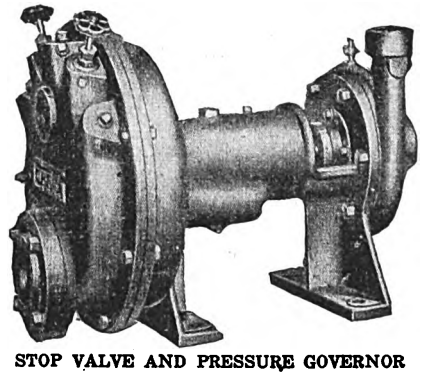


MOVEMENT OF SCOOP IS CONTINUOUS INSTEAD OF RECIPROCATING

Three main parts—truck, digging head and conveyor—constitute the loader. These parts can readily be dismounted and reassembled, permitting ease of handling in getting the machine under ground and in shifting from level to level. Levers for operating the loader are placed at one side in a position convenient for the operator to see the several movements. His duties consist of keeping the machine well up to the pile and swinging the shovel from side to side of the drift. Motors wound for 230 volts, direct current, are provided and furnish power for all the operations. These motors are entirely inclosed, and all chains and gears have suitable protective guards. The whole framework is of steel, the digging head is mounted on a large ball bearing, and all parts are protected as much as possible against dirt and water. Chains are arranged so that they can be easily tightened, and the digging edge of the bucket is filled with renewable tooth sections.

Centrifugal Turbo Boiler-Feed Pump

In designing its type CCC centrifugal turbo boiler-feed pump it has been the aim of the Coppus Engineering & Equipment Company, Worcester, Mass., to develop a pump having few working and wearing parts, requiring little floor space and attention and delivering a continuous steady flow of hot water into the boiler without pulsation. One shaft serves for both pump and steam turbine, and the turbine casing, bearing housing and supporting feet for the machine are cast in one piece, making a complete unit. One oil reservoir serves both bearings, and the oil level for the bearings is said to be maintained regardless of the quantity of oil in the chamber.



STOP VALVE AND PRESSURE GOVERNOR REGULATE WATER SUPPLY

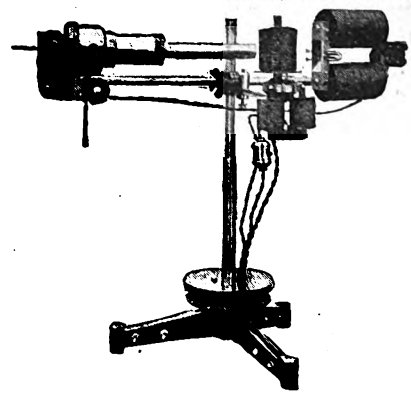
The feed-water capacity is regulated by means of an automatic safety stop and excess-pressure governor. It is pointed out by the maker that these pumps can run for some time against a closed discharge line without injury to either pump or lines. Therefore, in case of necessity, the water may be cut off by the hand valve at the boiler without first stopping the pump. Four sizes of pumps are obtainable, ranging in capacity from 100 b.-hp. to 3500 b.-hp. and having maximum pressures of 135 lb. to 175 lb. (9 kg. to 12 kg. per sq.con.).

High-Voltage Generators for Radio Communication

For use at ground stations in continuous-wave radio work the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has brought out a dynamotor to operate from batteries. It has an input of 10 volts, 9.3 amp., and an output of 80 milli-amp. at 350 volts or 166 milli-amp. at 300 volts. The dynamotor is contained in a metal carrying case, which has a top plate carrying switch, fuses and terminals, to which leads are permanently attached. When not in use, these are folded inside the lid, while a rubber gasket makes the box water-tight when closed. This dynamotor may be used with continuous-wave sets for both telegraph and telephone communication. A similar dynamotor is being made for use on small vessels, the voltages being 27.5 and 300. These machines are mounted in pairs, one serving as a spare, in a spring cradle to minimize noise.

Compact Lecture-Room Oscillograph

By means of the lecture-room oscillograph, which throws large-size images on a screen, it is possible for a number of people simultaneously to view and study such phenomena as armature reaction, alternator wave shapes, current variations in telephone circuits, transients due to switching or sudden applications of load, etc. Harold G. Crane of Brookline, Mass., has recently improved his lecture-room oscillograph, the apparatus now being mounted on one tripod stand instead of three separate ones. The equipment consists of an arc lamp, a magnet and vibrators, and a rotating mirror driven by a small synchronous motor. These units are



ONE TRIPOD MOUNTING MAKES DEVICE MORE PORTABLE

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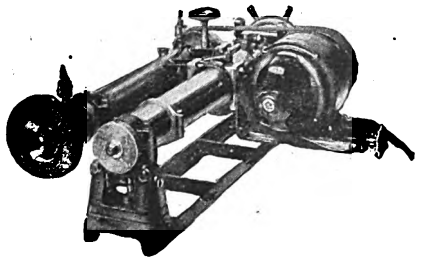
mounted in proper relationship on a movable arm, which is secured by a clamp to the tripod. At the base of the tripod upright is the arc-lamp ballast, and all connections from the various units are brought to terminals on the tripod legs. A shunt and multiplier, not shown in the illustration, are also included in the equipment. The apparatus is ready for use by properly connecting it to the circuit under investigation. It may be used in the laboratory for tracing by means of a small translucent screen placed at one end of the arms.

Motor-Driven Commutator Grinders

Two sizes of the Decker Universal commutator grinder are being marketed by the Shafer-Decker Company of Rochester, N. Y. One, intended for ordinary work, can be used with commutators having diameters up to 30 in. (0.76 m.), and the other, especially for naval use, can be applied to commutators up to 16 in. (0.41 cm.) long. These grinders consist essentially of the base, containing a hollow shaft, and the movable parts which comprise the motor, its carriage, the shafts and the grinding wheels they drive. The motor is of 1 hp. and is belt-connected to the grinding-wheel shaft.

To operate the grinder, its base section is firmly bolted so as to bring the grinding wheel into contact with the commutator. The carriage section may then be shifted from side to side on the hollow shaft in order to bring the grinding wheel into proper position to grind the high and irregular spots. The coarse abrasive wheel is used for the first operation, the armature being rotated at full speed and the grinding wheel being driven at its full speed.



EXTENSION ARM ALLOWS FINISHING IN OTHERWISE INACCESSIBLE PLACES

When a true circumference has been obtained, the coarse grinding wheel is removed and the finer wheel substituted to finish the surface. The regular model of this grinder weighs 600 lb. (272 kg.) and the naval model 325 lb. (147 kg.), so that they are both portable.

Electrical Equipment for Draglines and Shovels

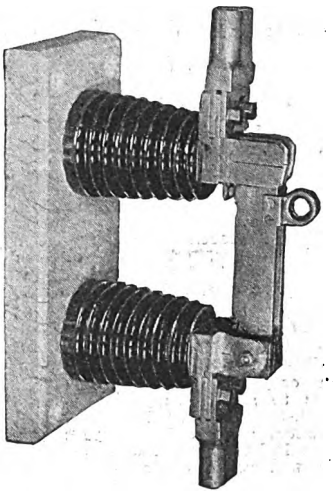
Electrically driven shovels or draglines are used for stripping overburden, mining coal, excavating, dredging, reloading coal and coke, making railroad cuts and similar work. Among the advantages arising from their use are lower operating cost, when fuels are scarce, expensive and hard to transport. Fewer operators are required; fuel is not an essential; there is no water to supply or freeze, no boiler or boiler troubles, no stand-by losses, no smoke, no sparks, no objectionable noises, and more material can be handled. A complete line of shovel and dragline electrical equipment designed to meet the especially severe service encountered in such work has been designed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and consists of wound-rotor motors, magnetic contactors, master controller and transformer apparatus.

Both alternating-current and direct-current equipments can be furnished. In general, the maker points out, the location of the shovels makes alternating-current equipment preferable because this current can be transformed more economically, and by using the alternating-current motors the necessity of converting alternating current to direct current is eliminated, resulting in simpler equipment.

The motors in this new line of apparatus are of the wound-rotor type capable of exerting powerful effort at the instant needed in the cycle of operation. Each motor is mounted on a massive frame with a strong shaft and amply large well-supported bearings of the oil-ring type. The rotating part is of small diameter and consequently has a low flywheel effect, which permits rapid starts, stops and reversals. The motors have few wearing parts and require little attention except for an occasional oiling. The controllers are said to be simple and compact and are designed and arranged so that the operator, by manipulating his master switches, can cause the shovel to respond to his wishes with facility. By means of the protective features of the controllers the shovel or dragline can be operated at its maximum rate of operation without injury to attendants or equipment and without loss of time. Because of this ease and simplicity of control and the savings in power cost the use of this electrical equipment is said to make possible the handling of more material and at a lower cost than where steam drive is used.

Locking Disconnecting Switch

For service on circuits ranging from 2300 volts to 33,000 volts, with ratings of 300 amp. to 2000 amp., a locking-type disconnecting switch is being manufactured by Thoner & Martens, Boston. The locking device, which is unsually simple and compact, consists essentially of a pair of eccentric rings attached to the blade and so arranged that when the switch hook is applied to the rings the pull moves one of them sufficiently against a small spring retention to release a composition arm from a catch mounted at the switch base. The blade, according to the maker, can neither fall out of place when locked in position nor be blown open by magnetic action. The blades are of drawn copper and mounted on porcelain insulators. A 300-amp., 5000-volt switch of this type recently withstood a tensile strain up to 2200 lb. between pillars and the following potential tests: Flashover, 50,000 volts; one minute, 45,000 volts; thirty minutes, 30,000 volts. The manufacturers



SINGLE-POLE, DOUBLE-BLADED TYPE FOR 1500 AMP., 15,000 VOLTS

produce these switches in both single-throw and double-throw designs, with single and multiple blades. The pillars are mounted on cast-iron ferrules or marble as required, wrought-steel bases being used in the former case.

NOTES ON RECENT APPLIANCES

Electric Time Switch

An electric time switch to close and open an electric circuit for evening service is being offered to the trade by L. T. Fenning of Jackson, Ohio.

Grinding and Polishing Machine for Litho Stones

The Cavicchi Polishing Machinery Company of Quincy, Mass., is now selling an electrically driven device for grinding and polishing the litho stones used by lithographers and music printers.

Small-Size Automatic Lighting Plant

A small-size farm-lighting plant which automatically and continuously operates fifteen to twenty lights is now being sold by the Consolidated Utilities Corporation, 730 South Michigan Avenue, Chicago.

Electric Refrigerators

Five styles of motor-operated refrigerators for residence, store, farmhouse and similar requirements are being manufactured by the McClellan Refrigerating Company, 564 West Adams Street, Chicago, with capacities up to 1 ton.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Scotland (No. 28,516) desires to purchase three inclosed-type, vertical, three-crank, condensing steam engines, speed not to exceed 350 r.p.m., steam pressure 160 lb., coupled direct to 3000-volt, 500-kw., 50-cycle alternator. Prices should be quoted separately for engine and generator, to be delivered at Cardiff, Wales.

An engineer in France (No. 28,524) wishes to secure an agency for the sale of apparatus for low-tension and high-tension electric current, electric lamps, electric wires and cables, insulation tubes and equipment, electric motors and dynamos, electric meters, etc. He desires to establish a depot of electrical supplies. Correspondence should be in French.

A doctor in France (No. 28.529) wishes to secure an agency for the sale of electrical apparatus used in medicine. Correspondence should be in French.

An engineer in France (No. 28,526) desires to secure an agency for the sale of high-tension and low-tension electrical apparatus, accessories, motors, generators, electric light fixtures, etc. He states that he is willing to come to this country to interview American firms. Correspondence should be in French.

A man in Australia (No. 28,507) desires to secure an agency for the sale of electrical supplies and equipment, electrical apparatus for mines, shipyards, etc., and particularly electrical railway supplies.

A. & T. Burt, Ltd., Dunedin, New Zealand, general importers and exporters, are interested in engineering requisites and lighting fixtures. Correspondence with view of handling American goods is solicited.

The All-Russian Central Union of Cooperative Societies has opened an office at 167 Post Street, San Francisco, Cal., to procure for Russia machinery and supplies which are available quickly and in large quantities. The representative in this country is Alexander Zelanko.

A firm in Italy (No. 28,440) desires to secure an agency for the sale of electrical equipment for power plants and electric light plants. Correspondence may be in English.

A commercial agency in Honduras (No. 28,452) desires to represent firms for the sale of all lines of goods used in tropical countries. Included in the list are electrical novelties. Quotations f.o.b. American port; correspondence in English.

A company in Brazil (No. 28,387) wishes to secure an agency for the sale of electrical materials. Terms, ninety days' sight draft with documents through local banks. Correspondence may be in English.

A man in Australia (No. 28,414) wishes to secure an agency for the sale of electrical goods and fittings.

A man in France (No. 28,416) desires to secure an agency for the sale of electrical machinery. Correspondence should be in French.

A man in France (No. 28,422) wishes to secure an agency for the sale of automobile electric starters. Correspondence may be in English.

A man in England (No. 28,436) desires to secure an agency for the sale of electric motor accessories.

Consul Buhrman reports from Malmo, Sweden, that the consulate is in receipt of inquiries from dealers and importers for catalogs of electrical installation materials. It is suggested that interested manufacturers forward such catalogs to the consulate.

CLOTH FOR STORAGE-BATTERY INSULATION.—*Il Sole,* published at Milan, states that, after a series of experiments made in Venice and Murano by Luigi Bisigato, felt and cloth made from spun glass have now been successfully produced there. A new society, the "Vitrum," has been formed, with extensive plants at Naples, for the manufacture of this felt and cloth for use as insulators in storage batteries.

THE ELLIOTT-LEWIS ELECTRICAL COMPANY, Philadelphia, has recently taken the agency for the Cofferfield electric washer.

THE CHICAGO PNEUMATIC TOOL COMPANY announces the removal on March 1 of its Cleveland district office from room 813 to rooms 406-408 Engineers' Building.

HERBERT L. SHERMAN, formerly president of the New England Bureau of Tests, Inc., and more recently in charge of inspection for the Construction Division of the United States Army, has been placed in charge of the structural material testing department of Arthur D. Little, Inc., Cambridge, Mass., chemists and engineers.

JOHNS - MANVILLE DISTRIBUTES BONUS.—The H. W. Johns-Manville Company will distribute to all salaried employees who were in continuous service for the full calendar year of 1918 an extra compensation of 20 per cent on the salaries paid them during 1918. It has been the custom of the company for some years past to recognize the faithful service of its big business family in this substantial way.

FREYN, BRASSERT & COMPANY, engineers, People's Gas Building, Chicago, announce the appointment of Wyman Eaton as chief engineer, effective Feb. 15. Mr. Eaton was formerly connected with the engineering offices of Julian Kennedy, Youngstown Sheet & Tube Company and others, and recently resigned his position as engineer-in-charge of the rolling mill works of the Mesta Machine Company to take up his new duties.

THE DUNTLEY-DAYTON COMPANY, it is understood, has taken over the entire output of the Dayton Pneumatic Tool Company. The Duntley-Dayton Company, which is located in the Westminster Building, Chicago, is also putting out a complete line of portable electric drills and grinders. W. O. Duntley, former president of the Chicago Pneumatic Tool Company, is president of the new company, and his son, C. A. Duntley, is vice-president.

THE POWDERED COAL ENGINEERING & EQUIPMENT COMPANY, Chicago, announces that Willis B. Clemmitt and George H. Ruppert have become associated with the company as advisory engineers. Mr. Clemmitt was formerly associated with the Central Iron & Steel Company at Harrisburg, Pa., and Mr. Ruppert before his entry into the chemical warfare branch of the service had charge of the sodium-ferro cyanide department of the Semet-Solvay Company.

OMER COX of San Francisco, Cal., has concluded arrangements with the Hygrade Lamp Company, Salem, Mass., to represent it on the Pacific Coast and in the Rocky Mountain region. Mr. Cox has recently visited the home office of the Hygrade company to complete arrangements for distributing its product through the following five offices in the West: Omer Cox, San Francisco, Cal.; Sands & Cox, Los Angeles, Cal.; Strimple & Cox, Seattle, Wash.; Jones & Cox, Salt Lake City, Utah, and Turnbull & Cox, Denver, Col. This organization sold 169 carloads of electrical material on the Pacific Coast in 1918, having been in business but four years, and is looking forward to a much larger volume of trade this year.

GEORGE H. OLNEY has resumed his old position as managing director of the Eugene F. Philips Electrical Works, Ltd., Montreal, Canada.

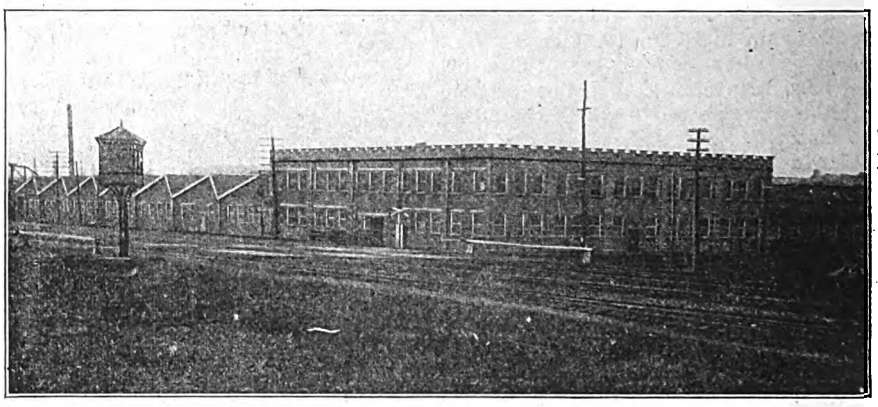
CHARLES PULACHECK & BROTHERS COMPANY, manufacturer of lighting fixtures, Milwaukee, Wis., announces that it is organizing a department of chandelier parts and supplies.

THE APEX APPLIANCE COMPANY, Chicago, manufacturer of washing machines, is planning to build a two-story factory, 60 ft. by 80 ft., at 3241-3247 West Thirtieth Street, Chicago.

R. B. COLEMAN, who was formerly with the Moloney Electric Company, St. Louis, Mo., as manager of its Chicago office, has become a member of the sales force of the Kuhlman Electric Company, Bay City, Mich.

B. I. SMART, formerly professor of railway engineering and transportation at McGill University, and J. A. Burnett, formerly electrical engineer with the Grand Trunk Railway system, are now associated as consulting engineers at 821 New Birks Building, Montreal, and will engage in civil, electrical and mechanical engineering.

THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has moved into its new factory at Salem, Ohio. An executive office will still be maintained at Alliance. The new plant is a two-story factory with about 70,000 sq.ft. of floor space situated on a nine-acre tract along the main line of the Pennsylvania Railroad at Salem. Adjoining the main two-story building, which is 96 ft. by 100 ft., are two sawtooth-roofed buildings, one 201 ft. by 97 ft. and the other 97 ft. by 54 ft. Provision is made for general offices, a drafting room, a special electric furnace laboratory and space for switch and transformer construction.



NEW PLANT OF ELECTRIC FURNACE COMPANY AT SALEM, OHIO

THE EDW. R. LADEW COMPANY, manufacturer of leather belting, with factory and general offices at Glen Cove, N. Y., announces important changes in its Southern organization, made with a view to more active efforts in the South. O. S. Horton has been appointed manager of the Southern branch, with headquarters at Charlotte, N. C., and territory covering all states south of Maryland, West Virginia, Kentucky and Arkansas, west to Texas. Walter Carr, formerly of the New York office, is assistant branch manager. Several new salesmen have been added to the organization, and a large stock will be carried at the Charlotte office and disposed of through distributers throughout the territory.

CHESTER A. GAUSS, who was formerly in charge of the advertising department of the Crocker-Wheeler Company, Ampere, N. J., has been transferred to the sales department, being temporarily stationed at Ampere. The company's advertising in the future will be handled by Sherman & Bryan, advertising agents, New York, N. Y. Mr. Gauss is a 1912 electrical engineering graduate of Lehigh University. Following his college work, he joined the services of the General Electric Company as a technical writer in its publication bureau. In 1914 he joined the editorial staff of the *Electrical Review* and later the editorial staff of the ELECTRICAL WORLD, from which position he resigned to become associated with the Crocker-Wheeler Company.

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THE BELDEN MANUFACTURING COMPANY, Chicago, Ill., manufacturer of wire and cable, it is reported, has increased its capital from $1,000,000 to $1,500,000.

THE CANADIAN ELECTRIC & MANUFACTURING COMPANY of London, Ontario, it is reported, has been purchased by the Western Ontario Electric Company.

THE CHICAGO FUSE MANUFACTURING COMPANY, Chicago, it is understood, is making preparations for the construction of a seven-story plant at Congress and Morgan Streets. It is reported that building will be begun in a few months.

THE CALDWELL ELECTRIC COMPANY, manufacturer of general electrical supplies, Champaign, Ill., is planning to move into the factory building which it recently purchased. The company, it is understood, is also planning the erection of a large warehouse.

FRED R. FARMER, president of the Beardslee Chandelier Company, Chicago, has been elected president of the recently organized National Council of Lighting Fixture Manufacturers. Except for about a year which he spent as sales manager for the Gibson Company, Indianapolis, Ind.,

F. R. FARMER

Mr. Farmer has been with the Beardslee Chandelier Manufacturing Company since about 1900. He was sales manager of the Beardslee company for fifteen years. Then for two years he was vice-president. Since the beginning of 1918, Mr. Farmer has been president of the company.

JOHN G. WADDELL, formerly of the Robertson-Cataract Electric Company, Buffalo, N. Y., and lately with the Wetmore-Savage Company, Boston, Mass., has been placed in charge of the construction department of the Brown-Gates Company, electrical contractor and dealer, Springfield, Mass.

THE MEACHEM GEAR CORPORATION, Syracuse, N. Y., with offices at 411 Canal Street, has been incorporated for the purpose of taking over from the New Process Gear Corporation the manufacture of New Process rawhide pinions and for the general manufacture of gears of all kinds. The company is incorporated for $300,000 and has purchased a three-story building which is to be devoted entirely to the manufacture of gears. The Meachems organizing this company are the same who owned and controlled the New Process Gear Corporation and the New Process Rawhide Company for a period of thirty years, and associated with them are George W. Wood, secretary and superintendent, and H. W. Kiddle, assistant superintendent, who had charge of the manufacture of rawhide and the rawhide pinion department of the old company. The plant purchased is now being remodeled and was to begin operations on March 1, at which time it took over the rawhide pinion business, the hide plant at 811 Free Street, Syracuse, and all of the raw materials and uncompleted orders pertaining to this branch of the business. The company will also manufacture a full line of cut-metal gears for mills and factories of all kinds.

Trade Publications

INTER-PHONES. — Inter-phone outfits are the subject of a new folder of the Western Electric Company, New York City.

SOLDERING IRON.—The Rite Manufacturing Company, Westport, Conn., has got out a folder telling about the "Solderrite" iron.

LIGHTING FIXTURES.—In bulletin No. 7 the World Lighting Appliance Company, New York City, describes some of its lighting fixtures.

PYROMETERS.—The Wilson-Maculen Company of 781 East 142d Street, New York City, in catalog No. 12 describes its line of pyrometers.

CONDUIT FITTING.—"No-splice" blocks are illustrated and described in a new leaflet being distributed by the V. V. Fittings Company, Philadelphia.

FANS.—The dealers' catalog of G. E. electric fans for the 1919 season is being distributed by the General Electric Company of Schenectady, N. Y.

STOKERS.—Two folders which tell about the "Cokal" hand-operated stoker have been prepared by the Cokal Stoker Manufacturing Company, 48 West Division Street, Chicago.

PORTABLE ELECTRIC MACHINERY. —Different portable electric machines are spoken of in a new booklet from the R. G. Haskins Company, 547 West Washington Boulevard, Chicago.

ADVERTISING ELECTROTYPES.—A 1919 catalog of electrotypes of its products for newspaper advertising is being distributed by the General Electric Company of Schenectady, N. Y.

ELECTRIC PORTABLE RADIATORS.— A leaflet setting forth the features of type No. 100 portable electric radiator is being distributed by the Simplex Electric Heating Company, Cambridge, Mass.

INDICES.—An index to its descriptive bulletins and sheets and another to its supply part bulletins, both dated January, 1919, have been issued by the General Electric Company, Schenectady, N. Y.

WIRE TERMINALS.—The Patton MacGuyer Company of Providence, R. I., has prepared a bulletin giving size and weights specifications and line illustrations of its standard copper-wire terminals.

FLASHERS AND COLOR HOODS.—A mailing folder from the Reynolds Electric Company, 422 South Talman Street, Chicago, advocates increased business by using "Reco" flashers and color hoods in advertising signs.

FLEXIBLE COUPLING.—Bulletin No. 26 has been issued by the Smith-Serrell Company, 90 West Street, New York City. It explains the construction, uses and operation of Francke flexible couplings of the heavy-pattern type.

CIRCUIT BREAKERS.—A circular briefly noting the growth of its circuit-breaker business in twenty years is being distributed by the Cutter Company of Philadelphia. Illustrations of two styles of this company's apparatus accompany the circular.

LIGHT AND POWER PLANT.—A reprint of an article in *Automotive Industries*, describing the automatic electric light and power unit made by R. M. Owens & Company, 1 West 142d Street, New York City, is being distributed by this concern.

STEAM TURBINES AND SPEED-REDUCING GEARS.—The De Laval Steam Turbine Company of Trenton, N. J., has just issued a thirty-two-page bulletin, M, which describes geared steam turbines. This apparatus could be used for driving direct-current generators and large centrifugal pumps and fans.

LIGHTING.—"Lighting from Concealed Sources" is the title of a comprehensive 250-page book, with upward of 600 illustrations, which has been written by J. L. Stair and issued by the National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago, of which Mr. Stair is chief engineer. This publication contains a practical treatment of lighting problems involved in obtaining satisfactory illumination and individual effects without exposed light sources. The book is intended primarily for distribution and use among architects, lighting men and contractors, but contains information of value to light users as well. In recording his information the author has preserved a balance between theory and practice, chapters being included on the history of X-ray lighting, the X-ray reflector, the principle of lighting from concealed sources, important laws in the control of light, indirect-lighting theory and practice, planning indirect lighting, application of indirect lighting, lighting from other than ceiling outlets, the Curtis portable lamp, general uses of direct lighting and equipment for it, planning direct lighting, applications of direct lighting, principles of show-window lighting, planning show-window lighting, showcase and wall-case lighting, uses and units for floodlighting, applications of floodlighting, bank desk lighting, definitions of illumination terms, units and quantities, and miscellaneous data valuable to lighting engineers.

New Incorporations

THE WAKEFIELD (NEB.) ELECTRIC COMPANY has been incorporated with a capital stock of $25,000. R. H. Matthewson is one of the incorporators.

THE COOPER (TEX.) POWER, LIGHT & ICE COMPANY has been incorporated by E. D. Borhead, H. B. Borhead and E. Hendricks. The company is capitalized at $50,000.

THE NORMANNA ELECTRICAL COMPANY of Brooklyn, N. Y., has been chartered by S. Kieldsen, B. Hagen and F. Werner, 322 President Street, Brooklyn. The company proposes to do a general contracting business.

THE SOUTHWESTERN UTILITIES COMPANY of Alva, Okla., has been incorporated with a capital stock of $500,000 by Percy Jones of Alva, R. F. Rice of Lawrence, Kan., and Albert Manuel of New York, N. Y.

THE LONGACRE HARDWARE & ELECTRIC COMPANY of New York, N. Y., has been incorporated with a capital stock of $10,000 by B. M. Fando, Harry Thal and Reuben Lebouitz, 438 West Forty-ninth Street, New York City.

THE NORTH AMERICAN ELECTRICAL PRODUCTS CORPORATION of New York, N. Y., has been chartered with a capital stock of $20,000 by M. F. Riley, E. C. Schiffmacher and J. Bernhart, 701 West 179th Street, New York City.

THE AUTOMOTIVE BATTERY & ELECTRIC COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $50,000. The incorporators are: C. L. Rimlinger, M. M. Clancy and P. B. Drew of Wilmington, Del.

THE CALORE CORPORATION of New York, N. Y., has been chartered by J. T. MacGregor, J. Monks and A. H. Schneer, 949 Broadway, New York City. The company is capitalized at $250,000 and proposes to manufacture electric heating and measuring devices.

THE HOME ELECTRIC APPLIANCE COMPANY, of Dover, Del., has been incorporated with a capital stock of $10,000 by W. I. N. Lofland, Frank Jackson and Charles R. Jones, of Dover, Del. The company proposes to manufacture washing machinery of all kinds.

THE KRETSHMER-BERGER COMPANY of New Brunswick, N. J., has been incorporated with a capital stock of $50,000 to manufacture electric and steam equipment, including motors, engines, etc. The incorporators are W. A. and V. P. Kretschmer of Metuchen and R. C. Berger of East Orange, N. J.

THE LIBERTY ALARM & ACCESSORIES COMPANY, Great Neck, N. Y., has been incorporated by F. A. Howe, of Hempstead; W. H. Turner, of Rockville Center, and H. Rohwer, 161 West Ninety-fifth Street, New York City. The company is capitalized at $50,000 and proposes to manufacture electrical products.

THE DONNELL-ZANE COMPANY of New York, N. Y., has been incorporated by J. C. O'Donnell, 148 West Ninety-seventh Street, New York City; H. J. Zane, Jr., Orange, N. J., and C. Ridnour, Millwood, W. Va. The company is capitalized at $25,000 and proposes to do a general electrical and mechanical engineering business.

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New England States

BANGOR, ME.—The Bangor Railway & Electric Company is planning to install three waterwheels of 250 hp. capacity each in its Veazie plant during the coming year.

ELLSWORTH, ME.—The Bar Harbor & Union River Power Company, it is reported, is planning to install a 3000-kva. waterwheel-driven generating unit at its local plant during the coming year.

VINAL HAVEN, ME.—The plant of the Islands Electric Company of Vinal Haven was sold at auction recently to H. W. Fifield of Vinal Haven for $25,000. He acted in behalf of the townspeople, who raised the money by public subscription. The plant was built three years ago at a cost of $80,000. Changes will be made in the equipment so that the plant can be operated less expensively.

BRISTOL, VT.—Plans are being prepared by the Hortonia Power Company of Brandon to enlarge its local hydroelectric power plant.

RICHFORD, VT.—The Vermont & Quebec Power Corporation contemplates the installation of a 500-kva. generating unit at its local plant, and also a new water-power development on the Missisquoi River, including dam, power house and transmission line. The plans provide for the development of 1500 hp. The transmission line will be from 15 to 22 miles in length and will carry 13,000 volts.

TEWKSBURY, MASS.—Application will be made to the State Legislature by the board of trustees of the State Infirmary at Tewksbury for authority to expend $28,000 to install a coal-handling plant.

WORCESTER, MASS.—The City Council is considering the installation of a new electric lighting system on Plantation Street.

Middle Atlantic States

ALBANY, N. Y.—Bids will be received by Dr. H. M. Biggs, Commissioner of Health, State Department of Health, Albany, N. Y., until March 15, for construction work, sterile rooms, media hood, refrigerator, cupboards, and shelving, electric dumbwaiters and electric clock system, laboratory building, Division of Laboratories, State Health Department, Albany. Drawings and specifications may be consulted at the New York office of the Department of Architecture, 1715 Tribune Building, and at the Department of Architecture, Albany. L. F. Pilcher, Capitol, Albany is state architect.

BAY SHORE, N. Y.—Mortensen & Company, 347 Columbus Avenue, New York City, have been engaged to prepare plans for an ice plant, including main factory buildings, boiler and engine plants and auxiliary buildings, to be erected at Bay Shore, for a new company being organized by Arthur Kelly and Wesler M. Oler, Jr., of the Knickerbocker Ice Company, 1480 Broadway, New York City. The cost of the proposed plant is estimated at about $100,000.

BROOKLYN, N. Y.—Contract has been awarded by Julius Kayser & Company, 45 East Seventeenth Street, New York City, for the construction of a power house, 50 ft. by 85 ft., on Classon Avenue.

BUFFALO, N. Y.—Bids will be received by the Commissioner of Parks and Public Buildings, until March 11 for the installation of lighting fixtures, conduits, electric wiring and other electrical work in connection with alterations and improvements to be made in the Stinson Building, Seventh Street, which it is proposed to use as an annex to Public School No. 1. John F. Malone is commissioner.

IONA ISLAND, N. Y.—Plans have been prepared by the Navy Department, Washington, D. C., for an addition to the power plant at the local station. The cost is estimated at about $30,000.

LOCKPORT, N. Y.—Plans have been completed by the Lockport Hydraulic Race Company for the construction of a new hydraulic power plant with a group of industrial buildings. A large quantity of power machinery, electrical equipment and auxiliary apparatus will be installed. Charles E. Dickinson is president.

NEW YORK, N. Y.—Plans have been prepared for extensive alterations and improvements in the old Stewart Building, Broadway and Chambers Street, in connection with the proposed new printing plant to be installed by Frank Munsey. Considerable electrical equipment, it is understood, will be required.

NEW YORK, N. Y.—Preparations are being made by Lewis Nixon, State Superintendent of Public Works, to rush to completion construction work on the terminals in New York for barge canal purposes, to cost about $400,000. The proposed work will include barge canal terminal and frame freight house, Flushing, estimated cost, $162,590; the erection of two 1½-ton electric overhead wharf cranes at Pier 6, East River, to cost $28,000; erecting electric capstans and trolley hoists at points along the canal not yet designated, $15,000; erecting four semi-portable revolving jib cranes, two each at Greenpoint and West Fifty-third Street, New York City, $92,598; constructing barge canal terminal freight shed at Pier 93, West Fifty-third Street, North River, at $53,969, and installing battery-charging motor-generator sets for terminals in New York City, $7,800. Bids, it is understood, are to be advertised immediately, and the contracts awarded early in the spring.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

OSWEGO, N. Y.—The city has voted $150,000 to be added to the existing appropriation of $345,000 to develop water power. W. A. McCaffrey is superintendent of water works.

PORT HENRY, N. Y.—The Port Henry Light, Heat & Power Company, it is reported, is contemplating the construction of a new hydroelectric power plant near Millbrook, N. Y. I. M. Frost of Rutland, Vt., is vice-president.

SAVONA, N. Y.—A franchise has been granted to Charles D. Davis to construct and operate an electric light plant in Savona. The village will contract for street-lighting service.

JERSEY CITY, N. J.—Plans have been completed by Percie A. Vivarttas, 110 Fourth Street, West New York, for the proposed building, 95 ft. by 107 ft., for power house, heating and lighting plant, to be erected at Laurel Hill to furnish service for the county buildings, etc. Oscar L. Aufuder Heide, Court House, is chairman of Board of Chosen Freeholders.

LAKE DENMARK, N. J.—Plans have been completed by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the installation of a new lighting system at the local naval station, to cost about $50,000.

NEWARK, N. J.—Plans have been prepared by the Hay Foundry & Iron Works, 93 Plum Point Lane, for alterations and improvements in its power plant.

NEWARK, N. J.—The American Oil & Supply Company, 52 Lafayette Street, Newark, it is reported, is planning to erect a new plant on Wilson Avenue, to cost about $100,000. New equipment, including electric motors, pumping equipment, boiler apparatus, etc., it is understood, will be required.

ALLENTOWN, PA.—The City Commission has engaged Frank Koester, 50 Church Street, New York, N. Y., consulting engineer, to make investigations as to the feasibility of installing an electric lighting plant at the city pumping station to utilize the excess boiler capacity.

GOODVILLE, PA.—The Tri-County Electric Company, it is reported, contemplates changing its entire system to three-phase, whinh will require a separate wire of about 6 miles. The rest of the system is already operated at three phase.

HARRISBURG, PA.—An ordnance is under consideration by the City Council providing for the installation of underground electric conduits to replace all overhead telephone wires and the removal of all existing poles.

WILKES-BARRE, PA.—Bids will be received at the office of the city clerk, City Hall, Wilkes-Barre, until March 11 for furnishing materials and labor for changing over the present four-lamp and five-lamp clusters on East Market Street, North Main Street and Public Square in the city of Wilkes-Barre, in accordance with specifications on file in the office of the city clerk. Fred H. Gates is city clerk.

WINDBER, PA.—The Berwin-White Coal Mining Company of Windber, it is reported, contemplates the construction of an electric power plant to supply electricity to the eight mines of the company. The company, it is stated, will also open two new mines in the Windber district within the next year.

YORK HAVEN, PA.—The York Haven Water & Power Company is contemplating extensions and improvements to its hydroelectric power plant. Gannett, Seelye & Fleming, engineers, 204 Locust Street, Harrisburg, have been engaged to make investigations and report on same.

BALTIMORE, MD.—Bids will be received at the office of the city registrar, City Hall, Baltimore, until March 15 for furnishing and erecting one 30,000,000 gal. turbine-driven centrifugal pump, reduction gearing, condenser and auxiliaries, including condensate and air removal pumps. Plans and specifications can be obtained at the office of the water engineer, City Hall, Baltimore, upon deposit of $5. Walter E. Lee is water engineer.

CHARLESTON, W. VA.—The Fryland Coal Company, recently organized, is contemplating an expenditure of $50,000 for erecting a plant in Kanawha County. Two drift mines will be opened, equipped with electrically driven machinery. C. G. Rowland of Nitro is president.

MARTINSBURG, W. VA.—The new plant of the Berkeley Woolen Mills, now under construction at Raleigh and Stephens Streets, Martinsburg, it is understood, will be equipped with electrically operated machinery. The cost of the plant is estimated at $100,000.

NORFOLK, VA.—Arrangements are being made by the Seaboard Ice & Cold Storage Company of Norfolk for the construction of a new ice manufacturing and cold storage plant, to cost about $500,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 4, Portsmouth, Schedule 3848—30,000 lamp sockets. Washington Navy Yard, Schedule 3849—miscellaneous electrical equipment; Schedule 3852—3000 ft. electric cable. Until March 14, f.o.b. works, Schedule 7836½—generators, extensions, shaft and ammeters with scale. Alexandria, Va., Schedule 7839½—miscellaneous conduit and conduit fittings. Applications for proposal blanks should designate the schedule desired by number.

North Central States

BOYNE CITY, MICH.—Plans are under consideration by the City Council for the installation of an ornamental lighting system on five blocks.

DETROIT, MICH.—The Public Lighting Commission is planning to expend about $500,000 during the ensuing year for the construction of conduits, street-lighting equipment, pole lines and underground cable.

HUDSON, MICH.—Arrangements are being made by the Southern Michigan Light & Power Company to extend its transmission lines to supply electrical service to surrounding villages and to farmers along the line. C. J. Avis is manager.

KALAMAZOO, MICH.—The City Commission is considering the installation of a municipally owned electric plant to supply electricity, lamps and motors for commercial purposes. The present plant furnishes street-lighting service only. The commission is also considering the installation of 22 new fire alarm boxes in the business section, rewiring practically all the alarm circuits, and replacing 12 boxes now in use in the residence portion of the town.

RIVER ROUGE, MICH.—The Ford Motor Company, it is reported, will soon receive bids for the construction of a substation and transformer house, 40 ft. by 80 ft., and a pig-casting machine shop, 70 ft. by 300 ft., in River Rouge.

ALLIANCE, OHIO—An election will be held on March 18 to submit the proposal to issue $200,000 in bonds for construction of an electric light and power plant.

DAYTON, OHIO—The Dayton Power & Light Company has completed the erection of its transmission line from its new plant at Miller's Ford to Piqua, a distance of 40 miles. The company hopes to complete this year its transmission line from Dayton to Wilmington, a large portion of which is now in operation. About 12 miles of construction will be required to complete the connection to Wilmington. This line will be approximately 42 miles in length.

OXFORD, OHIO.—Robert S. Ashe, president of the Liberty Light & Power Company of Richmond, Ind., has submitted a bid to the Village Council to supply electricity in Oxford.

LEXINGTON, KY.—The rebuilding of part and possibly the entire municipal electric lighting system, consisting of approximately 700 lamps, changing from the present series multiple system to Mazda lamps, is under consideration by the Lexington

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Utilities Company. The company also contemplates numerous extensions to its commercial lighting and power circuits as required from time to time.

LINN GROVE, IND.—The Linn Grove Light & Power Company has purchased at receiver's sale the overhead wire system of the defunct Bluffton, Geneva & Celina Traction Company between Bluffton and Geneva and also the entire distributing system at Linn Grove and Geneva. The Linn Grove company at present is securing energy from the Marion & Bluffton Traction Company, but has contracted to purchase electricity from the municipal electric plant in Bluffton. The change will be made as soon as the necessary equipment can be installed. Arrangements have been made to supply electricity in Vera Cruz and Craigville from the Linn Grove lines, and a line may also be extended to Berne.

MORAN, IND.—The Moran Electric Light & Power Company, recently incorporated with a capital stock of $15,000, is planning to furnish electricity in Moran. The company will secure electricity to operate the proposed system from the Terre Haute, Indiana & Eastern Traction Company. N. E. White is interested in the company.

ROCKFORD, ILL.—Extensions and improvements are contemplated by the Rockford Electric Company, including the installation of a 7500-kw. Curtis turbine, changes in coal-handling apparatus, switching apparatus and extensions to its distribution lines.

SPRINGFIELD, ILL.—The City Council is considering extensions to the municipal electric light plant and the installation of a municipal heating plant.

VARNA, ILL.—The local substation of the Central Illinois Public Service Company of Mattoon was recently destroyed by fire.

BURLINGTON, WIS.—The Burlington Brass Works is contemplating the construction of four new foundry and machine units, to cost $250,000 complete. The first unit, it is understood, will be built this coming summer. H. L. Sierks, 108 North Dearborn Street, Chicago, Ill., is architect.

MADISON, WIS.—F. L. Kronenberg, architect, Carroll Building, has been engaged by the Board of Education to prepare plans for a new high school building, to cost about $250,000. The plans will provide for a manual training and domestic science department, assembly room, gymnasium, etc.

RADISSON, WIS.—Plans have been prepared by L. A. De Guer, engineer, Wood County Bank Building, Grand Rapids, for the construction of a reservoir at Radisson, for the Wisconsin-Minnesota Light & Power Company, to cost about $500,000.

HIBBING, MINN.—Bids, it is reported, will be received by C. Foster, engineer, of the Hibbing Power & Light Company, until March 10, for the construction of power house, 104 ft. by 158 ft., three stories, on Main Street, to cost about $150,000.

DUBUQUE, IOWA—The City Council is considering establishing a municipal electric light plant in Dubuque. The cost is estimated at $250,000.

MACON, MO.—Bids will be received by W. H. Martin, city clerk, Macon, until March 20 for furnishing and installing one 400-kva. to 450-kva. electric generating unit directly connected to a uniform or compound Corliss engine, condensing equipment, spray-pond equipment and switchboard for same. Specifications may be obtained from Frank L. Wilcox, engineer, Syndicate Trust Building, St. Louis, Mo.

MEMPHIS, MO.—The Memphis Electric Light, Heat & Power Company is reported to have decided to install an ice plant in connection with the electric plant.

ST. JOSEPH, MO.—The City Council has adopted a resolution to call a special election to vote on the proposal to issue bonds to enlarge the municipal electric light plant and to erect a municipal ice and fuel plant, provided that the citizens desire such an election. With the expiration of the contract with the St. Joseph Railway, Light, Heat & Power Company to furnish electricity for the ornamental lamps in the downtown section, the streets have been dark, with the exception of electric signs and show windows. The standards and fixtures are owned by the electric company.

FARGO, N. D.—The city is contemplating the construction of three garages, to cost from $50,000 to $100,000 each.

FESSENDEN, N. D.—Arrangements are being made by the Fessenden Light & Power Company for the erection of a high-tension transmission line 19 miles in length to an adjoining town; also an extension of one of its high-tension lines into a new territory, a distance of 8 miles. The company is negotiating with a third town to furnish electrical service, which if carried through will necessitate the installation of an additional 200-hp. unit.

STANLEY, N. D.—The Public Utility Company contemplates improvements to its plant and system, including the installation of generators, engines, switchboards, etc. The company expects to purchase the above equipment, also line material and alternating-current meters, in about three months. R. F. Wheelock is manager.

WATERTOWN, S. D.—Bonds to the amount of $175,999 have been authorized for the installation of a municipal electric light plant.

ARAPAHO, NEB.—Plans are being prepared by Grant & Fulton, engineers, Lincoln, for a hydroelectric plant to be built by the city of Arapaho and the Arapaho Milling Company.

ASHLAND, NEB.—Improvements are contemplated by the Ashland Light, Mill & Power Company for improvements to its plant, including the construction of a new wheel pit, installation of a new waterwheel with generator, directly connected, and waterwheel governor, and also other minor improvements.

OMAHA, NEB.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 15, for the installation of three electric triplex elevator pumps, etc., in the United States post office at Omaha. Specifications may be obtained at the above office.

PLYMOUTH, NEB.—The city is considering the installation of a municipal electric lighting system. Energy will probably be secured from Fairbury or Beatrice.

STERLING, NEB.—Bids, it is understood, will soon be asked for the installation of a municipal electric lighting system. Grant & Fulton, of Lincoln, are engineers.

WICHITA, KAN.—The installation of an ornamental lighting system on First Street, from Main to Lawrence Street, is under consideration.

Southern States

CHARLESTON, S. C.—Contract has been awarded by the General Asbestos & Rubber Company to the Fiske-Carter Construction Company of Greenville, S. C., for the construction of an electric generating station. The proposed plant will have an output of 750 kva. and will cost about $60,000. Lockwood, Greene & Company, Atlanta, Ga., and Boston, Mass., are engineers.

CORDELE, GA.—The City Council has engaged Lockwood, Greene & Company, engineers, of Boston, Mass., to investigate the local properties of the Georgia Public Service Company with a view of taking over same to be owned and operated by the municipality.

TALBOTTON, GA.—The Talbotton Electric Light Company, recently organized, is planning to install an electric light plant, the cost not to exceed $7,000. J. W. Jordon and others are interested in the company.

LEESBURG, FLA.—At an election to be held March 12, the proposal to issue $30,000 in bonds to purchase or build an electric light plant will be submitted to the voters.

UNION SPRINGS, ALA.—Bonds to the amount of $10,000 have been voted for improvements to the municipal electric light plant.

NATCHEZ, MISS.—The Natchez Oil Mill Company is reported to be in the market for a 75-kva. generator, a Corliss engine and considerable heavy motor equipment.

FOREMAN, ARK.—The Foreman Light & Water Company is reported to be considering new equipment for its light and water plant, to cost about $25,000.

NEW ORLEANS, LA.—The Southern Yacht Club is planning to erect a club house on Lake Pontchartrain. The tentative plans provide for a building, 300 ft. by 100 ft., the basement to contain heating plant, electric light and power plant and refrigerating plant. The cost is estimated at $200,000.

ALVA, OKLA.—The Southwestern Utilities Company is contemplating improvements to its electric light and power service in Alva.

NORMAN, OKLA.—An election will be held to vote on the proposal to issue $75,000 in bonds to establish a municipal electric light plant in Norman. The city may construct or purchase a plant.

PERRY, OKLA.—The City Council is considering improvements to the electric light plant and waterworks system, to cost about $100,000.

STILLWATER, OKLA.—The city of Stillwater is contemplating the installation of a new pumping station. The Mackintosh-Walton Company, State National Bank Building, Oklahoma City, is engineer.

WOODWARD, OKLA.—Bonds to the amount of $30,000 have been voted, the proceeds to be used to equip an electric light plant and waterworks system.

BURKBURNETT, TEX.—The Wichita Falls (Tex.) Electric Company is planning to enlarge its plant to supply electricity for the town of Burkburnett and also to operate well-drilling rigs.

Pacific and Mountain States

EVERETT, WASH.—A special election, it is reported, will be held in the near future to vote on the proposal to establish a municipal electric light plant in Everett. Investigations for the development of power on the Sultan River have been made by the City Commission. Plans for the initial development call for 6000 hp.

YAKIMA, WASH.—A power development of about 10,000 hp. in the Wapato project is included in the plans of the United States Indian Service. Power from this source will be available only during the irrigation season.

LEBANON, ORE.—The Lebanon Light & Water Company has purchased a site on which it proposes to erect a new power plant. The old plant will be used for a pumping station.

EL CENTRO, CAL.—Arrangements have been completed by the Holton Power Company for remodeling its plant at Sixth and Main Streets.

ELSINORE, CAL.—Application has been made to the State Water Commission by G. I. Lamy, engineer, Marsh-Strong Building, Los Angeles, for permission to appropriate 120 second-feet of water of Lake Elsinore to irrigate 20,000 acres of land. The plans include the construction of 42 miles of canal, with power and pumping plant.

FRESNO, CAL.—Surveys are now being made by the San Joaquin Light & Power Corporation for the construction of another large power plant on the San Joaquin River, to cost about $1,750,000. The new station will be located about 6 miles below the present station and will have an output of 20,000 hp.

MERCED, CAL.—Plans are being prepared by Allison & Allison, architects, 1405 Hibernian Building, Los Angeles, for a group of buildings for the Merced Union High School district, consisting of academic, administration and assembly building, domestic science, manual training and commerce building, power house and gymnasium. About $130,000 is available for the project.

SALESVILLE, MONT.—A project is under way for the installation of a hydroelectric power plant on Big Bear Creek, 5 miles south of here, to furnish electricity for lamps and motors in Salesville and to the farmers in this district.

LORDSBURG, N. M.—The purchase of a 1000-hp. boiler, a 1000-hp. steam turbine and steam equipment is reported under consideration by the Eighty Five Mining Company.

Canada

VANCOUVER, B. C.—The Pacific Electric Welder & Manufacturing Company, 1018 First Avenue, Seattle, Wash., contemplates the construction of a factory on Industrial Island, to cost, including machinery, between $60,000 and $70,000.

WINNIPEG, MAN.—Extensions to the municipal hydroelectric plant are under consideration.

ALLENFORD, ONT.—The installation of a hydroelectric system is under consideration by the Bruce County Council.

COLLINGWOOD, ONT.—Plans are under consideration to equip the Collingwood shipbuilding plant for electrical operation.

PARRY SOUND, ONT.—The installation of a new municipal electric light plant, to cost about $125,000, is reported under consideration. F. Murray is town engineer.

TORONTO, ONT.—Extensions to the lighting system, to cost about $100,000, have been recommended by the Property Commissioner.

MONTREAL, QUE.—Plans have been prepared by the Montreal Tramways Company for the erection of a substation on Cute Street, to cost $400,000, and also car barns on Fullum and Mount Royal Streets to cost $110,000. W. Graves, Tramways Building, is chief engineer.

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(Issued Jan. 14, 1919)

1,290,915. ARC-WELDING SYSTEM; Leonard P. Coulter, Milwaukee, Wis. App. filed April 4, 1914. Prevents excessive current at start and eliminates power waste.

1,290,917. REGULATION OF ELECTRICAL SYSTEMS; Gorham Crosby, Glen Ridge, N. J. App. filed June 24, 1915. Secondary series resistance utilized when voltage generated is excessive of battery voltage of a variable-speed generator.

1,290,928. THERMO CIRCUIT CLOSER; Frederick S. Denison, Minneapolis, Minn. App. filed May 3, 1917. Controls dampers of heating apparatus.

1,290,930. INCANDESCENT ARC LAMP; Philip K. Devers, Jr., Lynn, Mass. App. filed March 6, 1916. Resistance heater located adjacent to arcing space used for starting arc.

1,290,945. ELECTRIC SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed July 8, 1915. Employs pole-changing for obtaining increased motor torque for reversal.

1,290,946. ELECTRIC SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed July 8, 1915. See above patent.

1,290,957. SYSTEM FOR THE TRANSMISSION OF WRITING AND THE LIKE IN FACSIMILE; Herman Foss, Tjomo, and H. Petersen, Christiania, Norway. App. filed May 8, 1917. Generator at receiving station provides energy for recorder.

1,290,995. TESTING DEVICE FOR IGNITION SYSTEMS; Clara H. B. Holmes and O. G. Holmes, Cleveland, Ohio. App. filed Jan. 21, 1918. Plugs tested under pressure.

1,290,996. ELECTRIC WELDING MACHINE; Henry S. Holmes, Brooklyn, N. Y. App. filed Aug. 17, 1918. For projectile vanes.

1,290,997. METHOD OF AND APPARATUS FOR ELECTRIC WELDING; Henry S. Holmes, Brooklyn, N. Y. App. filed Aug. 17, 1918. For hand grenades.

1,291,010. SAFETY INDICATOR AND LICENSE BRACKET; Nels M. Johnson and Thomas S. Quin, Chicago, Ill. App. filed July 31, 1916. For automobiles.

1,291,035. BRAKE APPARATUS; David L. Lindquist, Yonkers, N. Y. App. filed Jan. 22, 1916. Insures quick release of brake on elevators.

1,291,039. CIRCUIT MAKER AND BREAKER; Fritz Lowenstein and Joseph Broich, Brooklyn, N. Y. App. filed Nov. 29, 1916. For relay keys used in radio communication.

1,291,051. SAFETY CHEST FOR CONTAINING VALUABLES; James L. McQuarrie, Montclair, N. J. App. filed July 17, 1913. Electrically protected.

1,291,056. FLOW METER; Harold H. Mapelsden, Schenectady, N. Y. App. filed Aug. 10, 1916. Indicating meter has uniform scale.

1,291,066. RECTIFIER SYSTEM; Frederick W. Meyer, Pittsburgh, Pa. App. filed June 20, 1914. Energy from plurality of induction motor secondaries may be rectified in same rectifier.

1,291,078. METHOD AND MEANS FOR THE OPERATION OF ELECTRICAL APPARATUS; Walter S. Moody, Pittsfield, Mass. App. filed Feb. 27, 1915. Prevents injury from line surges.

1,291,088. LOW-LEVEL INDICATOR AND ALARM; Alfred Newell, Ottawa, Ontario, Can. App. filed July 29, 1918. For gasoline tanks of automobiles.

1,291,097. IMPULSE STARTER FOR MAGNETOS; Pontus Ostenberg, Los Gatos, Cal. App. filed Oct. 25, 1917. Intensifies spark during starting period.

1,291,106. ELECTRICAL RESISTANCE; John H. Payne, Ballston Spa, New York. App. filed Nov. 21, 1917. For radio receiving systems.

1,291,107. DYNAMO; Carl E. Pearson, Lansing, Mich. App. filed Dec. 29, 1916. Intermediate brush machine for regulating voltage when charging batteries.

1,291,110. ENERGY METER FOR ALTERNATING ELECTRIC CURRENTS; Charles Perdrisat and Al. Peloux, Geneva, Switzerland. App. filed March 24, 1917. Operates on Ferraris rotating field principle.

1,291,111. SYSTEM OF DISTRIBUTION; John F. Peters, Edgewood Park, Pa. App. filed Oct. 6, 1915. Will not disturb adjacent communication lines.

1,291,121. APPARATUS FOR WIRELESS TELEGRAPHY; John St. V. Pletts, London, Eng. App. filed Nov. 9, 1917. Attracts attention of listening operator.

Record of Electrical Patents

Notes on United States Patents

1,291,124. TELEGRAPH APPARATUS; Edwin Pope, Quebec, Quebec, Can. App. filed June 29, 1915. Messages automatically sent into line and automatically reproduced in duplicate at receiving station.

1,291,132. TROLLEY HARP; Solomon H. Rahhal, Detroit, Mich. App. filed Feb. 13, 1918. Wire-retaining device.

1,291,139. INSULATOR; Rudolph R. Reese, Startup, Wash. App. filed Aug. 8, 1917. Wire is clamped to insulator.

1,291,144. ELECTRIC MOTOR; Garret Rekers, Rochester, N. Y. App. filed Feb. 15, 1915. Universal motor easily reversed by means of switch.

1,291,167. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING SAME; Earl J. Rueb, Oklahoma, Oklahoma. App. filed July 24, 1917. Durable and not likely to deteriorate.

1,291,174. INTERRUPTING DEVICE FOR MAGNETOS; Emile J. J. Salmson, Billancourt, France. App. filed March 27, 1918. Mounted in an independent cage, affording facility for repairs.

1,291,197. CURRENT DETERMINATOR AND INDICATOR; Milton H. Shoenberg, San Francisco, Cal. App. filed Aug. 13, 1917. Easily used.

1,291,204. CONTROL SYSTEM; Karl A. Simmon, Edgewood Park, Pa. App. filed Jan. 23, 1915. For electric railway vehicles.

1,291,209. ELECTRIC, GAS OR VAPOR LAMP; Franz Skaupy, Berlin, Germany. App. filed June 9, 1916. Arc does not touch walls of tube.

1,291,216. MAGNETO-GENERATOR; Reuben S. Smith, Milwaukee, Wis. App. filed Sept. 2, 1916. Field revolves about stationary armature.

1,291,217. ADJUSTABLE SUSPENSION INSULATOR; Sol S. Sonneborn, Brooklyn, N. Y. App. filed Feb. 10. 1917. Distance between insulators may be varied.

1,291,218. UNIVERSALLY GRADABLE SUSPENSION INSULATOR; Sol S. Sonneborn, Brooklyn, N. Y. App. filed Aug. 25, 1917. See preceding patent.

1,291,232. DYNAMO-ELECTRIC MACHINE; Norman W. Storer, Pittsburgh, Pa. App. filed Aug. 9, 1915. Multiple-armature generator in which field magnet is divided.

1,291,233. CONTROL SYSTEM; Norman W. Storer, Pittsburgh, Pa. App. filed Oct. 27, 1915. For electric vehicles.

1,291,234. SPARKING DEVICE FOR INTERNAL-COMBUSTION ENGINES; Ole O. Storle, Tacoma, Wash. App. filed Dec. 22, 1916. "Make-and-break" type.

1,291,247. TELGRAPH REPEATER; Alston D. Taylor, Omaha, Neb. App. filed Aug. 28, 1914. Repeating effected by energy from main or line circuits.

1,291,253. DIAPHRAGM OR SEPARATOR; Charles J. Thatcher, New York, N. Y. App. filed March 22, 1915. For use in electrolytic cell.

1,291,263. DYNAMO-ELECTRIC MACHINE; Edwin G. Tidlund, Pittsburgh, Pa. App. filed Jan. 10, 1916. Light-weight motor for electric railways.

1,291,268. ELECTRICAL FITTING; Fritz Tresselt, Passaic Park, N. J. App. filed June 22, 1917. Outlet-box terminal.

1,291,283. BURGLAR-ALARM DEVICE; Robert W. Vail, New York, N. Y. App. filed Aug. 7, 1916. Does not hinder passage of authorized person.

1,291,297. CONNECTOR; Stanley Walas, Chicago, Ill. App. filed May 18, 1915. Nut of binding post need not be removed.

1,291,310. COMPOSITION FOR ELECTROLYTES FOR ELECTRICAL ETCHING; Joseph H. Weeks, Rutledge, Pa. App. filed April 4, 1917. Principal active element a chloride or chlorides.

1,291,318. RAZOR; Frank White, St. Louis, Mo. App. filed June 8, 1916. Mild current supplied to razor.

1,291,337. APPARATUS FOR AND METHOD OF PLATING WITH METAL; John E. Woodbury, Worcester, Mass. App. filed May 29, 1915. For facing type with hard metal.

1,291,379. THERMIONIC CONVERTER; Wilfred T. Birdsall, Montclair, N. J. App. filed Jan. 10, 1916. Attains pure electron discharge.

1,291,386. LIGHTNING ARRESTER; Quincy A. Brackett, Pittsburgh, Pa. App. filed April 29, 1915. Choke-coil type.

1,291,406. ELECTRIC CONDUCTOR; Edwin D. Chaplin, New York, N. Y. App. filed Feb. 8, 1915. Fireproof and waterproof.

1,291,422. CONTROLLER FOR ARC-WELDING APPARATUS AND THE LIKE; Leonard P. Coulter, Milwaukee, Wis. App. filed April 4, 1914. Controlling apparatus functions with movement of electrodes.

1,291,423. ELECTRIC HAND GRILL; Jay D. Crary, Aberdeen, Wash. App. filed Oct. 10, 1917. May be used with broiler.

1,291,424. DYNAMO-ELECTRIC MACHINE; Frederick Creedy, Ilkley, Eng. App. filed July 20, 1915. Varies pole number by varying phase difference between zones.

1,291,441. ELECTRON VALVE; Harold P. Donle, Meriden, Conn. App. filed Aug. 8, 1918. Durable and simple.

1,291,443. SAFETY DEVICE FOR ELECTRIC CIRCUITS; Herbert G. Dorsey, Dayton, Ohio. App. filed Jan. 28, 1916. Automatic means of grounding appliances.

1,291,459. DYNAMO-ELECTRIC MACHINE; Allan B. Field, Marple, Eng. App. filed Sept. 10, 1914. Multiple-layer armature winding easily cooled.

1,291,460. ELECTRIC WIRING CONNECTOR; Charles W. Finley, Battle Creek, Mich. App. filed April 13, 1918. Neat appearing and easy to installed.

1,291,473. AUXILIARY TIME KEY FOR SELECTIVE RAILWAY SIGNALING SYSTEMS; Maurice F. Gerr, Irondequoit, N. Y. App. filed July 23, 1915. Does not require attention of operator at central station.

1,291,483. PORTABLE ELECTRIC LANTERN; William Grether, Dayton, Ohio. App. filed July 27, 1918. Battery securely yet removably connected to bulb.

1,291,501. ELECTRIC WELDER; Austin S. Hatch, Detroit, Mich. App. filed April 22, 1918. Movable upper electrode arm operated by treadle.

1,291,507. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Sept. 9, 1915. For electric railway vehicles.

1,291,508. CONTROL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 25, 1914. Prevents flashover in dynamo-electric machines.

1,291,512. PROTECTIVE DEVICE; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 7, 1913. Retains characteristics and mode of operation in spite of extreme conditions upon circuit.

1,291,527. WIRELESS RECEIVING SYSTEM; Albert W. Hull, Schenectady, N. Y. App. filed March 10, 1917. Sensitiveness and selectivity of receiving circuit increased.

1,291,538. WIRE SPLICE; Silas R. Jones, Coeburn, Va. App. filed June 19, 1918. For electric trolley wires.

1,291,545. CONNECTOR FOR ELECTRIC CONDUCTORS; Chester A. W. Keim, West Orange, N. J. App. filed March 20, 1918. One terminal consists of spring jaws engaging other terminal at right angles.

1,291,561. CONTROL FOR ELECTRIC ELEVATORS; David C. Larson, Yonkers, N. Y. App. filed Oct. 2, 1914. Shunt field effects dynamic brake action.

1,291,568. COUPLER FOR ELECTRICAL MUSICAL INSTRUMENTS; Frederick B. Little, Chicago, Ill. App. filed March 13, 1916. Each key controls two sound switches, one being optionally used.

1,291,583. CONTROL SYSTEM; Paul L. Mardis, Altoona, and Andrew H. Candee, Pittsburgh, Pa. App. filed Sept. 9, 1916. For operating electric vehicles in trains.

1,291,585. TELEPHONE TRUNKING SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Dec. 2, 1910. Combined trunk selector and repeater for three-wire systems.

1,291,586. TRUNKING AND SUPERVISORY SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Dec. 10, 1910. Combined selector and repeater furnished for connecting two-wire with three-wire systems.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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The Trend Toward Interconnection

WE SOMETIMES wonder whether public utility operators are alive to the situation regarding the interconnection of contiguous systems and the desire in some quarters to have the government undertake such work. There can be no question of the economy of interconnection and of the numerous other benefits accruing to users and utilities alike. For that reason it would be a calamity to have the government undertake the work owing to the disinclination of public utility companies to act. Thus far the initiative for interconnection has come from the industry itself, and there are a sufficient number of interconnected generating systems now in existence to prove or disprove the economic and operating advantages inherent in such a scheme. The electric lighting industry must face the fact that interconnection will take place and that if it does not grasp the opportunity some other agency will. It is for the best interests of all concerned that the electrical industry itself undertake this work, for, to quote Theodore N. Vail: "Initiation is the province of operation. Initiation must come from familiarity, continuous intimate association with and observation of operation. Initiative must be controlled by judgment that comes only from experience. Uncontrolled initiative has created havoc with many enterprises." This is the ripe judgment of a man presiding over the greatest interconnected communicating system in the world. Is it wise for the industry to wait until the government acts?

Oh, for a Moses to lead us out of the wilderness of industrial strife! Apparently we need a peace conference of employers and employees as badly as we need a peace conference of nations. We need also more action and less talking.

Preparing for New Water-Power Legislation

ONE redeeming feature of all of the discussion which the various water-power bills of the past seven years have brought forth is that it has served to clarify the situation. Little if anything new can be contributed to the subject of water-power utilization, so that quick action is to be expected in the next Congress. For ourselves, we could wish for nothing better than the reintroduction of the so-called administration bill reported by the conference committee of the House and Senate. While not perfection, the bill is as good a one as can be expected. Long debate has served to polish the measure so that it stands out like a diamond. It has some flaws, but they do not detract greatly from its sparkle. Life is too short to start again from the beginning on water-power legislation. Those interested in developing the country's natural resources cannot do better than benefit from what has already been done and start where the last Congress left off.

Some knowledge of administrative and commercial training is as essential to the professional engineer as technical knowledge. Unless an engineer learn somewhat of the first two without sacrificing the last, he must be content to fill a minor rôle in life.

Why Are They for Government Operation?

WE ARE lumbering along from day to day without a concrete national policy on vital railroad, telegraph and telephone systems. Why do those who favor permanent government operation of these properties argue against a return of them to their owners? As a matter of fact, extraordinarily little real argument is heard from any individuals in prominent position in support of a permanent extension of government operation in this direction. Under these conditions, so difficult to define, is it worth while to question whether a large issue of government policy is in the balance? Or is it more in the public interest or the interest of our industry to assume that we are still a long way from the bridge and crossing? We think that it is clearly in the public interest that this country shall not embark on a national policy of government operation unless and until it shall have first satisfied itself that that is the wisest and best economic course. We certainly maintain that it is not in the interest of the country to stumble slipshod to a revolutionary change without thought or study or clear knowledge of what is being done. In short, it is, in our opinion, a time when something may be gained by plain public discussion of the sequence of events at Washington, of their possible meaning, and of the principles which are at stake.

Among the reasons which might be advanced by the advocates of public ownership or operation are: Breakdown of service, excessive cost of property or operation under private direction, and financial jugglery involving inexcusable loss to investors or unwarranted cost of service to the public. Another class of reasons may be described briefly as desire for a centralized power or for socialization of the republic. Reviewing the conditions which preceded the action of the federal government in taking control of railroads as a war measure, it is evident that these utilities were strained to the breaking point. Yet the government did not try to provide them with the sweeping authority to correct part of the underlying responsible conditions which it used unhesitatingly itself as soon as it had the operation of the carriers on its own hands. It did not give

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permission to the privately operated carriers to meet rising cost of operation by unprecedented rate increases, but it made such rate increases together with enormous advances in wages when it became the responsible operator of the properties. Some one was responsible for the bad plight of railroads before they were taken over by the government. The companies were if they held back needed development and effort simply to force the government to act; the government was responsible if by its policy of declining fair rates it deliberately drove the carriers into a position where financing was impossible. What is needed is an economic inquiry into the railroad situation. Upon the present showing of facts it would be utterly senseless for even the most fervent proponent of government operation to urge a continuation of that form of control on the ground that it would mean rates lower than those attainable under private operation.

We believe that the days of financial jugglery in the regulated utilities are past. If there is any possibility that those days are not gone forever it will certainly be to the interest of the entire public that legislation shall be enacted to make the assurance positive. But there is similarity in kind if not in degree between rampant financial jugglery by private operators and possible misuse of funds by operators representing the public. It should not be forgotten that there is danger of abuse of the railroad capital investment and the railroad operating expense account under public operation too. To pay railroad employees unduly large salaries or wages at the expense of rates is an offense which can exist under public as easily as under private direction.

If the gentlemen who seek public operation or ownership have only a worthy ambition to promote the public welfare, is it still desirable that they should be encouraged to believe that this policy will be to the advantage of the nation? Should so powerful an instrument for political domination be put into the hands of any party as would follow nationalization of the interstate carriers and communication utilities? We do not attribute selfish motives to any one, but we hold that the great economic and social considerations should be given due weight before the country thinks of turning from a war-time expedient to new and untried platforms. Power distributed among many can be controlled through regulation. Power concentrated in a few who may keep the reins of government carries a possibility of self-perpetuation that is disquieting. We have progressed to eminence as a republic. To abandon the time-honored principles and to change without carefully weighing the factors involved is the course of peril.

One of the lessons war has taught is that an electrical association can have a good convention without providing great quantities of expensive entertainment for the delegates. Entertainment at conventions there will always be, of course, but at many meetings hereafter it will be of a different sort.

Industry Waiting on Water Power

THE present ubiquitous Ford car is to be outdone if Henry and his son Edsell succeed in circumventing the Dodges and finding suitable locations for their factories. Just now their chief concern is to determine on sites for their various works. That they are having some difficulty in this matter is evidenced by a statement of Edsell Ford. "We expect to start work on our plants in the early part of next year," he said. "We are hunting water power and so far have only two definite locations, and they were bought primarily for tractor factories. They are at Hamilton, Ohio, and Troy, N. Y." Here is tangible evidence of a case where a man with ability and ample funds runs against the brick wall of federal inaction regarding the nation's water powers. Thus not only are waiting thousands disappointed by the deferred advent of the cheaper automobile, but the new towns which usually spring up around factories of this sort must remain on paper a while longer.

On general principles, the end of a transmission system is the proper point for paralleling duplicate lines, since it simplifies the switching apparatus and cushions, so to speak, the whole system. It also permits a spare generator to be used for voltage regulation.

Military Radio Communication

ONE of the vital conditions characterizing the existence of an army is that all of its elements shall be constantly within administrative communication of its commander, both for the reporting of events to headquarters and for the reception of orders from headquarters to any or all units. The duty of maintaining this intercommunication in the American army devolves upon the Signal Corps. The methods employed are various and manifold. They include electric telegraphy and telephony by wires, semaphores, heliographs, visual signaling, rockets, flares, runners, pigeons, cyclists, mounted messengers, acoustic signaling, ground telegraphy and finally, in this war, radio-telegraphy and radio-telephony.

The importance of radio communication and measurements in the Signal Corps service of the American Expeditionary Forces is well described in our article this week by Capt. A. D. Cameron. It was doubtless of similar importance in all the allied armies. The enemy also used it very extensively. It is a foregone conclusion from what Captain Cameron describes that no army of a first-rate power in the world can dare to neglect the development and maintenance of military radio-communication methods, apparatus and training during times of peace. Even on the assumption, however fond and illusory it may be, that war shall be no more, the mere police duty of the allied armies, all over the world, for the keeping of the world's peace and the incipient nipping of war buds, will call for a proper and regulated development of army radio communication.

Although the article of this week is devoted, in the main, to radio and radio communication, it should be remembered that the installation, maintenance and operation of the entire communication system of the American Expeditionary Forces, from the submarine cable termini in Europe, through the numerous French bases, depots and headquarters, out to the most remote airplanes in radio touch with their supports, devolved on the Signal Corps. The officers and men of that corps won widespread approval from the army and deserve unstinted praise for the way in which their work was done. They were called upon to plan and install, under many handicaps in material, a large telegraph and telephone system in France, and to some extent also in England and in Italy. They carried on communication

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with American operators, methods and apparatus, often under conditions that would be regarded as hopelessly impossible from peace-time standpoints. Although rated as non-combatant troops, they had to advance with the infantry and field artillery, pushing forward and maintaining the network of communication, repairing wires under shell fire, and holding untenable positions. They operated in every place that the infantry occupied, from buildings and billets, to dug-outs, huts, trenches, shell holes and the open fields, in all weathers and conditions of support. Captain Cameron's article indicates how much interest, both historical and human, might attach to a book written on the service of the Signal Corps with the A. E. F., giving not only such technical and historical information as is proper but also an accurate presentation of the service conditions.

From Sir John Jellicoe's book it is apparent that engineering and technical matters were treated much more successfully by the German navy than by the English. The searchlight equipment of the latter seems to have been scandalously deficient, but whether this is a criticism of English electrical engineers or of the British Navy is not indicated. The thing that is apparent is that the British naval officials did not utilize the skill of the electrical engineer.

Some Specific Problems of Industrial Lighting

WE HAVE preached so many times upon the text of good lighting as an aid to efficiency that general propaganda would seem to be almost superfluous. In the current issue Professor Clewell gives some details of the lighting of two large industrial plants which are peculiarly valuable, inasmuch as they deal not with the general situation but with some of the special problems which have to be met. One of these cases is a set of large new buildings for a munition plant. Their form is not unusual, the space being divided by concrete columns into three bays 20 ft. (6 m.) wide with a 10-ft. (3-m.) aisle extending down the center of each shop. Throughout the entire space the outlets are on 9-ft. by 10-ft. (2.7-m. by 3-m.) centers, each provided with a 100-watt gas-filled lamp in a steel-enameled dome. For most of the work this proved quite sufficient, as will usually be the case where the power expended per square foot is high, as it was in this case. For some operations, especially the running of lathes, screw machines and drill presses, this general lighting was not adequate in following the action of the tool and setting the index graduations on the machines. Therefore 40-watt individual lamps properly shaded have been installed to meet this particular requirement. As a rule, the new plants erected for war industries have been pretty well lighted, although contrary instances are unfortunately to be found, due perhaps partly to carelessness and partly to the difficulty of getting suitable lighting equipment on short notice.

In closing, Professor Clewell lays stress on the very important point that all lamps on drop cords should be fitted with reflectors, and the same rule applies with equal force to the case of any individual lamp, which should not only be fitted with a suitable reflector to keep the glare out of the eyes of the workman but should also be adjustable so that lamp and reflector can be brought into the most effective position for illumination of the work.

The Oil Engine and Electrical Supply

OF THE many things which have varied in cost with most startling rapidity during the war, none has been more conspicuous than fuel. Fuel of every kind has shot up in expense to forbidding figures. The price of coal has been enormously increased by added charges for labor and transportation and by scarcity of both, and it is not likely to decline rapidly, for the price of labor must keep pace with the cost of living and neither shows any very hopeful signs of retreat. They are at a deadlock, neither wishing to be the first to climb down, so that fuel costs are likely to remain high for some time, producing in the case of electrical supply stations a necessary added charge which has been many times recognized in the rates permitted to the utility companies.

A brief paper in our columns this week directs attention to the effect of the cost of coal and the need of conservation and brings out especially the possible importance of the oil engine as an economic remedy, not for the general case of power generation perhaps, but for certain important special cases which in the aggregate hold a large place. At the present time fuel oil has, of course, been considerably affected in price, but in the long run it is likely to decline more than coal, for the simple reason that labor and transportation are less serious in its case than in the case of a fuel which has to be mined and carried in cars. Oil is obtained at very moderate production costs so far as labor is concerned, and much of its transportation is via pipe lines. The oil engine, as our correspondent points out, is from a thermo-dynamic standpoint extremely efficient, something like twice as efficient as a steam generating equipment of moderate output.

The oil engine has been used only to a moderate extent in this country thus far, chiefly because many of the American machines were designed to be built cheaply and not for the highest possible efficiency, and also because, inasmuch as they are relatively simple, they have not always received their fair share of skilled attendance. At the present time the tendency in design is toward highly efficient units even if of considerably greater cost than the earlier types. In the long run the gain in fuel efficiency considerably more than offsets the first-cost charges, with the added advantage of being better able to cope with rising costs of oil, if they should come in the future, and thus reducing on the whole the relative costs of operation.

Where electric supply can be obtained from large and well-planned power stations driven either by water-wheels or steam turbines electric power can be obtained under ordinary circumstances at a figure which leaves little room for economy in independent plants driven either by steam or oil engines. There are many cases, however, where it is desirable to have power in considerable amounts at points remote from a convenient or economical source of electrical supply or where the conditions of demand are such as to make it difficult to obtain low enough rates from existing plants. In such instances generating equipment driven by oil engines is well worth very serious consideration, since the cost of operation, including all items, can be brought to a figure in most cases below that attainable by coal in similar situations. At all events the subject is one which deserves careful investigation on the part of engineers, particularly in view of the likelihood that the price of coal will for a considerable period of time remain at a high level.

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Field Testing of Instrument Transformers

Experiences with the Agnew Method Show It to Be Very Valuable for Tests Conducted at Place of Installation—Simplifications in Calculations and Amount of Equipment Used

BY H. M. CROTHERS
University of Wisconsin

THE method* of comparing instrument transformers with a standard transformer of known characteristics has proved so valuable in field testing and for small laboratory work that the results of the author's experiences with it may be of value to other engineers. To make clear the discussion which will be presented a brief review of the theory of the Agnew method will first be given.

For comparison of current transformers the standard and the test transformers have their primary windings connected in series in the supply circuit as shown in Fig. 1. The secondaries are connected to the current coils of two portable standard watt-hour meters, and a four-pole switch is interposed for the purpose of switching the meters from one transformer to the other. The voltage coils are connected either in series or parallel according to the voltage available and are controlled by a common snap switch.

For comparison of the current ratio of the transformers the voltage supplied to the potential coils should be in phase with the current through the current coils. Under these conditions the phase-angle shift between the primary and secondary currents in the transformers has no appreciable effect on the registrations of the meters.

With a chosen primary current flowing the ratio between the readings of the meters, if started and stopped together, will depend on their own adjustments and upon the current ratios of the transformers through which they are supplied, or

$$A_s/B_x = (R_x K_a)/(R_s K_b) \qquad (1)$$

in which R_s = the current ratio of the standard transformer; R_x = the current ratio of the test transformer; K_a = a constant depending upon the adjustment of meter A; K_b = a constant depending upon the adjustment of meter B; A_s = registration of meter A connected through standard transformer, and B_x = registration of meter B connected through test transformer. If the meters be interchanged in the transformer secondaries and another pair of readings taken with the same current, then

$$A_x/B_s = (R_s K_a)/R_x K_b \qquad (2)$$

or dividing the equations member by member eliminates the meter constants and gives

$$(A_s B_s)/(A_x B_x) = (R_x/R_s)^2,$$

$$\text{or } R_x/R_s = \sqrt{(A_s B_s)/(A_x B_x)} \qquad (3)$$

Agnew shows that this equation may be put in the form

$$(R_x - R_s)/R_s = \tfrac{1}{2}[(A_s - A_x)/A_x + (B_s - B_x)/B_x] \qquad (4)$$

To determine the difference between phase angles of the two transformers it is necessary to operate the meters at a low power factor. The registrations, then, are affected both by the current ratio and by the phase shifts of the secondary currents. If the voltage be shifted by the angle θ (measured positive when the voltage leads the current) and another set of readings (A'_s, B'_x, A'_x, B'_s) is taken, then the angle α_x, by which the secondary current leads the reversed primary current according to Agnew is

$$\alpha_x \text{ (in minutes)} = \alpha_s - 3438/\tan\theta\,[(A'_s - A'_x)/2A'_x + (B'_s - B'_x)/2B'_x - (R_x - R_s)/R_s]$$

This is equivalent to the form given below in the discussion.

Simplified Calculations

Use of this method in testing a large number of transformers has led to the development of simpler forms of the equations given. For the calculation of the current ratio of the test transformer a form is used which may be obtained from equation (3) by use of two simple expedients.

The first and most obvious step is, when taking the readings, to make $A_s = A_x$ and equal to some integral number of revolutions. Doing this, equation 3 becomes

$$R_x/R_s = \sqrt{B_s/B_x} = \sqrt{1 + (B_s - B_x)/B_x}$$

Expanding by the binomial theorem, all terms after the second may be dropped with a resulting error of the order of 0.01 per cent. This gives

$$R_x/R_s = 1 + \tfrac{1}{2}[(B_s - B_x)/B_x] \text{ or}$$

$$(R_s - R_x)/R_s = \tfrac{1}{2}[(B_s - B_x)/B_x] \qquad (5)$$

The same form is obtained immediately from equation (4) when $A_x = A_s$.

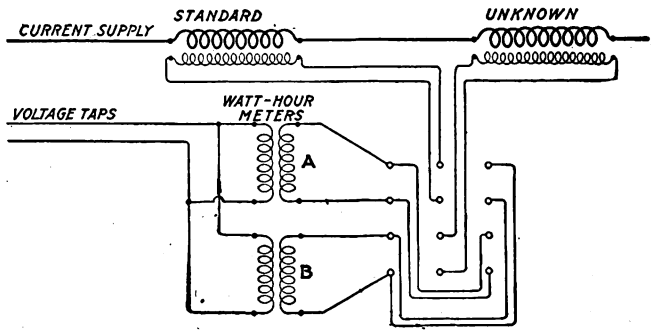

FIG. 1—CONNECTION OF APPARATUS USED BY AGNEW IN TESTING CURRENT TRANSFORMERS

The second expedient is the use of the "ratio factors" F_s and F_x instead of the ratios. As used by the Bureau of Standards, this term is defined as the true ratio divided by the marked ratio. It is convenient to state the ratio factor in per cent

F_s (in per cent) = 100 R_s/R_m (marked ratio).

The use of ratio factor is found helpful not only in this case but in all work with instrument transformers. Meters connected through instrument transformers usually have their scales or dials numbered to take account of the marked ratio of transformations so that if the ratio factor is stated in per cent the percentage error in the readings due to transformers is at once apparent.

*Described by P. G. Agnew of the Bureau of Standards in the Nov. 21, 1914, issue of the ELECTRICAL WORLD.

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The ratio factors are obtained by multiplying the numerator and denominator of the left member of equation (5) by $100/R_m$, giving

$$(F_x - F_s)/F_s = \tfrac{1}{2}\,[(B_s - B_x)/B_x],$$
$$\text{or } F_x = F_s + F_s\,[(B_s - B_x)/2\,B_x] \qquad (6)$$

The second term of the right member of equation (6) is of the order of 1 per cent of the first term. Therefore a few approximations in the second term will not affect appreciably the final result of the calculations. For F_s the value 100 may be substituted since the ratio factor of the standard transformer is always very close to 100 per cent. Again for B_x the value A_s, which is very nearly equal to it, may be substituted. A_s is an even number and makes the arithmetic easier. Finally,

$$F_x = F_s + 100\,[(B_s - B_x)/2A_s] \qquad (7)$$

(F_s and F_x are stated in per cent.) ($A_s = A_x$).

The error in the value obtained for F_x due to all approximations involved will not exceed 0.1 per cent when the difference between the two transformer ratios is not over 3 per cent and the difference between the meter rates is under the same limit.

To calculate the phase angle α_x the following line of reasoning may be used: It may be seen from equation (7) that $100\,[(B_s - B_x)/2A_s]$ gives the percentage difference in the ratio factors of the transformers. The only new element affecting the second set of readings taken at low power factor is the fact that the secondary currents are displaced by different angles from the primary current, and therefore the power factor at which a meter operates depends on the transformer through which it is connected. The difference then between $100\,[(B'_s - B'_x)/2A'_s]$ and $100\,[(B_s - B_x)/2A_s]$ will give the percentage difference in the power factors $\cos(\theta - \alpha_x)$ and $\cos(\theta - \alpha_s)$,

$$\text{or } 100\,[\cos(\theta - \alpha_s) - \cos(\theta - \alpha_x)]/[\cos(\theta - \alpha_s)]$$
$$= \pm 100\,[(B'_s - B'_x)/2A'_s - (B_s - B_x)/2A_s] \qquad (8)$$

The left member reduces approximately to $(\alpha_x - \alpha_s)\tan\theta/34.38$, so

$$\alpha_x = \alpha_s \pm (34.28/\tan\theta)\,[100(B'_s - B'_x)/2A'_s - 100\,(B_s - B_x)/2A_s]$$

When a three-phase supply is used, θ is usually 60 deg., so

$$\alpha_x = \alpha_s \pm 20\,[100\,(B'_s - B'_x)/2A'_s - 100(B_s - B_x)/2A_s] \qquad (\theta = 60) \qquad (10)$$

The sign of the bracketed expression is determined by the definition of α and θ and by the kind of transformers under test. With α defined as the small angle by which the secondary current (or voltage) leads the reversed primary current (or voltage) and θ defined as the angle by which the supplied voltage leads the supplied current, equation (9) becomes for current transformers,

$$\alpha_x = \alpha_s - (34.38/\tan\theta)\,[100\,(B'_s - B'_x)/2A'_s - 100\,(B_s - B_x)/2A_s] \qquad (11)$$

For voltage transformers

$$\alpha_x = \alpha_s + (34.38/\tan\theta)\,[100\,(B'_s - B'_x)/2A'_s - 100\,(B_s - B_x)/2A_s] \qquad (12)$$

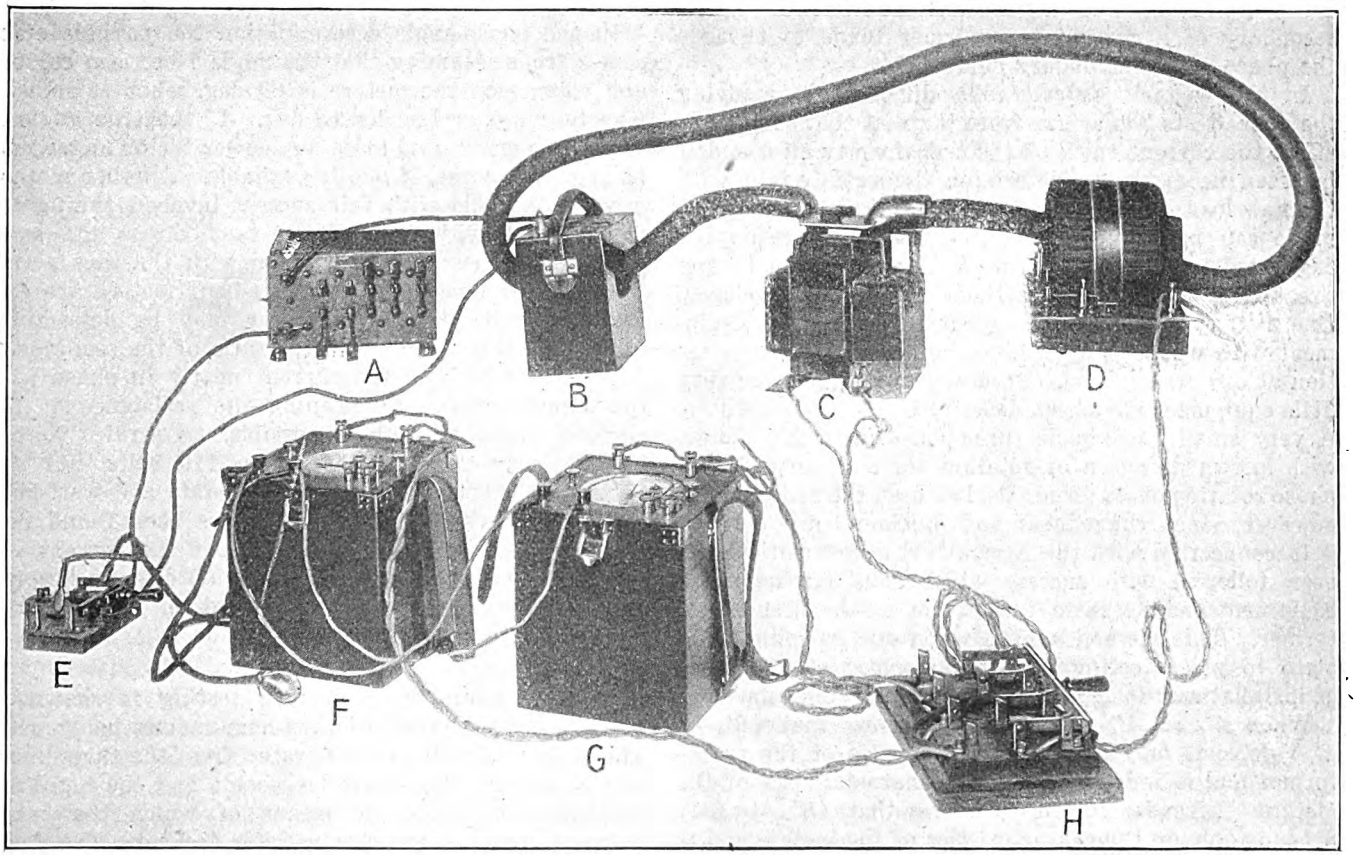

FIG. 2—ACTUAL APPARATUS USED IN CONDUCTING CURRENT TRANSFORMER TEST

A—Control rheostat. B—Auxiliary transformer. C—Test transformer. D—Standard transformer. E—Three-phase supply switch. F—Meter A. G—Meter B. H—Four-pole double-throw switch.

Example.—To illustrate the computation which must be made a numerical example will be presented for a given current transformer.

Let $F_s = 99.4$ per cent; $\alpha_s = 30$ min.; $\theta = 60$ deg.;

$A_s = 10.00$,	$A_s' = 5.00$,
$B_x = 9.88$,	$B_x' = 5.04$,
$A_x = 10.00$,	$A_x' = 5.00$,
$B_s = 10.04$,	$B_s' = 4.97$.

From equation (7)

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F_x = 99.4 per cent + (1004 — 988)/20 per cent = 99.4 per cent + 0.8 per cent = 100.2 per cent.

From equation (11)

α_x = 30 min. — 20 [(497 — 504)/10 — 0.8] min. = 30 min. + 30 min. = 60 min.

The use of equations (7) and (11) or (12) has been found to reduce greatly the work of calculation and to eliminate even the necessity of using the slide rule in most cases.

To Determine Whether θ Is Positive or Negative.—By connecting the voltage coil of a watt-hour meter to one phase of a three-phase circuit and supplying the current coil from another, the meter (if the direction of rotation is forward) will be operating at a power factor of 50 per cent, but the voltage may be either lagging or leading. It is necessary to determine which is the case in order to fix the signs of equation (11) or (12).

Agnew, in the original paper, pointed out that it is possible to determine whether the test transformer has the greater or the smaller phase angle from the following facts: "(1) Adding non-inductive load to a voltage transformer always tends to lag the secondary voltage. (2) Adding non-inductive resistance in the secondary of a current transformer tends to advance the phase of the secondary current."

In the writer's experience a difficulty in applying the above tests has arisen from the fact that such loads affect the current ratio of the transformer also, and it is often necessary to determine the ratio again with the new load before the effect of the load on the phase angle can be definitely known. For this reason the suggested method has not been depended upon to any great extent, and other methods have been developed. One method used involved the carrying of extra equipment with which to determine the order of phase rotation at any installation. Several plans calling for very little equipment have been described by various authors. A very small home-made three-phase induction motor, with known direction of rotation for a given order of phase rotation at its terminals, has been the usual choice, however, since ruggedness and quickness are desired.

In connection with the Agnew test a new method has been followed with success which calls for no extra equipment and no extra test except at the first transformer. This method applies when one is going from place to place testing each transformer at the place of installation. It depends upon the following relations:

When $A'_s = A'_x$ equation (11) shows that $(B'_s - B'_x)$ depends only on the characteristics of the transformer and is independent of the characteristics of the meters. Likewise it can be shown that $(B'_s + B'_r)$ depends only on the characteristics of the meters and is independent of the characteristics of the transformers. These relations can be utilized as follows: In the laboratory, or in some installation where the order of phase rotation is known, let a set of readings be taken at some chosen current through the meters and with $\theta = +60$ deg. Suppose $B'_s + B'_x = N'$. Take another set of readings with the same values for the A readings and with $\theta = -60$ deg. If there is a small difference in the phasing adjustments of the two meters, the sum of the B'' readings will be different from N', say $B''_s + B''_x = N''$. On the subsequent tests at other places shift the voltage taps at random and take the readings for the phase-angle determination. At the current previously chosen again make the A readings the same as used before, and if the sum of the B readings is equal to N', the angle is positive. If the sum is equal to N'', the angle is negative.

Effect of Inductance in the Current Circuits.—In the preceding discussion it has been assumed that the currents in the transformers and meters are in phase with the voltage to which they are connected. Experience shows that this is sometimes far from being the case. Instances have been met in which the current lagged 30 deg. or more. It is necessary to be always on guard against this possibility, for neglect to do so may lead to large errors.

It will be recalled that in determining the ratio of the transformer it was assumed that the meters were operating at a high power factor so that the effect of the transformer phase angles would be negligible. However, the effects of the phase angles are not negligible, generally, if the meters are operating at a power factor of 0.96 or lower. This corresponds to a lag of the current behind the voltage of 15 deg. or more. If the angle is 15 deg., equation (7) may be applied with a possible error due to this cause as high as 0.2 per cent; it will be less than 0.1 per cent if the phase angles of the two transformers differ by 30 min. or less.

In the phase-angle determination the possible error comes from assuming that the angle θ between current and voltage on the meters is 60 deg. when it actually may be more or less by 15 deg. If the true angle is known, no error need arise. A power-factor meter may be used, of course, if one is available. Another method used in the field with fair success involves timing the meters first with the voltage taps across the same phase as the current leads, then with the taps across the adjacent phase. If the watt-hour meters are correctly phased, the power factor may be determined within a few per cent from the ratio of the readings.

It is best to keep the current nearly in phase with the supply voltage by keeping the resistance of the current circuit as high as possible. A service voltage of 220 is better, therefore, than 110 volts, but 440 volts is still better if suitable rheostats and watt-hour meters are available. It has always been found possible to keep the phase angle between the current and voltage within the 15-deg. limit of 60 deg. by keeping the resistance of the control rheostat up to at least 20 ohms.

FIELD TESTING

The equipment used in field testing is shown in Fig. 2, rotating standard watt-hour meters being used. The current circuit may be traced from the three-phase supply through the control rheostat and the auxiliary current transformer by means of which the heavy primary currents are obtained for testing. The four-pole switch in the secondary circuits for interchanging the meters is preferred to two single-pole switches, because there is less chance for errors in switching which might result in a short circuit on the secondaries of voltage transformers or in an open circuit in the secondaries of current transformers.

The Agnew method of testing instrument transformers has proved of great value in conducting tests on both current and voltage transformers at the places of installation and under conditions in which no other test would have been feasible. In one mining district sufficient equipment was carried around in a light buggy to test current transformers rated as high as 800 primary amperes. Even with the bad voltage regulation which existed, no difficulty was experienced in

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checking results, and the work demonstrated that the method is exceptionally good for field testing practically as well as theoretically.

It is possible to adapt this method of test to the absolute calibration of the standard current transformer which is used in checking the others. This adaptation enables any small laboratory to test current transformers without depending on outside assistance for even the calibration of the standard. It will be described in a later paper.

Place for Oil-Engine-Driven Generators

Attendance and Grade of Oil Required—Operating and Maintenance Expenses—Efficiency Compared with Other Prime Movers—Analysis of Expenses with Old and New Types of Engines

THE European war has forced a great and rapid change in our whole economic structure. Perhaps most marked of all these changes is the national realization of the limitations of fuel supplies. This was emphatically brought out during the war by the serious curtailment in some instances of both coal and oil fuels through government regulations. These regulations are now largely removed. However, the nation has been forced to realize the importance of fuel conservation. With this realization comes hand in hand the demand for maximum returns from such fuel as is used. The extravagant waste of coal under many thousands of small boilers has already received some attention. Probably the most important step in conserving fuel has been the interlocking of electric power systems. Remarkable results have been obtained and still further improvements from a fuel conservation or utilization standpoint may be expected.

However, there are conditions under which it is not practicable to tie in with large electric service systems, such as in a small town not near a transmission system, and here a small plant is necessary. When operated by steam the small power plant has an inherently low efficiency, and the total expenses per kilowatt-hour delivered are relatively high. Contrasted with this is the oil engine with its inherently high over-all efficiencies ideally suited for small power plants where oil is readily available, where solid fuel is expensive, where low load factor would cause high operating expenses.

In making this statement it is assumed, of course, that the oil engine is applied under proper conditions. It finds its special field of application in small municipal power plants, small utility electric light and power stations, in mines, also those industrial plants where, owing to the power demand, the owners are unable to obtain attractive central-station rates (excepting those plants where large quantities of steam are required in the factory processes). Where only general heating is required water from the engine jackets can be passed through low-pressure oil-fired or coal-fired steam boilers.

The economic changes this country is now experiencing have been under way for the past decade in Europe; hence engineers there were the first to appreciate the many advantages of the oil engine and the first to foster the development to its present high standard. In this country, however, conditions have not been favorable to the development of this prime mover until recently. As a result the typical American oil engine was designed and built to sell for the lowest possible price, until lately. This has been a serious limitation to its improvement. Furthermore, owing to the fact that the oil engine is comparatively simple to understand and operate, owners have hired the cheapest operating skill obtainable. As a result of these two conditions the general experience with oil engines has not been all that could be expected, from either the development or the operating point of view.

However, European experience has shown and is showing that the oil engine is capable of rendering the highest degree of reliable service and at the same time of utilizing liquid fuels with an attractive over-all plant efficiency* nearly twice as good as the best obtainable in large central stations and from three to four times as good as can be obtained in a small steam-driven power plant. For example, in a central station it is excellent performance to convert more than 12 to 14 per cent of the energy in the coal into useful energy at the busbars. A representative isolated steam-driven electric generating plant in this country, including even a modern uniflow condensing installation, will rarely show higher than 10 per cent returns from initial energy delivered to the equipment in the form of coal. The energy available in the form of fuel oil delivered to an oil engine is returnable in the form of useful electric energy at the switchboard to an extent of 20 to 25 per cent, in some instances as high as 30 and 32 per cent.

American manufacturers anticipated the now rapidly developing economic conditions, but the war precipitated these conditions in a comparatively short time. Hence the oil engine is rapidly undergoing a marked period of development in America both in design and in capabilities. The importance of first cost is being rapidly relegated to its proper place in relation to the other costs involved. Thus manufacturers are now in a position to pay more attention to the various features of design that have to do with the actual operation and maintenance.

From the owners' point of view, after a prime mover has once been installed and started up, the questions of operating and maintenance expense are probably the most important. The fuel costs depend largely upon the type of engine and the grade of oil on which it is capable of operating. The smaller engines of representative makes, as a rule, will run satisfactorily on kerosene and distillate oils as heavy as 28 deg. Beaumé, or possibly 24 deg. Beaumé, depending largely on the

*See Mark's "Handbook," page 1104; Kent's "Handbook," eighth edition, page 985; abstracts test reported by H. G. Stott in A. I. E. E. *Transactions*, 1906; A. S. M. E. *Transactions* 1916, page 743

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oil source. The larger units will operate on still heavier oils. So-called medium and high-compression engines give good results when using practically any crude or fuel oil obtainable, including the various distillates and kerosenes. A great many engines in this country are operating to-day on some of the heaviest Mexican and Californian crude and fuel oils. The distillate oils are easily handled and, being more or less a by-product in the crude refining process, are comparatively cheap and easily obtainable.

As already mentioned, one of the great features of the oil engine is that, being comparatively a simple and self-contained prime mover, it can be operated by mechanics of varied intelligence. Almost any one who can open a few valves, turn on the air, start the engine and throw in a few switches may call himself an oil-engine operator, but unless he has a knowledge of its limitations and mechanical make-up, based on good previous experience, the owner is liable to find in the course of time that what he saves in having the cheapest of operating skill is more than offset by the subsequent repair and maintenance charges. For the ordinary stationary power plant the owner can well afford to hire good operating skill, especially when he takes into consideration the fact that no boiler-room help is required. A good conscientious corps of engineers of the same type as are typical in steam plants of equivalent capacity and in charge of later-day oil engines will show results that well justify the coming and rapid application of this type of prime mover.

It is very interesting to compare a typical oil-engine installation of some years back with what could be expected in the same installation were up-to-date oil engines installed. The plant under consideration consists of seven 250-hp. low-compression twin-cylinder oil engines. Mounted on the shaft of each unit between the cylinders is a 165-kw., 220-volt direct-current generator. There are also four 350-hp. vertical three-cylinder high-compression units with direct-connected 230-kw. direct-current generators. The first high-compression engine was installed in 1904, the first low-compression engine in 1906. The plant was completed in 1910. During the subsequent years they have been in constant operation except for a few months when the output of the factory was curtailed somewhat.

Data taken from a report for the fiscal year from July, 1916, to July, 1917, are presented in the accompanying table. Distillate oil is used as fuel, and the report is based on a cost of 7½ cents per gallon delivered. The maintenance and repair charges will appear rather high, but due allowance must be made for the fact that most of the engines have operated from ten to twelve years and are not at all representative of present-day larger-sized oil engines. Column B of this table gives data for the same plant equipped with up-to-date representative oil engines. These figures thus contrast what could be expected under the same conditions using old and modern oil engines. It is assumed that the new plant would be equipped with four 800-hp. multi-cylinder units and direct-connected generators. The initial cost of the equipment in this case is based on war-condition prices and so carries a severe overhead charge. The operating and maintenance charges are based on reports from typical later-day plants. The oil charges are taken the same as above.

Oil engines of the high-compression type suitable for stationary power-plant practice are built in this country in sizes as small as about 100 brake-hp. per cylinder. Competing with the high-compression type are the medium-compression engines, which are widely used and built in units as large as 600 hp. For the smaller sizes the solid-injection engine and the hot-bulb low-compression engine are used extensively. The latter is manufactured largely as a two-cycle unit and in the small sizes is rapidly forging into a prominent position in the field until recently held solely by the gasoline engine. The most recent development in the smaller engine sizes is the solid-injection type with both medium and high compression. Representative makes of the larger sizes are designed and built for constant full-load operating conditions. Their rated capacity is generally conservative, and so they have considerable overload reserve.

ANALYSIS* OF EXPENSES IN A PLANT EQUIPPED WITH OLD-TYPE AND NEW-TYPE OIL ENGINES

	A	B (4-800 Hp)
Initial investment	$204,870	$385,600
Interest	12,292.20	23,100.00
Depreciation (based on fifteen years' life)	8,788.92	16,542.00
Insurance and taxes	3,073.05	5,784.00
Attendance	16,400.00	11,800.00
Lubricating oils and supplies	2,200.00	1,500.00
Maintenance—labor	7,400.00	3,000.00
Supplies	3,202.00	2,000.00
Fuel oil	44,454.00	21,120.00
Water	1,061.00	800.00
Total annual cost of power	$98,871.17	$85,646.00
Total annual output in kilowatt-hours	4,477,300	.....
Average cost per kilowatt-hour	$0.0221	$0.0191

*There seems to be considerable dissension as to the probable life of power-plant equipment, so depreciation has been based on fifteen years' actual life. Interest at 6 per cent compounded annually gives a somewhat higher depreciation charge. The cost of fuel oil in the new plant is reduced to $21,120, which is still a liberal allowance for this charge. The fuel oil is taken at 7½ cents per gallon. This is an unusually high charge for fuel, as under normal conditions it is readily procurable at from 4 to 5 cents per gallon. The initial investment has also been increased so as to be consistent with present prices.

All of the various types and sizes give remarkable economies. The medium and the high-compression units show over-all efficiencies of from 30 to 36 per cent. These engines are therefore peculiarly well adapted for power development in small or isolated power plants. The larger-sized oil engines, especially the medium and high-compression types, can be made to operate on certain typical tar oils, English engineers having obtained excellent results during the war with fuels containing 90 per cent tar oil and 10 per cent petroleum or ignition oils. The logical tendency in efforts to conserve fuels should therefore be gradually to eliminate the present wasteful bee-hive coking system and substitute therefor the by-product coking system, thus making available, among the rest of the many useful byproducts which are obtainable, great quantities of tar oil.

In view of the various economic conditions pointed out above and the great possibilities offered by the oil engine in the way of maximum power returns for a given fuel consumption, it is only natural to expect that this prime mover will rapidly come into its own in American power-plant service.

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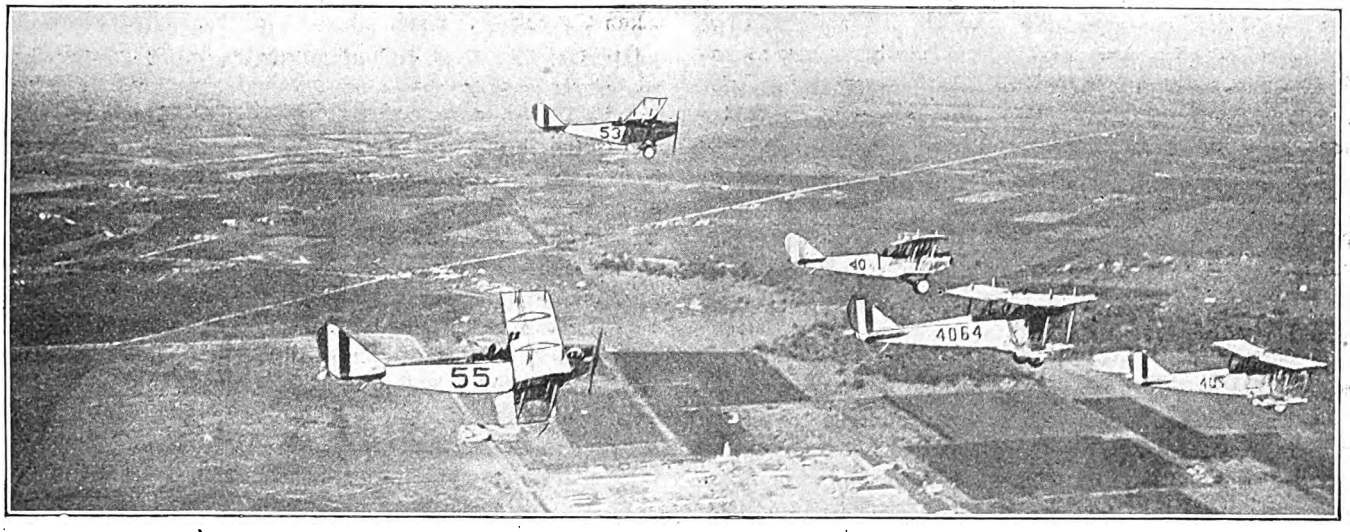

FIG. 1—GROUP OF AIRPLANES IN FLIGHT DIRECTED BY WIRELESS TELEPHONE ON THE GROUND

Military Radio Communication

Co-ordination of Army Operations Depends Upon Communication by Radio—Goniometric Stations Serve Important Purpose in Locating Enemy Units, While Telephone and Telegraph Systems at Listening Posts Intercept and Report Enemy Messages

BY CAPT. A. D. CAMERON, SIGNAL CORPS, U. S. A.

IN THE anatomy of an army the communication systems serve the same purpose as the nerves in the human anatomy. Sensations are instantaneously transmitted to a central point where information is consolidated and action directed. From the front-line trenches to the general headquarters is a network of telephone and telegraph wires linking together every unit. Wires are buried or laid in trenches in the most advanced sections. Farther back they rise to slender poles or saplings of low visibility. Beyond the range of enemy artillery begins the more orderly procession of line poles with spreading cross-arms. Paralleling the wire system in each divisional sector are a number of other signaling devices, for other agencies must be provided against the emergency when an unbroken line of communication will be vital.

Arm signaling and sound signaling may be employed over short distances. Visual signaling, using small searchlight projectors and sending Morse signals, increases the range of communications. Rockets and flares can be used to denote positions, to direct airplanes and to call for artillery support. Messenger dogs and carrier pigeons play a part in some operations. Mounted couriers and runners serve when other devices fail. But wires, whether buried or concealed, are not proof against shell fire. During heavy artillery bombardments wires are cut, poles are shattered, and repair men cannot by their own efforts keep pace with the rate of destruction. During the barrage at Soissons a wire one-sixth of a mile (270 m.) long had 350 distinct breaks in one day. Fogs, rain and the nature of the terrain may interfere with visual signaling devices. Pigeons go astray and runners cannot live under heavy shell fire. When such conditions obtain the integrity of the communication system is maintained by the network of radio.

To a certain extent this radio net is purely an emergency system, but as such it is installed and operated with the greatest of care. At each post of command, at each regiment, brigade, division, corps and army headquarters, at each air station and at each battery of artillery, is a detail of radio operators with apparatus installed and in working order every minute of the day and night. The net is "rung out" several times each day by sending short practice messages at irregular intervals. Maneuvers and tests are frequent. Everything is in readiness for the day when the barrage falls and other means of communication fail.

For company and battalion posts of command and at regiment headquarters there are combined transmitting and receiving sets, employing a loop antenna of one to three turns and one meter square, which are capable of transmitting signals over a range of 3 miles to 8 miles (4.8 km. to 12.8 km.) when installed in a trench or shell hole during the advance or in a deep dugout during attack. Between battalion and regiment headquarters this is supplemented by a wireless communication system which uses the earth rather than the ether as a transmitting medium, with an insulated antenna wire lying on the earth and grounded at certain intervals. At regimental and brigade headquarters are spark transmitting and receiving sets with low V-shaped antennas. For communication between brigade and division, division and corps, corps and army headquarters, continuous wave sets are used. Here distances are greater, there is little or no danger from the enemy's artillery, and antennas can be higher and apparatus more powerful. All this communication is arranged not only in depth but laterally along the battle front.

Radio apparatus forward of brigade headquarters is subdivided into units weighing not over 30 lb. (13.6 kg.)

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and therefore easily portable. Such stations can be set up or dismantled in a few minutes. All apparatus is waterproof, built for severe service and with as few adjustments as possible. The continuous-wave stations at brigade, division and corps headquarters are carried by hand for short distances, but a special truck has been designed for division and corps headquarters which serves as an operating house for the radio apparatus and for transporting the reserve equipment when a division moves. Portability is an important item in an army where supplies, artillery and even troops are transported by motor.

Organization Prevents Confusion

It will be appreciated that this arrangement of apparatus presents endless possibilities of interference and confusion, and very careful supervision is necessary in regulating its operation. In the first place, sets are not more highly powered than necessary to work the required distance. The messages sent in a divisional net are very short and entirely in code. Call letters are allotted by schedule and frequently changed, while a very careful arrangement of wave lengths is in effect. For communication between ground stations sets in front of regimental headquarters are allotted certain wave lengths; between regiment and brigade, between brigade and division, from division to corps, from

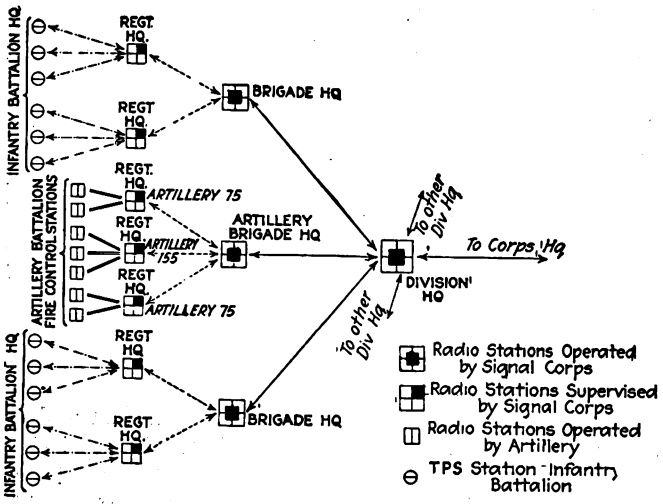

FIG. 2—ORGANIZATION OF ARMY DIVISION, SHOWING LINES OF COMMUNICATION, WHICH EXTEND BOTH AT RIGHT ANGLES TO AND LATERALLY ALONG THE FIGHTING LINES

corps to army, other wave lengths are in effect. Similar allotments are made in the air service and in all other branches equipped with radio. By subdividing these allotments among the various units and by utilizing different tone adjustments little difficulty is experienced in such a system under all conditions and reception is usually 100 per cent. A certain amount of interference may be expected from enemy stations, but very little of this is intentional since any "jamming" station would operate with equal effect on sets of its own side.

All radio sets in the division net are operated by dry cells or by storage batteries. Each set has a battery in operation and another fully charged in reserve. At division headquarters is a small gasoline-electric generating set for battery charging. Every radio station in a divisional sector is visited every second day by a light truck bringing fresh batteries and carrying back old batteries to the charging station. Batteries in forward positions are carried into the trenches, for fresh batteries, like food and ammunition, must go forward under all conditions.

Airplanes and Tanks Require Radio

In the Air Service radio is of greater importance since it maintains all communication between airplanes and ground stations and between airplanes in flight. The pilot in training may be directed by radio telephone by his instructor on the ground. Artillery fire is directed by fire-control airplanes or observation balloons equipped with a spark-transmitting set working direct with the batteries. Patrol planes, reporting to brigade and division headquarters, fly over the infantry in attack, to report progress and to call for reinforcements, supplies or artillery fire, using a spark transmitting set or perhaps a continuous wave set. Pursuit planes fighting in combat formation may be commanded by voice by the radio telephone. Day bombing airplanes may not only be voice-commanded by the flight leader but are in touch with headquarters by continuous-wave radio sets. Night bombers are equipped with radio telephone and also with direction-finding radio receiving sets. The latter apparatus makes possible navigation at night over unknown territory by determining the angle of reception of signals from two or more home beacon stations and determining position by triangulation.

Another important branch of the service which is utterly dependent upon radio for reliable communications is the Tank Corps. A number of other systems have been tried, colored flags, carrier pigeons, runners, but without complete success. The proposition of developing radio apparatus for operation in a tank presented several extremely unusual problems, but now signal tanks accompanying each formation of American tanks may carry continuous-wave transmitting and receiving sets for communication with airplanes, artillery and headquarters. The antenna may be a slender telescoping mast or a short collapsible umbrella. Transmission may be carried on during the progress of the tank over the roughest ground, but on account of the tremendous noise of the mechanism reception is possible only when the tank is stationary.

Intercepting Enemy Communication

Perhaps the most interesting use of radio in the war zone is in the intelligence service. Here radio is used, not for communication, but for intercepting communication, and there is a complete system for the interception of enemy radio messages and for the location of enemy stations. This service is distinct from the radio communication net and is controlled directly by army headquarters. The intercept stations are usually installed on a line with division headquarters at a comparatively safe distance from shell fire. The radio system consists of a receiving circuit with multi-stage, high-frequency amplifier and a V-shaped or umbrella antenna. The number of stations per division or corps depends upon the concentration of the opposing forces, but a sufficient number of stations are always in operation to handle all enemy traffic. The receiving sets are of several different types in order to permit reception of both spark and continuous-wave sets of wave lengths ranging from

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100 m. to 2000 m. Operators are continually on duty to pick up all enemy radio communications, noting the exact time at which the message is received, the wave length, the call letter, the message itself and the sign-off. Daily reports are furnished to the army headquarters and to general headquarters, where they are immediately referred to the decoding experts. These daily reports yield a mass of information regarding the movements of troops and forecast impending events.

Operating in conjunction with these intercept stations are the goniometric or direction-finding stations, perhaps the most fascinating of all army radio work. The goniometric service is also under direct control of army headquarters. Covering one wall of a room in general headquarters is a map showing the entire battle front with the exact location of all enemy forces. This map shows the location of every army headquarters and the name of its commander, the number of corps operating under the army and the location of their headquarters, the number of divisions in the line and the location of division, brigade and regimental headquarters, the classification of the division, whether Prussian Guard, Bavarian Guard, etc., and its numerical designition. This ever-changing map is the result of coördinated intelligence reports from airplanes, prisoners and other sources, but the location of various headquarters is definitely fixed and verified by the radio goniometric service.

The goniometric stations are located not farther than 5 miles (8 km.) from the enemy trenches, closer than intercept stations because signals must be more than merely readable. They are arranged in groups of at least two stations and one control station. The number of stations depends entirely upon the characteristics of the battle front, whether a salient or reëntrant, and upon the concentration of opposing troops. Each station is equipped with a receiving circuit and an amplifier with a loop antenna. A station consists of a small wooden hut with a bench for the radio receiving set and with a vertical loop antenna from 6 ft. to 10 ft. (1.8 m. to 3 m.) square, projecting about the roof. This loop revolves on a heavy wooden shaft which passes through the center of the hut. Where this shaft passes through the bench in the hut is a metal dial graduated in 360 deg. and fractions thereof, and attached to the shaft of the loop is an index needle so placed as to touch lightly the surface of this dial as the loop is revolved. First the loop is oriented in such a manner that when the index needle on the shaft points to zero on the dial plate the plane of the loop is exactly east and west. The principle of operation is based upon the fact that a loop antenna is exceedingly directional. When the plane of the loop is parallel to the line of direction of the transmitting station, signals are loudest, and as the plane of the loop becomes perpendicular to the line of the transmitting station signals fade away. With very strong signals an experienced operator can detect within one or two degrees the exact direction from which the signals were transmitted. With the loop properly oriented and with the location of the goniometric station spotted on the map, it is possible to show the line on the map along which the signals pass. With two or more goniometric stations working on the same signal it is possible to determine with an astounding degree of accuracy the exact location on the map of the transmitting station. The strength of the signals, the characteristics of the note and the wave length used indicate the type of apparatus used for transmit-

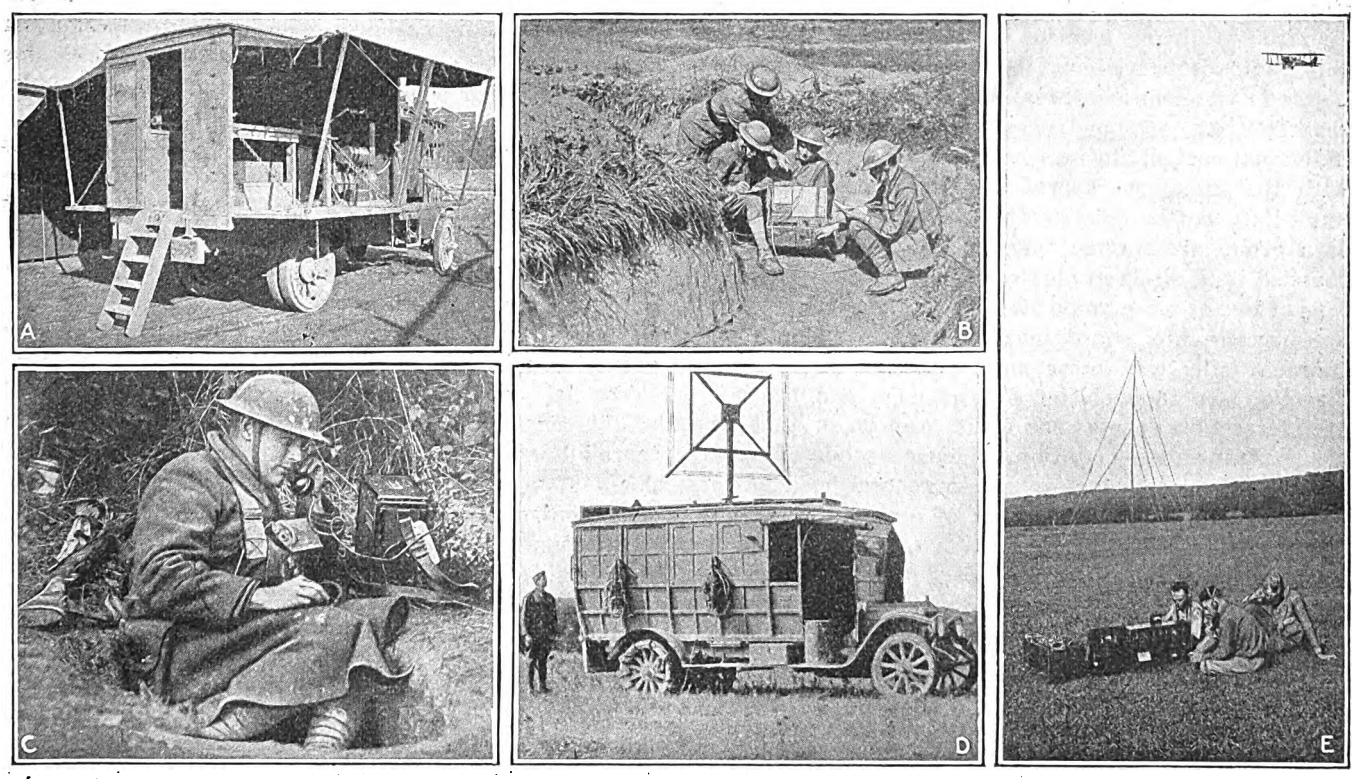

FIG. 3—EXAMPLES OF MILITARY COMMUNICATION IN THE FIELD

A—Radio repair truck for testing, repairing and battery charging. B—Inspecting a T.P.S. ground telegraph set in the trenches. C—Liaison officer of field artillery receiving orders from the first line. D—Mobile goniometric station with undamped wave transmitting and receiving apparatus. E—Radio-telephone conversation between ground and airplane.

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ting and hence its probable classification as belonging to regiment, division, corps or army. The operation of such a station calls for the highest degree of skill in the reception of signals and in the operation of the loop. Practically all radio messages are sent in code and such codes are so arranged that the average message is not longer than thirty seconds.

SPEED REQUIRED IN GONIOMETRY

In such a small margin of time the goniometric operator must tune for the proper wave length with his right hand, with his left hand rotate the loop slowly until signals fade out, then note the dial reading, continue rotation until signals again appear, note that point, revolve the loop through 180 deg. and take two similar readings. The angle between the two points where signals die away denotes the direction of the transmission station. The other two readings taken after the loop is revolved through 180 deg. act as a check on the first two readings and also compensate for any inaccuracies in the construction of the loop itself. In the meantime the operator has noted the exact time, call letter, sign-off, wave length, readings taken and remarks regarding tone characteristics and strength of signal. All this in thirty seconds. Such messages may be received at any moment of the day and night, and this radio detective must be constantly running over his scale of wave lengths and revolving his loop. The reports from goniometric stations are sent to their individual control stations, where they are consolidated with the intercept reports. A large map shows the immediate battle front. The goniometric stations of each group are spotted thereon and each spot is surrounded by a circle graduated into 360 deg. The readings of two or more gonio stations on the same messages are discovered by comparing the time, wave length, note characteristic, call letter and sign-off. The lines of direction are then plotted on the map, and the point of intersection denotes the exact location of that particular transmitting station. This consolidated report goes to army headquarters and to general headquarters and presents a daily statement of enemy radio traffic. The intercept report gives the body of the message; the gonio report tells the location. Each day the changes are noted on the big map. Enemy divisions move from one point to another, changing slightly the location of the transmitting station or the call letter. A raid verifies the fact and gives the designation of the new division. A new enemy headquarters is established—the goniometric station gets the location. That night it is bombed. Troop concentrations are detected and the necessary action is taken. Radio plays a most important part in such operations.

A variation of this goniometric operation serves as a detector of hostile aircraft. An airplane comes over the lines to drect the fire of an enemy battery. At the first range signal the goniometric stations take readings, and the local control station is notified by telephone. As the readings come in from the various stations they are plotted. When the exact course of flight is evident a telephone message to the nearest pursuit squadron brings action. Cases are on record where by this method enemy fire-control planes have been shot down or driven off within seven minutes after they crossed the lines. In these stations the daily reports are merely a confirmation of the day's business; in each case the action is immediate.

Another class of intercept stations which come directly under the supervision of army headquarters are the listening posts which are established for the purpose of overhearing telephone conversation and ground telegraphy (T.P.S.) communications of the enemy. They also serve the purpose of policing the telephone lines and T.P.S. communication systems of their own lines, disclosing what sort of information the enemy may be obtaining at his own listening posts.

Since the possibility of overhearing such communications depends upon the proximity of the listening post to the lines of communication of the enemy, these posts are placed rather close to the front-line trenches. In general, T.P.S. communication can be easily heard at a distance of 2½ miles (4 km.). Conversation over a single-wire, ground-return telephone system cannot be heard at a distance much exceeding 1¼ miles (2 km.) Telephone communications over a two-wire system insulated from the ground are never intercepted unless breaks occur in the telephone line or the insulation becomes faulty or otherwise grounded.

EQUIPMENT OF LISTENING POSTS

These listening posts are equipped with a low-frequency amplifier and have available for purposes of communication with neighboring units either a telephone, a buzzer phone or a T.P.S. transmitting set. The electrical phenomena which the listening posts make use of are elementary. The T.P.S. transmitting station receives its power from storage batteries and radiates by means of an insulated wire laid along the earth and grounded at certain intervals. A buzzer transformer is used for breaking up this power into signals. Through the earth, as a conductor, the current flows between grounded points of the wire. This establishes an electrical field which is limited by the character of the earth's strata and by climatic conditions. The equipotential lines are perpendicular to the lines of current flow. If two earth connections are made, not on the same equipotential lines, and if the wires leading to the earth connections are connected to a pair of telephone receivers, a current will flow through the phones. If the current is of sufficient strength, the T.P.S. buzzer signals will be heard. If the current is weak, it is necessary to insert an amplifier. This permits signals of very feeble intensity to be heard. This amplifier, two wires and the earth connections, or "earth antennas" as they are called, make up the essentials of a listening station. Such a receiving device picks up communications from a grounded telephone system in exactly the same way as from a T.P.S. transmitting station. An insulated telephone system presents a considerably different case, since reception at the listening post is possible only by induction. This may be done in two ways—first, by direct inductive action on the earth antenna of the receiving station; second, indirectly by inducing earth currents which are then picked up by the earth antenna of the receiving station.

These stations are in a dug-out with the earth antennas laid in trenches. In some cases three antennas are laid in the front-line trench or as far forward as conditions permit, with an additional antenna close to the station and another directly behind. The anten-

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nas in the front-line trenches are for intercepting enemy communications, while those near the station and in the rear are used for interception of our own cummunications. These stations are installed at more or less regular intervals with approximately twelve to an army front. It may happen that for several weeks a station in a quiet sector will hear no signals from the lines of the enemy except the usual routine testing signals, but continual vigilance is necessary, because at any moment messages of supreme importance may be overheard, or its own lines of communication may be damaged to such an extent as to render it possible for the enemy to overhear important information. A station placed in an active sector before an offensive has the opportunity of intercepting practically the entire communication traffic of the enemy, because at such a time the artillery units, tanks, infantry, etc., advance nearer to the front-line trenches and use freely the various means of communication, especially T.P.S. sets and grounded telephone systems.

Listening posts furnish reports daily to general headquarters, to army headquarters and to division headquarters, and in an emergency information is transmitted direct to the nearest battalion or regimental headquarters. The service rendered by these listening posts has been of the greatest value in anticipating and checking movements of the enemy. Unlike the intercept station, the listening post is nearer the centers of activity and is able to intercept emergency messages, which are transmitted only by telephone or T.P.S. For the work of the western front the best operators for listening posts were found to be men who were not only expert operators but who spoke German fluently and had at least a high-school education. They were then trained in German military terms and even in up-to-date German slang as used by telephone operators. The service was sufficiently exciting to satisfy the most adventurous. The listening posts were within easy range of the enemy artillery, and the earth antennas had to be constantly inspected, particularly after bombardments, to repair breaks.

Another service which radio renders in military communications is in the simultaneous transmission to a large number of receiving stations of such meteorological data as weather forecasts, ballistic data, standard time, etc. This information has proved of the utmost value. Weather forecasts are essential to practically all branches of the service in determining the most favorable moments for attack. The probable occurrence of fogs, rains and prevailing winds is particularly interesting to the Air Service, to the chemical warfare organizations in the projection of gas attacks and to the artillery in determining range cards. Standard time was particularly essential in a war which depended so entirely upon the closest coördination on the simultaneous efforts of so many varied branches of service. At a certain given minute the artillery preparation must change to a barrage, which moves at a certain rate of speed. The infantry leaves the trenches and advances under cover of the barrage. At a certain moment the barrage lifts. The action is accompanied by tanks, airplanes and other agencies. All effort must be coordinated to obtain the desired results, and such coördination can only be secured by a common exact knowledge of time and conditions.

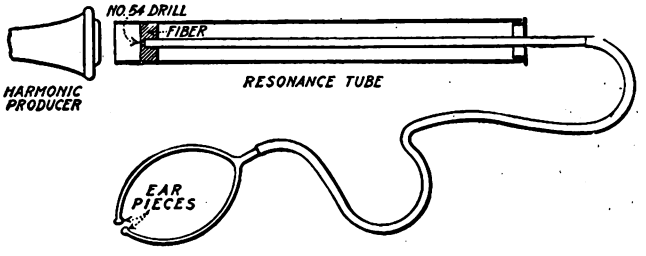
THE DETERMINATION OF HARMONICS IN CIRCUIT

Method of Determining the Harmonics in an Alternating-Current Power Circuit That Causes Inductive Interference with a Telephone

BY F. T. IDDINGS
Chesapeake Potomac Telephone Comp any, Baltimore, Md.

A SIMPLE acoustic arrangement permits ascertaining the presence and the order of a prominent harmonic in a power circuit that is causing interference with an adjacent telephone circuit. It is essentially an organ pipe of adjustable vibrating length which can be brought into resonance with one of the harmonics of the humming diaphragm of a telephone receiver. From the distance between two consecutive nodal points the number of vibrations of the sound may be computed, and this gives the frequency of the corresponding electric harmonic.

An exploring coil of 500 turns of No. 28 D.C.C. wire is used, wound in the tire groove of a 2-in. (71-cm.) wooden bicycle-wheel rim. The coil is paraffined, taped, varnished and supplied with terminals to receive the tips of a bipolar telephone receiver cord. This coil is placed in inductive relation to the source of the interfering currents, and a bipolar telephone receiver in series with the coil is placed before, but not tightly against, the open end of the resonator tube described below.



TUBE CAN BE MADE RESONANT TO ANY PARTICULAR FREQUENCY

The adjustable resonator is made of 1-in. (2.5-cm.) outside-diameter brass casing, $\frac{1}{32}$-in. (0.8-mm.) wall 25 in. (65 cm.) long, with piston of $\frac{1}{4}$-in. (6-mm.) outside-diameter brass tubing 26 in. (66 cm.) long, sliding through a hole in the cap on one end of the larger tube. Screwed onto the end of the small brass tube is a piston head of $\frac{1}{4}$-in. (6-mm.) fiber, the bore of the small tube being continued through the piston head by a small hole (No. 54 Morse drill). The piston head must slide freely in the bore of the larger tube and yet fill the whole bore. On the end of the small tube which projects through the cap of the larger tube there is placed 2 ft. (60 cm.) of flexible rubber tube terminating in ear pieces such as were used formerly with phonographs.

With a humming receiver near the end of the tube, the sounds due to the interfering currents are plainly heard through the ear tubes. If now the piston be withdrawn slowly into the tube, thus enlarging the resonating chamber, a point will be noted where a certain tone is much louder than at any other points. Still further withdrawing the piston, another resonant point will be found for each tone, about twice as far from the first maximum point as the first point is

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from the open end of the tube. The distance between the first and the second maximum points will be a half wave length of the harmonic. Doubling this length and dividing by it the distance which the sound travels in one second, *i.e.*, 13,440 in. (20,160 cm.) will give the frequency of the harmonic.

Should there be two harmonics of prominence which are close together, say the eleventh and the thirteenth on a 60-cycle line, the result from the resonator will likely be the twelfth harmonic. This will be clear from the following table:

Harmonic Number	Half Wave Length
Eleventh	10.18 inch
Twelfth	9.33 inch
Thirteenth	8.61 inch

The ear will probably select as the center of the maximum the point where the two harmonics overlap and thus get the average wave length, corresponding to the twelfth harmonic.

A resonator of the dimensions given would not give the half wave of a harmonic lower than the seventh on a 60-cycle system, *viz.*, 420 cycles per second. To measure frequencies as low as the third harmonic on 60 cycles would require a tube 56 in. (142 cm.) long.

Engineering Aspects of Industrial Lighting—IV

Examples of the Illumination of Manufacturing Establishments During the War When Maximum Production Was Essential Are Pointed Out, and the More Important Aspects of the Economic Side of Industrial Lighting Are Considered

BY C. E. CLEWELL
Assistant Professor of Electrical Engineering, University of Pennsylvania

THE economic advantages not only of the best in factory lighting but often of intensities of illumination materially higher than values which have been considered good practice in the past have been outlined in fairly complete form in the preceding installment of this series. These advantages are not merely abstract ideas that are applicable in a general way to industrial lighting questions, but they are often reflected in modern plants by the excellence of lighting systems which have received the careful study of plant managers in advance.

It is the purpose in the following notes to give special attention to several of these encouraging reports[1] which have been received during the last few months and thereby to illustrate through actual examples some typical installations in the better lighted industries, as well as to give a number of opinions which have recently been advanced in connection with both natural and artificial lighting. These examples will logically fall into two general classes—first, those cases where standard practice is shown for the older plant structures; second, those where new buildings are chiefly concerned.

While cases have come to the attention of the writer where the most elementary principles of good lighting have been violated in buildings used as part of the war program, it is gratifying to have reports from war industries in which the lighting problem, even during the war, has received the most careful attention and where the results have been equally satisfactory.

The pressure of the war emergency was felt in the rapid expansion of some of the plants, and one of these, as more or less typical of the older established munition factories, has experienced a very rapid expansion and may be taken as the basis for some interesting details resulting directly from the field observations. The plant in question has been expanded from 800 to 8000 employees, thus calling for a considerable amount of new building. The older buildings are of a common form of brick factory construction with beams spaced on centers of 8 ft. (2.4 m.) and with window spaces 4 ft. 6 in. by 9 ft. (1.37 m. by 2.7 m.), resulting in a ratio of window area to floor area of one to eight.

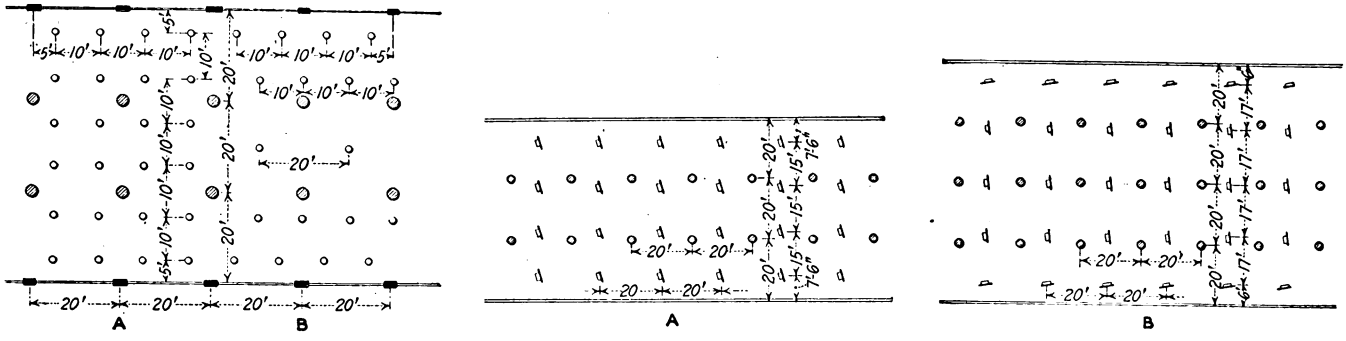

FIG. 1 A AND B—STANDARD LAYOUTS FOR GAS-FILLED LAMPS IN A MODERN INDUSTRY; FIG. 2—REPRESENTATIVE ARRANGEMENTS OF MERCURY-VAPOR LAMPS IN A PROGRESSIVE PLANT, A FOR NARROW BUILDING AISLES AND B FOR WIDER BUILDINGS

The new buildings are of reinforced concrete construction, are 60 ft. (18.3 m.) wide with concrete columns in two rows, dividing the plant into bays of 20-ft. (6.1-m.) width, and with a 10-ft. (3-m.) aisle extending the full length of each shop down the center. In these new buildings outlets are spaced on 10-ft. by 9-ft. (3-m. by 2.7-m.) centers and are equipped with 100-watt gas-filled lamps in Benjamin enameled fixtures of the steel-dome type. Bowl-frosted lamps are preferred.

This general scheme of artificial lighting is reported as ample for many of the operations, among which are mentioned profiling, power and hand milling, broach-

[1]Based in general on material gathered for the employment management division of the War Industries Board and herewith published by permission of that division of the board.

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ing, gun boring, reaming and rifling, and for wet grinders. This is a rather interesting statement, for it confirms the rough figure of, say, 1 watt per square foot (10 watts per sq.m.) which has been mentioned as a fair average of value for good lighting practice in certain industrial cases. In the foregoing divisions of the plant in question the general lighting is reported as adequate without the use of individual lamps.

In those sections, however, typified by work on lathes, automatic screw machines and drill presses, the general lighting has been found inadequate for discerning the

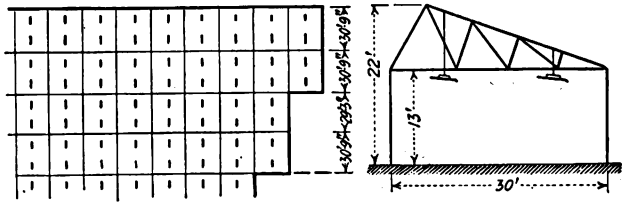

FIG. 3—ELEVATION AND PARTIAL PLAN, SHOWING THE ARRANGEMENT OF MERCURY-VAPOR LAMPS IN A SHELL PLANT

action of the tool on the work and the index graduations on the machines themselves. Here individual lamps of the 40-watt size are installed to supplement the general lighting. Moreover, in such departments as the filing, fitting, assembling and inspection sections it has been considered necessary to employ individual lamps, and where the men require the lamps very close to the work —for example, in filing or assembling—the White adjustable bench fixture is used, this device being adjustable in every direction. The advantages of permitting these workmen to adjust their lamps conveniently to the work is apparent. Metal half shades of the Hubbell type are used in conjunction with these adjustable fixtures, this obviously being an important item in glare prevention.

In those cases where it has been found necessary for the workmen to move the lamps with an overhead flexible suspension drop cords are employed, and the 40-watt lamps in such cases are equipped with a tin cone shade. An interesting feature here is the vertical adjustment of these lamps by a cord which passes over two pulleys and is connected to the lamp cord and a counterweight. This scheme makes it possible for each workman to raise his lamp and to place it in a position out of the way when not required.

In the older buildings of this plant the common practice has been to use 200-watt lamps equipped with Benjamin enameled steel-dome fixtures, mounted 10 ft. (3 m.) above the floor and about 10 ft. apart. The presence of countershafting and belting in these older shop sections has, however, frequently made it necessary to modify these spacing distances. In other cases aisle lighting has been resorted to; thus in one section two sets of power milling machines were arranged to face each other with the workmen occupying the aisle. Here the lamps are arranged in the aisles and illumination is furnished to both rows of machines. Where a better distribution of illumination is required than that secured by the 200-watt gas-filled lamps, smaller units of the 100-watt size are used with enameled steel-dome fixtures.

An interesting feature in this plant is the office and drafting-room lighting. In one of the new drafting rooms "Brascolite" fixtures with translucent bowls are used with 300-watt lamps. This is reported as a very satisfactory system with 20-ft. (6-in.) spacing for the outlets and the units 10 ft. (3 m.) above the floor, and the absence of all drop lamps for the drafting tables is an indication of the satisfactory condition of the general overhead lighting. Equally satisfactory conditions are reported for the offices in this plant with the same general scheme of overhead lighting.

It is perhaps only proper to state at this point that the ideas advanced in the foregoing notes and in those to follow, and particularly where comments are made on specific types of equipment, must be accepted by the reader as comments from men in the field who have attempted in the recent war emergency to give definite opinions on their experience with given equipment as an aid to other war industries. For obvious reasons, therefore, the writer cannot, under these circumstances, be held as either favoring or differing from such ideas as may be presented on specific types of equipment, and all the opinions of this character are therefore placed before the reader for what they may be worth at this time.

GOOD ILLUMINATION PAYS

Turning now to another interesting case, it has been found in a second large plant that good lighting has been a paying investment from the start of the industry. This is brought out by a statement at the very outset of the report which deserves notice on the part of other plants where the advantages of the best in lighting may not yet be so clearly recognized. The statement referred to is as follows: "I regret to say that we have no comparative data on the effect on production of good and inferior lighting, as we have always installed good lighting from the time the plant was built."

The foregoing statement apparently is possible because of the more recent establishment of the industry in question, but it may be observed that this plant is one of the larger and more modern automobile organizations where such factors as good lighting have received careful attention from the beginning of the industry. A number of diagrams are available show-

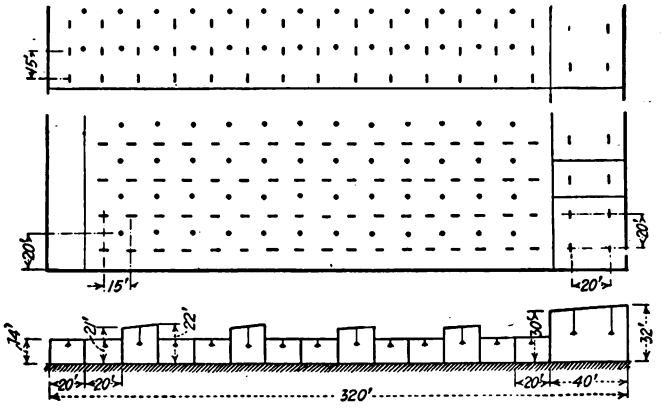

FIG. 4—PLAN OF MERCURY-VAPOR LAMPS IN A MUNITION PLANT

ing the typical layouts of the lighting equipment in this establishment, and these are of particular interest —first, because they indicate methods which have been adopted and which have been considered as successful in a given large plant; second, because they indicate further the ideas of good practice on the part of the electrical department in a large manufacturing organization.

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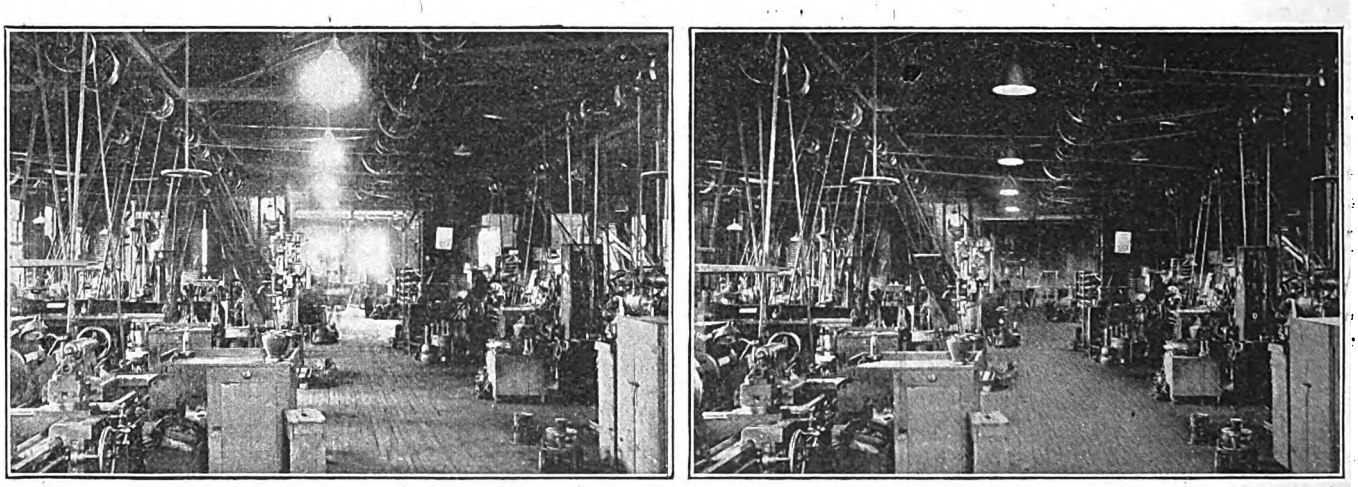
Reference is made first to Fig. 1, part A, where the use of 100-watt gas-filled lamps is shown. Here the spacing distance between lamps is seen to be 10 ft. (3 m.) with 5 ft. (1.5 m.) between edge lamps and walls. Note the symmetry of this arrangement in respect to columns and walls, and also, here again, to the adoption of about 1 watt per square foot (10 watts per sq.m.) for a standard of good general illumination. Each lamp in the installations of both A and B in Fig. 1 is equipped with a 14-in. (35-cm.) porcelain-enameled reflector and is mounted about 10 ft. (3 m.) above the floor.

Fig. 1, part B, shows a plan somewhat similar to part A of this same figure, with the exception that the central aisles are equipped with one lamp per bay rather than four, and also that the lamps in adjacent rows are arranged according to a staggered scheme. The elimination of three of the four aisle lamps per bay is due to the fact that these central bays are not devoted to manufacturing purposes.

Figs. 5 and 6 are included to show companion day and night views of the illumination produced with recently designed units for industrial purposes. The under shallow glass bowl of these units (seen more clearly in Fig. 6 is intended as a protective feature for the eyes of employees, with some sacrifice, of course, in the light-giving efficiency of the unit as a whole. Efforts to minimize glare from brilliant lamps, as typified by Figs. 5 and 6, are highly commendable and are in the direction of reducing one of the greatest evils of many existing factory-lighting systems.

A number of interesting conclusions may be derived from the reports used as a partial basis for the present article. First, perhaps, should be mentioned the care which these reports indicate has been devoted to highly adequate lighting in industries which have been working under the pressure of war conditions. It is apparent that not all cases of structures devoted to war work have been characterized by equal care in the lighting plans, and cases might be cited to show where op-



FIGS. 5 AND 6—NIGHT VIEW OF SHOP EQUIPPED WITH A NEW TYPE OF REFLECTOR FOR PREVENTING GLARE; DAY VIEW IN THE SAME SHOP, SHOWING THE GENERAL LIGHTING EFFECT WITH ONE TYPE OF INCANDESCENT LAMP EQUIPMENT

In this plant the layouts corresponding to Fig. 1, parts A and B, may be looked upon as standard for use in such departments as assembling, painting, upholstering and top building, for sewing rooms and the like. Of great importance to the success of the lighting systems is the recorded fact that the walls and ceilings are painted white and are kept reasonably clean. Obvious advantages also result from the flat ceilings in the buildings, which are of concrete construction.

For machining operations this plant uses mercury-vapor lamps mounted from 10 ft. to 12 ft. (3 m. to 3.7 m.) above the floor, and in buildings of the same general consruction as that applying to Fig. 1 an arrangement like Fig. 2, part A, is employed, this case being one in which relatively narrow buildings are involved. For wider buildings, with the saw-tooth roof construction, the machining sections are equipped with mercury-vapor lamps as in Fig. 2, part B.

General arrangements in portions of large munition plants are indicated in Figs. 3 and 4. Both of these figures represent layouts of mercury-vapor lamps on a large scale, and the type F unit is employed in the two cases corresponding with Figs. 3 and 4. Special attention is directed to the elevations in these two cases, which indicate clearly the solution that has been made of the lighting problem with regard to the structural details of the plant.

portunities for producing a good lighting effect have been overlooked and where the results have been anything but satisfactory and effective. Such cases have often undoubtedly been due to ignorance on the part of those who planned the system, although the scarcity of suitable lighting equipment at the time the installation was made may also readily have been a handicap to the attainment of good results in some cases.

The several instances mentioned in the foregoing notes, however, contain items of excellence which point to the advances in the art of industrial lighting during the immediate past, and the results obtained in these cases are undoubtedly far better than would have been realized in the same plants under similar circumstances twenty years ago.

DROP CORDS SHOULD HAVE REFLECTORS

A second point which these reports evidence is the growing attention devoted to the reflector proposition. The emphasis placed upon reflectors for drop lamps as a protection for the eyes of employees and upon the types of reflectors for lamps mounted overhead constitute items of encouragement for those departments of labor in various states where efforts are being made to educate manufacturers generally up to this very point. In fact, in one report specific mention is made by the writer of contemplated tests on quite a variety

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of types of reflectors for tungsten lamps, for the purpose of obtaining comparative data for the benefit of the plant in its choice of lighting equipment.

A third point relates to the emphasis placed upon the use of individual or local lamps in certain cases. It is assumed by the writer, in going over one of the reports mentioned above, that the emphasis placed upon local lamps is not to the exclusion of an adequate system of general lighting. The importance of this point has been discussed in a former article of this series from the standpoint of accident prevention, and it is an item which demands considerable care in this connection.

It is very easy to see, however, that where the general lighting system is intended more as a means for furnishing some light to spaces between machines than for the illumination of the machines themselves drop lamps might be essential to the satisfactory conduct of the work in hand.[2]

IMPORTANT TO CONSERVE THE NEW ENGLAND WATER POWERS

Henry I. Harriman Says that That Section Can Absorb All Water Power Which Can Be Developed Within Its Limits

Henry I. Harriman, president of the New England Power Company, addressed the New England Forestry Congress at Boston Feb. 24 upon the water-power situation, emphasizing the importance of conservation through development and utilization and touching upon the latent resources of that section of the country. On the assumption that the average run-off in New England is 18 in. (45.7 cm.), that its area is 60,000 square miles (15,540,000 hectares) and that its average elevation above sea level is 900 ft. (275 m.), it is computed that it would be theoretically possible to develop for 3000 hours of every year 15,500,000 hp., or the equivalent of using 52,000,000 tons of coal annually.

"Of course," said Mr. Harriman, "such a computation is nothing but an interesting mathematical calculation. It is, however, entirely possible that 10 per cent of this theoretical power may some time be developed from its streams and that New England may be able to produce energy equivalent to that yielded by 5,000,000 tons of coal."

The speaker pointed out that the eight largest rivers of New England have a total fall of 10,169 ft. (3000 m.), draining 35,000 square miles (9,000,000 hectares). Because of their great watershed and large drop, these streams—the Penobscot, 1500 ft. (457 m.) fall; Kennebec, 1000 ft. (304 m.); Androscoggin, 2200 ft. (670 m.); St. Croix, 400 ft. (121 m.); Saco, 1900 ft. (579 m.); Merrimac, 269 ft. (81 m.); Connecticut, 2000 ft. (609 m.), and Housatonic, 900 ft. (274 m.)—are New England's greatest sources of present and future power. Along them are found the greatest water-power developments and manufacturing centers.

An estimate has been made by the federal government that in New England there is now developed and used more than 600,000 hp. of water energy, but that these same water powers, if properly reconstructed along scientific lines, could generate an additional 200,000 hp. It is also estimated that it is possible to create in New England a minimum water-power development of 1,000,000 hp., which by storage and by the utilization of some of the less desirable power ultimately can be increased to 2,000,000 hp. Maine leads in both developed and undeveloped water power, having a maximum possible development of nearly 1,000,000 hp. The power of New Hampshire, Vermont and Massachusetts is reckoned at from 200,000 hp. to 300,000 hp. each; Connecticut has 160,000 hp., and Rhode Island a possible 16,000 hp.

"There is little doubt," Mr. Harriman said, "that New England can absorb all the water power which can be developed within its limits, for it is one of the greatest and most diversified manufacturing centers of the country. The Census Bureau gives the total value of manufactured products of the United States at $20,000,000,000. New England, with about 2 per cent of the area of the country and about 4 per cent of its population, produces more than 10 per cent of this total."

Mr. Harriman said that it would not be profitable to make hydroelectric developments on the New England rivers on the basis of their minimum flow, and it is therefore customary to make the development on the basis of a flow which can be counted on for six or seven months of the average year, the deficiency being made up by storage or by the use of steam relay. Very considerable progress has been made in the development of storage and in the conservation of flood waters in spring. A dam at the outlet of Moosehead Lake impounds more than 30,000,000,000 cu.ft. (about 1,000,000,000 cu.m.) of water and has more than doubled the minimum flow of the Kennebec River at Augusta. The storage on the Rangeley Lakes has raised the minimum flow of the Androscoggin at Rumford Falls and Berlin to about 2000 sq.ft. (about 180 sq.m.), this storage having been created by the coöperative effort of all the power users on the river. On the upper waters of the Deerfield, in Vermont, the Somerset reservoir is now storing water sufficient to produce in existing plants approximately 25,000,000 kw.-hr. per year which would otherwise be wasted.

Mr. Harriman touched briefly upon forestation in relation to minimum stream flow. Unforested drainage areas always produce what are known as "quick" streams. Fortunately for New England, most of its territory was originally a forest area, and in this region reforestation is not so important as the conservation and proper cutting of the forest area now in hand, and it is particularly important in this connection that when the forests are cut over the small trees and the underbrush be left intact. This will to a great degree protect the forest humus, which is the great "sponge" that absorbs and holds the rains. The water powers of New England are to-day producing more than 2,000,000,000 kw.-hr. of energy yearly, saving an annual coal consumption of about 3,000,000 tons. While the merits of different types of prime movers may be discussed, in the long run it appears certain that the energy of falling water will be utilized to the fullest extent and that the powers of our streams will be made to do useful work for the benefit of mankind.

[2]In the compilation of these notes the writer is indebted to the Macbeth-Evans Glass Company and the Cooper-Hewitt Electric Company; also to Louis A. Cressy, electrician Colt's Patent Fire Arms Manufacturing Company, and M. A. Van Norman, chief electrician Hudson Motor Car Company.

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New Security Issues of Electric Utilities

Recent Capital Issues of About Fifty Companies Furnishing Electric or Combined Utility Service Reach Total of $110,000,000 and Mean Continued Expansion of Plants to Meet Demands for Electrical Energy

DESPITE adverse conditions in the investment markets, a number of electric utilities have been successful recently in marketing securities. The accompanying list summarizes information available on offerings of such securities by bankers, applications for authorization laid before state public service commissions or reports of plans to put out new stock or bonds. These amounts total over $110,000,000. That sum is of course, small in comparison with the real capital needs of the electric utilities of the country. It is significant, however, that these properties have been able to put out securities on any acceptable terms in the prevailing situation.

About fifty companies are included in the list, and most of the financing is for small amounts. It will be seen that the average sum per company is roughly $2,000,000. When it is stated that five of the companies represent $51,000,000, or nearly one-half of the total, it will be seen that the average for most of the properties is very small. The five companies whose borrowing shows this large total are the Philadelphia Company of Pittsburgh, the Public Service Corporation of New Jersey, the Southern California Edison Company, the Pacific Gas & Electric Company and the Great Western Power Company.

In justice to their community requirements many of the companies have been unable to postpone their financing any longer. They are obliged to place orders for electrical apparatus in advance of their actual needs and must have capital to meet their obligations. In order to plan construction ahead with confidence they must in fact have reasonable assurance that when capital is needed it will be forthcoming. The successful issue of securities at this time is a fair indication that the investment market will be able to provide more funds for expansion later in the year when government loans are out of the way.

With the great issues of Liberty bonds on the market and the Victory loan impending, the disposition of the companies is to postpone financing. This course is recommended not only by the government priority of interest in investment funds but also by the current high rates for money. Companies are not anxious to burden their operations any more heavily than is necessary for interest on securities issued on the only terms open now. The are in urgent need of capital to meet expenditures for additions required by the public demand for energy, but it is important for them to borrow as cheaply as possible.

It was to have been expected that cost of capital would be raised to high figures by the present unprecedented conditions. The indicated costs, however, are not by any means high in comparison with prevailing prices of similar securities already on the market or with issue prices of new securities. On the contrary, they show that the credit of electric utilities ranked well in a market in which the best-secured obligations of nations and corporations are regarded critically.

In at least one conspicuous instance the securities were offered directly to the public in the communities served instead of through the regular investment banking channels. Successful selling of securities directly to the investment buyers in this way has the advantage that it involves less expense than the usual commission changed by bankers. It also frequently attracts private capital from people who are not ordinary investors in touch with the customary banking houses.

It is of special interest to note the financing plans of Pacific Coast companies. These involve relatively large amounts and indicate plans to make substantial expansions in plants. It is evident that a material part of the outlay for new construction in that section of the country will be for development of hydroelectric resources.

As many electric utilities are joined with other classes of utilities under single corporate control the statistics given do not relate wholly to electrical construction. The large proportion of purely electric utilities represented in the list, however, is assurance that most of the capital issues mentioned will go to increase electric systems.

Undoubtedly the list includes some cases of refunding operations. To the extent that it does so, it does not represent new capital for enlargement of plant. In general, it is believed to mean considerable fresh capital for expansion. Viewed in this way it is, as indicated, significant of an investment standing that enables these properties to dispose of securities under adverse influence. It is, moreover, a foretaste of a great output of securities to meet the enormous construction requirements of the future.

EASTERN COMPANIES

American Railways Company, Philadelphia.—Issued $3,000,000 7 per cent three-year notes, dated Feb. 1, 1919, $1,672,000 to retire a like amount of notes maturing on that date, balance being offered at par by Newburger, Henderson & Loeb and Bioren & Company, Philadelphia.

Brooklyn Edison Company, Inc.—Guaranty Trust Company, New York, offered $5,500,000 general mortgage 5 per cent bonds, due Jan. 1, 1949, at 91 and interest.

Central Hudson Gas & Electric Company.—Authority given by New York Public Service Commission, Second District, to issue $750,000 debenture bonds carrying privilege of conversion at par into stock on Jan. 21, 1921.

Cohoes (N. Y.) Power & Light Corporation.—The First National Bank and Hemphill, Noyes & Company, New York, offered $2,500,000 first mortgage 6 per cent bonds, dated Jan. 1, 1918, due Jan. 1, 1929, at 102½ and interest.

Erie (Pa.) Lighting Company.—Brown Brothers & Company offered $1,350,000 first mortgage 5 per cent sinking fund bonds, due April 1, 1967, at 88 and interest.

Lockport (N. Y.) Light, Heat & Power Company.—Howard R. Taylor & Company, Philadelphia, offered $350,000 general mortgage 7 per cent bonds, due Jan. 16, 1920, guar-

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anteed principal and interest by United Gas & Electric Company of New Jersey.

Lowell (Mass.) Electric Light Corporation.—Issue of 2,941 shares of stock proposed.

Municipal Service Company.—Baker, Ayling & Young offered $700,000 6 per cent debenture bonds, dated Dec. 2, 1918, due December, 1928, to yield 7 per cent.

New England Power Company.—Baker, Ayling & Young, Boston, offered 6 per cent preferred stock.

Niagara, Lockport & Ontario Power Company.—William Solomon & Company, New York, offered $990,000 refunding mortgage 6 per cent bonds due Feb. 1, 1958, at 93 and interest.

Philadelphia Company, Pittsburgh.—Sold through Lee, Higginson & Company and First National Bank, New York, $10,000,000 three-year 6 per cent secured notes, dated Feb. 1, 1919. Price, 96½ and interest.

Philadelphia Electric Company.—Brown Brothers & Company and Drexel & Company, Philadelphia, offered $1,500,000 first mortgage sinking fund 5 per cent bonds, due Oct. 1, 1966, at 94 and interest.

Pittsfield (Mass.) Electric Company.—Increase of $125,000 in stock reported.

Public Service Corporation, Newark, N. J.—Bonbright & Company, New York, and Drexel & Company, Philadelphia, sold $12,500,000 three-year secured convertible 7 per cent notes, dated March 1, 1919, at 98½ and interest.

Rochester Railway & Light Company.—Asked New York Public Service Commission, Second District, to authorize issue of $500,000 preferred stock.

Syracuse Lighting Company.—Authorized by New York Public Service Commission, Second District, to issue $920,000 6 per cent notes due Jan. 1, 1929, to fund outstanding notes.

Turners Falls (Mass.) Power & Electric Company.—Stock increased by $2,409,100.

Worcester (Mass.) Electric Light Company.—Authorized to issue $400,000 stock.

CENTRAL WESTERN COMPANIES

Cincinnati Gas & Electric Company.—A. B. Leach & Company, New York, offered $550,000 first mortgage 5 per cent bonds at 95 and interest.

Cleveland Electric Illuminating Company.—National City Company and Spencer Trask & Company, New York, offered $2,500,000 first mortgage 5 per cent bonds, due April 1, 1939, at 94½ and interest.

Commonwealth Edison Company, Chicago.—Illinois Trust & Savings Bank, Chicago, sold $4,000,000 first mortgage 5 per cent bonds to net about 5½ per cent.

Commonwealth Public Service Company.—W. G. Souders & Company offered $600,000 7 per cent notes dated March 1, maturing $300,000 in one year, $300,000 in two years.

Galesburg (Ill.) Railway, Lighting & Power Company.—Illinois Public Utilities Commission asked to authorize issue of $350,000 consolidated and refunding mortgage bonds.

Louisville Gas & Electric Company.—Bonbright & Company, Inc., New York, offered $228,000 bond-secured 7 per cent notes, dated March 1, 1918, due Sept. 1, 1920, at 98½ and interest.

Merchants' Heat & Light Company, Indianapolis.—Paine, Webber & Company offered at 99½ and interest $7,000,000 one-year 7 per cent notes dated March 1.

Milwaukee Electric Railway & Light Company.—Offered $3,600,000 five-year 7 per cent secured notes, dated Nov. 1, 1918, due Nov. 1, 1923, at par, convertible into Milwaukee Light, Heat & Traction Company general mortgage bonds.

North West Utilities Company, Chicago.—W. G. Souders & Company, Chicago, offered $1,000,000 6 per cent collateral notes, dated Jan. 1, 1919, due in varying amounts each Jan. 1 to 1929, to yield 7 per cent.

Northern States Power Company, St. Paul, Minn.—Sold $1,500,000 first and refunding mortgage 5 per cent bonds.

Public Utilities Company, Evansville, Ind.—National City Company offered $3,000,000 first and refunding mortgage 6 per cent ten-year bonds, dated Jan. 1, 1919, to yield 6.65 per cent.

Richmond (Ind.) Light, Heat & Power Company.—Offers $450,000 two-year 7 per cent notes, guaranteed principal and interest by United Gas & Electric Company of New Jersey, in exchange for outstanding $450,000 notes maturing on March 1, paying holders also 3 per cent in cash.

Toledo Railways & Light Company.—Shareholders authorized issue of $3,200,000 bonds to provide for additions and improvements to electric light and power properties.

Western United Gas & Electric Company.—Emery, Peck & Rockwood, Chicago, offered $500,000 7 per cent debentures.

Wisconsin-Minnesota Light & Power Company.—Offered through Paine, Webber & Company, $1,000,000 one-year 7 per cent notes, dated Feb. 1, 1919, at 99½ and interest.

SOUTHERN COMPANIES

Carolina Power & Light Company, Yadkin River Power Company, Palmetto Power & Light Company.—Spencer Trask & Company and W. C. Langley & Company, New York, offered the first and joint mortgage 6 per cent five-year bonds at 95¾ and interest, yielding over 7 per cent.

Charleston (S. C.) Consolidated Railway & Lighting Company.—Reported to be considering issue of $1,500,000 common stock.

Georgia Railway & Power Company.—Application made to Georgia Railroad Commission for authority to issue $633,000 refunding and improvement mortgage bonds.

Georgia-Alabama Power Company.—Howard R. Taylor & Company, Philadelphia, offered $525,000 two-year 7 per cent collateral trust bonds, dated Feb. 1, 1919, at 99½ and interest.

Pensacola (Fla.) Electric Company.—Stone & Webster offered $500,000 two-year 7 per cent notes, dated Jan. 2, 1919.

FAR WESTERN COMPANIES

Arizona Power Company.—Bonbright & Company, Inc., New York, offered $500,000 bond-secured 7 per cent five-year notes, dated Jan. 1, 1919, at 96 and interest.

Coast Valley Gas & Electric Company, San Francisco.—Applied to California Railroad Commission for authority to issue $125,000 bonds.

Colorado Power Company.—Bonbright & Company, Inc., New York, offered 7 per cent preferred stock.

Great Western Power Company.—A new holding company will issue $6,000,000 first and refunding mortgage 6 per cent bonds and $1,500,000 7 per cent cumulative preferred stock.

Pacific Gas & Electric Company.—Authority given by California Railroad Commission to issue $1,500,000 first preferred 6 per cent stock at not less than 87½ or a like amount of 5 per cent general and refunding mortgage bonds, due Jan. 1, 1942, at not less than 85 and interest. In December $3,500,000 bonds were sold.

Pacific Power & Light Company.—White, Weld & Company and William A. Read & Company offered $1,265,000 first and refunding mortgage 5 per cent bonds, due Aug. 1, 1930, at 89¾ and interest.

San Joaquin Light & Power Corporation, Fresno, Cal.—Application to issue $662,000 bonds reported.

Southern California Edison Company.—Sold through Harris, Forbes & Company, National City Company, E. H. Rollins & Sons and Coffin & Burr, $8,000,000 7 per cent debenture bonds, dated Jan. 15, 1919, and due $1,000,000 annually on Jan. 15 each year, 1921 to 1928, at par and interest; also $8,000,000 general and refunding mortgage 6 per cent bonds at 98 and interest.

Washington Water Power Company.—Offered, through Spokane & Eastern Trust Company, to yield a little over 7 per cent, part of $3,000,000 one-year 6 per cent notes, dated Feb. 2, 1919, balance being used to refund $2,779,000 notes due on Feb. 2, 1919.

Western States Gas & Electric Company.—California Railroad Commission asked to authorize sale of $450,000 5 per cent bonds at not less than 82½ and interest.

CANADIAN COMPANY

Shawinigan Water & Power Company, Shawinigan Falls Que.—Sale of $500,000 stock reported.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

LABOR DATA PERTAINING TO INSTALLATION OF CABLES

Organization of Gangs for Various Types of Installations—Amount of Work Performed and Unit Costs for Various Crossings

BY JOHN D. MORGAN
Mechanical Engineer the Superno Company, Inc.

When electric service companies are called upon to make extensions to their lines on short notice, it is difficult to make accurate estimates of cost because of the rapidly changing market prices. It is thus desirable for engineers to coöperate by making available unit costs on various types of construction. Herewith are presented labor costs of laying submarine cables, with sufficient analysis to make the matter useful to other engineers. The unit costs do not necessarily apply now, but the method of analyzing expenses indicates a way in which old cost data can be applied under changed conditions.

Armored submarine cables can be generally subdivided into the following groups: Transmission cables of 6600 volts to 13,000 volts or higher; distribution cables of 2400 volts, and two, four or one-conductor distribution cables for arc circuits and telephone cables.

In a great many crossings work must be done in order to lower the cables beneath the dredging limits of navigable streams. This work is generally done by contract, and hence no discussion of this factor in submarine cable installation will be given.

The labor of installing submarine cable is generally meant to include the trucking of cable reels to and from the job, setting up reels (except where a scow is used), pulling in cable, anchoring at both ends, splicing at both ends and installing pole lateral.

For convenience is discussing this problem arbitrary classes of construction are made as given below:

Class A —Crossing of 100 ft. to 300 ft.; no scow used.
Class B —Crossing of 300 ft. to 600 ft.; no scow used.
Class C —Crossing of 600 ft. to 950 ft.; no scow used.
Class D —Crossing of 1000 ft.; scow used.
Class D1—Crossing of 10,000 ft.; scow used.
Class E —Crossing of 500 ft.; on bridges.

With this classification in mind, it is seen that gangs will be needed as given in Table I to set up reels (except on scow), install cable and anchor at both ends. These gangs will perform the amount of work, or, in other words, make the number of crossings, shown in Table II.

From Tables I and II the unit cost table given in Table III is obtained.

In general, setting reels on scows will cost about $25, while the trucking of reels will cost as follows:

6600-13,000-volt armored-cable reels, full $25, empty $10; total $35.
2400-volt two and four-conductor cable reels, full $15, empty $5; total $20.
100-volt one-conductor and other reels, full $2.05, empty $0.83; total $2.88

TABLE I—GANGS FOR 13,200-VOLT AND 2400-VOLT TWO-CONDUCTOR AND THREE-CONDUCTOR CABLES

	A			B and C			D and D1			E		
	No.	Rate per Day	Cost	No.	Rate	Cost	No.	Rate	Cost	No.	Rate	Cost
Foreman	1	$4.50	$4.50	1	$4.50	$4.50	1	$4.50	$4.50	1	$4.50	$4.50
Helpers	8	2.25	18.00	12	2.25	27.00	10	2.25	22.50	8	2.25	18.00
Chauffeur	..	....	.....	1	3.75	3.75	..	....	.....	..	...	.....
Wagon	1	....	6.00	..	Auto	12.00	..	Scow	25.00	..	Wagon	6.00
Boat	1	....	2.00	1	....	2.00	..	Tug	100.00	..	....	.....
Total,	..	....	$30.50	..	.....	$49.25	..	.....	$152.00	..	....	$28.50

TABLE II—AMOUNT OF WORK PERFORMED BY GANGS IN TABLE I

	A	B	C	D	D1	E
No. of days per crossing	1	1	2	1	3	½
Crossings per day	1	1	½	1	⅓	4
Feet per day per gang	100–300	300–600	300–475	1000	3333	2000

TABLE III—UNIT COST TABLES

	A	B	C	D	D1	E
Labor cost	$30.50	$49.25	$98.50	$152.00	$456.00	$7.125
10 per cent added for bad weather	3.05	4.93	9.85	15.20	45.60	.713
Total labor cost	$33.55	$54.18	$108.35	$167.20	$501.60	$7.838
Unit cost per foot (cents)	33—11	18—9	18—11.1	16.7	5.02	1.57

NOTE.—For 2400-volt single-conductor arc cables and telephone cables use next cheaper class, or, if already in class A, use 75 per cent of class A cost, or if in class D, use also 75 per cent of class D cost.

TABLE IV—GANG USED FOR SPLICING CABLE

	No.	Rate per Day	Cost
Foreman	1	$5.00	$5.00
Helpers	6	2.25	13.50
Splicers	6	4.50	27.00
Wagon	½ day	.....	1.00
Total	13	.....	$46.50

TABLE V—UNITS PER DAY AND UNIT COSTS PER SPLICE

	Units per Day					
	Four-Conductor, All Sizes	Three-Conductor, All Sizes	Two-Conductor, No. 8 4/0	Two-Conductor, Above 4/0	One-Conductor No. 8 500,000 Circ. Mil.	Eyelet for Pulling
(1) Straight	12	12	24	18	48	42
(2) One-way, two-way	6	6	18	12	24	..
(3) One-way, three-way	6	6	12	12	18	..
(4) More than	6	6	12	12		
	Unit Costs					
(1) Cost of labor	$3.88	$3.88	$1.94	$2.58	$0.97	$1.10
10 per cent for unsettled conditions	0.39	0.39	0.19	0.26	0.10	0.11
Total labor cost	$4.27	$4.27	$2.13	$2.84	$1.07	$1.21
(2) Total labor cost	8.53	8.53	2.84	4.27	2.13	...
(3) Total labor cost	8.53	8.53	4.27	4.27	2.84	....
(4) Total labor cost	8.53	8.53	4.27	4.27	....	....

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Table IV shows the gang generally used for splicing cable and Table V the units per day and unit costs per splice.

In a great many cases it is necessary to install a pole lateral at the ends of submarine cable. This item is generally understood to consist of the following operations: Pulling cable up the pole to pot-head location, trucking material, but not connecting at either end. Using these assumptions, Table VI shows the gang needed, units per day done, and unit cost per lateral.

TABLE VI.—GANG NEEDED, UNITS PER DAY AND UNIT COST PER LATERAL

	Gang Needed		
	No.	Rate	Cost
Foreman	1	$4.50	$4.50
Lineman	1	3.25	3.25
Helpers	6	2.25	13.50
Driver	1	3.75	3.75
Auto			12.00
Total			$37.00

	Units per Day	
	13,000-volt three-conductor 2,400-volt, four-conductor	13,000-volt, one-conductor Arc cables 2,400-volt, one-conductor 2,400-volt, two-conductor
No. of laterals per day,	3	4
Unit cost per lateral	$12.33	$9.25
10 per cent for unsettled conditions	1.23	.93
Total labor cost	$13.56	$10.18

In all work or calculations involving labor it must be remembered that figures are subject to wide fluctuations, yet the writer believes that the foregoing figures represent a true weighted average, and that the installation of submarine cables demands the supervision of a man thoroughly versed in the installation of them.

SIZE OF THE GAS FILMS IN MICA INSULATION

May Be Sufficient to Cause Corona When Insulation on Rectangular Conductors Is Not Clamped in Place

Gas films of sufficient thickness to cause corona may occur in insulations, and therefore they must be particularly guarded against. Of the wrapped insulations mica must be particularly watched because its spring-like qualities tend to make it bulge away from rectangular conductors unless clamped in space. The following observations made by G. B. Shanklin and J. J. Matson after conducting some ionization tests are instructive:

Approximation of the stresses in insulation around conductors of rectangular cross-section were made by comparing the voltages at which ionization started with those for a similar sample of round cross-section. The working stresss observed in mica-insulated rectangular-section conductors varied over a considerable range, usually between 7.9 kv. and 17.9 kv. per centimeter. With samples having the insulation clamped to prevent bulging the gas spaces ranged from 0.003 cm. to 0.007 cm. at 100 deg. C. for fresh and aged samples respectively. Without clamping, but with insulation applied with reasonable care to reduce air spaces, their thicknesses were of the order of 0.015 at 25 deg. C. and 0.005 cm. at 102 deg. C. Observations indicated that the higher the voltage rating of insulation on rectangular-section conductors (*i.e.*, the greater the thickness), the more carefully must bulging be guarded against.

RAISE TRANSMISSION VOLTAGE TO MEET GROWING DEMAND

Extension to Longest Line in World, Operating in California, Changed to Y-Connected Grounded-Neutral Circuit

Because of the increasing load on the Imperial Valley line of the Southern Sierras Power Company plans are being made for increasing the voltage of transmission. This line, extending from San Bernardino (at the southern terminus of the main tower line) to Yuma, with a total length of 224 miles (360 km.) was originally designed for operation at 55,000 volts as an isolated system. It is now proposed to change to a "Y" connection of transformers with solidly grounded neutral and operate this line at a potential of 88,000 volts. The conductor, of No. 3/0 aluminum, is of sufficient size to allow this increase without excessive corona loss, and by changing to a "Y" connection it is planned to increase the voltage without increasing the line insulation. A 2000-kva. synchronous condenser at the approximate center of load, some 165 miles (265 km.) from the point of supply, will aid in voltage regulation at the more distant points of delivery.

CORRECT CONDUIT SIZES

Formula by Which the Proper Size of Pipe May Be Determined for Any Combination of Wires

The rubber-covered-wire committee of the Western Association of Electrical Inspectors has called attention to the relation which the total area of the insulated wires in a conduit bears to the inside area of the pipe. From an analysis of the number and size of conductors allowed in conduit by the National Electrical Code, the following limiting conductor areas were obtained in per cent of the inside conduit area: One conductor, 56 per cent; two conductors, 32 per cent; three conductors, 42 per cent; four conductors, 40 per cent, and over four conductors, 37 per cent. These figures have been used successfully on standard wire combinations for years.

The following illustrations will show the method of determining the proper size of conduit where there are combinations of odd sizes of wires. What size of conduit is required for six No. 8 and six No. 2 wires? The area of six No. 8 wires is six times 0.06 in. (0.39 sq.cm.), which equals 0.36 in. (2.32 sq.cm.). The area of six No. 2 wires is six times 0.21 sq.in. (1.35 sq.cm.), which is equal to 1.26 sq.in. (8.03 sq.cm.). The sum of the two combined areas is 1.62 sq.in. (10.45 sq.cm.). According to the table, twelve wires should have an area not greater than 37 per cent of the area of the conduit. The area of the twelve wires in question is 1.62 sq.in. (10.45 sq.cm.), which when divided by 0.37 gives the area of the conduit required. The result is a conduit 4.37 sq.in. (28.2 sq.cm.) in area, and the standard conduit which should be used is 2.5 in. (6.35 cm.) in diameter.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

COMMENDING GOOD WORK INCREASES EFFICIENCY

Idea of Expressing Recognition for Services Well Rendered Can Be Carried Throughout the Entire Organization with Success

"Judicious use of commendation for work well done is a powerful aid in maintaining the spirit and good will of employees as well as in increasing the efficiency and output of any plant," said M. R. Buchanan, speaking before the New Mexico Electrical Association on efficiency of organization, "yet there are men in positions of authority who are blind to the value of this instrument in their hands, if we may judge by their failure to use it.

"The man who is absolutely callous and unresponsive to a word of praise for the performance of a good piece of work has yet to be discovered. Natural modesty may prevent an individual from openly showing that he is pleased, but there is no way by which he can disguise or ignore the warm glow that thrills through him when he hears words of approval.

"No class of worker is immune from the effects of a complimentary remark. The superintendent may wear a silk undershirt and the fireman may cover his torso with red flannel, but beneath the skin they are both human and therefore equally susceptible to the magic of an appreciative look or word. If the board of directors, at the annual meeting, passes a resolution congratulating the superintendent on the showing he has made during the year, he carries that congratulatory letter around in his pocket and shows it to his intimate friends until it becomes worn at the creases and frayed at the edges; moreover, he goes at the work of the new year with an increased determination to improve on his already good record.

"Similarly, if that superintendent pauses on his way through the plant to tell the fireman that he has been right on the job and doing fine work, according to the figures on the daily report sheet, that fireman involuntarily suffers an increase of chest expansion measurable in inches, and the chances are that he goes home and tells his wife that his boss has at last discovered his abilities.

"Recognition—that is the whole matter in a nutshell. To a greater or less degree we all like to attract attention to ourselves or to our achievements. One of the most discouraging and depressing things in the world is indifference. But when to indifference is added routine work of an unattractive and oftentimes laborious nature we have a plausible explanation of the lack of interest and the general low efficiency in many branches of industry.

"There are employers and chiefs who never praise the meritorious efforts of subordinates. Just why they should be so chary of approval is a mystery. If a few well-chosen words of tribute required the spending of money or involved a lowering of prestige or influence, withholding them could be understood; but they cost nothing and their influence is beyond all calculation. To many a man weary with repetition of the same motions and the same round of duties they come like a refreshing breath of air and they act as a pleasing stimulus to better performance.

"There may be excellent reasons why it is impossible to increase the pay of an employee who has accomplished praiseworthy results, but there is no excuse for failure to show recognition of his services when they are unusual in quality or value. More that that, the time to speak the well done is now. If a man deserves praise for what he has produced, let him know it while he can hear the sound of your voice."

FOUNDATION FORCE FOR HOLDING METER DEPARTMENT

This Group of Employees Is Paid Higher Wages—Helpers Paid Smaller Wages, but Not Much Is Expected of Them

A method of holding the meter department of the Cleveland Electric Illuminating Company together was described by J. T. Kermode before a recent meeting of the general meter conference of the Ohio Electric Light Association.

For each division of the work a competent man was selected on the assumption that if these men had the physical ability to work long enough hours they could perform everything required to carry on the operation of a meter department. These men were considered the foundation of the department on which the company could rebuild at a future date. In order to carry out this idea successfully, the pay of all men considered as a part of the foundation was materially increased. Readjustments were then made by lowering the rate of pay for certain classes of work not considered essential in holding the foundation of the department. Men were replaced by women to do clerical work such as making stock-room charges, time reports, meter-testing schedules and meter records, looking after service files, answering customers' inquiries, testing meters in laboratories and such janitor work as was needed in the building. A classification was made of each branch of the work, and a rate of pay was established for each job in connection with the responsibility still imposed in the execution of the work. Thus, if the labor cost to man a meter wagon was $200 per month, the installer receiving $120 and the helper $80, neither man was well paid and consequently both were dissatisfied. Under the conservation policy, the installers were in-

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creased to $140 per month and the helpers replaced with young men at $60 per month. Only one out of a certain number of helpers would develop into a good man, it was stated, and therefore a labor turnover among the helpers on meter wagons is expected. The maximum rate to helpers is $60 per month, and except in the cases of those proving exceptionally good no effort is made and no inducements are offered to keep them. By adopting this policy the company is able to pay the foundation of the organization a higher salary without materially increasing the cost of work. In some instances the services of men that could have been used to advantage were lost. However, the company kept sufficient men to hold its foundation for reconstruction at a future period.

ELECTRICAL ADVERTISING SHOULD AGAIN BE PUSHED

Experience of Chicago Lighting Company Points to Profitable Load and to Value of Utility's Itself Using System

BY JOHN F. GILCHRIST
Vice-president Commonwealth Edison Company, Chicago

As the writer sees it, now as never before is the time for the central station to make a determined effort to spread the good cheer of electric light advertising and display. The logic of the situation is almost irresistible. The war is over. The arts of peace are being rehabilitated. The "boys" are coming back to a hearty welcome and to their old jobs or possibly better jobs. The grim necessity of lightless nights is a thing of the past. It is now as much our duty to put the country on the best possible basis of production, of material well-being and good cheer as before the signing of the armistice it was to win the war. In making this tremendous readjustment hardly any other agency can have the same psychological effect as electric light advertising and electric display lighting.

In Chicago we have been doing some newspaper and mail advertising to bring this fact home to the manufacturers, merchants and business men generally, and here are quoted a few sentences:

Brighten up for the boys coming home.

When the boys come home let's have the streets ablaze with cheering light and filled with happy crowds to welcome them.

Electric signs back on the job to help boost your business.

All restrictions off. Use your electric sign to keep trade humming. The brightest stores are the busiest.

Now the war is over and won, Uncle Sam wishes to encourage business expansion along normal pre-war commercial lines.

The booming of the cannon has ceased over there. It is time to boom business over here.

In answer to the questions of what electric sign and other forms of electrical advertising and display lighting mean to a central station and why the use and increase of electric signs should be encouraged, the following tabulation has been prepared from the experience of the Commonwealth Edison Company, giving an estimate of the business of sign and other special outdoor lighting for one year. The figures given are the results of careful estimates, but they are not exact figures and relate to the time before the United States restrictions were in force.

DATA ON ONE YEAR'S SIGN AND SPECIAL OUTDOOR LIGHTING—COMMONWEALTH EDISON COMPANY

	Kw.-Hr. Consumed	Maximum Kw.	Hours' Use
Signs	10,287,000	6,350	4.5
Billboards	958,100	443	6.0
Outline lighting	714,500	442	4.5
Street posts	1,513,300	702	6.0
Exterior brackets	376,100	232	4.5
Total	13,849,000	8,169	4.7

It will be seen from the foregoing that the revenue to be obtained from this class of business is decidedly worth while. In Chicago it is estimated under normal conditions at $850,000 a year. This, too, in spite of the fact that Chicago, from its street arrangement, is not a particular good town for spectacular signs and other large display signs. The number of small signs in use, however, is large. The long-hour characteristics of sign and display lighting speak for themselves. A small part of the sign-lighting load comes on the peak, no doubt, but not enough to make the business undesirable. In the foregoing table street post (curb) lighting is included with other forms of electric light advertising.

Electric sign advertising is good advertising, and this truth should be borne in mind by the central station. The Commonwealth Edison Company has demonstrated this fact by its own experience. It uses electric signs and electric display lighting extensively. On a large proportion of its fifty substations, and also on some of its generating stations, there have been erected rather elaborate roof signs with the best results. These signs are of various design, size and shape, some being as large as 40 ft. wide and 30 ft. high. They all carry the legend "Edison Service" or "Use Edison Service" in letters from 3 ft. to 12 ft. high and accompanied by differing designs, sometimes in colors, representing incandescent blubs with rays or various ornaments and borders, often with flashing effects. The company can trace orders for at least half a dozen big roof signs to this electrical advertising of its own.

In its 1917 report the committee on electrical advertising of the lighting sales bureau of the Commercial Section of the National Electric Light Association makes the point that central stations should as far as possible endeavor to censor the character of signs in its community. By this is meant that the central station, with its excellent opportunities for studying the subject, should use all its influence to bring electrical advertising up to the highest plane possible. The committee criticises, and rightly, the erection of electric signs which in point of design are mere monstrosities. It says, too, that abuses of this character have been responsible for the severe electric signs restrictions that have been adopted by ordinance in many American cities. There is, of course, reason in all things, and the effort should be made to make electric signs, not disfigurements, but rather very decided additions and betterments to the city which they help so greatly to illuminate.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Converter of Three-Phase Into Direct Current.—O. M. CORBINO.—This apparatus is an adaptation of the mercury-jet break in an inert gas, widely used for industrial coils. The fixed plates of the new apparatus, three or six in number, are connected to the terminals of the star-connected secondary windings of an ordinary three-phase or a special transformer. The power obtained can be as high as 10 kw. and the efficiency as high as 97 per cent.—*Science Abstracts, Section B,* Dec. 31, 1918. (Abstracted from *Elettrotecnica,* Oct. 5.)

Recent Developments in Shaft Pressing at Destination.—N. L. REA.—Until recently the task of pressing on shafts at destination has been accomplished by improvised methods, few means, if any, having been provided by the factory. The resulting facilities have often been inadequate, and a great deal of trouble and delay have ensued in many cases. This subject has been fully studied by erection engineers and means have now been developed for performing the operation with precision. The methods that have been found successful are described in this article.—*General Electrical Review,* February, 1919.

Lamps and Lighting

The Tungsten Arc.—O. KRUH.—The author reviews various methods that have been adopted for forming an arc between tungsten electrodes, in some cases one electrode being brought into contact with the other by means of an electromagnet and then withdrawn, in others a third, conical element being interposed by the same means between the electrodes to strike the arc. Ionization methods, involving the heating of a rod composed of suitable alkali-earth oxides, are discussed. The light from the tungsten arc is essentially whiter than that of gas-filled glowlamps; the consumption is stated to be 0.4 watts per candlepower and the intrinsic brilliancy about 40 cp. (Hefner) per square millimeter. The lamp is rich in actinic rays, and the nature of the source lends itself to projection and ultra-microscopic work.—*Science Abstracts, Section B,* Dec. 31, 1918. (Abstracted from *Elektrot. u. Maschinenbau,* Aug. 4, 1918.)

Generation, Transmission and Distribution

Hydraulic Power in the "Massif Central" of France.—P. MORIN.—While the Alpine regions of France have naturally been those most considered in the discussion of hydroelectric installations, other parts of the country also offer great opportunities of this kind. This article discusses at length the water powers of what is known as the "Massif Central," formerly called the central plateau, where two rivers in particular, the Dordogne and the Truyère, are capable of furnishing a great amount of energy. Maps of the river basins and diagrams of the areas drained by the rivers and their tributary streams are printed.—*Revue Générale de l'Electricité,* Feb. 8, 1919.

Lighting Legislation.—H. E. MAHAN.—The Illuminating Engineering Society has given a great deal of attention to the question of legislation regulating lighting in industrial plants, and, after considerable study, a set of requirements has been drafted for presentation to the several state legislatures for their consideration and guidance in enacting laws on the subject. These rules or recommendations are given in this article, and the significance of each is pointed out and discussed.—*General Electric Review,* February, 1919.

Calculation of Short-Circuit Currents in Alternating-Current Systems.—W. W. LEWIS.—The value of being able to calculate short-circuit currents in large power networks, in order to provide and set suitable protective devices, has long been recognized. However, the mathematical methods used in the past for securing the data necessary to this end were laborious and often impossible of application in the more complicated cases. They have nearly all been based on the assumption that the limitation of the short-circuit current is due almost entirely to the inductive reactance of the circuit and that the effect of resistance and capacitance is negligible. The effect of thus neglecting the resistance and capacitance reactance is to give a somewhat larger short-circuit current than would be obtained were they considered. This assumption also greatly simplifies the calculation as, instead of having to add impedances at various phase angles, reactances only need be added and these are all in phase. The author then shows how the short-circuit currents will differ in various parts of a complicated network and that it is desirable to make up what is known as a calculating table for the solution of such problems. By means of the calculating table a miniature representative system is set up and a short circuit placed on it at any point, current being read in any element of the circuit. The author illustrates the method by solving a number of problems.—*General Electric Review,* February, 1919.

Traction

Control of Tramcar Trains.—R. WOLFF.—The safety system of control described is due to the A. E. G. and has been used for trains of tramcars in Dresden during the past year. The use of from one to three trailers is common in many cities owing to the density of traffic at certain hours and the scarcity of labor. Early tests with several coupled motor cars controlled from one point led to cumberson switch, resistance and coupling gears. These defects are overcome by the new equipment, which has been tested on a train of two motor cars (each with its own trolley pole and two 28-kw. motors) and a plain car between them. The weights of the three cars empty and with 142 persons are 33½ tons and 44 tons respectively. The track includes severe gradients and four electrically operated point-setting devices. The motors are controlled on the series-parallel system, and provision is made for isolation of a defective motor. Mechanical design of the equipment and

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the principle on which the resistance sections are utilized are such that the control gear is light and compact enough to be fitted to any car. The only connection between the driving platforms is the ten-core control cable. Wiring diagrams are given in the original. Special insulation is provided where required to allow for the fact that when the front and rear cars span section points of the three-wire system there is a potential drop of more than 1000 volts between certain conductors. The experimental train ran 25,000 km. without electrical breakdown or any serious depreciation. Trains of four or more cars may be operated on the same principle. Depreciation of control gear is less and that of motors no higher than in ordinary service. The motors used in the experimental train proved to be unnecessarily powerful, so that no reliable cost data can yet be given.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elektrot. Zeits.*, Sept. 12, 1918.)

Installations, Systems and Appliances

Control and Safety Devices for Three-Phase Winding Gear.—M. GRAF.—Few hoisting installations of high or medium power have been equipped with simple three-phase motors in the past owing to the violent starting of such machines and their poor flexibility. In spite of the advantages of three-phase motors in other respects, these limitations have led to the use of more costly and complex equipments (Leonard system, three-phase commutator motors, and double Deri motors). The Gewerkschaft Bernsdorf of Hildesheim has had in use for two and one-half years past a winding plant driven by two three-phase induction motors each of 380 hp. (total overload 1175 hp.). The equipment is provided with Brown-Boveri automatic safety devices and is said to be the first installation of its kind. The system is described in considerable detail.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Zeits. Vereines Deutsch. Ing.*, July 13, 1918.)

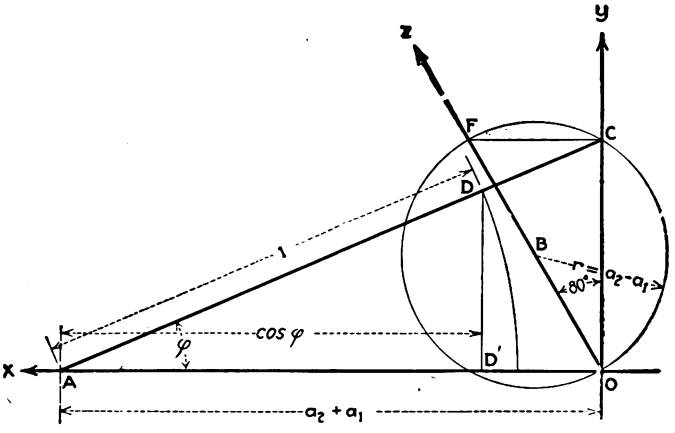
Electric Trucks for Factory Use.—JACQUES DESCHAMPS.—The author describes the various types of small electric trucks, the use of which in French workshops has been greatly increased by the necessities of the war. He gives a brief description of the Edison storage battery and enumerates some of the functions of the trucks. Those now employed in France are of American manufacture.—*Revue Générale de l'Electricité*, Feb. 1, 1919.

Electrophysics and Magnetism

Properties of Electric Circuits of Zero Resistance.—G. LIPPMANN.—A study presented at the January session of the French Academy of Sciences bearing upon this subject, of which the theory received a striking confirmation from the experiments of Kamerlingh Onnes upon superconductors. The author shows that the advantage resulting from the consideration of null resistances is that one arrives at a relation establishing that the general laws of the phenomena of induction are static laws.—*Revue Générale de l'Electricité*, Feb. 1, 1919.

Units, Measurements and Instruments

Graphical Determination of Three-Phase Power Factor.—E. HAIDEGGER.—Assuming symmetrical loading in a symmetrical three-phase system, the power $= \sqrt{3}\ EI \cos \Phi$, and if the two-wattmeter method of measuring power be employed, using instruments with equal constants, then $\tan \Phi = \sqrt{(3)}\ (a_2 - a_1)/(a_2 + a_1)$, where $a_1 a_2$ are the deflections of the wattmeters. A convenient graphical construction for $\cos \Phi$ is shown in the diagram. Between axes OX, OY of the rectangular coordinates draw OZ at 30 deg. to OY. Set out to scale $OA = (a_2 + a_1)$ and $OB = (a_2 - a_1)$. With center B and radius $(a_2 - a_1)$ draw a circle cutting OY in C. Join CA, then the angle $CAO = \Phi$. Set out $AD' = 1$ and drop the perpendicular DD'; then $AD' = \cos \Phi$.



GRAPHICAL DETERMINATION OF POWER FACTOR FROM TWO WATTMETER READINGS

The author gives a proof for this construction.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elektrot. Zeits.*, Aug. 22, 1918.)

New Method of Measuring High Temperatures.—A. BOUTARIC.—The author expounds the principle of the new method of evaluating high temperatures by means of the coloration of the light emitted by the incandescent body. The method of application is extremely simple, necessitating the use only of a photometer and a lamp previously standardized. Allusion is made to the work of Paterson and Dudding, Hyde, Cady and Forsythe, Pirani and Meyer, Nutting, and Langmuir.—*Revue Générale de l'Electricité*, Feb. 8, 1919.

Amplification Obtainable by the Heterodyne Method of Reception.—G. W. O. HOWE.—Some difference of opinion appears to exist as to the maximum amplification obtainable by the simple heterodyne method of receiving undamped signals. In this paper the author contrasts the Cohen theory that heterodyne amplification can be increased indefinitely by increasing the local current (using an ideal detector of unlimited current-carrying capacity) with the Liebowitz theory that the maximum "true heterodyne amplification" is four. Armstrong's results, obtained with the auto-heterodyne, appear to support the view put forward by Liebowitz (*Abs. 403*, 1917). It is shown by several different methods of considering detector and heterodyne action as compared with chopper detection of received energy that if the detector gives an audibility current proportional to the received current the maximum amplification of audio power is 2.43 and does not increase indefinitely with the local current. With detectors giving an audibility current proportional to the square of the received current — *e. g.*, ordinary contact detectors through a considerable range—the amplification may greatly exceed four, and its excess over four cannot be accounted for on the basis of "increased detector efficiency," since a steady polarizing current will not produce the same increase.—*Science Abstracts, Section 5*, Dec. 31, 1918. (Abstracted from *Proceedings Inst. Radio Eng.*, October, 1918.)

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Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ANTENNAS, ELECTRICAL OSCILLATIONS IN.

The mathematical theory of circuits having uniformly distributed electrical characteristics, such as cables, telephone lines and transmission lines, is applied to the oscillations in antennas and inductance coils. Methods have been worked out for determining the frequency of the natural oscillations of an antenna, analytically or graphically, when inductance coils or condensers are inserted in the lead-in. Expressions have been derived which permit the calculation of the effective resistance, inductance and capacity of the antenna, and it has been shown that in so far as frequency or wave-length computations are concerned the simple formula applicable to ordinary circuits with lumped constants gives very accurate results. Experimental methods have been developed for determining the effective and static or low-frequency values of the antenna constants.—*John M. Miller, Bureau of Standards, Washington, D. C.*

HEATER, INDUCTION-TYPE.

A new electric heater of the induction type has been developed which possesses a power factor as high as 95 per cent and whose humming noise, due to transformer action, may be kept quite low. The iron pipe through which the heated water flows forms the transformer core. The secondary winding consists of one turn which is a sheet of copper fitting snugly on the outside of the iron pipe. The primary winding consists of insulated copper wire wound around the secondary—*C. E. Magnusson, University of Washington, Seattle, Wash.*

HYSTERESIS, EFFECT OF CROSS-MAGNETIZING FIELDS UPON.

The effect of an alternating field applied at right angles to the direct field while the hysteresis curve was being traced has been investigated for steel specimens of varying degrees of hardness. The direct field reached a magnitude of 150 gausses, while an alternating field of maximum intensity equal to 80 gausses was applied in some cases. With soft specimens all traces of hysteresis disappeared; with very hard steel the width of the loop was reduced to less than one-tenth of that of the original loop. For soft steel the magnetization curve with the transverse alternating field applied lies almost wholly outside and beneath the normal hysteresis loop. With hard specimens it lies within the normal loop, except near the top, where it passes outside and above it. It is to be observed that the actual magnetizing field at any instant is the vector sum of two fields at right angles, and hence in general it is greater than either component. When the alternating field is applied it is found with hard steel that the longitudinal component of the flux is greater than can be produced by the longitudinal field. This seems to indicate a rotational hysteresis or a tendency for a large flux to maintain its magnitude while it is forced to change its direction.—*N. H. Williams, University of Michigan, Ann Arbor.*

INSTRUMENTS (INDICATING), CRITERION OF PERFORMANCE.

The origin and nature of hysteresis losses in typical instruments and the methods of evaluation have been investigated in detail. This method occupies a field distinct from that of the usual methods of calibration in that it affords a criterion as to the performance of the type rather than as to the errors of an individual instrument, which latter errors are inherently subject to variation of a more accidental character. The investigation will be published in full in the *Journal* of the Franklin Institute.—*Frederick J. Schlink, Bureau of Standards, Washington, D. C.*

MACHINERY, DIRECT-CURRENT, ARMATURE DESIGN DATA.

Analysis shows the armature output to be proportional to the product of the cubical contents, speed, allowable specific electric loading, polar arc, etc. Also, for a given output, polar arc, etc., the armature capacity varies inversely as the cube root of the speed. About ten high-class direct-current dynamos of various sizes and makes from 1 kw. to 10 kw. were tested with due regard to armature dimensions, accepting the name-plate ratings as reasonable, and curves were drawn giving various factors. Other curves prepared from the data show armature length as a function of armature diameter and speed for two-pole and four-pole dynamos with 70 per cent polar arc. Still another family of curves shows allowable watts per square inch of cylindrical surface of armature as a function of capacity and speed. This work ought to be further extended and checked with a considerable number of the very latest machines with confirmed ratings and supplemented by data in terms of various grades and thicknesses of armature laminations in use.—*C. R. Wylie, Detroit, Mich.*

PERMEABILITY, INFLUENCE OF MAGNETIC TREATMENT ON.

An investigation on laminated ring specimens was made by the ballistic galvanometer method. The apparent permeability for a given field strength, plotted against the logarithms of the number of reversals of the measuring field before observation of the galvanometer deflection, gives an "accommodation curve." This curve shows clearly whether the iron is polarized, or demagnetized, and if so whether completely or not, and even indicates any preceding treatment with a field strength *smaller* than that used in measuring. If the iron is polarized, the curve slopes down; if demagnetized, it tends upward toward an asymptote. After an incomplete demagnetization the curve has a maximum, which is reached at a higher number of reversals the more carefully the demagnetization is carried out. This criterion has shown that ninety reversals are entirely insufficient for demagnetization. About 300,000 were necessary for a good demagnetization of a certain sample. Alternating-current and direct-current demagnetization proved to be absolutely equivalent for laminated samples and commercial frequencies, alternating-current being the only one practically useful.—*Edy Velander, Massachusetts Institute of Technology, Boston, Mass.*

RADIO, ANTENNA CONSTANTS.

An accurate determination has been made of the equivalent and true antenna constants for long horizontal aerials. One set of formulas is a logical sequel of the ordinary transmission-line equation and of Dr. Cohen's graphical procedure described in the ELECTRICAL WORLD, Vol. 65, No. 5. The problem may be solved directly with the slide rule. The second new method employs an approximate solution, but the formulas give about the same results as those of the first method. In both procedures the quarter wave-length distribution is considered, and both are in agreement with the actual conditions. A table prepared from experimental data shows the usefulness of the investigation.—*August Hund, Berkeley, Cal.*

RECTIFIERS, ALUMINUM.

Two matters of interest have been investigated that have received scant attention in former publications on this subject, viz., first, the production of voltages higher than those usually obtained and, second, the wave form of the rectified current. Forty lead-aluminum cells were used grouped with ten cells in series in place of each of the four elements of the Nodon valve arrangement. A rectified voltage having a maximum value of more than 3000 volts was thu sobtained, the r.m.s. value being 2600 volts. The wave forms were determined by means of the oscillograph. The current curve for all loads lies entirely upon one side of the zero axis. When the load is non-inductive, the voltage also is unidirectional, but with an inductive load the voltage curve shows small negative values at the minimum points. By graphical differentiation of the current curve the emf. due to self-induction may be determined. It is found that the ordinates of this curve account satisfactorily for the difference between the voltages when the load is inductive and when it is non-inductive. Efforts to obtain currents with as little fluctuation as possible were made by putting inductance into the load circuit and a condenser in parallel with the load. In some cases it has been possible to reduce the fluctuations of the rectified current from its mean value to a trifle over 1 per cent.—*N. H. Williams and J. M. Cork, University of Michigan, Ann Arbor.*

Suggestions for Research

CONTACTS, OXIDATION OF.

It is very desirable to understand the limitations in the design of circuit breakers, contactors, switches, etc., caused by oxidation on contacts. There is no question that the circuit-breaker contacts will increase in temperature quite rapidly under certain conditions. It is questionable whether contactors would show the same effect. This may be due (a) to the contactors being small and the circuit breakers large. (b) to a difference in design which produces a different action on the contact, (c) to trouble caused by something entirely apart from oxidation. This problem could be handled experimentally in an ordinary laboratory if the investigation were confined to comparatively small values of current. It is a very important subject to understand, as it is the basis for the limiting temperatures on many forms of contacts.—*H. D. James, Pittsburgh, Pa.*

FUSES FOR DIRECT-CURRENT LOCOMOTIVES.

A fuse adapted for a 3500-volt direct-current circuit, which shall be small enough to be placed in a locomotive cab and reliable enough adequately to protect circuits whose normal current is from 5 amp. to 500 amp.—*Capt. Chester Lichtenberg, Washington, D. C.*

IMPEDANCE, MUTUAL.

While this term, as applied to telephone circuits, has been defined in the A. I. E. E. Standardization Rules, it is desired that a general mathematical expression be worked out similar to the formula for ordinary impedance, to avoid confusion in applications.—*Editorial Suggestion.*

INSTRUMENT TRANSFORMERS, EFFECT OF OVERLOADS.

It is a well-known fact that the indicating errors of a current transformer are widely changed if its magnetic circuit is accidentally overloaded. This is due to polarization effects, which constitute aperfectly definite ferro-magnetic phenomenon and have been studied from a physical point of view. It would be of great interest to obtain quantitative data on actual instrument transformers, showing the changes in ratio and phase error after heavy short circuits. These errors, indeed, must be expected whenever the measured current drops suddenly from a higher value to a lower. Such data would enable one to develop some standard process of demagnetization and would help to settle some other equally important practical and theoretical questions.—*Edy Velander, Massachusetts Institute of Technology, Boston.*

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

ELIMINATION OF STATIC IN RADIO COMMUNICATION

Roy A. Weagant Explains Method by Which He Has Been Able to Avoid Disturbances — Makes Radio More Reliable

The invention of Roy A. Weagant, chief engineer of the Marconi Telegraph Company, which was announced several months ago as a device that would completely eliminate the so-called static interference of radio signals, was explained in full last week at a joint meeting of the Institute of Radio Engineers and the New York Electrical Society. About 500 persons were present.

In general the solution is based almost wholly on the discovery that the static waves which cause the most trouble are propagated vertically with respect to the earth's surface whereas signaling waves move horizontally. This difference made it possible to eliminate interference from the "grinders," as they are called, by placing two low rectangular loops in the same vertical plane but at the same elevation. The static waves, moving vertically, reach both loops simultaneously, whereas the signal waves, traveling horizontally from a given direction, set in vibration, first, the loop which is nearest to the sending station and afterward the second loop.

As a result the currents set up in the two loops by the static disturbance are in phase and may be canceled by proper connection of the loops. On the other hand, the currents set up by the signal waves will be out of phase by an amount depending on the sending wave length and the distance that the loops are apart horizontally. By placing them exactly one-half wave length apart a phase difference of 180 deg. will be obtained, but these currents can be made to add arithmetically by proper connection of the loops, so they really strengthen the signal received.

Another advantage of Mr. Weagant's method is that costly towers, which are required with high antennas, are eliminated. Experiments were mentioned by the investigator in which he was able to obtain very satisfactory results with antennas laid on the ground or slightly buried, provided that the length was not too great.

While the foregoing method eliminated "grinders," it did not reduce the disturbance from "clicks." Investigation indicated that the static waves producing these disturbances follow no definite direction but seem to come from all azimuthal points. Of the many methods tried to eliminate these "clicks" one using three loops was most satisfactory. Two of the loops were placed as in eliminating "grinders," while the third loop was placed between. The connections were made in such a way that the currents produced in one set of loops by the second kind of static could be used to cancel those produced by the same cause in the other set of loops, leaving the signaling current free of disturbances.

These methods of eliminating static disturbances are not merely theoretical schemes but devices which have actually been tested on a commercial scale in a number of places and under very severe conditions by Mr. Weagant. By these methods he has been able to maintain undisturbed communication with European stations during summer months and in the afternoon when disturbances are the worst. Furthermore, he has been able to screen out interference from neighboring stations rated as high as 200 kw., provided that they are not in the direction of the sending stations—this by changing the directional-sensitivity characteristics, which can be easily done with three loops.

While much of the investigation work conducted by Mr. Weagant was done with aerials as long as 6 miles, he stated that he has been able to receive transatlantic messages with antennas which can be set up in an average-sized room, provided that amplifiers are used.

Several men noted in radio circles took part in the discussion which followed the presentation of the paper, among them being Prof. M. I. Pupin, Dr. A. N. Goldsmith, G. H. Clark, David Saranoff, E. F. Alexanderson and F. N. Waterman. All hailed Mr. Weagant's investigation as an epoch-making accomplishment. It has placed transatlantic radio-telegraphy on a competitive basis with cable telegraphy because of its greater speed and smaller expense. Furthermore, the great barrier in the way of practical radio-telephony has been removed and transatlantic radio-telephony brought much nearer. When this is effected it will revolutionize international relations in the same way as the telephone has revolutionized business relations in this country. Another feature of Mr. Weagant's investigation is that he has discovered a new law of nature that static waves producing "grinders" are vertically propagated.

The value of amplifiers in radio work was also emphatically brought out, their use and the manipulation of phase differences being two distinct steps in recent radio development.

LAUNCHES CAMPAIGN TO "ELECTRIFY YOUR HOME"

Meeting Called by Society of Electrical Development in New York This Week Decides to Make Effort for April 1 to May 15 Demand

At a meeting called by the Society of Electrical Development in New York on Wednesday of this week it was decided to launch an "Electrify your home" campaign. The slogan will be "Electrify your home for convenience, comfort, efficiency and economy." From Apirl 1 to May 15 is the date. Circulars, posters, etc., to those specially interested will be sent out by the society.

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Census Bureau Report of Electric Light and Power Stations—1917

Preliminary figures, published herewith, of the forthcoming quinquennial report on the central electric light and power stations of several states have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics cover both commercial and municipal plants. They do not cover electrical plants operated by factories, hotels, etc., which generate for their own consumption, those operated by the federal government and state institutions, and those that were idle or in course of construction.

	New York			California			Kansas		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	332	321	3.4	98	112	—12.5	302	176	58.6
Commercial	277	272	1.8	79	97	....	116	94	.....
Municipal	55	49	....	19	15	....	186	82	.....
Income	$84,716,578	$57,218,973	48.1	†$40,277,613	†$27,685,573	45.5	‡$6,954,518	‡$3,020,154	130.3
Electric service	$79,831,241	$53,189,000	50.1	$38,768,970	$26,461,154	46.5	$6,733,688	$2,909,012	131.5
All other	$4,885,337	$4,029,973	21.2	$1,508,643	$1,224,419	23.2	$220,830	$111,142	98.7
Total expenses, including salaries and wages	$67,251,033	$44,297,869	51.8	$32,705,192	$22,803,526	43.4	$6,014,633	$2,626,270	129.0
Number of persons employed	16,251	13,733	18.3	6,167	5,738	7.5	1,775	1,109	60.1
Salaries and wages	$15,315,788	$11,034,898	38.8	$7,132,056	$5,823,203	22.5	$1,409,778	$787,189	79.1
Total horsepower	1,753,191	1,157,809	51.4	1,181,394	848,248	39.3	207,854	98,328	111.4
Steam engines:									
Number	488	553	-11.8	122	169	-27.8	209	192	8.9
Horsepower	1,052,345	638,932	64.7	450,180	414,206	8.7	167,885	82,372	103.8
Internal-combustion engines:									
Number	70	66	....	11	11	....	275	103	167.0
Horsepower	5,948	6,471	—8.1	2,237	1,980	13.0	21,965	7,136	207.8
Waterwheels:									
Number	42	405	4.0	224	205	9.3	34	26	
Horsepower	694,898	512,406	35.6	728,977	432,062	68.7	18,004	8,820	104.1
Kilowatt capacity of dynamos	1,211,904	772,030	57.0	816,974	588,281	38.9	143,274	69,205	107.0
Output of stations, kilowatt-hours	3,828,592,184	2,175,048,634	76.0	2,746,567,337	1,747,459,041	57.2	269,983,648	133,252,988	102.6
Stationary motors served:									
Number	62,181	82,525	—24.7	21,480	29,059	—26.1	7,253	5,021	44.4
Horsepower	1,193,264	795,256	50.0	1,410,271	603,742	133.6	121,259	33,277	264.4
Number of street lamps:									
Arc	20,373	47,391	—57.0	13,738	19,341	—29.0	2,666	3,933	—32.2
Incandescent, etc	156,940	62,706	150.3	108,781	75,802	43.5	35,170	14,573	141.3

* A minus sign (—) denotes decrease. Per cent not computed where base is less than 100.
† Exclusive of $107,617 in 1917 and $75,817 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $518,326 in 1917 and $283,522 in 1912, reported by street and electric railway companies as income from sale of electric energy.

SUPPLY JOBBERS OF THE ATLANTIC DIVISION MEET

Generally Stated that Business in First Two Months of 1919 Surpassed Same Period in 1918—Excess Supplies of Government Electrical Goods

A well-attended meeting of the Atlantic division of the Electrical Supply Jobbers' Association was held on Tuesday at the Hotel Commodore, New York City. Reports of the publicity, war service, lamp and appliance committees were read and the several geographical sections of the division made reports on the local business conditions. It was generally stated that business for the first two months of the current year surpassed that for the similar period of 1918. The new taxes on automobile supplies, portable electric fans and portable electric lamps were discussed, but no decision relative to a method of payment was reached.

At the morning session Ainslie A. Gray, the advertising counselor for the association, outlined the plans for conducting the association's jobber publicity campaign. W. E. Robertson of Buffalo, in telling of post-war activities of the jobbers' war service committee, stated that the committee will send to all certificated jobbers for signature a form giving to the committee power of attorney to purchase surplus government electrical goods, the price to be at the committee's discretion.

These goods will then be distributed among those houses for which the power of attorney was received. In this way the jobbers expect to prevent the demoralization of the market which might follow should the goods find an outlet through the usual channels of the electrical trade.

W. T. Bickford of the Iron City Electric Company, Pittsburgh, Pa., was elected chairman of the Atlantic division for the ensuing year.

PROBLEM OF EFFICIENT OPERATION IS NOW FIRST

Time for Output at Any Cost Has Passed, Say Members of Station Operating Committee of Ohio Electric Light Association

The time for output at any cost has passed, and the problems of efficient operation must now be given first consideration, according to the members of the station-operating committee of the Ohio Electric Light Association, which met at Youngstown, Ohio, on Wednesday of this week. Prof. Henry B. Dates of the Case School of Applied Science, chairman of the committee, presided, and Walter N. Polakov, consulting engineer of New York, made the principal address to about sixty engineers on the subject of cheaper power as a reconstruction problem.

In the course of his remarks Mr. Polakov said that inefficient operation is tolerated in many power plants to-day because economy and efficiency are expected from the perfection of equipment without the proper consideration being given to the manner in which it is used. Engineers owe it to their country to use its power-producing equipment in such a way that the greatest amount of power will be generated at the lowest possible cost. It will require a scientific study of processes and an analysis of all losses to accomplish this, and the results cannot be kept up to the desired standard without an efficient organization.

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The audience was advised to pay special attention to boiler rooms because the greater economies can usually be made there. Instruments were advocated in boiler rooms, in order to guide the men in adjusting the condition of combustion to the requirements of the load. Some incentive, preferably a bonus, was advocated for firemen and also for as many other employees as can be given definite tasks. Seventy per cent boiler efficiency was suggested as the point in many plants where the firemen's bonus may be started with advantage. Twelve-hour watches were condemned from the standpoint of efficiency.

The speaker read letters from plant operators who testified that the change from twelve-hour to eight-hour shifts saved them enough in coal more than to offset the additional 50 per cent in wages. The eight-hour shift was also said to have attracted a better class of men and to have made better service possible.

The discussion which followed showed a general agreement on the part of those present with the salient points brought out by the speaker. Among those who contributed to the discussion were R. T. Sullivan, O. H. Hutchins, E. H. Biel, J. Dolan, H. W. Bromley, W. Long, J. B. Lindsay, A. Schellman and A Kirby.

A two-phase electric furnace which melts brass with but one-third the spelter loss of present fuel-fired furnaces was described by Edgar F. Collins, industrial heating engineer for the General Electric Company, Schenectady, in a paper entitled "Melting Some Nonferrous Metals in an Electric Furnace." The paper was read at Cleveland on March 11, before about 200 members and guests of the Cleveland Engineering Society.

CENTRAL DIVISION JOBBERS ON GOVERNMENT SUPPLIES

Federal Government Method of Dealing with Existing Installations or Warehouse Stocks Arouses Comment at Meeting in Chicago

Meeting in Chicago on Wednesday of this week, the central division of the Electrical Supply Jobbers' Association discussed the government's method of dealing with electrical supplies on hand either in the form of existing installations or in the form of stocks in warehouses.

Franklin Overbagh, general secretary of the Electrical Supply Jobbers' Association, stated that he had a letter from the government authorities to the effect that no materials owned by the government would be disposed of in such a manner as to disrupt market conditions. This statement promptly brought forth reports concerning several specific sales of government materials in a manner which decidedly disrupted market conditions.

Other topics which were discussed at the meeting included the future plans for collecting more statistics on the jobbing business and the publicity campaign of the Electrical Supply Jobbers' Association.

Mr. Van Winkle of the publicity committee reported progress and called for criticisms of the advertising. There was practically no adverse comment from the jobbers on the campaign, but all seemed to realize the necessity of tying in their own sales and the executive efforts with the campaign in order that each individual jobber might get the maximum advantage from the $12,000 expenditure which the association has authorized for 1919. It was suggested that, while copy for the advertising is to be prepared by A. A. Gray of Chicago, the committee would welcome suggestions from the members as to probable copy appeals that would be likely to interest the readers of trade papers in which the jobbers' advertisements are being run. One idea which the committee will probably adopt in order to assure more widespread attention to the campaign is that of calling attention to the campaign on the letterheads of each of the individual association members. Mr. Gray spoke briefly about the scope of the plan.

The salaries and expenses of salesmen for country, city and store work and also of clerical workers were discussed, and statistics were shown from sixteen jobbing houses. The averages taken from these statistics indicated that the lower-priced help received greater percentages of increases than others. Statistics on volume of business done by the sixteen jobbers showed a decrease of approximately 3 per cent for 1918 over 1917. The operating expenses increased more than 7 per cent in the same period.

The discussion of the general business situation indicated that jobbers are having no difficulty in securing stocks and that good business for 1919 is expected. Especially in the agricultural districts is the outlook bright. In the last half of the year building of a general character is expected to be brisk. Many small line extensions are to be built. These facts, together with the knowledge that money is plentiful, are making the jobbers optimistic.

There was some discussion as to the advisability of figuring income tax, which last year amounted to about 2 per cent of the gross business of jobbers, as an item entering under the expense of doing business.

As the result of a communication from W. R. Herstein of Memphis, the general secretary was instructed to take up with the National Board of Fire Underwriters the possibility of substituting No. 12 wire as the approved size instead of No. 14 wire in residential work on account of the very marked tendency on the part of residential electric service users to overload circuits with socket devices.

W. R. Herstein of Memphis was elected chairman for the central division.

WAGE AGREEMENT AT LYNN GENERAL ELECTRIC WORKS

Work of the Joint Committee and Conference Board Ends Long-Standing Controversy— Back Pay for Employees

The joint committee and conference board which has been sitting for several weeks upon the questions of wages and working conditions at the Lynn (Mass.) Works of the General Electric Company reached an agreement March 6, ending a controversy between the company and its employees which began July 17, 1918. The employees will receive back pay to the amount of about $[illegible]00,000, the agreements having been made in accordance with an award of the War Labor Board issued Oct. 24, 1918. The conference board, officially designated as the general joint committee on adjustment, consists of four representatives of the employees and four representatives of the management. Harland A. Perkins, examiner of the War Labor Board, who has been at Lynn for several weeks, sat with the conference board.

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NEW PLAN OF PROCEDURE FOR N. F. P. A. ELECTRICAL COMMITTEE

Adoption of Method for Discussions of Code Rules and the Preparation of Future Editions of the Code — Details of the Plan

The electrical committee of the National Fire Protection Association, which has charge of the National Electrical Code, at a meeting held in New York on March 4 and 5, adopted a new procedure for discussions of code rules and for the preparation of future editions of the code.

The purposes aimed at are to provide an established methods of dealing with proposed changes, secure their early and deliberate consideration by all who are concerned with code affairs and encourage and provide for a more orderly participation than heretofore in investigations and recommendations for changes in the rules by the various associations having representatives on the committee and all others in any way interested.

The plan in general includes the division of the electrical committee into standing committees having charge of groups of subjects and the general supervision of the work of technical sub-committees which will report to them. Each standing committee is charged with the duty of advising all associations, companies or individuals especially interested in the topics supervised by the committee of items under consideration and inviting comments, criticism and assistance.

The bulletin issued by the electrical committee just before each of its biennial meetings for revising the code will consist chiefly, if not wholly, of the reports and recommendations of these standing committees. It is hoped and intended that such reports shall be so fully discussed before the bulletin is issued that they will have been well understood and their recommendations have been quite generally indorsed by all those who are most concerned with them and who are best qualified to judge of them.

It is evident that the success of this method will depend not only on the work of the standing committees but quite as much upon the coöperation of other organizations and individuals. This coöperation the electrical committee earnestly desires and solicits.

Before final action is taken by the electrical committee on a new edition of the code a public hearing is to be held for the discussion of standing committee reports and such other matters as an advisory committee may recommend for consideration. The final action on the code will be taken after the public hearing and with due regard to evidence and opinions developed by it.

The standing committees are to be assigned charge of the following ten general groups of subjects:

Grounding rules.
Industrial applications.
Cars and railways.
Devices and materials.
Outside wiring, building supplies and services.
Wiring standards and systems.
Generating stations and substations.
Theaters, moving-picture establishments, garages and other special buildings.
Lamps, fixtures, heaters and signs.
Signal systems.

The personnel of these committees will be announced shortly.

All suggestions for changes in the next edition of the code (that of 1920) should be sent as soon as possible to Dana Pierce, chairman of electrical committee, N. F. P. A., 25 City Hall Place, New York.

The formal statement of the new procedure as adopted by the committee is as follows:

Committees.—Except as expressly directed by the electrical committee as a whole, the work of investigation and reports on technical and engineering subjects affecting the National Electrical Code shall be conducted by and through two classes of committees, to be known as standing committees and technical sub-committees.

The appointment of such committees is not intended by the electrical committee to establish any hard and fast limitations of responsibility or of authority or to restrict in any manner the interest or activity either of any member of the committee itself or of any coöperating association or individual, and it is expected and intended that the work of committees will, as heretofore, be assisted and supplemented by others through general and deliberate discussion of all changes and revisions of the National Electrical Code.

Standing Committees.—(1) Standing committees shall be appointed to receive suggestions, initiate action and organize investigations. They shall invite opinions and statements of experience from associations, bureaus, organizations and individuals interested in subjects under consideration by the electrical committee for the betterment of the National Electrical Code.

(2) Standing committees shall be composed of members of the electrical committee and shall be appointed by the chairman.

(3) The duties of a standing committee shall be:

(a) To act as advisers to the electrical committee and its technical sub-committees on the most suitable and appropriate methods of relating the work of the electrical committee to that of associations, bureaus and other organizations, both those represented on the electrical committee and also others interested in or affected by the committee's work.

(b) To advise the chairman of the electrical committee of topics which should receive consideration.

(c) To receive from technical sub-committees reports as prepared from time to time, referring these to other associations as may be desirable for concurrence, criticism or suggested changes in advance of final recommendation to the electrical committee.

(d) To render to the electrical committee reports on all matters referred to it. Such reports may contain recommendations for or against changes in the National Electrical Code and shall indicate which portions of the report should properly be included in the bulletin. All reports to be acted on at the regular biennial meetings of the electrical committee shall be filed by the standing committees with the secretary on or before the first of December preceding such biennial meeting, except that by vote of the advisory committee reports filed at a later date may be presented at the public hearing and subsequently acted upon by the electrical committee.

Technical Sub-Committees.—Technical sub-committees shall be appointed by the chairman of the electrical committee either as judged necessary by him or by direction of the electrical committee or upon the recommendation of a standing committee.

Technical sub-committees shall be composed either of members of the electrical committee or of other persons, or both.

The chairmen of technical sub-committees shall be designated by the chairman of the electrical committee.

Topic or topics to be dealt with by each technical sub-committee shall in general be designated by the chairman of the electrical committee, but other related topics or phases may be acted upon and reported.

Upon the appointment of each technical sub-committee, its chairman shall be advised with which standing committee he shall confer and to which he shall report. He shall as promptly as possible advise both the members of his sub-committee and of the designated standing committee of the nature and scope of the subjects to be acted upon and invite their active coöperation.

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Advisory Committee.—There shall be an advisory committee consisting of the chairman and secretary of the electrical committee and the chairmen of the standing committees.

The advisory committee shall hold a meeting shortly before the public hearing, at which it shall determine which committee reports and other recommendations and suggestions received too late for publication shall be presented for consideration at the public hearing and for subsequent action by the electrical committee.

Procedure for Public Hearings.—The meetings of the electrical committee for revision of the National Electrical Code will ordinarily be held between the first and the fifteenth of March every other year.

Prior to a meeting of the electrical committee at which final action is to be taken on the next edition of the National Electrical Code a public hearing shall be held.

In advance of a public hearing the secretary shall prepare and issue a bulletin of the subjects to be considered. This bulletin shall contain reports and recommendations from the standing committees and from the electrical committee as a whole.

Reports, recommendations or suggestions received from standing committees or from other sources too late for inclusion in the bulletin may be considered at the public hearing upon the recommendation of the advisory committee.

Votes taken at a public hearing shall be recorded as expressing the sense of the meeting.

After the public hearing the electrical committee will consider and act on all reports, recommendations and suggestions for the next revision of the code.

SAYS HIGH PRICES HAMPER GROWTH OF EXPORT TRADE

President Herr of Westinghouse Electric & Manufacturing Company Advocates Vigorous Effort to Lower Electrical Machinery Prices to Foreign Level

In outlining the steps which American manufacturers must take to hold their foreign trade, E. M. Herr, president of the Westinghouse Electric & Manufacturing Company and a director in the American Manufacturers' Export Association, declares that reductions in high wages accompanied by a reduction of prices are essential.

"The development of export business in electrical machinery, under the present condition of export markets," said Mr. Herr, "would be very rapid and of unusual extent were it not for the high prices which must now be charged for this product. There are some countries which, owing to the ravages of war and the necessity of first remedying the most serious destructive effects of this strife, cannot immediately take up the development of peaceful pursuits. It is in this that electrical machinery finds its legitimate field.

"The most vigorous effort should be made by those engaged in the manufacture of electrical machinery to bring prices to a point approximating those obtained for this material in foreign countries, as with the domestic market slowing down, owing to the transition from war to peace conditions, the present time is particularly advantageous for the development of the export field. It is encouraging to note important decreases in the cost of a few of our raw materials, and if some yielding of the very high labor costs can also be obtained, we should very soon find an expansion of the export demand for electrical machinery that would more than compensate labor for any sacrifices in hourly rates by the longer hours and more continuous employment which would result.

"In the industrial countries of the world the enormous increase in demand for manufactured products caused by the war has shown the great need for and advantage in the use of electrical machinery, making these countries particularly keen to avail themselves of the economies and advantages of electrical power. This is especially true in countries where fuel is scarce and expensive and where water power is available. Plans are already well matured for the development of larger central electrical power stations in some of the most important industrial countries, and extensive projects for the electrification of some of their railroads are well under way. The smaller and less economical steam plants will in this way be displaced by larger and more economical ones and the demand for transmission and energy-consuming devices be greatly enlarged.

"The largest electrical manufacturing companies abroad are in Germany, and it will be some time before they can operate advantageously. This will give the American companies an unusual opportunity, if promptly seized, of bringing our exports of electrical machinery to an amount and value which is not possible under normal conditions.

"If this situation is found in the industrial countries of the world, what is the prospect for export business in the class of product under discussion in the non-industrial countries? These countries not having been at war, the advantage of electrical machinery and the development of electrical power is not so insistent, so that the market for these products will develop more slowly.

"Countries such as South America, South Africa, Australia, India and China have been dependent upon Europe for their supply of capital and the financial arrangements, credits for loans, etc., were made in London, Paris or Berlin. America is now the great creditor nation, and unless we arrange to invest our capital in these countries and in the industrial countries also but to a lesser degree, we cannot command our fair share of their export trade even though our prices are competitive.

"Before the war we did a comparatively small part of the business of furnishing foreign countries electrical machinery, but we will not keep even this small part of the business long—though we should succeed in securing a great many orders while Europe is prostrated—unless we invest our money there, arrange ample credit facilities and send our well-trained young men to those lands, not to make a business trip or excursion, however complete or extended, but to settle down and make their homes in such countries, learning the needs and tastes of these people, not by casual observation but by intimate, friendly and long-continued personal and sympathetic contact.

"We should never forget in any industrial business that we are selling service as well as product and that, however good the quality of one's product, if the material does not come when needed, is not packed properly or in any other way our service to the customer is unsatisfactory, the transaction fails to tend to tie him to the producer and permits a competitor to obtain a foothold not otherwise possible."

In order to bring about better coördination of the various government agencies directly or indirectly concerned with foreign trade matters, the American Manufacturers' Export Association has expressed itself as in favor of a closer and more definite union of these agencies under some control board or commission.

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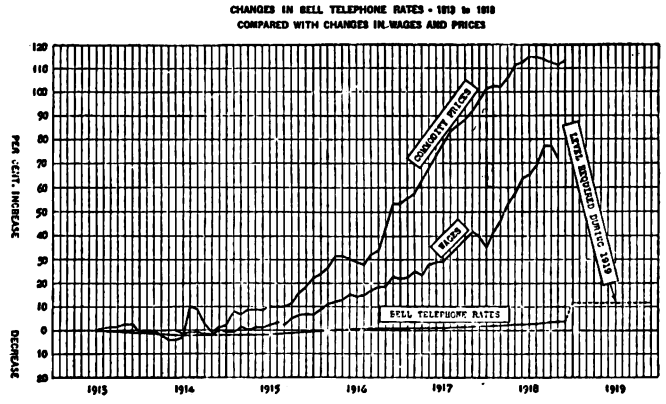
POSITION OF THE TELEPHONE DURING AND AFTER THE WAR

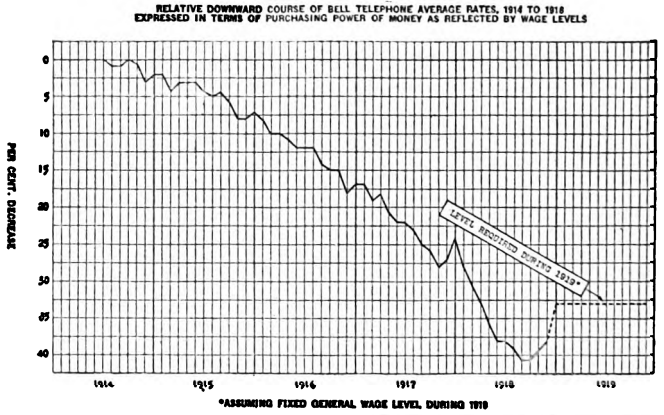
President Vail of American Telephone & Telegraph Company Reports on Operations of Bell System and the Present Outlook

In reporting to stockholders of the American Telephone & Telegraph Company for 1918, President Theodore N. Vail devotes most of his usual interesting discussion to matters connected with the war and to questions arising from the new relations involved in government operation of the properties.

Except for 1906 and 1912 the net amount of plant additions in 1918, $77,922,600, was the largest since 1900. It was distributed as follows: Real estate, $10,066,038; equipment, $30,558,721; exchange lines, $21,713,369; toll lines, $19,894,646. There was a decrease in construction work in progress, etc., of $4,310,143, leaving a total increase of $77,922,631.

Mr. Vail speaks of the difficulty of maintaining standards, of meeting the increasing demands of service and of maintaining a full complement of employees. "Altogether, exclusive of employees of the Western Electric Company, Inc., about 14,000 of our employees entered service." He adds: "Of our highly educated scientific staff in our highly technical departments, over 15 per cent were taken into special service, while of our highly skilled expert staff, trained and educated in the art, over 20 per cent were taken into special or active service. The great increase in the openings for women in all kinds of work, although from its very nature temporary, together with greatly increased compensation far above that which the telephone revenue would warrant, attracted many of our operators and made serious inroads on our operating force."





In speaking of the natural disturbance in the change to government control, accompanied as it was by rumors from irresponsible people, Mr. Vail says: "This cause of disturbance and uncertainty should be completely quieted by the continuance of existing operating organizations under the operating board of the Postmaster General, and also by the full realization that all who are capable, efficient and interested in the work are now needed even more than in the past for the proper carrying on of a service that must be continued at the highest possible standard of usefulness and efficiency."

Referring to government control Mr. Vail says that this "is in no sense permanent nor can it be likened to a sale and purchase. It is very temporary in its nature, for the property is to be returned after a limited period. The necessity of ample time to prepare for common supervision of operations was recognized and cared for in the order of the President, which continued temporarily the operation in the hands of the existing organizations.

"It seemed as if there was above the respective interests of either the government or the Bell system a common 'super-interest,' an obligation and responsibility resting upon both, in the preservation of a high standard of the plant, equipment and organization necessary to the maintenance of the service to be rendered to the public. The Post Office Department could not but be vitally interested in maintaining the service up to the past standards or better, and to do that the plant, equipment and operating organization must be maintained. The Bell system was interested, if the plant and organization were to be returned at the end of the period of control, in having them returned in at least as good condition as when taken over. If the system was to be retained permanently, through subsequent legislation, the Bell system wanted no depreciated plant upon which the valuation would be based."

Much attention to the matter of increased rates is given, and this statement is made in the report: "The increases in the telephone charges have been about 4 per cent, and the increases which have been asked for and which are necessary to preserve the equilibrium of revenue and expenses would amount to less than 13 per cent, which compared to increases in all other commodities is almost negligible."

Concluding his presentation of conditions, Mr. Vail discusses combination and regulation. His observations follow in part:

It will be extremely unfortunate if with a very pronounced public sentiment in favor of it a wire system with nation-wide, universal, comprehensive service and complete utilization of all the facilities cannot be evolved from the existing conditions.

The era of small capital and great expectations in utilities of necessity is passed. The era of large possibilities and large investment capital is here. The incentive of large accomplishment must now control and this requires large capital. The only incentive to capital in large amounts is certainty and security, and certainty and security can only come through responsible control and regulation recognizing economic rules or laws deduced from experience, judicial in its conclusions, equitable in its findings, prompt in its action, and, above all, the controlling and regulating bodies to be of such standing and such authority, either moral, legal or personal, as will give effect to or command respect for their decisions.

Control and regulation should be divorced as far as possible from partisan or class influence, and the influence of misinformed or interested public prejudice. It is impossible for any body to be judicial or equitable if its decisions are subject to hostile criticism and public condemnation without any other reason than prejudice based on misinformation or ignorance.

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PLAN FOR ORGANIZATION OF AMERICAN WELDING SOCIETY

First Meeting to Be Held in New York on March 28—Relation to Existing Organizations and the American Engineering Standards Committee

During his presidential address at the midwinter convention of the American Institute of Electrical Engineers in New York on Feb. 19 to 21 Prof. Comfort A. Adams spoke of a plan to form a welding society. Details of this plan have just been made public by the American Welding Society (temporary association) through H. C. Forbes, secretary, Engineering Societies Building, New York.

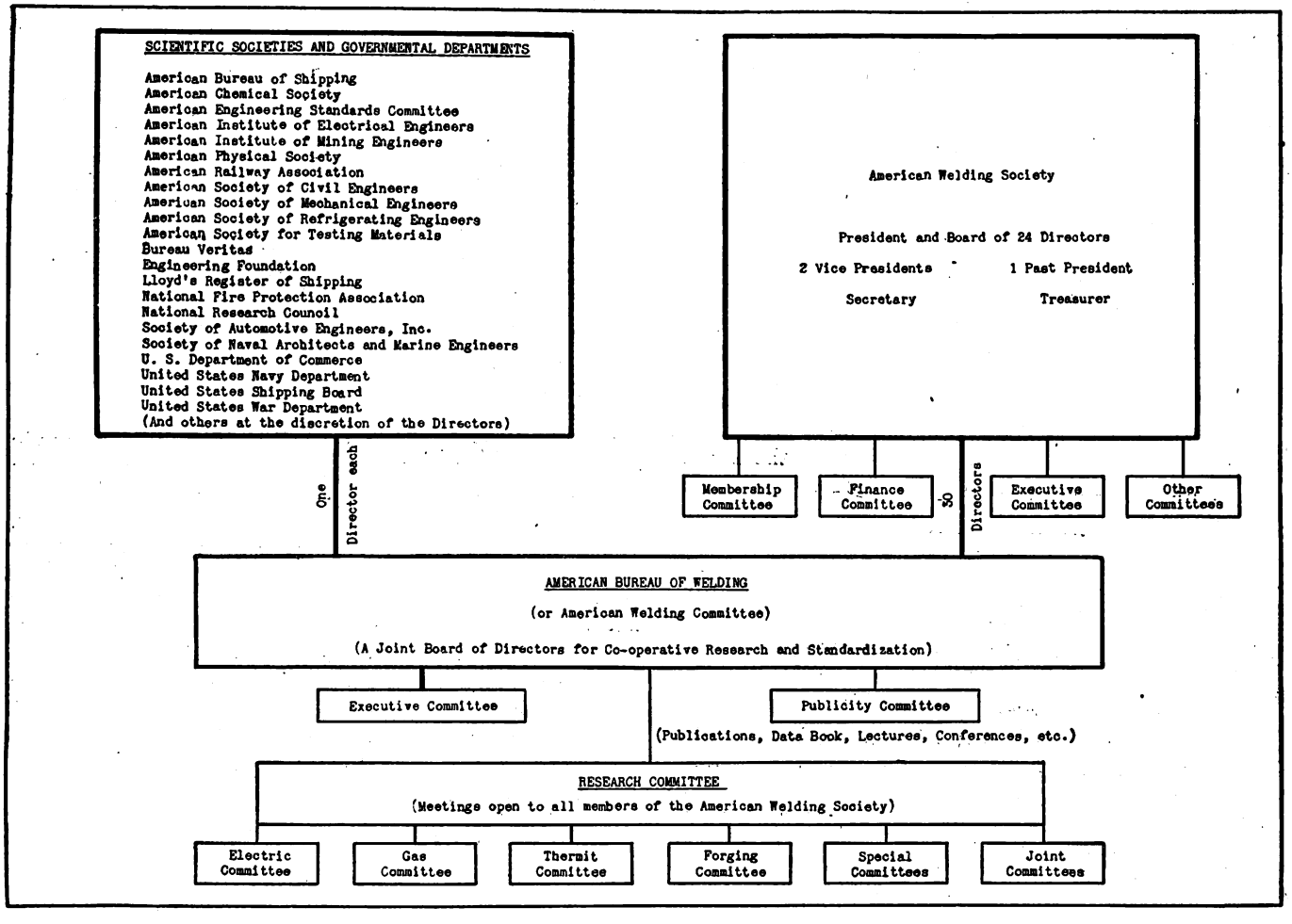
This society will merge the welding committee of the Emergency Fleet Corporation and the National Welding Council and will include others who may be interested. It is the purpose of the society to become a disinterested and dependable source of information on welding, not only for the benefit of the manufacturers of welding apparatus and supplies but also to aid those who use welding in their production and those who purchase welded goods.

The society will give greater stability to welding by standardizing welding processes and thus make its economies available in a wider field of industry. The first meeting will be held on Friday, March 28, at the Engineering Societies Building, New York, at 10:30 a.m.

Shortly after the United States entered the war the Council of National Defense appointed an engineering committee which undertook as one of its chief tasks a study of the possibilities of electric welding in shipbuilding. This committee was taken over by the Emergency Fleet Corporation and, as the welding committee, later broadened its scope to include gas and thermit welding. When the armistice was signed its investigations were still in progress.

The welding committee, by its discussions, researches, lectures and conferences, its interchange with foreign countries and its dissemination of information, gave a great impetus to use of electric welding in this country. Concurrently with this work, another move to advance welding, with the emphasis on gas welding, was started by the formation of the National Welding Council, which accomplished important results.

The American Welding Society will bring together, in the manner usual for scientific societies, persons from all branches of the industry who may be interested in any of the welding processes—forge welding, electric resistance welding including spot welding, electric arc welding, gas welding, thermit welding, etc. In addition to this, it will have another function which alone would justify its existence. It will create and assist in maintaining a Bureau of Welding, which will be a separate organization designed to take full advantage of the principle of coöperation in research and standardization.



As part of its routine, the society will ascertain what specific investigation or assistance is needed in any branch of the industry. If this assistance involves research, a definite program will be arranged and presented to the portion of the industry affected, indicating the benefits to be derived therefrom. It is the intention to finance separately each research that is undertaken.

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TO DISCUSS THE STATUS OF INDUSTRIAL LIGHTING CODES

G. H. Stickney to Present Paper at Meeting Arranged by the Lighting and Illumination Committee of the A. I. E. E.

The lighting and illumination committee of the American Institute of Electrical Engineers will hold a meeting at the Engineering Societies Building, New York, at 8:15 o'clock on the evening of April 11. The meeting is to be devoted to a discussion of the "Present Status of Industrial Lighting Codes in the United States." G. H. Stickney, past-president of the Illuminating Engineering Society and a member of the committee on lighting legislation of that society, will present the paper of the evening. The program for the meeting is purposely limited to one paper so that there may be time for an expression of many different viewpoints.

ASSOCIATED MANUFACTURERS' ANNUAL MEETING IN NEW YORK

More Details of the Gathering on March 20—Gov. W. E. Edge of New Jersey, R. K. Sheppard and Major Paul Debevoise to Speak

As stated in previous issues of the ELECTRICAL WORLD, the fourth annual meeting and banquet of the Associated Manufacturers of Electrical Supplies will be held at Delmonico's, New York, on the afternoon and evening of Thursday, March 20. The business session will be at 2 p. m. In the absence of President A. W. Berresford in Europe, the vice-president, B. E. Salisbury, Pass & Seymour, Inc., will preside. Among the speakers at the banquet in the evening will be Walter E. Edge, Governor of New Jersey; Robert K. Sheppard, first president of the association, and Major Paul Debevoise.

A list of the section and committee meetings to be held from March 17 to 21 in connection with the annual meeting was published in last week's issue.

WESTERN ELECTRIC COMPANY SALES $145,200,000 IN 1918

Large Total Distributed Between $67,800,000 to Associated Bell Companies, $21,800,000 to War and Navy and $55,600,000 to Others

Sales of the Western Electric Company, Inc., for the year 1918 aggregated $145,200,000, of which $67,800,000 was to the associated Bell companies, $21,800,000 was to the United States War and Navy Departments and $55,600,000 was to other customers. These figures are given by President Theodore N. Vail of the American Telephone & Telegraph Company in his annual report.

Mr. Vail adds that, although with the exception of 1917 this was the largest year's business ever done by the company, the very high costs of labor and material during the year, the unusual taxes, the writing down of inventory at the end of the year because of decreasing values of materials then on hand and other necessary reserves will probably result in only a small balance after the payment of the regular dividends.

The unfilled orders at the end of the year aggregated about $26,200,000 after deducting those canceled or likely to be canceled by the government on account of the cessation of hostilities. This is a decrease of $2,500,000, as compared with unfilled orders at Dec. 31, 1917, and it now seems probable that the total sales in 1919 will be considerably less than in 1918.

ENGINEERS TO AID NEW YORK RECONSTRUCTION COMMISSION

Engineering Council Names Five Prominent Engineers from Different Branches to Advise and Confer with New State Body

The following five prominent engineers, representing the several branches of the profession, have been selected by the Engineering Council to advise and confer with the Reconstruction Commission of the State of New York: George W. Fuller, Dr. George F. Kuntz, H. de B. Parsons, Lewis B. Stillwell and Paul C. Brown.

This body will be known as the Advisory Engineering Committee and is at present interested in the following public works: The vehicular tunnel, water-power developments, port and harbor developments, garbage, sewerage and highway construction.

This commission was recently appointed by Governor Smith, with Abram I. Elkus as chairman. The office of the Advisory Engineering Committee is with the Reconstruction Commission at the Hall of Records, New York City. Address correspondence in care of Walter S. Dickson, engineer Secretary for Public Works.

ENGLISH INTERESTS SOLD BY THE WESTINGHOUSE COMPANY

Securities Taken by United States Company in Electric Holdings, Ltd., in 1917 Are Reported Sold to English Interests

English interests, according to an announcement made this week, have bought from the Westinghouse Electric & Manufacturing Company for approximately $7,000,000 the holdings of that company in Electric Holdings, Ltd. The last-named company was formed in London in May, 1917, taking over the British Westinghouse Electric & Manufacturing Company. At that time the parent Westinghouse company received $6,500,000 of ten-year 5 per cent prior lien bonds and about one-half of the common stock of Electric Holdings, Ltd. Gen. Guy E. Tripp, chairman of the Westinghouse company, and other officials are now abroad.

GOVERNORS AND MAYORS ON NATURAL RESOURCES

Washington Conference Urges States to Consider Means of Releasing Resources from Those Who Willfully Withhold Use

During the conference of national officials with state governors and mayors of cities in Washington last week a resolution was adopted recommending "to the states that they consider means of releasing natural resources from controllers who willfully withhold such natural resources out of use for speculative profits or for visionary future development, thus contributing to non-employment." This was adopted in place of a resolution urging speedy enactment of the water-power, oil, coal and phosphate legislation.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Jovian Electric League, Los Angeles.—Senator George W. Cartwright spoke on the labor situation at the Feb. 19 meeting of the league.

Louisiana Engineering Society.—At the March 10 meeting held by this society W. T. Hogg's paper on "Suggested Changes in the Operation of the Street Railway System of New Orleans" was discussed.

Southwestern Electrical and Gas Association.—The fifteenth annual convention of this association will be held at Galveston, Tex., May 12 to 14. Details of the program will be published in a later issue.

Connecticut State Electrical Contractors' Association.—At the annual meeting of this association held in New Haven, Conn., on Feb. 20, E. S. Francis of Hartford was chosen chairman and George M. Chapman of Waterbury was made secretary.

A. S. M. E., San Francisco Section.—F. A. Anderson, electrical inspector of the United States Shipping Board, spoke before the Feb. 13 meeting of this section of the American Society of Mechanical Engineers on "The Present Status of Electrical Arc Welding."

Electric Club of Chicago.—"The New Competition" was the subject of R. E. Paterson Cline at the March 6 meeting of the club. The board of managers has been authorized to obtain full details on the matter of permanent quarters for the Electric Club, and submit a plan to the membership.

Illuminating Engineering Society, New York Section.—Two papers are to be presented before the March 20 meeting, which is to be held in the Engineering Societies Building, New York City. The first will be "Some Experiments on the Eye with the Different Illuminants" (Part 2), by C. E. Ferre and G. Rand, and the second "Transmission of Colored Light Through Fog," by C. L. Utterback.

A. S. M. E., Worcester Section.—Eskil Berg, General Electric Company, Schenectady, N. Y., gave an illustrated talk on "The Recent Development of Propelling Machinery for War and Merchant Ships" at the section's meeting held on Feb. 19. In his talk Mr. Berg described the electrically propelled battleship New Mexico. Dr. A. E. Kennelly gave a lecture on "Some Features of Electrical Engineering in the War" before this section on March 6.

High Tension Club.—At a meeting of the High Tension Club of Keokuk, Iowa, which took place on Feb. 18, C. W. Kellogg, manager of the Stone & Webster properties in the Middle West, read an interesting paper called "The Critical Period of the War," it being an analysis of the economic problems of the present, dealing with the relations of capital, labor and Bolshevism. J. L. S. Scadding and J. T. Wycoff, Mississippi River Power Company, are respectively president and secretary of the club.

Society of Industrial Engineers.—A national conference of the Society of Industrial Engineers on "Industrial Reconstruction Problems" will be held at Hotel McAlpin, New York City, from March 18 to 21. At a session on "The Influence of Engineering Education," of which Dean Herman Schneider, University of Cincinnati, will be chairman, papers will be presented by L. P. Alford, on "The Engineer's Place in Reconstruction"; by Norman A. Hill, on "The Need for the Engineer's Viewpoint in Industry"; by H. E. Miles, on "Training and Education of Workers," and by C. R. Dooley, on "Standards of Engineering Education." Leon I. Thomas will present a paper on "The Need for Labor-Saving Equipment" at the session on "Labor-Saving Equipment as a Factor in Maximum Production and Fatigue Elimination," which will have A. Russell Bond for its chairman. Other papers of importance on labor and kindred subjects will be read.

American Institute of Electrical Engineers

Denver Section.—G. N. Robinson of the General Electric Company spoke on "Electric Welding" on Feb. 15.

Philadelphia Section.—Dr. Joseph W. Richards spoke on "The Importance of the Electrochemical Industry" at the Feb. 10 meeting.

Schenectady Section.—Prof. F. W. Sexton will have for his subject "The Education of Crippled Soldiers" at the March 21 meeting of this section.

Fort Wayne Section.—C. I. Hall, Fort Wayne Works of the General Electric Company, is to speak on "Some Electric Developments Brought About by the War" on March 20.

Urbana Section.—"The Measurement of Small Alternating Currents by Means of an Acoustical Resonator" was the title of Dr. F. R. Watson's talk before the Feb. 26 meeting.

Minnesota Section.—"Electric Furnaces" was the subject discussed by L. H. Berry, metallurgist of the Western Crucible Steel Company, Minneapolis, at the Jan. 30 meeting held by this section.

New Year Book.—The 1919 year book of the American Institute of Electrical Engineers, containing the constitution of the society, lists of its members and other related information, is now being distributed.

Seattle Section.—At the Feb. 18 meeting papers were read by C. L. Coward and J. D. Ross on X-ray developments, by Dr. C. E. Magnusson on scientific research, and by G. R. Quinan on the work of the Bureau of Standards.

Annual Convention.—The thirty-fifth annual convention of the American Institute of Electrical Engineers will take place at the Lake Placid Club, Adirondacks, New York, in the week of June 23. Dates and details of the program for the convention are to be announced later.

Detroit-Ann Arbor Section.—Dr. Saul Dushman of the Research Laboratory, General Electric Company, is to speak on "Modern Applications of the Electron Theory" at the March 14 meeting. On Feb. 28 Prof. John C. Parker gave one of his round-table talks on "Alternating-Current Generators."

Indianapolis - Lafayette Section.—"French Warfare Ammunition" was the subject of Lieut. B. P. Lyons, Ordnance Inspection Department, and "Development in Signal Corps Apparatus During the War" that of Emerson Pugh, Electrical Engineering School, Purdue University, at the Feb. 11 meeting.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Daylight Service.—A decision of the Missouri Public Service Commission affecting the Iron County Electric Light & Power Company, Ironton, says regarding daylight service: "The only question at issue is whether the company shall be required to give daylight service. That there will be an additional expenses in the full operation of this plant as against its operation for a portion of the time only cannot be questioned. Whether there will be any loss in such operation cannot be estimated without an actual check of the sales during the day and night periods. From the record made in this case the commission is of the opinion that some daylight service should be given and is of the further opinion that the revenues to be secured therefrom will offset any additional expense therein incurred. It is the duty of the company to give its patrons a reasonable service. By written contract and by verbal promises the company has induced its patrons to invest in electrical facilities for the use of daylight current. It owes a duty to these patrons of furnishing this service, and it would appear that if the plant were placed in continuous operation from 12 o'clock noon until a reasonable time after daylight in the morning sufficient service would be rendered to the public. The period of inoperation in the morning hours would permit the company to have its boiler cleaned and do the necessary work upon machinery to have it available for operation during the other hours of the day."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Council Will Investigate Charges at Toledo.—A resolution has been introduced in the City Council at Toledo, Ohio, providing for an investigation of complaints against the Toledo Railways & Light Company of making excessive charges for service connections. It is also complained that power rates have been greatly increased. The resolution was referred to the railways committee.

Power-Plant Equipment Manufacturers Organize.—The International Power Economy Conference, formed in Chicago on Dec. 6, 1918, is beginning to perfect its working organization. A tentative list of committees has been drawn up and tentative appointments to these committees have been made. The general character of the work which will be done by the International Power Economy Conference is perhaps best shown by the names of the committees it will organize. These are committees to coöperate with the Fuel Administration and with the stoker association, and committees on foreign trade, combustion, solid fuel, washed and pulverized fuel, oil fuel, steam engines, steam turbines, oil engines, refractories, boiler feed water purification, steam superheating, cooling and condensing equipment, separator and trap economy, insulation and boiler covering, packing, valves, piping and pipe accessories, coal storage and handling, ash handling, steam and water meters, recording instruments, mechanical draft, and lubricants. Joseph Harrington is acting chairman of the conference.

Receivership of Fort Wayne & Northern Indiana Property.—Robert M. Feustel, receiver for the Fort Wayne & Northern Indiana Traction Company, has made the following statement: "For several years past the security holders of the Fort Wayne & Northern Indiana Traction Company have recognized that the earnings on the property were not sufficient to take care of operating expenses, taxes and the necessary fixed charges. For the last two years default has been made in the interest on more than 90 per cent of the bonded indebtedness of the company, and this interest money has been devoted to operation and betterments. During this period the security holders have been working on plans for a reorganization of the company, and the appointment of a receiver at this time is for the purpose of consummating some satisfactory reorganization plan. The company will continue in its efforts to improve service in both the railway and light and power departments, to the end that the public may obtain the best possible service under all conditions. The appointment of a receiver will not change the policy which has always been in effect on this property, of making sure that every one who has furnished materials for operation or maintenance is fully protected."

Electric Vehicle Charging Stations.—A chain of charging stations, extending in all directions from New York City, now makes it possible for electric vehicle owners to reach points a hundred or more miles away without fear of becoming stranded. A battery boost at Lakewood makes Atlantic City a fine one-day run; boosting stations in eastern Connecticut and central Massachusetts bring Boston within reach of the electric car; stations at New Brunswick and Trenton make the Philadelphia run easy, and south of Philadelphia there are charging stations all the way to Washington. Electric vehicle routes from New York to Philadelphia, to Atlantic City, to Easton, Pa., to Ellenville in the foothills of the Catskill Mountains, to Pittsfield, Mass., and to New Haven, Conn., are described in the 1919 automobile handbook just issued by the New York Electric Vehicle Association. Included is a complete list of charging stations in and near New York, with particulars as to capacity and rates. The booklet is designed to aid not only the electric vehicle tourist but the operator of electric commercial vehicles whose deliveries are in the suburbs. The book will be sent free to any one upon request to the association, Irving Place and Fifteenth Street.

Federal Trade Commission to Curb Misrepresentation in Sale of Stocks.—The Federal Trade Commission officially announces that it will take immediate steps to coöperate with the Treasury Department, the Capital Issues Committee and banking and commercial institutions throughout the country to curb the present widespread misrepresentation in the sale of stocks and securities, recognized as being at this time a particular menace to holders of Liberty bonds and war savings stamps. The commission will accord immediate consideration to complaints presented to it involving alleged fraudulent practices in the sale of securities in interstate commerce. The commission has designated Commissioner Huston Thompson to supervise the entire subject. The commission's action follows appeals made to it by representatives of the Treasury, Capital Issues Committee, Federal Reserve Board, Associated Advertising Clubs of the World and numbers of banking and commercial interests that the power given the commission under its organic act to prevent unfair methods of commerce in interstate commerce be at once employed to protect holders of government war securities from bogus "get-rich-quick" schemes under which promoters offer to accept Liberty bonds in exchange for stocks of doubtful value.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Confiscatory Rates.—Although Chapter 227 of the Laws of 1907, fixing maximum charge for illuminating gas in Albany, was not confiscatory when enacted, where, because of changing conditions, the rate fixed precluded a fair return to plaintiff gas company, there is "confiscation," and plaintiff has a remedy in the courts, its only right not being by petition to the Legislature, the Court of Appeals of New York hold (121 N.E. 772).

Separation of Tax-Exempt from Unexempt Property.—An electric light and power plant located on property exempt from taxation as being used for educational purposes may be taxed where, in addition to supplying the school, it is used to supply a neighboring town and its citizens with light if it and its value can be separated from the remainder of school property exclusively used for school purposes, the Supreme Court of Appeals of Virginia held (975 S. E. 805).

Property Status of Fixtures.—Electric lighting fixtures furnished and used for the purpose of equipping an office building and the labor performed in installing them are included in the term "permanent improvement of real property," as used in lien law, as it read in 1910, the Court of Appeals of New York holds (121 N.E. 763). Gas and electric fixtures, as ordinarily attached to a house or other building for use, are in actions between grantor and grantee, landlord and tenant, mortgagor and mortgagee, held to be personal property.

State and Municipal Rate Regulator.—The regulation of rates for services or a commodity furnished by a public utility is an exercise of police power, the Supreme Court of Ohio holds (121 N.E. 701). Section 3 of Article 18 of the Constitution of Ohio, as amended, confers upon the municipalities of this state authority to adopt and enforce within their limits such local police regulations as are not in conflict with general laws. An ordinance fixing the rate that may be charged for telephone services by a telephone company within the limits of a municipality is a local police regulation within the meaning of the term. The state statutes creating the Public Utilities Commission of Ohio and conferring authority upon it to regulate public utilities and to fix the rate that such utilities may charge for commodity furnished or service rendered to municipalities and citizens of this state are a valid and constitutional exercise of the police power by the General Assembly of Ohio.

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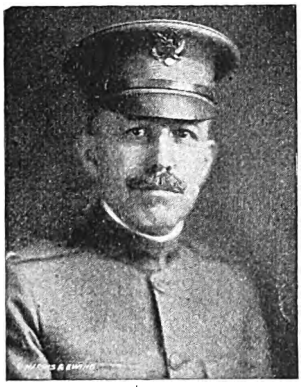
B. R. Laraway has resigned as manager of the Jackson (Mich.) district of the Consumers' Power Company to become vice-president of the Jackson City Bank.

Col. Peter Junkersfeld, who since the middle of 1917 has been an officer in the United States Army, returned on March 6 to his civilian work as assistant to the vice-president of the Commonwealth Edison Company, Chicago. Colonel Junkersfeld, who was twice promoted—major to lieutenant-colonel and then to colonel—had charge of the electrical construction of the cantonments. He joined the operating staff of the old Chicago Edison Company shortly after graduation in 1895 from the University of Illinois. His advance through the engineering department was rapid, and in 1906 he became electrical engineer for the company. Three years later he became assistant to the vice-president, in which capacity he has large responsibilities in connection with the company's engineering work. Besides being a fellow in the A. I. E. E. he has been very active in the work of the N. E. L. A., the A. S. M. E. and the Western Society of Engineers. During the war Colonel Junkersfeld was a frequent speaker before engineering bodies on the topic of cantonment construction.



PETER JUNKERSFELD

C. M. Brewer, manager of the Richmond division of the Western States Gas & Electric Company, has been appointed vice-president and general manager of the Mountain States Power Company, operating in Montana, Idaho, Washington and Oregon. Mr. Brewer became manager at Richmond for the Western States Company in the early part of 1913.

Secor Cunningham, Jr., has been appointed engineer of the newly created position of engineer of the transportation department of the Commonwealth Edison Company, Chicago. Mr. Cunningham, who was a captain in the Signal Corps of the United States Army during the war, was previously employed by the Commonwealth Edison Company as assistant to George B. Foster.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

E. A. Burrill has resigned as general manager of the Northwestern Ohio Railway & Power Company, Toledo, Ohio. Mr. Burrill was formerly vice-president and general manager of the Peoria (Ill.) Railway Terminal Company.

Henry A. Reed, president of the Bishop Gutta Percha Company, an old-time telegrapher and one of the early workers on insulated wire, celebrated his ninetieth birthday on Feb. 11. Mr. Reed has always taken an interest in electrical affairs and continues to keep well posted on the developments within the industry.

Lieut.-Col. Charles Hamilton Mitchell, well known for his work in Canadian hydroelectric developments, has been appointed dean of the faculty of applied science and engineering of the University of Toronto, the largest engineering educational institution in Canada. Colonel Mitchell was born in 1872 and at the age of twenty was graduated from the University of Toronto. A few years later he began to engage in water power development in Ontario. From 1901 to 1905 he was principal assistant engineer for the Ontario Power Company. During 1906 he traveled in Europe studying hydroelectric developments, and since that time has been in partnership in Toronto with his brother, P. H. Mitchell, in consulting engineering, largely along the lines of hydroelectric development. Mr. Mitchell was consulting engineer to the Ontario Power Company when it doubled its capacity to 100,000 hp., and later to the water-power branch of the Canadian Department of the Interior. He has written a number of books on hydroelectric development. During the war he served as a general staff officer and was mentioned in dispatches on six occasions, winning the Distinguished Service Order, Companion of the Order of St. Michael and St. George, Officer of the French Legion of Honor, Officer of the Order of Leopold, Croix de Guerre (Belgium), Companion of the Bath, Officer of the Crown of Italy and Italian War Cross.

Charles S. Banghart, formerly vice-president and general manager of the Binghamton (N. Y.) Railway Company, has been appointed general manager of the Augusta-Aiken Railway & Electric Corporation of Augusta, Ga., by the J. G. White Management Corporation, New York, the operating manager, succeeding W. C. Callaghan, resigned. After leaving Lehigh University Mr. Banghart was employed successively on the electrifications of the Allentown & Bethlehem Rapid Transit Company of Allentown, Pa., and the Union Railway Company of New York City. In 1894 he became superintendent of the Flushing (N. Y.) & College Point Lighting, Power & Railway Company, and from 1895 to 1903 he was associated with the Interstate Railway Company of Reading, Pa. He was employed by the New York & Queens County Railway Company, Long Island City, N. Y., from 1903 to 1914, serving six years as general superintendent. In 1914 Mr. Banghart took up his duties as vice-president and general manager of the Binghamton company.

Lewis B. Stillwell, consulting electrical engineer of New York City, has been elected president of the American Institute of Consulting Engineers. Mr. Stillwell was born at Scranton, Pa., in 1863. He attended Wesleyan University for two years and then Lehigh University, from which he was graduated in electrical engineering in 1885. In the fall of 1886 he entered the employ of the Westinghouse Electric & Manufacturing Company and was soon promoted to assistant electrician. He retained that position until 1892, working with O. B. Shallenberger in the laboratory for a considerable time, where he was also associated with Nicola Tesla and the late William Stanley. In 1889 he visited Europe in the interests of the Westinghouse company and again in 1890. Later he became electrical engineer for the Westinghouse company. He has been in consulting electrical engineering practice in New York City for a number of years. Mr. Stillwell was president of the American Institute of Electrical Engineers in 1909-10.

L. B. STILLWELL

Obituary

Earl Coit Eldredge, an expert designer of electrical measuring instruments, died at Springfield, Mass., Feb. 27. Mr. Eldredge was born at Canterbury, Conn., in 1868, and after finishing his education he acquired the jewelry trade. His skill in designing delicate mechanism was ultimately turned into the electrical field.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

BETTER FEELING IN THE MARKET FOR TRANSFORMERS

Reduction Expected Shortly in Price of Small Units, After Which Prices Are Expected to Remain Firm for the Remainder of Year

Although the demand for transformers is far below normal, a better tone is apparent in the market. Two or three weeks ago buying reached perhaps the lowest point since the armistice began. Price reductions of the order of 10 per cent on larger transformers were quoted about that time, and a logical reaction can be seen in the increased number of inquiries now coming in. Business is still dull in comparison with the outputs and sales of a few months ago, but the outlook cannot be called discouraging, to say the least.

As soon as central-station development becomes freer the transformer market will respond quickly to the stimulus. The high cost of financing extensions of plant in respect to both money rates and the abnormal cost of apparatus has held back the growth of systems normally to be counted upon. Some signs of improvement are now noted by the transformer manufacturers. Raw material and labor are plentiful; factory stocks are in excellent shape for exceedingly prompt delivery of sizes ordinarily specified for distribution work, and in the larger units, say from 200 kva. upward, deliveries can be made in about one-fourth the time required last summer on orders carrying anything less than very high priority ratings. Virtually any commercial requirement in large units can now be met in from sixty to ninety days.

The price situation is of much interest at this time. There will probably be a reduction of about 10 per cent in the price of the smaller sizes of transformers soon, possibly within a month or two. The opinion is advanced in reliable circles that following this reduction no further decline in prices is to be expected before the year is nearly over. The point is emphasized that electrical equipment of the transformer class was advanced only about 60 per cent in price during the war, compared with advances of from 100 to 300 per cent in many other manufactured products.

The price paid to labor appears likely to continue to be high; much material purchased at high prices is at hand to be worked up before lower cost material will be available, and with the exception of copper very little reduction has taken place in the cost of supplies entering into transformer construction. The high-grade steel and insulation needed show little or no tendency to weaken in cost. Consequently, in view of the strong probability that labor will be able to command very high wages compared with pre-war standards, and because of the continued high cost of most material and of the conservation of the electrical manufacturers in raising prices under the stress of war, the transformer buyer of 1919 will take no great chances if he places his orders almost immediately.

It is well to remember that transformer prices per kilowatt of capacity have long compared very favorably indeed with other equipment built to deliver energy efficiently in bulk. It is to be doubted whether transformer prices will go back to a point 30 or 40 per cent above pre-war levels in any future which can be apprehended now. Had it not been for the excellent progress toward standardization begun before the war and continuing to this day, prices would have been carried considerably higher than was actually the case. So far there have been few transformers released from war plants for the second-hand market, and the effect on prices has been negligible. There does not appear to be much ground for disquiet in this field, judging from experience in connection with second-hand motors of high quality which have been put upon the market after a tour of duty in war-plant operation.

RELATIVE POPULARITY OF INCANDESCENT LAMPS

Fifty-Watt Vacuum Lamp Gaining Fastest—The 100-Watt Size Has Proved to Be the Most Popular of the Gas-Filled Type

A prominent Eastern lamp manufacturer reports that sales of all tungsten lamps increased 22 per cent over the previous year's record in a recent analysis, there being a 52 per cent gain in the gas-filled type and an 18 per cent gain in the vacuum type. The 40-watt lamp still continues to be the most popular size, representing now 25 per cent of this maker's output, with the 25-watt size second and the 60-watt lamp third, the latter being one-seventh of the total. The 50-watt lamp is gaining fastest of all the vacuum lamps, and promises to become the standard central-station type, though it has been on the market less than three years. The 100-watt unit continues to be the most popular gas-filled unit, its sales being nearly 50 per cent in excess of the 100-watt vacuum type for the year. Sales of the 75-watt gas-filled lamp doubled in the year.

STREET-LIGHTING EQUIPMENT HAS BECOME MORE ACTIVE

Difficulty of Financing New Construction Has So Far Prevented Public Utilities from Going Ahead in This Direction

Just now the market for steet-lighting equipment seems to be coming to life again. A few new projects have definitely been decided on, and inquiries on others are coming in. An Eastern district office of one prominent producer reports that it is working on inquiries aggregating in the neighborhood of 3000 standards.

During the past two years there has been little demand except for such types as could be adapted to use in industrial yards, in cantonments and around other government property. The ornamental types of equipment had very little new development. The metals entering into the manufacture of the standards were difficult to secure, and the ban on new developments in glassware curtailed work in that direction.

There was much work done, however, along engineering lines in the laying out of systems for many communities, in the hope that the close of the war would bring into being extensions of lighting into new streets and changes from obsolete to up-to-date systems. But the trend of operating costs has placed such hardships on lighting companies that they have had difficulty in seeing their way clear to the financing of the extensions.

A plan that has been brought forward by a representative of a large manufacturer to assist lighting companies in their financing is that the city shall purchase the necessary equipment, allowing the lighting company to pay for

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it over a period of five years, either through straight payments periodically or through a change in rate. This would leave the equipment in the hands of the company at the end of the normal city contract period.

One big factor in the development and extension of street lighting has been vehicular traffic between neighboring cities. Originally street lighting was a police measure, but in recent years intercity traffic on the highways has brought the necessary lighting, and street lighting has brought and increased to a large extent this same traffic in its turn.

Furthermore, recent developments in transformers permits of the automatic control of series street-lighting circuits at any distance from the power house, thereby eliminating the expense attendant on constant current control for new extensions which may be needed far from the power house.

The field of application for the use of electrical energy which may be opened up through the medium of street lighting in outlying districts is, of course, very large.

METAL MARKET SITUATION

Copper Starts Upward for First Time in Four Months—Tone Better

Conservatism and caution still dominate the general trade situation but the larger volume of buying in both primary and secondary markets has been noted in the Northwestern and large Southern cities.

Copper for the first time in four months took a slight turn upward of one-quarter of a cent. It retreated, however, and stands at 14.87½ cents. It has been reported that some of the smaller companies have offered the metal at 14 cents a pound, and that even at such a low price they have been unable to uncover any sizable orders. However, the outlook is more encouraging than at any time since the signing of the armistice, and a better domestic demand is developing. The price of copper in the London market advanced £3 to £77.

The lack of any important foreign demand and a dark outlet for exports in the near future still have a depressing effect. Electrolytic is reported difficult to buy even at 15 cents for spot or April delivery.

Although the copper companies have ratified the agreement entered into with the government representatives concerning the disposal of the government's supply of copper, the federal authorities have not as yet ratified it.

Spelter and aluminum have dropped very slightly. Prices in the old metal market have become very stable. This can hardly be attributed to active demand.

NEW YORK METAL MARKET PRICES

	March 4	March 11
Copper:	£ s d	£ s d
London, standard spot	74 0 0	77 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	16.00	15.50
Electrolytic	14.87½	14.87½
Casting	14.75	14.75
Wire base	18.75 to 19.00	18.75 to 19.00
Lead, trust price	5.25	5.25
Antimony	7.00 to 7.12½	7.00 to 7.12½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.62½	6.50
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent.	31.50	30.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.75	12.75 to 13.25
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.25
Lead, heavy	4.75 to 4.87½	4.75 to 4.87½
Zinc, old scrap	4.50 to 4.75	4.50 to 4.75

THE WEEK
IN TRADE

MARKET conditions in general have continued quiet. On account of labor conditions in the Northwest building in that territory has not opened up, but in other sections of the country there has been a noticeable increase. Figures show large increases in letting contracts for building and engineering operations in February over January in the Middle Western States, but smaller increases in New York and northern New Jersey. In this latter section February increased nearly $5,000,000 over January, while in the Middle West it increased $82,000,000. Declines were reported in New England and Washington, Baltimore and Philadelphia, but in these cases new building developments were unusually large in January.

Prices of many materials are gradually decreasing, but sufficient confidence apparently has not been developed to cause much movement in the electrical market. Considerable activity in the appliance market as a whole shows the desire of the individual to buy rather than the investing interests.

NEW YORK

Labor conditions have not improved. There is still considerable tendency toward demands for higher wages, and in several trades labor has voluntarily left its work. The discharge of workers from factories in this state from November last to February has been reported by the State Industrial Commission as constituting a decrease of employees amounting to 7 per cent.

Some jobbers are reporting surplus stocks with very little movement. The shipbuilding industry has considerably decreased. Schedule material is in general very quiet, but one jobber reports that within three days 15,000 pull-chain sockets were sold within seven blocks of his store, and he predicts the sale of 50,000 more within a very short time.

The outlying districts are rather active, and pumps and farm-lighting sets have been reported as enjoying considerable sale. From the sale of these and household appliances it appears that domestic uses are providing considerable market, while the investing interests are practically inactive.

Collections have been reported by jobbers as satisfactory, and credits are good. Trade acceptances are assisting the credit conditions very well. There is a tendency to eliminate cash discounts.

MEDICAL APPARATUS.—A very good market has been reported for hair dryers, vibrators, heating pads and lamps for projecting rays for local heat applications.

VACUUM CLEANERS.—The market continues satisfactory. Deliveries are behind on one make, while on other makes local stocks seem to be ample.

WASHING MACHINES.—Generally speaking, local stocks are good, although in one line a shortage is reported. The demand is very good, and in one instance a dealer is selling from catalog against expected shipments.

ELECTRIC STOVES.—Apartment house restrictions against gas in kitchenettes in converted houses have made a favorable market in New York City for disk stoves where high rates would otherwise prevent their use. These have run into rather high numbers per house.

MOTORS.—Large orders have been reported from the garment trade for motors for both group and individual sewing-machine drive.

CONDUIT.—Reports have shown about a 5 per cent drop in price, there being a 2½ to 4 per cent change in brokerage in carload lots. Manufacturers are delivering on back orders placed on lower cards. In one instance a

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local jobber is receiving conduit on an order placed two years ago at the price current when the order was placed.

STAMPED STEEL BOXES.—Discounts are reported at 60 per cent, a decrease in net price of about 18 per cent.

TRANSFORMERS.—Distribution type up to about 25 kva. have opened up very well in the last two weeks.

LIGHTNING ARRESTERS.—One of the largest manufacturing concerns reports that recent orders have absorbed its entire output for the next three months.

STORAGE BATTERIES.—Edison storage batteries, types A, B and G cells, have dropped approximately 16 per cent effective March 1 for April 1 and later delivery. However, there is a 15 per cent cancellation charge. This reduction virtually wipes away all increases made during the war.

MILL-TYPE LAMP.—Factory facilities of one manufacturer have increased considerably, permitting virtually stock deliveries.

FANS.—The Emerson Electric Manufacturing Company has announced that prices on portable fans have been advanced to include the federal excise tax of 5 per cent.

RUBBER-COVERED WIRE.—The average base has dropped approximately 2 cents to 20.8 cents. One manufacturer quotes on 23 cents, three on 22 cents, five on 20 cents, one on 19 cents and two on cost.

BOSTON

Although business continues rather quiet, the underlying tone is better. Stocks are still rather large, with the exception of appliances. Deliveries are generally good, though some difficulty is reported in getting vacuum cleaners enough to meet the demand. Prices are holding firm in most lines, and the reductions in copper-wire base quotations this week are of the order of ¼ cent per pound, with the exception of rubber-covered, which is quoted at about a cent below last week's figure. Collections are rather slow at present. In banking circles there is a disposition to relax the interest rate on building loans about one-half of 1 per cent, which it is hoped will stimulate activity. Labor conditions show less unrest this week. A reduction of 15 per cent took effect March 1 on alkaline batteries. Although the central stations are pursuing an extremely conservative policy regarding extensions, they are branching into vigorous advertising here and there for adding socket appliances to their lines.

VACUUM CLEANERS.—The demand is brisk, and prices hold firm. Some types are considerably behind on deliveries, so that it is necessary to order further ahead than usual in meeting the requirements of the market.

STORAGE BATTERIES.—Inquiries for road-truck batteries are coming in well, but the industrial truck battery demand is at present below normal. Stocks are in good shape. Following a cut in prices of 16 per cent March 1 in alkaline batteries, business has taken a decided spurt. The above reduction offsets the last advance.

FIRE-ALARM SIGNAL APPARATUS.—The municipal business hoped for has not materialized, despite the fact that the price increases in this class of equipment total only 25 per cent compared with pre-war figures. The factories are handling a fair amount of maintenance and replacement business, with occasional new box orders, but system orders are few and far between. There is a good demand at present among high-class industrial concerns for private fire-alarm equipment. By and large, the city and town business probably does not exceed 50 per cent of that enjoyed in 1917.

ELECTRIC HEATING APPARATUS, DOMESTIC.—Business is brisk and the principal difficulty seems to be to obtain raw material in sufficient amount to yield the production demanded by the current orders.

SUBWAY BOXES.—An improved demand is noted.

WIRE.—Lower prices are stimulating demand somewhat. This week bare copper is quoted at 17.75 cents base, weatherproof at 20.75 cents and rubber-covered at 21 cents.

ELECTRIC COAL-LOADING EQUIPMENT.—Stocks are favorably conditioned for immediate delivery in standard machines. Sales are rather sluggish for the moment.

MOTORS.—Prices continue steady. Eleven leading distributers said Monday that no general reductions have been made in quotations, that stocks are in good condition in smaller sizes of motors, and that deliveries are improving in larger units. The local demand is nothing to boast of at present, though it is said that in the country as a whole the first eight weeks of 1919 showed almost as much total motor business as the corresponding period of last year. One Boston distributer actually increased his motor sales a little in this period. Some anxiety is beginning to be felt about the release of motors from war plants rapidly approaching the end of their contracts. The prediction is made that new motors will not be sold much below present levels for at least six months

FIBER CONDUIT.—Inquiries incline dealers to believe that central-station construction will shortly show a revival of activity, at least on a moderate scale.

WASHING MACHINES.—The supply appears plentiful at present, with a well-maintained demand. The deferred payment system is an important distribution factor.

ATLANTA

There appears to be increasing activity in the demand for all lines of material this week. Manufacturers and jobbers report a number of inquiries for apparatus and schedule material from industrial centers. Trade on the whole is well sustained through purchases from central stations and industrials.

A building and construction boom has started at certain Florida cities, Miami and Jacksonville being the most active. Jacksonville municipal, business and shipping authorities are making preparations for increased trade relations with Latin-American countries. The next few months will see the installation of improved port machinery.

Reports for the current week show a greater increase in the number of unemployed, but at the same time a greater demand for common labor. In the Southeastern cities affected by strikes the scarcity of skilled workers is more acute, but as these conditions are spotty they do not reflect the general tendency. The two government-operated shipbuilding plants at Brunswick, Ga., reduced their forces about half this week. The hold-up in work is expected to be only temporary.

RANGES.—The demand has slowed up lately, and all interests are putting forth greater efforts to stimulate this line during the coming spring and summer months. Shipments have reached the point where prompt deliveries in large quantities can be made.

HEATING APPLIANCES.—Jobbers report an increasing call from the contractor-dealers. Shipments are coming in freely, and Southeastern stocks are in good shape.

CABLE.—Electrical contractors are apparently becoming more active as indicated by the movement of the heavier cables this week. A number of jobs that were delayed around the first part of the year are being completed. March 3 saw a reduction of weatherproof and rubber-covered copper base to 20 cents. Manufacturers report a slight decline in orders accompanying the weakening of copper products prices. Deliveries are good, covering all immediate requirements.

POLES.—Comparing the volume of business to-day with that of a month ago, the tendency shows a falling off. An interesting feature in connection with this line, however, is the fact that while government requirements have eased up, the demand from other sources shows a decided gain, which has helped to maintain a very satisfactory volume of business. No change in price has been recorded and shipments are much freer.

HARDWARE.—Following a drop in price, the call for standard material and miscellaneous items shows sluggish tendencies. Deliveries are good and stocks are in fair shape.

INSULATORS.—Activity is fairly well sustained in the glass type and shipments have shown a decided improvement. There has been no change in price of porcelain insulators since February, and although a substantial reduction took place at that time, business did not respond and

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a period of dullness is noticed. Manufacturers are looking forward to an active spring demand, however, as factory facilities are much improved.

CHICAGO

Plans are being made for new buildings of practically every description. During the week "loop" building projects were increased by the announcements that both the Stratford and the Grand Pacific Hotel are to be demolished to make room for more modern structures. Extensive additions will be made to the Congress, Blackstone and Morrison Hotels as soon as prices of building materials become more attractive.

Most jobbers say that February this year was better than a year ago. Prospects for this month are not so good, however, judging by this first week. There are plenty of inquiries but few orders. It is believed that many of the inquiries are simply to supply information required on tax returns. Part of the decrease in business is ascribed to the failure of Congress to pass the railroad appropriation.

WIRE.—The base on both rubber-covered and weatherproof wire is around 20 cents this week, but there is not much being sold. Buyers are afraid to commit themselves.

CONDUIT.—There is no change in conduit prices, although steel prices have dropped. However, there is less hesitancy about buying conduit at the high price than there is in ordering wire at its reduced price.

FANS.—Fan business is beginning to open up with the dealers. The new 5 per cent luxury tax is being added to the price of every fan. Some make out invoices for the gross amount including the tax, but where jobbers have contracts the tax is usually added as a separate item.

AUTOMOBILE LAMPS.—Deliveries are getting much better and the demand is maintained.

TIME SWITCHES.—Manufacturers of time switches are not in a position to go after business aggressively at this time. The stocks of clocks are practically exhausted, although the output, which is still small, is steadily increasing, and it should not be long before the time switch manufacturers are again able to get all the clocks they want.

MOTORS.—At the present time deliveries of motors up to 50 hp. are good, but orders are falling off.

SEATTLE—PORTLAND

The Seattle, Tacoma and Aberdeen steel and wooden shipbuilding industry, which has been paralyzed by the strike since Jan. 21, resumed operations on March 11. Workers will return under the Macy board award in effect before the strike. The Metal Trades Association will also resume operations. It is estimated that a week or ten days will be required before full crews will be back on their jobs. With the expiration of the Macy award agreement on March 31 individual shipyards will be required to deal with their own employees. At that time the government will cease to make guarantees and enter into agreements, but will stop the construction of vessels contracted for if employers pay the disproportionate wages demanded by the men. Resumption of shipbuilding will do much to solve the labor problems directly. A solution of the non-employment problem in Oregon is rapidly taking form.

Lumber conditions throughout the next eighteen months are viewed with optimism by the Pacific Northwest lumbermen. It is believed that the latter part of this month will show a decided increase in the amount of residence construction all over the Northwest. Much building activity has been planned throughout eastern Oregon and eastern and southwestern Washington. Larger cities in the Puget Sound district are expecting a decided increase as soon as settled weather is assured. Larger building projects are being held up awaiting the settlement of labor difficulties and an expected decrease in building materials.

Electrical jobbers as a whole in Seattle during the past week report business very quiet. There were no sales reported of any importance, although the usual number of inquiries were received.

Business transacted by dealers showed a decrease. It is believed that with the reopening of yards and shops the normal volume will be regained speedily. The Portland district reports that retail business for the month of February has been good—almost equal to that of 1918. There was no marked movement of any special line. Wholesale stocks are reported in good shape owing to the fact that jobbers had placed orders previous to the signing of the armistice which manufacturers refused to permit them to cancel. Large purchasers are buying just enough to care for immediate needs. Jobbers report that sales are good in general, although not up to a year ago. Central stations are placing considerable orders for materials necessary for maintenance purposes. It is believed that proposed extensions or the major portion of contemplated projects will await a settled and a lower market. The Pacific Power & Light Company, Portland, officially announces that it is prepared to install a 5000-hp. generating plant at a cost of approximately $400,000. This company has purchased transformer equipment with a rating of 10,000 kw. to be used at Lind, Wash., in connecting the Pacific Power & Light Company lines to those of the Intermountain Power Company.

SAN FRANCISCO

Although one still hears talk of hand-to-mouth buying, still the aggregate business has been very good, and even those who complain about the waiting tendency of most buyers and builders admit that if this is the kind of business that is being placed in a season supposed to be quiet, then business when it does come will make a bumper year. Although there has not been much apartment-house building yet, still many private owners have decided to take advantage of a few small reductions in the cost of various building materials to begin construction, and the residence districts of many cities, particularly those of the better sort, show great activity. Recent buildings reported include new canneries at San José, Modeste and Sacramento, public buildings such as court houses and banks in Fresno and Blakersfield and big government construction in the sea-plane school near San Diego. Arizona especially is showing a marked increase in construction, and significant of the tendency to make the West more of an industrial center are the reports that a factory and warehouse for pipe and steel construction will be partly built in Phoenix.

Credits and collections are good. There is an increased tendency on the part of certain dealers to handle higher-priced devices, such as domestic helps, on a monthly basis scheme.

POLE-LINE HARDWARE.—Bolts and braces have again taken a small drop. Recent changes aggregate about 15 per cent.

POLES AND CROSS-ARMS.—There have been no recent changes in price schedules. Were there a demand, deliveries would be far easier than last year, since the government is not now so active in the north woods in procuring its aëroplane wood. The lines also will be affected by the proposed power-line construction.

RUBBER-COVERED WIRE.—All sizes of rubber-covered wire, with the exception of the circular-mil sizes, have again dropped 5 per cent. No. 14 single-braid solid is now selling for about $13 per 1000 ft. on the coast in 5000-ft. lots. Deliveries and stocks are good, and the demand, especially for house-wiring sizes, No. 14 in particular, is indeed good.

LAMP CORD.—Lamp cord has recently decreased 10 per cent, which is a considerable drop when it is figured that a comparatively small amount of the cost of the cord is copper cost. Dock cable is being offered in large lots at special prices owing to the stocks of marine cords ordered, especially for the emergency fleet, that are being carried over into this year. The local demands for all lamp cord have been rather light, although some fairly good export orders are reported.

SCHEDULE MATERIAL.—Sockets are in good demand, although in the smallest quantities possible to secure fair prices. Push switches are very slow.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	List to +20%
1/5 to std. pkg	20% to list
Std. pkg	17% to 36%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25 to $78.75	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05½	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
1/4-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$60.00	$30.00	$26.00–26.50
1/4-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08½
3/8	.08½
1/2	.08½
3/4	.11½
1	.17
1 1/4	.23
1 1/2	.27½
2	.37½
2 1/2	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 to 1/2 In.	3/4 to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.00—$36.00
Coil to 1000 ft	25.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$25.00 to $51.33

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$16.00	$26.00
1/5 to std. pkg.	13.60	21.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.—Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41–$0.66
No. 18, full spools	.39– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.60 to $0.90
No. 18, full spools	.53 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.50–$25.00	$10.50–$17.00	$10.50–$15.00
12	20.20– 27.09	18.18– 23.22	15.15– 23.22
10	27.00– 32.40	24.30– 32.40	19.44– 27.45
8	33.12– 45.72	30.36– 45.72	26.50– 38.10
6	52.50– 72.36	48.13– 60.30	42.00– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$19.50–$20.00	$14.50–$15.00	$13.00–$14.50
12	17.50– 24.57	17.55– 24.57	17.55– 21.06
10	24.05– 32.97	24.05– 32.97	21.16– 28.26
8	33.35– 46.69	33.35– 46.69	29.35– 40.02
6	52.95– 73.71	46.60– 63.18	46.60– 52.65

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$26.75 to $34.75
25 to 50 lb	26.75 to 34.75
50 to 100 lb	25.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$32.75 to $35.75
25 to 50 lb	31.75 to 34.75
50 to 100 lb	30.75 to 37.75

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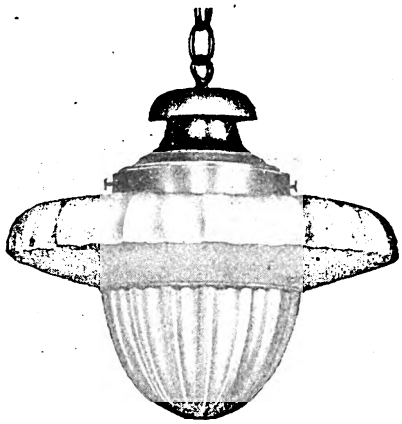
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Inclosed Lighting Unit

By using aluminum for finishing the interior of the reflectors of a recently developed unit, Shapiro & Aronson, 20 Warren Street, New York City, have obtained what they claim to be a very



ALUMINUM USED FOR FINISHING INTERIOR OF REFLECTORS

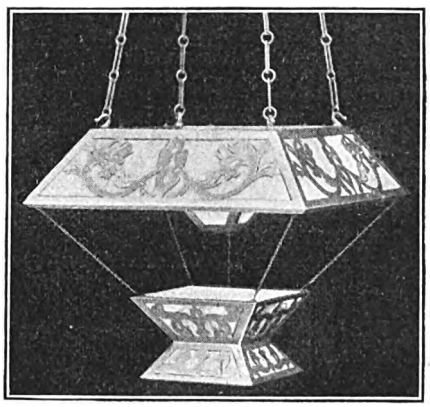
efficient and economical unit. This unit, which is known as Sa-Lite, is inclosed and is therefore dust-proof and bug-proof. It is said to have a wide range of commercial applications and presents a good-looking appearance that makes it extremely favorable for this type of service. The unit is shipped completely wired and adjustable for immediate installation.

Triple-Illumination Lighting Fixture

Elimination of eye strain and the utilization of direct, indirect and semi-indirect illumination are pointed out by the Dempsey-Glavin Electric Corporation, 408 West Thirty-fourth Street, New York City, as some of the features of the Dempsey light unit which it is manufacturing.

An upper section and a lower section compose the main parts of the unit, which is customarily suspended by four chains. The upper reflector, which is oblong and has sloping sides, is formed either or metal or glassware with metal edges and has a lining of opalescent glass. The lower reflector is also made of metal or glass and has a lining of white glassware. Placed in the top of the upper section is an inverted reflector whose outside forms a portion of the upper reflector and whose inside serves as a means of directing light toward the ceiling for reflection. Two bulbs are used, one in the ceiling reflector and a larger one attached to a socket in the bottom of the ceiling reflector but inclosed by the lower section. These two bulbs are controlled by separate pull switches. By using the top light in the ceiling reflector indirect illumination is obtained, and by using the lower light direct illumination is given through the bottom of the lower reflector and semi-indirect illumination by the rays reflected from the inside of the upper section. When both bulbs are in use the entire three types of illumination are obtained.

The lower reflector is adjustable so that when raised toward the upper section the reflective rays are broadened and when lowered away from the top section the rays are narrowed. The maker says that the fixture's ventilation is exceptionally good since free circulation for air is provided up through



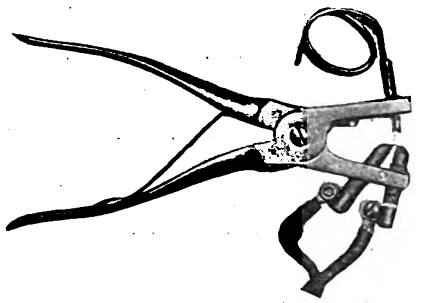
GIVES DIRECT, SEMI-INDIRECT AND INDIRECT ILLUMINATIONS

the lower section and in the upper reflector, thus lengthening the life of lamp bulbs. This unit may be obtained with plain or decorated glass sides, with metal sides finished in bronze or brushed brass, or with a special lower reflector adapted for library use.

Electric Soldering Device

A novel electric soldering device for light soldering work, in which the metal to be soldered is heated directly by an electric arc established between two carbon points, has been developed by J. H. Hendricks, 513 Congress Building, Detroit, Mich. Closing the tool brings the solder into contact with the electrodes. The device is designed to be attached to a 6-volt storage battery, but can, of course, be used on ordinary lighting voltages in connection with a step-down transformer.

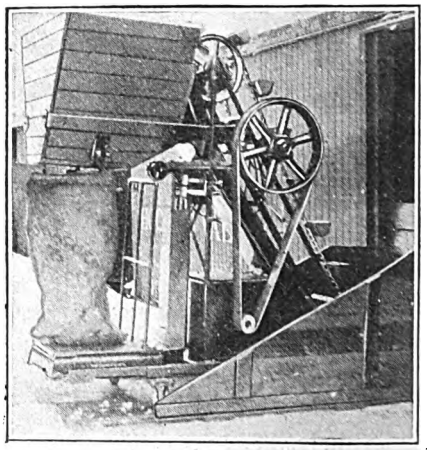
As pointed out by Mr. Hendrick, all of the heat is applied directly at the point where it is needed, and only during the time necessary for soldering, so that about one-tenth of the energy consumed by other soldering irons of equivalent capacity is required. The device is always ready and the workman does not have to wait to heat up the tool before making use of it. It is of light and simple construction, and the way in which the solder is fed makes for the greatest economy in the use of soldering metal.



CORDS ATTACHED TO BATTERY BY CLIPS

Electrically Operated Grain-Bagging Machine

While it is more economical to buy grain in bulk, the cost of hand bagging (2 cents per bushel under average conditions), and also the fact that the work has to be done promptly in order to avoid demurrage freight charges, often preclude doing so. The equipment illustrated herewith, which was recently developed by the Conant Ma-



GRAIN DELIVERED DIRECTLY FROM CAR TO BAG

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chine Company, Concord Junction, Mass., for service in unloading cars for retail dealers and others, as well as in bagging from bins, will bag grain in about half the time required by hand. This, according to the manufacturer, makes it possible to unload and bag a car of oats or corn, about 2000 bushels (705 barrels), in five to six hours, against the two and sometimes three days required by the old hand methods.

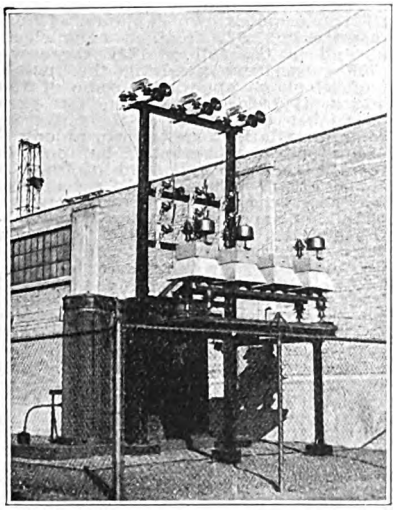
The equipment consists essentially of a bucket conveyor driven by a ¾-hp. electric motor mounted on a steel frame.

Compact Armature with Internal Commutator

Instead of using cotton-insulated armature conductors in its new motor-dynamo, the Dayton (Ohio) Electrical Manufacturing Company employs hair-pin-shaped flat-copper strips which are inserted in closed slots and insulated with bakelite after assembly. The ends of the conductors are welded to the commutator, which is of the internal type; i.e., contact is made on the inside rather than on the outside. Twelve brushes are used because of the heavy starting duty of this motor, two being of almost pure graphite. This outfit, whch was developed for automobile starting and lighting service, is furnished with a starting switch and automatic battery cut-out. While starting, the batteries are connected in series to give 12 volts, whereas when operating as a generator the machine develops 6 volts.

Unit-Type Steel-Frame Outdoor Substation

Instead of supplying large individual power consumers from 2300-volt distribution lines, it is often desirable for

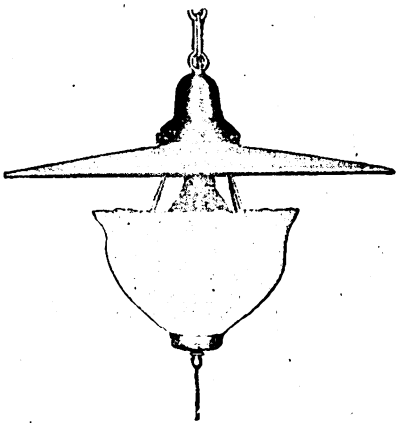


COMPLETE 600-KW., 13,200-VOLT THREE-PHASE INDUSTRIAL SUBSTATION

central stations to supply them directly from high-tension transmission lines. The Delta-Star Electric Company, 2433 Fulton Street, Chicago, has developed a unit-type 13,200-volt, three-phase outdoor substation for supplying power directly from transmission lines. A steel-frame structure is used and is equipped with long-turn choke coils, disconnecting switches and limit fuses for use with oxide-film arresters. A three-pole, double-break-per-phase, fused-type air-break control switch is installed on a separate pole ahead of the substation and is used for entirely isolating the substation. This eliminates all chances of danger when working on the apparatus.

Locally Controlled Commercial Lighting Unit

To meet varying requirements in the proper illumination of offices, factories, stores, meeting halls, schools, armories, etc., S. Edw. Eaton & Company, 585 Hudson Street, New York City, have developed the "Econolite," which is made in several sizes accommodating gas-filled lamps ranging from 75 watts to 1000 watts. The intent and purpose of the design, say the makers, and the selection of material for this unit were to provide a means to diffuse properly the pow-



DIRECT RAYS ARE SPREAD OVER LARGE AREA WITHOUT GLARE

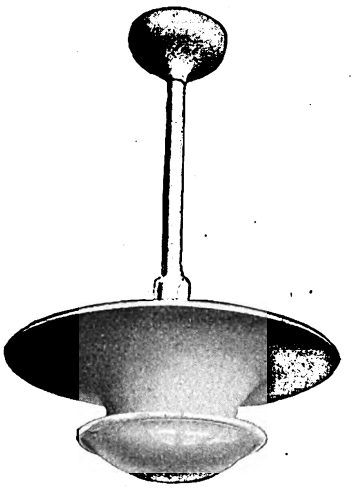
erful light of the gas-filled lamp without sacrificing a large percentage of its candlepower. The lines of the translucent reflector and the relation of the diffusing dish to it meet the requirements of a broad spread of reflected light, while the diffusing dish breaks up the direct rays of light and renders a soft white light without the glare.

A distinctive feature of the unit is in its method of affording local control. The pull chain from a standard socket is guided around the bulb and out through the bottom of the dish support, thus accentuating the balance and symmetry of the fixture and eliminating the installation of the pendent switch or wall switch.

Direct and Indirect Lighting Unit

Among the features which J. Livingston & Company, Grand Central Terminal, New York City, claim for the "Economy" light, which they recently developed, are simplicity in construction to allow for cleaning, economical initial cost of unit, small energy consumption, total absence of glare and long life of the lamp bulb due to maximum ventilation.

The fixture is simple and pleasing in outline and is well proportioned. A soft, direct downward illumination is given through the "Celestialite" glass



DISH IS OF DAYLIGHT GLASS AND REFLECTOR OF PORCELAIN ENAMEL

dish. Indirect downward illumination is obtained by means of the outside of the porcelain-enameled reflector and the ceiling. The unit may be used in homes, studios, offices, stores, factories, etc., and may be obtained in both plain and decorated styles.

NOTES ON RECENT APPLIANCES

Motor-Driven Screwdriver

The George C. McKay Company, 4247 Greenlee Avenue, Cincinnati, Ohio, has placed on the market an electrically driven nut, bolt and lag-screw driver.

Flexible Heater

A flexible electric heater which may be used for thawing frozen water pipes, for heating the intakes of automobile engines and for other uses is being sold by the Despatch Manufacturing Company of Minneapolis.

Alternating-Current Fan

A series transformer in the base of the motor has replaced the choke coil for speed controlling in the 12-in. and 16-in. (30-cm. and 41-cm.) desk and wall fans made by the Westinghouse Electric & Manufacturing Company.

Hand and Face Dryer

The "Airdry," a machine for drying the hands and face by electrically heated air, made by the Borton Electrical Devices, Inc., Groton, N. Y., and which was described in the May 4, 1918, issue of the ELECTRICAL WORLD, has been recently improved.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A man in Italy (No. 28,564) desires to secure the representation of firms for the sale of electrical apparatus.

A firm in France (No. 28,537) desires to secure an agency for the sale of equipment for electrical appliances. Terms, commission to be included and deducted from catalog prices. Credit, thirty or forty-five days from date of arrival of merchandise; payment by draft drawn on clients. Correspondence should be in French.

An agency is desired by a man in Australia (No. 28,557) for the sale of magnetos, self-starters, and other electrical appliances for motor cars.

South Australia, Consul Bickers reports, unlike many other countries, has not derived from the war much initiative for increasing its own manufacture. There is on this account a great scarcity of many goods. The shortage in stocks which must be replenished by importations is found, among other things, in wire and copper cable.

Albert Gimat, engineer of arts and trades, 5 Rue Lacapelle, Montauban (Laon et Garonne), France, desires connection with an American manufacturer of small electrical apparatus for a depot in France, with a shop for assembly in case shipping of detached parts is found convenient. Correspondence should be in French.

A firm in Switzerland (No. 28,570) desires to secure an agency for the sale of material and supplies for tramways and electric lighting. Correspondence should be in French.

A company in Norway (No. 28,624) desires to secure an agency for the sale of electrical fixtures. Correspondence may be in English.

A man in France (No. 28,625) desires to secure the representation of manufacturers of high-tension insulators. Correspondence should be in French.

A Belgian company (No. 28,639) desires to represent firms dealing in automobiles and trucks (electric) and all necessary accessories for electrical installations on farms, in churches and other large buildings.

A firm in Norway (No. 28,643) desires to purchase electric fixtures, electrical apparatus and supplies for light, heat and power service. An agency for these goods is also desired. Correspondence may be in English.

BRITISH GUIANA ELECTRICAL IMPORTS.—Imports of electrical apparatus into British Guiana during 1916 amounted to $18,391 and in 1917 to $26,709. Of this latter amount $25,477 came from the United States and $5,841 from the United Kingdom.

FIXTURE DEALERS MEET.—The following officers were elected for the ensuing year at the convention of the Lighting Fixture Dealers of America held on Feb. 10-11 at the William Penn Hotel, Pittsburgh, Pa.: President, C. J. Netting, Detroit, Mich.; vice-president, William L. Collines, Pittsburgh, and secretary-treasurer, Charles G. Scott, Detroit, Mich.

UNUSUAL FEATURE LINE PUBLICITY OF PHILADELPHIA JOBBERS.—The Philadelphia Electric Company, supply department, Philadelphia, is building up a set of bulletins of its lines in a way that is somewhat out of the ordinary. Instead of giving the customer a manufacturers' catalog or sending him a straight catalog list of the goods handled, this jobbing house is featuring the lines it handles by means of its own bulletins. Thus, if a line of reflectors is to be treated, a bulletin under the company's name descriptive of these reflectors is distributed, and in the bulletin all of the facts are given but in such a way as to make it easy reading. At the same time there is quite a bit of sales information showing methods of application and proper utilization. Other lines are handled similarly. The bulletins sometimes treat on only one device and at other times cover a group of devices. This supply house feels that it is building up an effective set of bulletins, which talk for it and not just for the manufacturer. At the same time it is placed in a position to furnish new customers with a comprehensive presentation of its feature lines. Furthermore, the bulletins give the house material to answer inquiries in a distinctive and personal manner.

GERMANS TO MANUFACTURE OSRAM LAMPS.—The London *Electrical Review* reports the appearance in one of the German papers of the statement that the Osram Company, Ltd., has been registered with premises at Berlin and a capital of 300,000 marks for the purpose of manufacturing electric bulbs, especially with the Osram trade mark, and other electrical technical articles.

ENGLISH DECEMBER FOREIGN TRADE.—During the month of December last there was imported into Great Britain about $300,000 worth of electrical goods and about $4,000,000 worth of machinery. This is a decrease from the preceding month of about $200,000 in electrical goods and an increase in the imports of machinery of $500,000. The exports during December last of Great Britain amounted to about $1,200,000 in electrical goods, an increase over the previous month of a little more than $250,000. The exports of machinery during that month amounted to about $5,850,000, which was a decrease of about $250,000.

GERMAN INSULATION SUBSTITUTE.—In a report by the War Trade Intelligence Department of Great Britain pertaining to metal shortage in Germany during the war and substitutes consequently employed, mention is made of a compressed paper product termed "Pertinax." This has many uses, one of which is in place of mica for insulation. Not only was this found to be cheaper than mica, it is stated, but it could be turned, stamped and drilled. It had a puncture-proof voltage of about 25,000 volts per millimeter, is unaffected by hot oil and only begins to be destroyed at about 200 deg. C. It has a tensile strength, it is said, of around 14,000 lb. per square inch and is already competing in Germany with precelain for insulation purposes.

SWEDISH ELECTRICAL MANUFACTURERS ORGANIZE.—The Electrical Industry Association of Sweden has been formed at Stockholm, for the purpose of looking out for the common interests of the industry so far as they do not concern the work of electrical contractors or such relations between employers and employees as are objects of the work of other associations. The new association will particularly look after the interests of electrical manufacturers. The association's program includes working for the electrification of industry of Sweden, watching the interests of the electrical trades from the point of view of commercial policy, striving for the standardization of electrotechnical manufacture, trying to bring about uniform forms for business agreements, etc

NEW ENGLAND WESTINGHOUSE PLANTS CLOSING DOWN.—F. N. Kollock, secretary of the New England Westinghouse Company, has announced that the Springfield and Chicopee Falls plants of the company will complete their orders and go out of business about May 1. No attempt will be made to turn the plants over to peace uses. They were originally purchased for the manufacture of rifles for the Russian government, but before the contract was completed the revolution occurred. Rifles were later produced for the British government, and after the United States entered the war the company began the manufacture of Browning machine guns for the American forces. About 2000 employees will be released from work as the orders now on the books are gradually completed.

SOUTH AFRICAN ELECTRICAL IMPORTS.—Imports of electrical goods into South Africa for 1913 and 1917, as reported by the "British and South African Export Gazette," were as given in the table below. While the total was cut about in two, the amount for the United States, as will be noticed, increased.

	1913				1917			
Principal Articles of Import	United Kingdom	United States	Germany	Total, All Countries	United Kingdom	United States	Other Principal Competitors	Total, All Countries
Electrical materials..	$1,625,340	$172,775	$689,620	$2,772,185	$620,500	$352,700	$30,970	$1,302,415
Electrical machinery	709,925	255,275	1,263,730	2,256,400	408,120	303,755	33,540	751,310
Total.....	$2,335,265	$438,050	$1,943,350	$5,028,585	$1,028,620	$656,425	$64,510	$2,053,805

GERMANS PREPARING FOR FOREIGN TRADE.—Although peace has not been formally declared, there are many indications already that Germany is strenuously making every effort to regain her position in the foreign market for electrical goods. A report in a recent issue of the London *Electrical Review* states that the Heddern Copper & South German Cable Works Company has found little difficulty in changing over from war to peace work, the output now being fine rather than coarse work. The directors of Voigt and Haeffner A. G. of Frankfort-on-Main state that, although a large number of army orders have been canceled, the transition to peace work has been easily completed owing to the urgent demand for the company's products by central stations. In addition, there is a demand, the report states, from Holland, Switzerland and Scandinavia, although this business is endangered through interference of the Allies with the German export trade.

AMERICANS ABROAD TO ASSIST AMERICAN FOREIGN TRADE.—As part of a broad plan to stimulate the effective development of the country's export trade the American Manufacturers' Export Association announces that it is linking up the organization in this country with American chambers of commerce in other countries. The first step in this direction was taken at a recent conference between G. M. Cassatt, president of the American Chamber of Commerce in London, and George E. Smith, president of the Export Association, when arrangements were completed whereby the two organizations will coöperate in a definite and practical way. The London chamber receives a great many inquiries from British importers which require investigation in the United States. The Export Association will undertake to render this service, while, on the other hand, the London organization will perform a like service by answering inquiries from America regarding local conditions, credit matters and special trade opportunities in England. In discussing this coöperative plan, Mr. Cassatt declared that American chambers of commerce abroad are in a particularly advantageous position to assist American manufacturers and exporters in developing their foreign markets.

FAR EASTERN MARKETS FOR AMERICAN ELECTRICAL GOODS.—So great is the demand for telephone installations in Japan that when a subscriber is willing to give up his telephone he sells it through a broker, there being a regular market value of from $250 to $750, according to a bulletin issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. Japan, it appears, has shown a wonderful electrical growth in the last ten or fifteen years, as there are now nearly 700 central station systems, 530 electric power and light systems, 42 electric tramways and 48 combined railway and lighting systems, together with 1609 private and 53 government-owned plants. In 1915 there were 3,051,925 families using electric light, and in the fall of 1917 there were 152,000 subscribers awaiting the installation of telephone apparatus, some of them having waited for more than ten years. In December of that year there were to be some installations made from among the 4000 "urgency applications," but only 300 of them were made and some of these not until the March following. In recent years Japan has changed from an exclusively importing to an exporting country and has established its own electrical goods industry. It is now a strong competitor in some lines in its own markets instead of being solely a consumer of imported goods. In 1916, says Trade Commissioner R. A. Lundquist, author of the report, there were imported into China electrical goods to the amount of approximately $4,000,000. This, in connection with the fact that the Chinese people have developed a progressive tendency and their great population and increasing purchasing power, indicates an important future demand for electrical goods. The bureau's bulletin gives a good idea of the climate, customs of the people, conduct of trade, business methods and many other matters having a direct or indirect bearing on the electrical goods

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business. Copies of "Electrical Goods in China, Japan and Vladivostok," Special Agents' Series No. 172, can be obtained at 20 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C., or from any district or coöperative office of the Bureau of Foreign and Domestic Commerce.

WESTINGHOUSE, CHURCH, KERR & COMPANY opened a Southwestern headquarters for negotiating and engineering in Dallas, Tex., about Feb. 1. The offices are in the Western Indemnity Building, and A. W. Nichols is in charge.

THE BODINE ELECTRIC COMPANY, Chicago, has with the February number commenced the publication of a new house organ called the *Motorgram*. This is a monthly publication, mostly about motors in the small sizes, published for those interested in motor problems and new developments in the industry.

ROY E. SCHAULIN, who recently became manager of the Chicago division of the American Appliance Company, distributers of electric incandescent lamps, has been continuously engaged in sales work in the electrical field for more than twenty years. Mr. Schaulin's first work

R. E. SCHAULIN

in the electrical field was with the Sawyer-Man Electric Company, beginning in 1898. Three years later he went with the Westinghouse Electric & Manufacturing Company, Pittsburgh, to sell lamps and appliances. After nine years in that position he was employed by the Westinghouse Lamp Company of Bloomfield, N. J., as special representative for one year, after which he returned to the parent company (Pittsburgh) as manager of the lamp division. In the latter part of 1912 he was transferred to the company's Chicago office, and in 1913 he was again transferred to the New York office of the Westinghouse Lamp Company, where he had charge of lamp sales to central-station syndicates. Late in the year 1913 he joined the advertising sales forces of the ELECTRICAL WORLD in Chicago, where he remained until Nov. 1, 1914, when he was transferred to the New York office. Resigning that position on Sept. 1, 1916, Mr. Schaulin was made district manager of the Franklin Electric Manufacturing Company, New York, where he remained until that concern was purchased by the Westinghouse Lamp Company on Feb. 1. He was first tribune of the Jovian Order in New York in 1917.

N. M. HARALSON, who has been connected with the Bureau of Aircraft Production for the past seventeen months and since June, 1918 has been chief of the section of instruments and armament, New York office, has resigned his position with the bureau and has taken charge of the Atlanta branch of the Haralson Sales Company, Inc., headquarters being in Birmingham. Mr. Haralson was formerly connected with the engineering and sales departments of the General Electric Company at New Orleans and the Westinghouse Electric & Manufacturing Company at Philadelphia.

JAMES W. THOMPSON has been appointed manager of the electrical department for the H. W. Johns-Manville Company of San Francisco, succeeding Sam Russell.

THE ELECTRICAL ENGINEERS' EQUIPMENT COMPANY'S Salt Lake City office, which is in charge of Arthur Purdon, has been moved from 218 Judge Building to 1119 Boston Building, Salt Lake City.

R. J. DEARBORN has recently withdrawn from the patent-law firm of Marshall & Dearborn, 160 Broadway, New York City. Mr. Marshall has arranged to continue the entire general patent and trademark practice of the old firm at the old address.

THE AMERICAN IRONING MACHINE COMPANY of Chicago, manufacturer of motor-driven ironers, is making arrangements to establish a Western warehouse in San Francisco for Pacific Coast distribution. The company has a branch now in San Francisco and another in Oakland, Cal., with H. R. Basford as Pacific Coast representative.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, which was recently taken over by the Westinghouse Lamp Company, has consolidated its district office with that of the latter company at 165 Broadway. W. W. Briggs, district manager of the Westinghouse Lamp Company, is also district manager of the Franklin Electric Manufacturing Company.

THE EDISON ELECTRIC APPLIANCE COMPANY of Chicago, it was announced by President George A. Hughes before a recent meeting of electrical contractors, is planning to add to its line this year a motor-driven sewing machine and a vacuum cleaner. It is expected also to work out a standard Edison plug and to equip all but nine devices of its manufacture with this plug.

THE HOOVER SUCTION SWEEPER COMPANY, of North Canton, Ohio, has acquired the adjoining plant of the W. H. Hoover Company, manufacturer of leather goods. This line will be discontinued. The additional capacity, it is understood, will be used by the cleaner company to manufacture some of the motors used in its cleaners. It is the intention of the company later, it is reported, to enlarge the plant and then manufacture all motors required.

THE REMY ELECTRIC COMPANY, Anderson, Ind., manufacturer of automobile accessories, which for the past five years has been affiliated with the United Motors Corporation, it is reported, has now become a subsidiary of the General Motors Company. So far as can be learned, no change in present operations is planned. It is proposed at a later date to erect an administration building at the local works and to move the present office and laboratory at Detroit to this location.

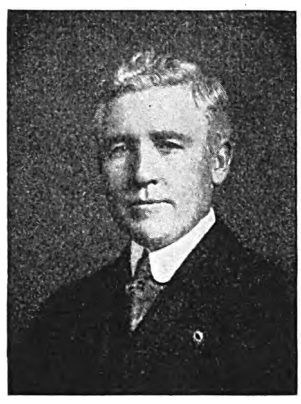
THE EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY are announcing a new plan for the distribution of window-display material. In the future, instead of offering dealers and agents separate pieces of display matter to be shipped from the factory, they will have prepared a special assortment with full instructions for its proper use carefully packed in a flat cardboard container which the agent can obtain promptly upon request sent to the district sales office. This assortment will be uniform for a given period, at the end of which time a new assortment will be issued in order that the agent may have fresh and new material to use throughout the year.

THE FACTORY PRODUCTS CORPORATION, successor to the Factory Products Export Corporation, has been incorporated and its offices have been removed from 61 Broadway to 2 Rector Street, New York City. The corporation has already established export and import relations in the Argentine, Chile, Ecuador, Venezuela, Mexico, the British West Indies, China, India, the Philippines, the Straits Settlements and the Dutch East Indies. The Factory Products Corporation announces its association with the Engineers' Corporation, a subsidiary of the J. G. White Engineering Corporation, for the export of machinery and contractors' and builders' supplies. The corporation's principal trade, so far, has been built up in textile and general exports to the River Plate, general merchandise to the Far East and to the northern end of South America, and in importations from Venezuela. Ten resident agencies have been established also in the principal trading cities of the Far East.

E. M. HAIG, factory representative on the Pacific Coast of the Manhattan Electrical Supply Company, is now at 1629 Harvard Avenue, Seattle, Wash., instead of 604 Mission Street, San Francisco, Cal.

J. CORBUS BUSHNELL, formerly associated with the Business Men's Clearing House, Chicago, and until recently connected with the United States Employment Service as special agent to examine the personnel methods in vogue at Vickers, Ltd., and the Woolworth Arsenal, England, has been engaged by the General Engineering Agency, Pittsburgh, Pa., as personal director.

THE WELLMAN-SEAVER-MORGAN COMPANY, at the annual meeting of the stockholders on Feb. 18, re-elected for the current year the retiring board of directors. At the annual meeting of the board, immediately after the meeting of the stockholders, the following officers were elected: Edwin S. Church, president and general manager; S. H. Pitkin, vice-president; George W. Burrell, second vice-president; W. H. Cowell, secretary and treasurer. G. W. Burrell, who was elected second vice-president, has been in the continuous employ of the company for twenty-one years. He will have entire charge of the company's works both at Cleveland and Akron. He was born in 1871 and was graduated from the Ohio State University in 1891 in me-



G. W. BURRELL

chanical engineering. He entered the employ of the Wellman-Seaver-Morgan Company in 1898 and has worked his way up from draftsman.

C. W. JOHNSON has been appointed assistant manager of works of the Westinghouse Electric & Manufacturing Company. After graduating from Ohio State University, Mr. Johnson entered the employ of the Steel Motor Company of Johnstown, Pa. A year later he became associated with the Bullock Electric Company, Cincinnati, Ohio, and in 1904 was made superintendent of the Allis Chalmers Bullock, Ltd., Montreal, Canada. In 1907 he entered the employ of the Westinghouse company, being appointed chief inspector of works, later being promoted to general superintendent, in which capacity he served until his recent appointment.

THE PERSIAN-AMERICAN COMMERCIAL CORPORATION, capitalized at $20,000,000, has been formed for the development of Persian-American trade, as the indirect outcome of an address delivered late in December in Newark by the Persian Minister to the United States, Dr. Mirza Ali Kula Kahn. Dr. Kahn has been elected vice-president of the corporation, which is headed by Warren C. King, president of the Manufacturers' Council of the State of New Jersey. The corporation will send to Paris a number of Persians who have long been resident in the United States, together with a number of American engineers and experts, to establish branches of the corporation. A large consignment of American products is expected to leave this country in April. Speaking of the corporation Mr. King says: "The corporation expects to develop the water supply as well as the supply of gas and electricity to the principal cities of the Empire. Persia has a population of about 15,000,000 and is three times the size of France."

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Trade Publications

CHAIN DRIVE.—Small power drives are illustrated in publication No. 16 from the Morse Chain Company, Ithaca, N. Y.

OSCILLOGRAPH. — H. G. Crane of Brookline, Mass., has issued a forty-two-page booklet containing detailed information about his lecture-room oscillograph.

TRUCKS AND TRACTORS.—Catalog No. 19 has been prepared by the Walker Vehicle Company of Chicago to describe its balanced-drive electric trucks and tractors for road use.

LIGHTING FIXTURES.—The Charles Polacheck & Brother Company, Milwaukee, Wis., has issued an eight-page supplement, No. 26, illustrating some advanced designs from its new general catalog No. 27, which will be ready for distribution in the spring.

FANS.—A folder about fan advertising matter for dealers has been issued by the Robbins & Myers Company, Springfield, Ohio. Two circulars, one about ceiling fans and the other about desk and wall fans, have also been prepared for distribution by dealers.

ELECTRIC SPECIALTIES.—The C. D. Wood Electric Company, 441 Broadway, New York City, will shortly have ready for distribution a new catalog listing and illustrating the items it markets. These include switches, flashlamps, lamps, porcelain receptacles and batteries.

TELEPHONE SWITCHBOARDS.—Bulletin No. 1021 of thirty-three pages from the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., contains reading matter and illustrations about its private-branch exchange switchboards.

INDOOR BUS SUPPORTS.—The Delta-Star Electric Company, 2433 Fulton Street, Chicago, has issued an addenda bulletin No. 31-A, describing unit-type busbar supports with adjustable fittings for use with round busbars. This leaflet supplements bulletin No. 31.

WIRING DEVICES.—The Cutler-Hammer Manufacturing Company of Milwaukee is distributing the 1919 edition of its wiring devices catalog written in Spanish. It lists and illustrates the majority of the C-H wiring devices shown in the 1919 English catalog and comprises twenty-four pages, being intended for distribution to the Central and South American trade.

TRANSMISSION LINE AND ELECTRIC RAILWAY EQUIPMENT. — Containing more than 600 pages, catalog No. 17, dated 1919, has been published by the Ohio Brass Company of Mansfield, Ohio, to cover its line of appliances used in the construction, maintenance and operation of electric railway, mine haulage systems and transmission lines. It is well bound in cloth, printed on coated paper, very well illustrated and has thumb indexes for eight sections of the catalog. The titles of these are: "Porcelain Insulators," "Pole Hardware and Miscellaneous Materials," "Trolley Materials," "Catenary Materials," "Rails, Bonds and Tools," "Third-Rail Insulators," "Car Equipment Materials," and "Tables, Data and Indexes."

New Incorporations

THE MUTUAL LIGHT & POWER COMPANY of Milan, Ohio, has been incorporated with a capital stock of $10,000 by J. O. Drake, George Mason, A. G. Odell, Fred J. Boose and Prescott Milliman.

PREBLE (IND.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $8,000. The directors are: James A. Steele, Albert Huser, Charles Arnold, William Beineke, O. Adler and William M. Meyer.

THE CALIFON (N. J.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by J. B. Apgar, Kinzie Apgar and L. M. Apgar, all of Califon. The company is capitalized at $100,000 and proposes to generate and distribute electricity.

THE WARRENTON (VA.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $50,000 to operate an electric light and power plant. The officers are: James O'Connell, of Washington, D. C., president, and J. M. O'Connell of Warrenton, secretary.

THE GREAT SOUTHWEST POWER & DEVELOPMENT COMPANY of Wilmington, Del., has filed articles of incorporation with a capital stock of $1,000,000 and proposes to control, operate and develop water and power rights, plants, etc. M. L. Horty, M. C. King, S. L. Mackey of Wilmington are local incorporators.

New England States

WEST POWNALL, ME.—Arrangements are being made by the board of managers of the Home for Feeble-Minded for the erection of a new power plant, 53 ft. by 72 ft., at the institution, to cost about $69,500.

BROOKLINE, MASS.—Estimates are being received by the Christian Science Benevolent Association of Boston for a group of buildings to be erected at Brookline, including a power house, 70 ft. by 120 ft.

PAXTON, MASS.—Plans have been approved by the Town Council for extensions to the street lighting system.

WESTFIELD, MASS.—The installation of a new fire-alarm system is under consideration by the Town Council.

PROVIDENCE, R. I.—Work has begun on the proposed new turbine house to be erected by the United States Finishing Company, to cost about $25,000.

CHESHIRE, CONN.—An appropriation of $80,000 has been voted by the State Legislature for the construction of a factory at the Cheshire Reformatory for Boys.

STAMFORD, CONN.—The Stamford Extract Manufacturing Company is planning to rebuild its manufacturing plant recently destroyed by fire. The loss is estimated at about $900,000.

Middle Atlantic States

ALFRED, N. Y.—The installation of an electric lighting system in Alfred is under consideration by the Town Council.

BUFFALO, N. Y.—The Public Service Commission has authorized the merger of the Buffalo General Electric Company with the General Transmission Company of Buffalo.

KINGS PARK, N. Y.—Plans are under consideration by the board of managers of the Kings Park State Hospital for the completion of improvements now under way in the electric lighting system at the institution and the installation of outside electric lighting units, to cost about $18,000. The board, it is understood, is also considering plans for rewiring of buildings A, B, C and D at the institution, to cost about $18,000. Application has been made to the State Legislature for appropriations to cover the cost of the work.

NEW YORK, N. Y.—Plans have been prepared by F. J. Bird, architect, 101 Park Avenue, for the erection of a garage on Fifty-fourth Street near Eighth Avenue, for the Buick Auto Repair Shop, 244 West Forty-ninth Street, to cost about $400,000.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Room 2800, Municipal Building, New York City, until March 17 for, item 9, passenger elevators, and item 10, electric-ash hoists of the mechanical equipment in Evander Childs High School, East 184th Street and Field Place. Separate bids to be submitted for each item. Blank forms, plans and specifications may be obtained at the temporary estimating room, Brooklyn Branch of Board of Education, 131 Livingston Street, Brooklyn.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

OGDENSBURG, N. Y.—Application has been made to the State Legislature by the board of managers of the St. Lawrence State Hospital for an appropriation to provide for the installation of additional boiler equipment and new mechanical laundry equipment. The cost is estimated at about $68,000. R. H. Hutchins is superintendent.

RICHMOND HILL, N. Y.—Initial steps have been taken by the Richmond Hill Business Men's Association for the organization of an independent company to furnish electricity in the Richmond Hill section.

SONYEA, N. Y.—The contract for electrical work in connection with the construction of new buildings at the Craig Colony for Epileptics, Sonyea, has been awarded to A. J. Beuerlein of Mount Morris.

TOTTENVILLE, N. Y.—The Richmond Light & Railroad Company has recently completed the erection of a 6600-volt new transmission line from its power plant at Livingston to Tottenville, and is now making arrangements for the installation of transformers and auxiliary equipment at its local substation. The company is now installing a new booster station in the Arthur Kill Road.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., is reported to be considering a water power development at Brown's Falls. The plans include construction of dam, power house, flume and tailrace on Oswegatchie River. J. B. Taylor is president.

WATERTOWN, N. Y.—Options have been obtained by the Northern New York Utilities, Inc., Light & Power Building, on land along the north bank of Black River for a proposed interurban electric railway connecting Watertown with Vincent, passing through Glen Park, Brownville, Dexter, Chaumont, Three Mile Bay, Rosier and Cape Vincent, a distance of 30 miles. J. B. Taylor is president.

WATERTOWN, N. Y.—Plans are under way by the New York Air Brake Company, Starbuck Avenue, the Northern New York Utilities Inc., Light & Power Building, J. B. Wise, 401 Mill Street, and associates to charter a company under the name of the Beebe Island Corporation to develop a water power in Watertown. The proposed project includes power house, concrete dam, flumes and tailraces, installation of 7500-hp. generating units, etc. The cost is estimated at about $500,000.

DOVER, N. J.—The New Jersey Power & Light Company is negotiating with Roxbury Township for street lighting. Roxbury Township comprises Succasunna, Ledgewood and Kenvil. The communities have appropriated $3,000 per year for street lighting.

NEWARK, N. J.—Plans are being prepared by the Board of Freeholders for the installation of electrical equipment for the operation of the Avondale drawbridge across the Passaic River.

POMPTON LAKES, N. J.—Work has begun on the construction of the addition to the municipal hydroelectric plant.

TRENTON, N. J.—Plans are under consideration by the City Council for extensions and improvements to the electric street-lighting system in the North Trenton section.

TRENTON, N. J.—Arrangements, it is reported, are being made by the Mercer County Traction Corporation for an extension of its traction system to begin at the Market Street division and extend to the municipal dock at a cost of about $80,000.

WHITEHOUSE, N. J.—Plans are under consideration by the Town Committee for the installation of a new municipal electric light plant to furnish service at Whitehouse Station, East Whitehouse, Lebanon and Oldwick.

ALLENTOWN, PA.—Plans are under consideration by the city officials for extensions and improvements in the electric cable system.

BEAVER FALLS, PA.—Plans are under consideration by the Beaver County Light Company for the installation of a new electric lighting system in Beaver Falls. The present contract calls for 123 arc lamps, 41 lamps of 80 cp., 2 of 40 cp. and 2 of 60 candlepower.

HANOVER, PA.—Plans have been prepared by the Hanover Light, Heat & Power Company for the installation of a 1000-kw. turbo-generator and surface condenser with a suitable spray cooling system. Revamping of certain existing distribution lines by raising the voltage to 13,000 volts is also under consideration. A new switchboard is now being installed to meet the requirements of the new plant.

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HERSHEY, PA.—Plans have been completed for a new factory and power plant addition at the works of the Hershey Chocolate Company.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 17, for two 15-ton electric traveling bridge cranes for the navy yard at Philadelphia, to cost about $70,000.

PITTSBURGH, PA. — Plans are under consideration by the City Council for the construction of a new crosstown traction system, to be operated from the Southside district to Millvale.

PITTSBURGH, PA.—Contract has been awarded by the Duquesne Light Company for the construction of an addition to the machine shop at its power station on Brunots Island to D. T. Riffle, Keenan Building, Pittsburgh.

READING, PA.—The Carpenter Steel Company has taken out a permit for the construction of a power house to be erected on the west side of the Schuylkill River, between the river and Schuylkill Avenue and Glenside. The cost is estimated at $90,000.

SCRANTON, PA.—If approved by the City Council the Board of Trade will erect a factory incubator on the city viaduct property on Lackawanna Avenue, to cost about $500,000. Preliminary plans call for a concrete and steel building, equipped with a power and lighting plant.

WILSON, PA.—Plans are under consideration by the City Council for extensions and improvements to the police and fire-alarm systems.

MILFORD, DEL.—A bill has been passed by the State Legislature allowing the town of Milford to appropriate $20,000 for extensions and improvements to the municipal electric plant and waterworks system.

BALTIMORE, MD.—Plans are being prepared by the Canton Air Brake Company, Calvert Building, for the construction of a plant, the first unit to cost about $180,000. The ultimate cost is placed at $1,000,000. R. Schoenwetter and C. A. Zarobsky, Calvert Building, are engineers.

BALTIMORE, MD.—The Bartlett Haywood Company and the Furst Realty Company of Baltimore, it is reported, have formed a combination for the purpose of building a large ship repair plant at Fort McHenry, where a site of about 100 acres has been acquired. The plans provide for the construction of a large dry dock, machine shops, foundry and miscellaneous buildings equipped with electric traveling cranes and complete marine railroad system encircling the works. The cost of the entire work, including dredging harbor, is estimated at about $4,000,000.

CENTERVILLE, MD.—Plans are under consideration to extend the municipal electric lighting service to Queenstown. This extension would be made by the Town Commissioners of Queenstown to secure electricity from the local municipal electric plant. If the project goes through two 15-kva., 6600/220/110-volt, 60-cycle, single-phase transformers, 6½ miles of No. 8 hard-drawn bare copper wire, insulators and 320 poles will be required. About sixty 5-amp. and 10-amp. house meters will also be required by the Queenstown Commissioners. L. D. Shank is manager of the municipal electric plant.

MIDDLETOWN, MD.—The Middletown Packing Company is planning to equip its proposed canning plant with electrically operated machinery. E. A. Toms is secretary.

CHARLESTON, W. VA.—Arrangements are being made by the Virginia Power Company for extensions to its system in Cabin Creek Junction.

HUNTINGTON, W. VA.—Plans are under consideration by the Chesapeake & Ohio Railroad Company for extensions and improvements to its local shops, to cost about $500,000. F. I. Cabell of Richmond, Va., is chief engineer.

SWISS, W. VA.—The Kanawha Collieries Company is contemplating the installation of an electric power plant (to develop from 200 hp. to 400 hp.), in connection with the developments of 1200 acres of coal lands. Harold P. Tompkins of Charleston is general manager and engineer.

NORFOLK, VA.—The proposed new plant to be established by the Norfolk Glass Manufacturing Company will include power house, boiler house, machine shop, etc.

WASHINGTON, D. C.—Bids will be received by the Machinery and Engineering Materials Division, Room 2641, Munitions Building, Washington, D. C., until March 18, under M.E. circular No. 3, for furnishing 87,760 ft. cable, submarine type 327, Signal Corps specification 427-M.

WASHINGTON, D. C.—Bids will be received at the office of the Commissioners of the District of Columbia, Room 511, District Building, Washington, D. C., until April 3, for furnishing and delivering during the fiscal year beginning July 1, 1919, and ending June 30, 1920, electrical supplies, etc., for use for the various branches of the government of the District of Columbia. Form of proposal, specifications, etc., may be obtained from the purchasing officer, room 320, District Building.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 1, for furnishing for Charleston, under Schedule 3855, machine tools, electric drills, engine lathe, milling and grinding machine. Bids will also be received until March 21 for furnishing for Alexandria, Va., under Schedule 7856½—miscellaneous lead-covered cable, 5000 ft. of No. 16 lamp cord and miscellaneous copper wire. Application for proposal blanks should give the schedule desired by number.

North Central States

MILFORD, MICH.—The development of two water powers during the coming season is under consideration by the Milford Electric Company.

MULLIKEN, MICH.—An election will soon be held to vote on the purchase of the electric plant of the Mulliken Electric Company to be owned and operated by the municipality.

PECK, MICH.—The City Council is considering the establishment of a municipal electric light plant.

TRAVERSE CITY, MICH. — The City Council is considering the purchase of 200 acres of additional land to be used for flowage purposes in the erection of additional dam facilities in connection with the municipal electric light plant.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until March 21 for transformers for the division of light and heat. Bids will also be received at the same time and place for service switches for the division of light and heat. Specifications may be obtained upon application to Room 204, City Hall.

COSHOCTON, OHIO.—The Ohio Service Company is installing an additional 4000-kw. at its plant in New Philadelphia and is contemplating the installation of a new switchboard at its Dennison substation, and also the erection of a parallel circuit of 33,000-volt transmission lines from New Philadelphia to Dennison and from Newcomerstown to Cambridge. C. W. Howell of Coshocton is manager.

MARTIN'S FERRY, OHIO.—A special report submitted to the Council by John W. Tush, superintendent of the municipal electric light plant recommends the installation of an emergency boiler at once, and also the consolidation of the electric light and waterworks plants.

ORWELL, OHIO.—The Town Council is considering establishing a municipal electric light plant in Orwell.

SPRINGFIELD, OHIO.—The Springfield Light, Heat & Power Company contemplates extensions and improvements to its plant, involving an expenditure of about $20,000.

CARBON, IND.—Arrangements are being made for the installation of an electric lighting system in Carbon.

GOSHEN, IND.—The capital stock of the Hawks Electric Company of Goshen has been increased from $200,000 to $300,000.

INDIANAPIOLS, IND. — The Public Grain & Elevator Company is planning to erect a grain elevator with a capacity of 500,000 bushels. The company will also remodel its mill at Edinburg and install new machinery.

LOOGOOTEE, IND.—The city of Loogootee has purchased the local electric light plant for $7000.

TELL CITY, IND.—The Tell City Water & Light Company has petitioned the Public Service Commission for permission to sell $16,000 in capital stock. A number of improvements are contemplated by the company.

BISMARCK, ILL.—The Alvin (Ill.) Grain & Electric Company is contemplating the construction of a new electric light and power plant in Bismarck.

BLUE ISLAND, ILL.—The American Wire Fabrics Company, 208 South La Salle Street, Chicago, has purchased a site near Blue Island on which it proposes to erect a plant to cost about $1,000,000.

CHICAGO, ILL.—Bids, it is understood, will soon be asked by Fridstein & Company, engineers, 53 West Jackson Boulevard Chicago, for the extensions to the plant of the Vitanola Talking Company, 503 Thirty-fifth Street, Chicago, to cost about $250,000.

CHICAGO, ILL.—Marshall Field & Company have purchased a factory building at West Forty-seventh and Whipple Street, which will be equipped for the manufacture of burlap bags. The proposed plant will be equipped with electrically operated machinery.

FARMINGTON, ILL.—The Central Illinois Light Company of Peoria has petitioned the Public Utilities Commission for permission to erect a 13,000-volt transmission line from Farmington to Gilchrist, a distance of 9 miles.

MOUNT VERNON, ILL.—Extensions and improvements are contemplated by the Citizens' Gas, Electric & Heating Company, including the installation of a 450-kva. generating unit. Frank M. Stone is manager.

NAUVOO, ILL.—The Nauvoo Electric Light Company has petitioned the Public Utilities Commission for permission to issue $10,000 in bonds.

NEW ATHENS, ILL.—Work has begun on rebuilding the power house of the New Athens Power Company. The mill was recently damaged by fire and considerable damage was done to the machinery.

ROCK ISLAND, ILL. — The Universal Tractor Company, affiliated with the Moline (Ill.) Plow Company, is planning to build a plant on Forty-second Street and Third Avenue, to cost about $250,000. Plans are being prepared by J. D. Clark, engineer, care the Moline (Ill.) Plow Company.

WELDON, ILL.—The installation of an electric lighting system to cost about $15,000, is reported to be under consideration by the Town Board.

WINNETKA, ILL.—The Village Council is considering plans for placing all overhead electric lighting and telephone wires in conduits within the village limits.

MILWAUKEE, WIS.—Bids will be received by the Robert A. Johnston Company, 270 Florida Street, Milwaukee, for the construction and equipment of a factory, 135 ft. by 310 ft., seven stories, for the manufacture of candy and biscuits. The plans provide for a separate steam generating plant, 40 ft. by 90 ft. The cost of the project is estimated at $750,000. Herman J. Esser, Camp Building, Milwaukee, is architect.

SHELLY, MINN. — Contract has been awarded for the installation of an electric light plant in Shelly. Thomas T. Johnson is owner and manager of the plant.

BOONE, IOWA.—The Boone County Telephone Company contemplates an expenditure of from $25,000 to $30,000 for improvements to its lines.

MAQUOKETA, IOWA.—We are informed that the construction of a high-tension transmission line between Anamosa and Maquoketa has been in process of construction for a year and a half. An item published in the issue of Feb. 15 stated that the Iowa Electric Company was contemplating the erection of a transmission line to connect the hydroelectric plant in Anamosa with the steam generating plant in Maquoketa.

SIOUX FALLS, IOWA.—Work, it is understood, will soon be started on the erection of a 60,000-volt electric transmission line to connect the Sioux Falls division of the Northern States Power Company with the company's transmission system in southwestern Minnesota, between Pipestone and Dell Rapids, a distance of 35 miles. A new 3500-kw. steam turbine will be installed at the Sioux Falls power house to take care of the increased loads, which will be secured over the new line.

WASHINGTON, IOWA.—The Iowa Gas & Electric Company is contemplating extending its electric transmission line into the rural districts, a distance of 7 miles.

CABOOL, MO.—Bonds to the amount of $10,000 have been authorized to purchase the local electric light plant, owned by John Bauck.

CLARKSVILLE, MO.—Sufficient money, it is understood, has been raised for the installation of a municipal electric light plant in Clarksville.

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KANSAS CITY, MO.—The Quality Ice & Storage Company is contemplating equipping a power plant. Tair & Nordmayer of St. Louis, Mo., are engineers. A. L. Williams is secretary.

MARSHALL, MO.—Bids will be received by the city of Marshall until March 28 for the installation of a steam power plant and electric transmission system in Marshall. Specifications may be obtained from the Henrici-Lowry Engineering Company, 222 Commerce Trust Building, Kansas City, Mo., upon deposit of $10.

MACON, MO.—Bids will be received by W. H. Martin, city clerk, Macon, until April 2 for improvements to municipal electric light plant, including the installation of one 400-kva. to 500-kva. generator directly connected to steam engine with condensing equipment, spray pond or cooling tower and switchboard. For details see Searchlight Section.

ST. JAMES, MO.—Plans are under consideration for extensions and improvements to the Missouri State Soldiers' Home, including additions to existing hospital, to cost $20,000; miscellaneous additions, $20,000; elevators, $3,500; new power house equipment, $7,600; septic tank, etc., $8,000. W. V. Farris is president board of managers.

VALLEY CITY, N. D.—Bids, it is understood, will soon be called by the Board of Control for electric lighting plants for the various State institutions. E. G. Wanner is secretary.

HAYTI, S. D.—At a special election held recently the voters authorized an issue of bonds to purchase the local electric light plant owned by S. Abrahamson.

HERRICK, S. D.—Preliminary plans are being prepared by the Henningson Engineering Company, National Bank Building, Omaha, Neb., for improvements to the municipal electric light plant and waterworks system. An election will soon be held to submit a bond issue to the voters to provide funds for the work.

OMAHA, NEB.—A bill nas been introduced in the Legislature to appropriate $120,000 for improvements to the University of Nebraska College of Medicine, Forty-second Street and Dewey Avenue, to be used as follows: $40,000 for electrical apparatus, laboratory equipment, assembly room, elevator, etc; $80,000 for erection of heating plant, including chimney stack, water tube boilers, etc. J. Latenser & Sons, Bee Building, are architects.

STERLING, NEB.—Bids, it is understood, will soon be asked by the city of Sterling for the erection of an electric transmission line from Tecumseh to Sterling. Material has already been purchased. Grant & Fulton, Bankers' Life Building, Lincoln, are engineers.

ALTAMONT, KAN.—Plans are being prepared by Archer & Stevens, New England Building, Kansas City, Mo., engineers, for an electric light plant in Altamont. An election will soon be held to vote on the proposal to issue $25,000 in bonds to install the proposed plant.

MORGANVILLE, KAN.—The question of installing an electric lighting system in Morganville is being agitated. L. D. Huff is city clerk.

SYLVIA, KAN.—The towns of Sylvia and Lewis are considering the installation of a new lighting plant.

Southern States

AUGUSTA, GA.—The City Council is considering the installation of an electric lighting system.

PENSACOLA, FLA.—The Pensacola Electric Company, it is reported, is contemplating improvements to its plant and the purchase of additional equipment.

FLORENCE, ALA.—The City Council has engaged Evans & Brown, engineers, to prepare plans for a municipal electric light plant.

SELMA, ALA.—The installation of an electric light plant is reported to be under consideration by the City Council.

JACKSON, MISS.—Negotiations are under way between the city officials and the representatives of the Jackson Light & Traction Company in regard to improvements to the company's plant and service. The cost of the proposed improvements is estimated at from $100,000 to $150,000.

NATCHEZ, MISS.—The proposal to establish a municipal electric light and power plant will be submitted to the voters.

MENA, ARK.—Arrangements have been completed by the borough officials for the installation of an ornamental lighting system on two of the principal thoroughfares of the borough.

NASHVILLE, ARK.—The Nashville Light Company is reported to be considering extending its electric transmission line to Mineral Springs, a distance of 8 miles.

KAPLAN, LA.—Plans are being prepared by X. A. Kramer, engineer, Magnolia, for a municipal electric light plant and water works system in Kaplan.

CUSHING, OKLA.—The Minnesota Electric & Power Company is contemplating the installation of an ornamental lighting system in the business district of Cushing.

DEWEY, OKLA.—The installation of a municipal electric light plant in Dewey is under consideration.

FREDERICK, OKLA.—Plans are being prepared for improvements for the municipal electric light plant. The installation of an ornamental lighting system on Grand Avenue is also under consideration.

NEWKIRK, OKLA.—Plans are being prepared for reconstruction of the municipal electric light plant and water works system.

MUSKOGEE, OKLA.—Work, it is understood, will begin at once by the Muskogee Gas & Electric Company, subsidiary of H. M. Byllesby & Company of Chicago, Ill., on the erection of an electric transmission line from Muskogee to Drumright, traversing the heart of the eastern Oklahoma oil field and touching several large towns.

Pacific and Mountain States

COLFAX, WASH.—The City Council is considering the installation of a municipal electric light plant to furnish electricity for street lighting and pumping water to the reservoir.

SEATTLE, WASH.—The City Council has appropriated $20,000 for repairs to the Cedar River power plant pipe line and $15,000 for Light Department construction work.

ASTORIA, ORE.—Plans are being prepared by the Pacific Power & Light Company for the erection of a 4500-hp. electric generating plant adjoining its present plant on Astor Street. Additional power is required to supply service to the proposed new 3000-barrel flour mill of the Astor Flouring Mill Company and for the extension of the Astoria Marine Iron Works.

NORTH BEND, ORE.—The Mountain States Power Company, it is reported, is arranging for the removal of its power plant from Marshfield to North Bend. Until recently the plant has been operated in conjunction with the lumber mill of the C. A. Smith Lumber Company. The closing down of the mill has necessitated the removal of the plant or the installation of boilers and equipment. When the plant is removed new machinery will be installed.

LONG BEACH, CAL.—The City Council is considering the construction of a municipal electric light plant and purchasing the local distribution system of the Southern California Edison Company. D. S. Miller is city engineer.

SAN FRANCISCO, CAL.—The managers of the Letterman General Hospital is considering the construction of a new electric power plant, to cost about $60,000.

SAN FRANCISCO, CAL.—The Great Western Power Company has petitioned the State Railroad Commission for permission to reorganize the company and to build a hydroelectric plant on the North Fork River to cost about $5,000,000. The plans provides for the organization of a new company to be known as the Great Western Power Company of California, which is to take over the holdings of the Great Western Power Company, the City Electric Company and the Consolidated Power Company. The proposed development is to be located in the main canyon of the North Fork, six miles from Belden station. The spillway at Big Meadows dam (Lake Almanor) will be raised nine feet and the capacity of the reservoir increased from 300,000 acre feet to 380,000 acre feet. The power plant will be equipped with two 20,000-kw. generating units, together with necessary electrical apparatus for switching and stepping up energy to the transmission voltage. Ultimately the plant will be increased to 136,000 kw. From the power house a 150,000-volt steel tower transmission line will carry power to Big Bend and thence to Valona substation, a distribution center on the shore of San Francisco Bay south of Carquinez Straits. A nine-mile standard gage railroad will be built from the Western Pacific Railway to the plant site to deliver machinery and material. Water rights, land, etc. have already been obtained by the Great Western Power Company.

MOSCOW, IDAHO—A committee has been appointed by the City Council to investigate the feasibility of installing a municipal electric light plant in Moscow.

PAROWAN, UTAH.—Application has been filed with George F. McGonagle, state engineer, by John L. Lowden of Parowan for permission to use 10 second-feet of water to be taken from Parogonah Creek in Iron County. The power is to be utilized to generate electricity.

CUT BANK, MONT.—John Seal & Son have been granted a franchise to construct and operate an electric light plant in Cut Bank for a period of twenty-five years. It is expected to have at least one of the units in operation within sixty or ninety days.

WHITEFISH, MONT.—The City Council has appointed a committee to make investigations as to the feasibility of establishing a municipal electric light plant in Whitefish.

BRECKENRIDGE, COL.—The installation of an electric light plant is under consideration by the city of Breckenridge.

CRAIG, COL.—Work will begin on the construction of the proposed new electric light plant as soon as the frost is out of the ground. Mr. Dutcher will have charge of the work.

CROOK, COL.—An election will soon be held to vote on the proposal to issue $20,000 in bonds for the installation of an electric light plant and waterworks system in Crook. Plans are being prepared by the Henningson Engineering Company, National Bank Building, Omaha, Neb.

Canada

SYDNEY MINES, N. S.—Arrangements have been made by the Town Council for the installation of an electric light plant in Sydney Mines, to cost about $100,000.

COBOURG, ONT.—The residents of Hamilton Township are trying to secure an extension of the transmission line of the Ontario Hydro-Electric Power Commission from Cobourg to Bewdley, Cold Springs and Gore's Landing.

NORWOOD, ONT.—The Town Council has decided to secure power from the Hydro-Electric Power Commission.

ORILLIA, ONT.—Bids will be received by the Department of Public Works, Toronto Building, until March 31 for construction of power house and hospital on Main Street, to cost about $40,000 and $25,000 respectively.

PETERBORO, ONT.—Plans are under consideration by the City Council for the erection of a new hydroelectric transmission line from Healy's Falls, which will furnish electrical service in the municipalities of Havelock, Belmont, Norwood, Hastings, Keene and Westwood. The proposed line, if erected, will provide Peterboro with an auxiliary source of power.

QUEBEC, QUE.—Bids, it is reported, will soon be received by the Valcartier Lumber & Pulp Company for the erection of a pulp mill, to cost about $350,000.

SHAWINIGAN FALLS, QUE.—Plans are being prepared by D. J. Spence, architect, 246 Beaver Hall Avenue, for the construction of a community building on Transmission Avenue for the Shawinigan Water & Power Company, to cost about $150,000.

THREE RIVERS, QUE.—The North Shore Power Company, Power Building, is contemplating the installation of an electric lighting system, to cost about $10,000. W. B. Baptist is manager.

CABRI, SASK.—The installation of an electric light system in Cabri is under consideration by the Town Council.

HAWARDEN, SASK.—The installation of a municipal electric light plant in Hawarden is under consideration by the Town Council.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until March 25, under circular 1262, for furnishing wire rope, copper wire, lead wire, brass wire, ball bearings, indicators, connectors, conduits, etc. Further information may be obtained at the above office.

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(Issued Jan. 14, 1919)

1,291,587. TWO-WIRE PARTY-LINE LOCK-OUT TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Jan. 3, 1911. Subscriber can operate automatic switches or signals.

1,291,596. BATTERY; Herbert D. Morris, Chadds Fort, Pa. App. filed July 19, 1918. Cells protected from injurious outside influences.

1,291,597. ELECTRIC REGULATOR; Morris Moskowitz, New York, N. Y. App. filed May 22, 1909. Quickly responds to changes in circuit conditions.

1,291,598. SYSTEM OF ELECTRIC REGULATION; Morris Moskowitz, New York, N. Y. App. filed March 25, 1909. Used with constant-current generator for car lighting from axle.

1,291,601. METHOD OF ELECTRIC WELDING; Thomas E. Murray, New York, N. Y. App. filed March 28, 1918. For coupling end to end metal pipes, rods, etc.

1,291,641. RADIO COMMUNICATION; Harold P. Donle, Meriden, Conn. App. filed March 23, 1918. Electron valve for radio use.

1,291,651. ELECTRIC SWITCH; Ragnar O. W. Lundin, New Britain, Conn. App. filed Oct. 15, 1917. Push-button type.

1,291,660. PROCESS FOR PRODUCING REACTIONS IN GASES AT HIGH TEMPERATURES AND APPARATUS FOR PRACTICING THE SAME; Leland L. Summers, Chicago, Ill. App. filed July 31, 1913. Electric arc used.

1,291,667. ELECTRICAL SWITCH; Albert P. Ball, Royal Oak. App. filed June 24, 1916. Movably mounted switch contacts automatically and quickly thrown from starting to running position.

1,291,680. ELECTROLYTIC PRODUCTION OF PERMANGANATES; Benjamin F. Lovelace, Charles E. Lanning and William Judefind, Baltimore, Md. App. filed Jan. 21, 1918. Anode containing manganese and silicon employed.

1,291,681. ELECTROLYTIC PRODUCTION OF PERMANGANATES; Benjamin F. Lovelace, Charles E. Lanning and William L. Judefind, Baltimore, Md. App. filed Jan. 21, 1918. Anode contains manganese and molybdenum.

1,291,682. ELECTROLYTIC PRODUCTION OF PERMANGANATES; Benjamin F. Lovelace, Charles E. Lanning and William L. Judefind, Baltimore, Md. App. filed Jan. 21, 1918. Anode contains manganese and tungsten utilized.

1,291,697. TELEGRAPH REPEATER; Sylvester Voorhies, Enderlin, N. D. App. filed July 2, 1917. For working in main line or with main and duplex line.

(Issued Jan. 21, 1919)

1,291,699. METAL CONDUIT FOR ELECTRIC WIRES; Chauncey W. Abbott, Pittsburgh, Pa. App. filed Aug. 18, 1915. For exposed wiring in building interiors.

1,291,701. ELECTRIC CEILING FIXTURE; Harry C. Adam, St. Louis, Mo. App. filed May 16, 1918. Supporting means connected to ceiling outlet box without causing box to become unduly heated.

1,291,702. PHOTOGRAPHIC PHONOGRAPH; Frank W. Adsit, St. Paul, Minn. App. filed Dec. 4, 1916. Graphic representations of sound waves registered on film.

1,291,707. ELECTRICALLY OPERATED RELEASING DEVICE FOR WEIGHING MACHINE; Charles H. Allen, Pittsburgh, Pa. App. filed Feb. 19, 1918.

1,291,708. COMBINATION BOILER; Swen G. M. Anderson, Chicago, Ill. App. filed Oct. 20, 1917. Either for hot-water heating or steam generating.

1,291,710. FLASHLAMP; John J. P. Arter, Greet, Eng. App. filed July 6, 1918. Miniature semi-transparent maps inserted between light and magnifying lens.

1,291,713. SEPARABLE-PART INSULATOR; Arthur O. Austin, Barberton, Ohio. App. filed May 29, 1916. Threaded sleeves or shields separately secured to each insulator part.

1,291,722. LOCK SWITCH; Lionel F. Barnes, Aldershot, Eng. App. filed July 27, 1915. For ignition circuits of motor vehicles, etc.

1,291,723. VALVE; Harry W. Barrows, Omaha, Neb. App. filed June 19, 1917. Particularly for vacuum-brake systems of automobiles.

1,291,751. PROCESS FOR MAKING ALKALINE PERMANGANATES, CHLORATES AND HYDROGEN; Theodore J. Brewster, New York, N. Y. App. filed Oct. 17, 1917. Cheap raw materials used.

Record of Electrical Patents

Notes on United States Patents

1,291,766. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed April 24, 1917. Signaling means for central-energy-type systems.

1,291,793. PROJECTOR; Frank H. Doyle and John Wallace, San Francisco, Cal. App. filed Nov. 1, 1915. Simple, compact, safe and easily operable.

1,291,819. ELECTRIC MOTOR; Martin Fogel and Alexander Ascher, New York, N. Y. App. filed Aug. 3, 1915. Electric engine type.

1,291,830. ELECTROPLATING APPARATUS; Joseph Giuliana, Newark, N. J. App. filed Nov. 1, 1917. Readily manipulated by one man.

1,291,831. ELECTROMAGNET; Omer M. Glunt, Rutherford, N. J. App. filed June 22, 1917. Adjustment of armature to pole pieces, easily obtained, remains permanent in service.

1,291,842. THERMOSTATIC CIRCUIT CLOSER; Abilio M. de Silva Greaves, Cambridge, Mass. App. filed May 19, 1917. Used with fire-alarm systems.

1,291,858. SIGNALING DEVICE; Troy E. Hanna, St. Louis, Mo. App. filed Sept. 3, 1918. For gas-engine lubricating systems.

1,291,863. RECORDING APPARATUS FOR USE IN CONNECTION WITH ADVERTISING DEVICES AND THE LIKE; Henry K. Harris, Westminster, London, Eng. App. filed June 7, 1915. Affords check upon operator of electrically lighted bulletin signs.

1,291,894. REGISTERING SYSTEM; Henry Hovland, East Orange, N. J. App. filed April 26, 1917. For telephone systems.

1,291,911. TELEPHONE TRANSMITTER; Arthur R. Kahl, Withington, Manchester, Eng. App. filed March 20, 1916. Main diaphragm shaped and mounted to improve purity of tone.

1,291,933. ELECTRICAL CIRCUIT-CLOSING CONTACT; Frank Kuhn and Jay A. Hand, Detroit, Mich. App. filed Feb. 21, 1918. Resilient pressure of coöperating contacts maintained against each other.

1,291,942. VIBRATORY CONVERTER; Oscar M. Leich, Genoa, Ill. App. filed Sept. 28, 1915. Twin vibrators and ordinary style of transformer used.

1,291,944. LIGHT-CIRCUIT CONTROLLER FOR AUTOMOBILES; Alfred A. Leopold, Pambrum, Saskatchewan, Canada. App. filed Feb. 18, 1918. Roadway sufficiently lighted when engine runs at low speed.

1,291,950. AUTOMATIC TELEPHONE REPEATER; William A. Long, Sioux City, Iowa. App. filed June 27, 1912. Three-wire to two-wire type.

1,291,959. FINDER-STARTING SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Sept. 11, 1916. Used with telephone-exchange systems.

1,291,960. NUMBER-INDICATING SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Sept. 22, 1916. For telephone-exchange systems employing machine switching.

1,291,978. AUTOMATIC SWITCH; James L. McQuarrie, Montclair, N. J. App. filed April 27, 1918. For telephone-exchange system employing machine switching.

1,291,990. TWO-WIRE ROTARY-CONNECTOR TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Oct. 11, 1909. Rotary connector is controllable over line circuit.

1,292,003. ELECTROMAGNETIC DEVICE; Daniel D. Miller, New York, N. Y. App. filed May 25, 1917. Slow-operating without use of delicate spring adjustment.

1,292,024. ELECTROLYTIC CELL; Elmer E. Niswonger, Dayton, Ohio. App. filed Sept. 28, 1918. Shunt currents reduced to minimum.

1,292,028. DIRECTION INDICATOR; Lee A. Ownbey and Arthur A. Ownbey, Chattanooga, Tenn. App. filed July 16, 1917. For automobiles.

1,292,030. CIRCUIT CLOSER FOR ALARM CIRCUITS; Anthony J. Parissi, Cohoes, N. Y. App. filed May 10, 1918. Foot-operated.

1,292,037. METHOD OF WELDING; Carl Pfanstiehl, Highland Park, Ill. App. filed Dec. 17, 1917. High-speed steel united to low-speed steel by this method.

1,292,048. ISOCHRONIZING AND SYNCHRONIZING SYSTEM; Paul M. Rainey, West Hoboken, N. J. App. filed Nov. 4, 1916. Employed in multiplex printing telegraphy.

1,292,049. TELEGRAPH SYSTEM; Paul M. Rainey, Glen Ridge, N. J. App. filed Nov. 15, 1917. Speed of mechanism at one end of line controlled by line impulses.

1,292,081. ELECTRIC SWITCH; Joseph Sachs, Hartford, Conn. App. filed Dec. 19, 1916. Locked in one of its positions when box is sealed.

1,292,094. PORTABLE ELECTRIC HEATER; Carl Schoonmaker, New York, N. Y. App. filed Feb. 20, 1918. Shaped like bulb and readily attached to light socket.

1,292,110. ELECTRIC STARTER FOR AUTOMOBILES; Norman R. Simpson, Elizabeth City, N. C. App. filed Dec. 22, 1916. After engine is running, motor recharges battery used in starting engine.

1,292,122. ELECTRIC TIME SWITCH; Eugene Steiger, Zurich, Switzerland. App. filed April 22, 1916. Operates promptly whenever atmospheric light conditions render lighting or putting out lamps advisable.

1,292,123. ELECTRIC DEVICE FOR AUTOMATICALLY TURNING LIGHTS ON AND OFF; Eugene Steiger, Zurich, Switzerland. App. filed June 17, 1916. Uses large current but guards against an overloading of selenium cell.

1,292,140. PUSH-BUTTON SWITCH; Alexander K. Sutherland, Plainville, Conn. App. filed Feb. 23, 1915. Mechanism actuated with minimum of friction.

1,292,193. REVERSIBLE MAGNETO; Porter A. Wiley, Kokomo, Ind. App. filed Jan. 19, 1916. Change in motion made without alteration of parts.

1,292,206. MAGNET CORE; John C. Woodruff, New York, N. Y. App. filed May 26, 1916. For loading coils and other electrical apparatus.

1,292,207. BUZZER; James A. Wotton, Montclair, N. J. App. filed Dec. 10, 1915. Simple in construction, easy to maintain in adjustment and efficient in operation.

1,292,208. TRANSMISSION SYSTEM; Archibald Wray, Park Ridge, Ill. App. filed Oct. 2, 1915. Relates to train-dispatching circuits that connect train dispatchers' offices with various stations.

1,292,218. ELECTRIC CHANGE-SPEED GEARING FOR AUTOMOBILES; Thorstein von Zweigbergk, Lancaster, Eng. App. filed June 21, 1916. Eliminates necessity of controller having separable contacts.

1,292,238. DUPLEX CATENARY PULL-OVER; Glenn H. Bolus, Mansfield, Ohio. App. filed March 13, 1916. Two wires gripped in fixed relation and held to each other by single pull-over device.

1,292,241. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES; William C. Brinton, Jr., Kennett Square, Pa. App. filed March 23, 1916. To insure absolutely simultaneous production of sparks.

1,292,247. CONNECTOR AND TERMINAL FOR STORAGE BATTERIES; Herbert C. Busch, Jackson, Mich. App. filed Feb. 27, 1918. Secured or released without the aid of a wrench.

1,292,254. ELECTRIC BATTERY; Newcomb K. Chaney, Lakewood, Ohio. App. filed June 7, 1916. Dry-cell mixture free from ferrous sulphides but containing carbon and an electrolyte of ammonium and zinc chloride.

1,292,257. MULTI-OFFICE TELEPHONE-EXCHANGE SYSTEM; Edgar H. Clark, New York, N. Y. App. filed April 9, 1917. Final connecting operator informed of number of wanted line by automatically operated indicating device.

1,292,277. SWAGING MACHINE; Thomas A. Edison, West Orange, N. J. App. filed June 29, 1917. For fastening article such as diamond splint within holder or mounting.

1,292,279. CURRENT DETECTOR; Carl W. Eisenmann, Nebraska City, Neb. App. filed Aug. 3, 1916. Operates when brought adjacent to single conductor even though current flow is relatively small.

1,292,296. MAGNETO; Earl C. Freese, Marietta, Ohio. App. filed Feb. 12, 1917. Foreign matter prevented from coming in between contact members and from breaking connection.

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1,292,315. SYNCHRONIZER; Frank Heath, National City, Cal. App. filed June 15, 1915. Synchronizes two or more motors of any class whether close together or separated at considerable distance.

1,292,334. FLUID-FLOW INDICATOR; Louis Larsen, Brooklyn, N. Y. App. filed Jan. 12, 1916. May be used in water-sprinkler system.

1,292,335. ELECTRIC HEATING AND LIGHTING APPARATUS; Richard G. Ledig, Robert C. Ledig and Nikolaus Gerson, Philadelphia, Pa. App. filed March 5, 1918. For therapeutic, lighting, heating and other purposes.

1,292,381. ELECTRIC CONTROLLER; Frank W. Smith, Westfield, N. J. App. filed July 27, 1916. Particularly adapted to effect the successive circuit connections of an alternating-current motor started with an inductive resistance.

1,292,386. MANUFACTURE OF CALCIUM CARBIDE; Frederick M. Becket, Niagara Falls, N. Y. App. filed April 10, 1916. Processes and apparatus provided to prepare charge for reduction in electric furnace.

1,292,387. MANUFACTURE OF CALCIUM CARBIDE; Frederick M. Becket, Niagara Falls, N. Y. App. filed April 10, 1916. See above patent.

1,292,397. ELECTRIC ARC WELDING SYSTEM; Johannes Kjekstad, Brooklyn, N. Y. App. filed Oct. 19, 1918. Energy at arc kept constant within certain limits.

1,292,402. COMBINED CURLING-IRON AND WATER-BOTTLE HEATER; Herbert W. Christian, Detroit, Mich. App. filed Feb. 12, 1918. Same heating unit used for both appliances.

1,292,403. RHEOSTAT; Herbert W. Christian, Detroit, Mich. App. filed June 17, 1918. For combined curling-iron and hot-water-bottle heater.

1,292,428. COUPLING FOR ELECTRIC TRAIN-LINE CIRCUITS; Thomas R. Brown, Sparkill, N. Y. App. filed April 4, 1917. Simple and inexpensive construction.

(Issued Jan. 28, 1919)

1,292,431. HUMIDIFIER; William L. Cass, Manchester, Iowa. App. filed March 8, 1918. Heating means have specially formed electrodes within boiler of device.

1,292,438. ADJUSTABLE ELECTRODE FOR ELECTRIC RIVETING MACHINE; George A. Cutter, Dedham, Mass. App. filed June 21, 1918. Die brought into exact vertical line with part of work to be operated on.

1,292,451. LINE-WIRE INSULATOR; Louis Fort, Jersey City, N. J. App. filed April 13, 1915. Clamping device carries horizontal or vertical wires.

1,292,460. COMPOUND MAGNET; William J. Hansen, Princeton, Ind. App. filed Nov. 19, 1917. Electromagnet coupled to permanent magnet.

1,292,465. AUTOMATIC TELEPHONE SYSTEM; Harry E. Hershey, White Water, Kan. App. filed Nov. 28, 1913. Simplified mechanism completes connection to called line.

1,292,482. ELECTRIC LAMP; Frederick G. Keyes, East Orange, N. J. App. filed Feb. 11, 1914. Alkaline earth metals or alkali metals absorb minute traces of water vapor and oxygen.

1,292,496. ELECTRICAL MEASURING INSTRUMENT; Henry H. Lyon, Buffalo, N. Y. App. filed Dec. 1, 1916. Recording watt-meter and volt-ampere meter.

1,292,499. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Feb. 12, 1917. Inexpensive ringing system for small exchanges.

1,292,522. SEMI-AUTOMATIC TELEPHONE SYSTEM; Michael Schwartz, Los Angeles, Cal. App. filed Nov. 10, 1913. Relates to private-branch exchange systems.

1,292,523. ELECTRIC BELL; Carl J. Schwarze, Adrian, Mich. App. filed Sept. 1, 1917. Striker bar returns to normal by means of gravity.

1,292,551. METHOD OF WINDING DYNAMO-ELECTRIC-MACHINE ARMATURES; Charles E. Wilson, Wilkinsburg, Pa. App. filed Feb. 17, 1915. Particularly insures symmetrical distribution at ends of machine-wound armatures.

1,292,571. ELECTRICAL MEASURING INSTRUMENT; Charles B. Berst, Erie, Pa. App. filed March 2, 1917. Current supplied to rotating-element meter by means of mercury and not the ordinary form of brushes.

1,292,578. DISTRIBUTING SYSTEM; Alexander Chernyshoff, Swissvale, Pa. App. filed April 1, 1915. Means for minimizing inductive interference of parallel circuits.

1,292,584. SYSTEM OF ELECTRICAL TRANSMISSION AND DISTRIBUTION; Leslie N. Crichton, Salt Lake City, Utah. App. filed Dec. 13, 1912. Accidental interruptions to service prevented on high-tension networks.

1,292,585. PROTECTIVE RELAY; Leslie N. Crichton, Salt Lake City, Utah. App. filed Dec. 13, 1912. For sectionalizing electrical transmission and distribution systems consisting of complicated networks and loops.

1,292,590. COMMUTATOR CYLINDER FOR DYNAMO-ELECTRIC MACHINES; George M. Eaton, Pittsburgh, Pa. App. filed Jan. 5, 1917. High-voltage; comparatively small type.

1,292,592. DYNAMO-ELECTRIC MACHINE; Ralph E. Ferris, Swissvale, Pa. App. filed Sept. 9, 1915. Multi-armature driving motor of bi-polar type adapted for high-voltage direct-current railway systems.

1,292,598. ELECTRIC SWITCH; Monroe Guett, Hartford, Conn. App. filed June 29, 1917. Means for electrically connecting switch contacts with terminal plates.

1,292,599. CONTROL SYSTEM; Arthur J. Hall, Wilkinsburg, Pa. App. filed Oct. 27, 1915. Step-by-step movements of controller drum by means effected dependent upon current in motor circuit.

1,292,602. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Sept. 9, 1915. Phase-advancing means for effecting power-factor compensations in polyphase induction motors.

1,292,605. CIRCUIT CONTROLLER; Albert J. Horton, White Plains, N. Y. App. filed Feb. 8, 1916. Readily tripped and manually or automatically reset.

1,292,621. FIELD MAGNET FOR DYNAMO-ELECTRIC MACHINES; Frederick W. McCloskey, Pittsburgh, Pa. App. filed Nov. 7, 1916. Double-face pole piece constructed so that form-wound coil can be used.

1,292,644. CURRENT INTERRUPTER; Benjamin K. Read, Detroit, Mich. App. filed June 26, 1916. Strong and easily kept in order.

1,292,650. ELECTROMAGNET; Charles H. Rippl, Cleveland, Ohio. App. filed June 20, 1917. Time period of opening caused by presence of lubricating oil made negligibly small.

1,292,651. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; Charles H. Rippl, Cleveland, Ohio. App. filed July 6, 1917. Plurality of protective control-circuit contacts act in common upon single set of contacts.

1,292,656. CONTROL SYSTEM; Karl A. Simmon, Edgewood Park, and Hurd T. Morris, Wilkinsburg, Pa. App. filed Nov. 5, 1915. Embodies means for establishing loop circuit to include driving motors under predetermined operating conditions.

1,292,657. VAPORIZER; Arthur Simon, Milwaukee, Wis., and Edison O. Sessions, Chicago, Ill. App. filed Sept. 17, 1914. Heat applied directly to small quantity of fluid to be vaporized without heating entire fluid.

1,292,659. CONDUCTOR; James B. Speed, New York, N. Y. App. filed May 11, 1918. For high-frequency alternating or pulsating currents.

1,292,660. BRUSH HOLDER; Charles W. Starker, Pittsburgh, Pa. App. filed Jan. 23, 1915. Formed entirely from punched pieces of sheet metal.

1,292,682. BOX FOR ELECTRIC METERS; John V. Becka, Cleveland, Ohio. App. filed Oct. 27, 1917. Meter may be read from exterior of building while switch within housing may be operated from interior of building.

1,292,669. PORCELAIN SOCKET; John Weber, Schenectady, N. Y. App. filed Oct. 27, 1914. Casing of rigid insulating material interchangeably receives essential elements of various sockets.

1,292,708. SPEED CONTROLLER; Thomas E. Clark, Detroit, Mich., and Mark H. Hovey, Madison, Wis. App. filed Dec. 22, 1916. Adjustable device indicates highest selected speed at which vehicle may travel and causes application of air brakes when speed is exceeded.

1,292,714. ELECTRIC MOTOR SWITCH; Joel R. Cook, Cleveland, Ohio. App. filed Aug. 9, 1917. Manufactured from sheet metal by punching and stamping.

1,292,716. FLEXIBLE CONNECTION FOR ELECTRIC FURNACES; George E. Cox, Niagara Falls, N. Y. App. filed Sept. 10, 1918. Individual cables maintained in proper position.

1,292,730. DEVICE FOR CONTROLLING ELECTRIC CURRENT; Earle H. Duke and James D. Brown, Houston, Tex. App. filed March 8, 1917. For automobile lights.

1,292,759. VAPORIZER; Francis Granger, Greensburg, Pa. App. filed Dec. 5, 1914. Agreeable, healthful and germ-destroying vapors may be disseminated.

1,292,764. DRY CELL AND ITS METHOD OF MANUFACTURE; Carl Hambuechen, Belleville, Ill. App. filed April 27, 1916. Gelatinizable electrolyte contains zinc and ammonium chlorides and cereal.

1,292,765. INDICATOR FOR VEHICLES; Cameron G. Hamilton, Seattle, Wash. App. filed Oct. 23, 1916. Used day or night.

1,292,768. CONTROL APPARATUS; Frederic A. H. Harle, Paris, France. App. filed June 11, 1914. Rapidity and accuracy of action combined.

1,292,777. ELECTRIC CONTROLLER; Morris P. Holmes, Claremont, N. H. App. filed May 11, 1914. Applicable to mining machines.

1,292,800. ELECTRIC WELDING; Otis A. Kenyon, New York, N. Y. App. filed Aug. 7, 1918. Constant-potential constant-current system.

1,292,805. SELF-LOCKING SAFETY DEVICE; Hubert F. Krantz, Brooklyn, N. Y. App. filed July 31, 1915. Unskilled user barred from access to switch blades and contacts.

1,292,806. REMOVABLE SAFETY SWITCH; Hubert F. Krantz, Brooklyn, N. Y. App. filed July 31, 1915. Switch blades and immediate operating parts may be removed as units.

1,292,807. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 31, 1917. Safe and uniformly efficient even in hands of inexperienced operator.

1,292,808. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 31, 1917. Switch mechanism mounted in stationary position within casing.

1,292,809. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 31, 1917. Door locked closed whenever switch is in "on" position and switch locked in "off" position whenever door is open.

1,292,810. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 31, 1917. Similar to above patent.

1,292,812. METHOD OF UNITING METAL PARTS; Laurence S. Lachman, New York, N. Y. App. filed Feb. 8, 1918. Homogeneous welded joint.

1,292,815. VIBRATORY CONVERTER; Oscar M. Leich, Genoa, Ill. App. filed Sept. 28, 1915. Twin vibrators used in transforming alternating current into pulsating current.

1,292,827. TELEPHONE-EXCHANGE TRUNKING SYSTEM; Fritz Lubberger, Chicago, Ill. App. filed June 10, 1909. Call can be extended.

1,292,828. SEMI-AUTOMATIC TELEPHONE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Aug. 16, 1916. Connections established between manual and automatic exchanges by two-way trunking arrangement.

1,292,836. MEANS FOR MOUNTING CURRENT-DISTRIBUTER BLOCKS; Samuel C. McKeown, East Orange, N. J. App. filed Oct. 19, 1917. Holding-on means may be quickly removed so that block can be taken off ignition machine for inspection, etc.

1,292,837. MEANS FOR MOUNTING AND CONNECTING IGNITION BREAKER BOXES; Samuel C. McKeown, East Orange, N. J. App. filed Oct. 19, 1917. Means provided for adjusting box to get maximum efficiency from generator before locking it in working position.

1,292,838. IGNITION SYSTEM; Samuel C. McKeown, East Orange, N. Y. App. filed Jan. 29, 1918. Life of operating parts materially increased.

1,292,839. TELEPHONE-EXCHANGE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed July 11, 1918. Signaling means for systems in which inter-office trunk circuits are employed for completing connections between offices.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, March 22, 1919 *Number* 12

Boston Meeting of the A. I. E. E.

THE Boston meeting of the American Institute of Electrical Engineers was in keeping with the best traditions of that body. The character of the addresses and papers as well as the diversity of interests represented in the audience shows what can be accomplished in Institute affairs when there is a will and a determination to do. The railway electrification problems were discussed without reference to the battle of the systems and in a national and constructive manner. There was a realization that electrification of railways involves broader engineering than the mere substitution of an electric locomotive for a steam locomotive, and that the problem must be considered in connection with other national issues not intimately connected with, yet affecting, the electrical industry. It is refreshing to feel that the electrical industry is becoming broad enough and public-spirited enough to associate electrification, for instance, with fuel conservation and water-power development. The subject of technical education brought up at the evening session was admirably handled, and certainly the addresses of prominent educators, notably that of Dr. Eliot, were most inspiring. One naturally associates Boston with culture, so that pearls of wisdom were not lacking, and if there be anything in modern prophecy, the vision which Dr. Eliot holds of engineering, colored as it must be by his ripened experience and mellow philosophy, is certain of ultimate realization.

Rural development, which is so essential for the security of the nation, can be hastened by means of electricity. No other single agency possesses the power to make the remote sections of the country so attractive. The more electrical networks spread out, the quicker new towns and communities develop.

Water Power Must Be Developed

IT IS becoming increasingly clear that if water-power development is to be a reality, it must be the business not only of those directly interested in specific projects but of every public utility and every citizen of the country as well. From now on until proper legislation is enacted there must be throughout the length and breadth of the land continuous discussion of the subject of water powers and the relation their development bears to the country as a whole. Only in this way can a policy be translated into achievement. We must have informed public opinion working its will on every Representative and Senator. It is time that every one realized that development of water power is a national problem which concerns every citizen of the country, and the electrical industry, to which must be intrusted the development of these water powers, must work unselfishly with the rest of the country to bring such a condition about. While it is true that the industry will profit somewhat by water-power development, its reward for services rendered is as nothing compared with the advantages which such work brings to the entire human race. When manufacturers realize that only through water power can reasonably priced power for industry be obtained, and when every householder senses that through the same agency the coal resources of the country will be conserved and the day for fabulously priced coal be postponed for a longer period, then will come the realization that others besides those connected with the electrical industry are vitally concerned in this problem. No one begrudges the doctor his fee if by that means the health of a community can be maintained or its sanitary condition improved. A like situation should obtain with reference to water-power development, and every one in the industry should emulate the example of the eminent Roman, Cato, and insist not that "Carthage must be destroyed" but that "water power must be developed."

Commerce reports bring the information that Bulgaria, in anticipation of a revival of trade after the war, developed water-power facilities, created a bank for the promotion of trade and formed a variety of banks, with a total capitalization of $50,000,000, for the financing of industry. And yet we think of the Balkan countries as backward.

Design of Small Direct-Current Armatures

IN THE process of reëstablishing industries after the return of peace, electric distribution of power to machinery is bound to play an important part, in order that the most economical and effective use may be made of factory machinery. The average factory motor is of comparatively small power. Consequently the economical design of good small motors is a matter of considerable importance.

Small direct-current motors have been designed, built and industrially employed for many years. It would, however, be very unsafe to assume that there is no more room for improvement in them on that account. Even assuming that no general and sweeping improvements are possible in their design, there must always be possible improvements in detail, due to new available materials, new processes of construction and changes in the relative costs of steel, copper and other elements in the total expenses of building.

C. R. Wylie's article on the subject, in this week's issue, deals with the essential design constants of small direct-current armatures. The data are presented

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mainly in curve sheets, and many of the curves appear to be of the exponential type, or to follow straight lines, when plotted on logarithm paper. It is interesting to notice that the cost of small dynamos is indicated as having increased about 15 per cent between 1915 and 1917, owing to war conditions.

Dr. Eliot's recent remark that it is inexpedient, not to say absurd, to attempt to fix by law the same number of hours for all industries without regard to their infinite diversities, or for all establishments in the same industry, is economically indisputable. Irresponsible demands for a rigid wholesale limitation of the day's work are only a degree less culpable than advocacy of individual restriction of output. Increased production per expense unit is the line of least resistance to follow in international competition.

Opposing Government Operation

THERE are selfish reasons against government ownership or operation of our carrier and wire utilities just as there are selfish reasons for those policies. Is the ultimate disposition of these great utilities to be determined by selfish motives? Will the decision then fall to those whose motives are the most selfish, to those who best succeed in concealing their motives from the public or to those who by freak of chance have the most power to attain their ends? If a thorough understanding of the facts prevails, the question will be settled ultimately, not as selfish motives would determine it, but as economic considerations recommend. Those who oppose government ownership or operation should give their attention to the economic problems involved in the momentous issue. It is not enough to assume that because they think that public operation is wasteful the public will inevitably think so too. They must be prepared to prove their case.

Bankers who recall the profits of unregulated public utility corporations face a new responsibility, a heavier one in some ways, under the conditions that will obtain if the railroad and wire properties are returned to their owners. The turnover in securities will be less profitable. Manipulation will be dangerous. But while the time of exploitation is passed, the era of fair regulation substitutes equitable return on the investment. This is the alternative which those who oppose government ownership should be prepared to accept. It means less profit for the banker and promoter; it means a surer stabilized return for the real investors whose capital or savings aggregate the corporate investment. It may also be kept in mind that the idea of trusteeship is capable of much higher development than many people have accorded it. We do not mean the revival of the "widows and orphans," for their funds have not always been safeguarded in bygone days; but there is a sense in which the controlling individuals can exercise a trust equally for those who own, those who man and those who use the properties. This form of corporate trusteeship can be made more economical in administration than the operation of a bureau under our present practice in government.

What policy and under whom will best safeguard the public interest? Will it be private ownership with public operation? That is what we have now with the railroads and wire agencies. In principle it amounts to public use of private property for a return, but the individual holder has no opportunity to debate or question that return. Investment and property may be depreciated in the process. Public ownership and operation would mean enormous investment, a horde of government employees in politics. Private ownership and operation under regulation would be in part a continuation of the pre-war conditions, in part new conditions growing from experience. It is the practicable solution of which we have the most knowledge. Its defects are remediable, its abuses negligible.

The basis of the decision should be the conservation of capital investment, economy in operating expense, efficiency and low cost in service. Those who oppose permanent government operation of the properties now held under the direction of the administration face these facts: The administration appears to be reluctant to surrender its control. Rates have been increased heavily, also wages. Service is restricted. Competition has been abandoned. Coördination of properties must have brought some net economies, but evidently not enough to offset larger costs. Can these conditions be bettered? It is clearly up to those who oppose a continuance of present conditions to show, not merely hostility, but that with equal opportunities and fair regulation they can do better than the government. It is up to them not to complain against unfair treatment, but to support any claim that they make that they can do better. If the private owners or their representatives get the properties back, the public will not submit to a fiasco. It will demand results, and private owners cannot as easily find acceptable excuses for shortcomings as public operators.

The leaven of electricity has had results, and the uncharted future will be gained or lost according to what advantage is taken of the situation at present existing in the industrial world. If public utilities will purify themselves by eliminating the bad and invigorating what is good, we shall have a renaissance which will establish the central station more firmly and completely than ever.

Vacuum-Tube Amplifiers

ONE of the most wonderful devices in the world is a vacuum-tube amplifier. It corresponds in the electric field to the microscope in the optical field. But the range of available magnification of the electrical device is enormously greater than the greatest available magnification of the optical device.

Clerk Maxwell at one time suggested a purely ideal permeable barrier, which might enable work to be obtained thermally from the heat energy of gas in a closed chamber, without the application of heat from outside. The molecules of the gas are supposed to be vibrating and colliding through a sort of perpetual motion. As a result of this mode of action, each and every molecule is occasionally jarred into a high instantaneous velocity, while at other times it may give up nearly all its momentum to a colliding molecule. According to the law of probabilities, the root mean square of the velocity of any and all the molecules would remain strictly constant and in conformity with the temperature of the gas inside the chamber.

Across the middle of the space within the chamber a peculiar and ideal partition or barrier was to be established. In this barrier a great number of minute trap doors were to be set, in such a manner that each

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might suddenly be either widely opened or tightly closed. When toward the door on one side, say the *A* side, came a gas molecule with high velocity, the door would be opened to allow passage to the *B* side. When, however, a molecule came up with less than the root-mean-square velocity, passage would be denied. By this means the temperature on the *A* side of the partition would gradually be lowered, while on the *B* side it would be raised. The difference of temperature thus gained would enable subsequent mechanical work to be done.

In the vacuum-tube amplifier a metallic grid takes the place of the ideal partition, and electrons are allowed to pass or are held back according to the electric potential given to the grid. The result is, not a change in temperature, but a marked change in the density of an electron stream or electric current. The power necessary to produce the electric current is dispensed by a suitably arranged direct-current source, but the flow or cessation of the current is determined by the grid potential, at the expense of a much smaller electric power.

Lieut. Max C. Batsel's article in this issue describes the vacuum-tube amplifiers developed by the Signal Corps for various signaling systems. In particular, a seven-stage amplifier is described, with three stages for radio-frequency amplification, leading to a detector stage, and then followed by three stages of audio-frequency amplification. This makes a combination well adapted for use with radio direction finders.

Laissez faire and doctrines of like sort can have no place in the electrical industry. We have no room for reactionaries, either. Progress and initiative must be the guiding principles of our public utilities. Economies learned during the war must be held and even bettered. The industry must go forward, not backward, and interconnection is a forward step.

The Commission and Public Policy

WHEN the people of a state are satisfied with the treatment they receive from their public utility companies the commission form of regulation is accepted as a matter of course. But should dissatisfaction arise from any cause the innocent commission as well as the offending companies is made the target of attack. Certainly some of the attackers have political axes to grind, but the net result is antagonistic feeling stirred up against the commission. A rather full realization of this situation led the Illinois commission to attempt to alleviate it by inducing the utilities to adopt more modern methods of handling all complaints. As a part of this plan a letter was written to all utilities appealing for the installation of complaint-handling methods that would impart individuality to each complaint.

The results of these letters as a whole have been satisfactory in that most of the utilities expressed themselves as in accord with the suggestions of the letter. Some of them have been rather unsatisfactory because the correspondent has assumed that the duty rested with him to assure the commission that the policy of the company was in accord with that expressed in the letter rather than to give the matter any really serious consideration. Many of the utilities stated that they were having copies of the letter made for circulation among their employees and for posting in the office where the employees meet the public. Some of the larger utilities make it a practice to have all letters of complaint transmitted to a responsible executive of the company for perusal, which is certainly a very full and complete application of the principles set forth in the letter.

Practically all of the replies received were from the larger companies, and, as one would anticipate, the companies which already have the most satisfactory methods of dealing with their consumers are those to which the letter made the strongest appeal. The commission deserves credit for its keen analysis and for having devised a means for helping its own position while it was at the same time assisting the companies to a better understanding of their responsibility in matters of public policy.

The use of practical problems in teaching mathematics points the way toward an improvement in educational technique long needed in the training of engineers. Facility in the use of mathematics as a valuable tool in engineering practice is essential in much advanced work, and the edge of this tool should not be dulled by rubbing too many abstractions into the impressionable mind of the undergraduate.

Lighting a Small City

THE street-lighting plan of a city should always be, but seldom is, arranged with reference to the real requirements of the situation. There is a frequent tendency to put up cheap imitations of the systems that are appropriate only to the stately streets of a genuine metropolis. As a result we often see "white ways" that bring out in grotesque relief the shabby fronts of second-rate buildings and have no suggestion of gayety or magnificence save as they bear garish witness to the colossal and hypnotic nerve of the fixture salesman whose zeal outran his better judgment. It is a pleasure, therefore, to record a case where means were judiciously adapted to ends and a city was given street lighting of a character at once suitable, finished and efficient.

The problem that confronted C. D. Gray and E. Hagenlocher, an account of which is printed elsewhere in this issue, was a simple one in principle but required no small amount of work for its solution. It was the complete reorganization of the street illumination of a small city of the better class where a badly run and obsolescent arc system vied with a rather worse series incandescent system in the race for inefficiency. All concerned joined in wanting improvement, and they assuredly got it. The general principle followed was to settle upon a standard form of prismatic refractor worked out as a lantern with frosted bowl. In these lanterns, waterproof, neat in appearance and efficient, were installed such modern series incandescent lamps as the situation demanded, from 250 cp. to replace the ancient arcs down to 100 cp. and 80 cp.

Double-fixture poles were adopted at a standard height of 15 ft., and these were spaced oppositely every 100 ft. in the more important business districts and alternately in residence streets. In the former situation reducing transformers kept the voltage to 300 per circuit in the interest of safety and ease of handling. In outlying districts, where the ornamental fixtures were unnecessary, refractors were still installed and new brackets put up. The net result was a very great improvement both in appearance and efficiency. The energy spent was very modest, but the lamps were worked to their full intensity and the refractors gave them the carrying power that a bare lamp lacks.

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Vacuum-Tube Amplifiers

Weak Telegraphic Ground Currents and Stray Telephonic Currents Are Detected by the Use of Vacuum-Tube Amplifiers—Both Radio and Audio Frequency Signals Are Amplified, and Sensitive Direction Finding Is Made Possible

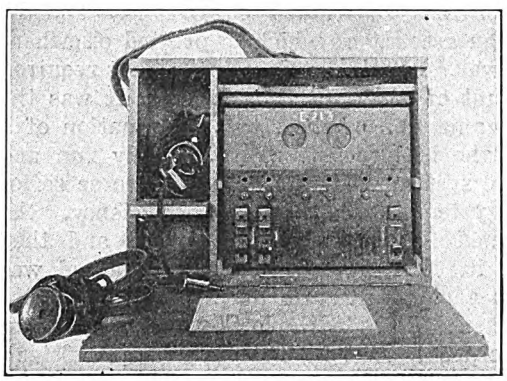
BY LIEUT. MAX C. BATSEL, SIGNAL CORPS, U. S. A.

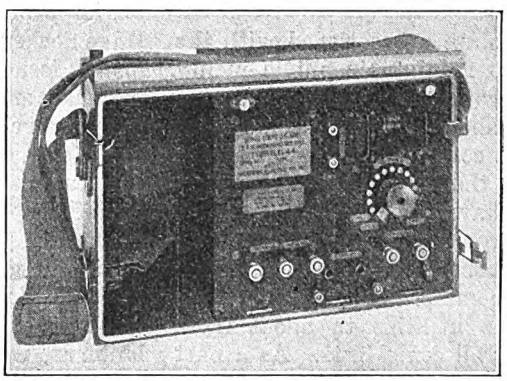
THE most fundamental and most useful property of the vacuum tube is its ability to amplify alternating electrical currents, voltages or power. This amplifying ability arises from the fact that the power required to cause a given variation in the potential of the grid of a tube is less than the power associated with the resulting variations of the current in the plate circuit. The Signal Corps of the United States Army has made two important uses of vacuum-tube amplifiers, for the amplification of weak ground currents in the reception of earth conduction telegraph signals and the picking up of stray telephonic currents, and for the amplification of radio signals both at radio frequency before being rectified by a detector and at audio frequency after the radio-frequency signals are changed to an audible frequency by means of the detector.

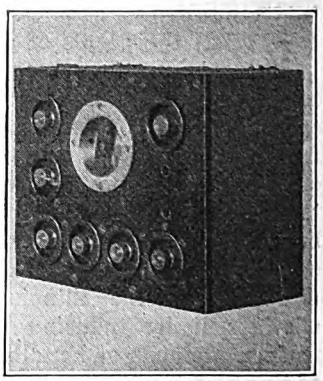
Although a vacuum-tube amplifier, in a sense, returns more energy than it receives, amplification does not violate the principle of the conservation of energy and does not literally give something for nothing. It may be likened to the action of an ordinary direct-current generator. An increase in the field current (or voltage) of the generator will cause a similar increase in the voltage produced by the armature and correspondingly in the load current. The increase in output will be much greater than the increase of power in the field circuit, but this added power is, of course, derived from mechanical forces which drive the generator shaft. In an analogous sense, the amplified power derived from a vacuum tube is obtained from the battery which supplies the plate voltage and current of the tube. In the generator the field voltage controls the output through the agency of a magnetic field. In the vacuum tube the grid voltage controls the output through the agency of an electric field.

When the grid of a tube is maintained at a mean potential more negative than any part of the filament the only current which flows in it is a very small one due to leakage or gas ionization. Therefore the amount of power required to cause a given change in the grid potential is small. Since the vacuum tube operates by virtue of the potential difference established between the filament and grid, it is desirable to transform the power supplied to as high a voltage as possible. If the source of voltage has an impedance Z_1, a transformer to supply current to the grid filament circuit should have a ratio K in the step-up sense such that $K^2Z_1 = Z_2$, where Z_2 is the impedance of the grid filament circuit. The maximum power is then derived from the source of voltage, and the greatest possible potential difference established between the filament and grid, resulting in the maximum power output from the tube. Such a transformer is known as an "input transformer," and its use with vacuum-tube amplifiers is almost universal. The combination of input transformer and tube is called one "stage" of amplification. Several stages may be connected in series or cascade, the plate circuit of one tube feeding into the primary of the input transformer of the next stage, and so on.

The problem of the design and construction of amplifiers, aside from the tubes themselves, is almost entirely one of obtaining suitable and efficient input transformers and of arranging various parts so as to avoid any coupling effects between input and output. Avoidance of magnetic or electrostatic coupling between input and output circuits is essential because such coupling results either in a decrease in amplification or in persistent howling, depending upon whether or not the impulse fed back from output to input opposes or assists the input impulse.







FIGS. 1, 2 AND 3—DEVELOPMENT OF AMPLIFIER SETS—LIGHT-WEIGHT SET AT RIGHT (WEIGHT 8 LB.)

The amplifier has been looked upon by the Signal Corps as an auxiliary device employed for the purpose of obtaining louder signals in a telephone head set. To be successful it must, therefore, be a simple, self-contained outfit requiring no attention or adjustment on the part of the operator other than the replacement of run-down batteries or burned-out tubes. The first audio frequency amplifiers were designed and built for the Signal Corps by the Western Electric Company. Signal Corps engineers have developed improved input transformers for such amplifiers and have carried out

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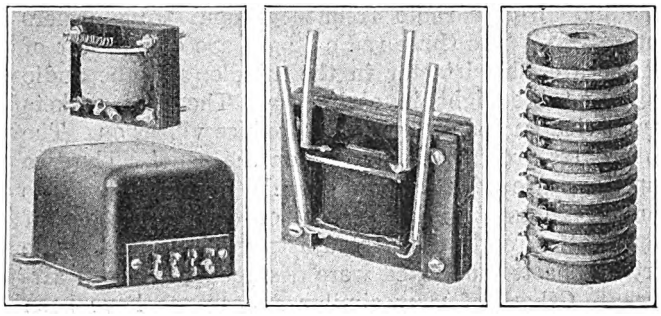
all of the development and design of amplifiers for use at radio frequencies.

AUDIO FREQUENCY AMPLIFIERS

One of the first pieces of radio equipment manufactured for the army after the establishment of the radio development organization was the type SCR-72 two-stage audio frequency amplifier designed and constructed by the Western Electric Company. Many hundreds of them were produced and have in service given excellent satisfaction. An SCR-72 set is shown in Fig. 1. The amplifier box proper, which contains the transformers, tubes and plate-circuit dry battery, is carried in a compartment of an outside case, which also has compartments for telephone head sets, spare tubes and batteries, connecting cord for storage battery, etc. On the amplifier box binding posts are provided for connecting to the input and to the 4-volt storage battery which heats the filament of the tubes. Telephone jacks are arranged so that the head set can be connected direct to the "input" or to the "output" of the first or second stage. There are no adjustments of any kind. Simplicity and reliability are the outstanding features. The power of the output signal is from 40,000 to 60,000 times that of the input signal.



FIGS. 4, 5 AND 6—INPUT TRANSFORMER DESIGNS FOR AMPLIFIERS

Audio frequency transformers (left); iron-core and air-core types (right).

The test of practical use showed that several minor modifications of the SCR-72 would improve its usefulness, and after sufficient practical data had been collected a redesign was made by the Western Electric Company which resulted in the SCR-72-B, illustrated in Fig. 2. Improved accessibility, more convenient arrangements for connections and decreased weight were obtained, and a variable shunt was added to the telephones for controlling the degree of amplification. The inner separate case was eliminated and everything mounted directly in one case. The amplification control by rather small steps proved necessary on account of the peculiarities of the human ear. If the signal to be received is weak and is masked by interfering noises of equal or greater loudness, it is found that amplification beyond a certain degree is detrimental. If the interfering noises are amplified to be louder than this rather critical value, the ear is overburdened and is unable to distinguish the signal as well as when both signal and interference are weaker.

More recently there has arisen a demand for a very small and light amplifier for miscellaneous uses. The amplifier shown in Fig. 3 was designed by the Signal Corps to meet this need. It utilizes the miniature transformers described in later paragraphs and carries no spares, cords or telephone headsets. It is, however, a complete set containing tubes, transformers and plate-circuit dry batteries. It is arranged so that the first tube may be used as a radio detector in order that the set may be either a two-stage amplifier or a detector and one-stage amplifier. When supplied with 4-volt storage battery and telephone headset it is ready for use. The dimensions are 9⅛ in. by 7⅜ in. by 4½ in. (23.1 cm. by 18.7 cm. by 11.4 cm.), and the weight is 8 lb. (3.6 kg.).

The input transformer which was used in the SCR-72-B amplifiers and in certain other equipment which involved stages of amplification as built in units was designed and manufactured by the Western Electric Company. It is a shell-type transformer, and its winding is composed of about 6000 ft. (1830 m.) of No. 40 enameled copper wire covered with a single layer of silk. The placing of orders with various manufacturers, which involved the construction of a total of nearly 40,000 of these transformers, revealed the fact that on account of the difficulty of manufacture and the scarcity of silk it would be impossible to obtain sufficient wire. Signal Corps engineers therefore attacked the problem of a substitute winding. The efficiency of the transformer depends largely on the reduction of turn-to-turn capacity, and enameled wire alone could not be used although the supply was ample. In cooperation with the Dudlo Manufacturing Company a sectionalized winding was developed using No. 40 enameled wire with paper insulation between layers. This winding is not only as efficient as the previous one but is considerably cheaper.

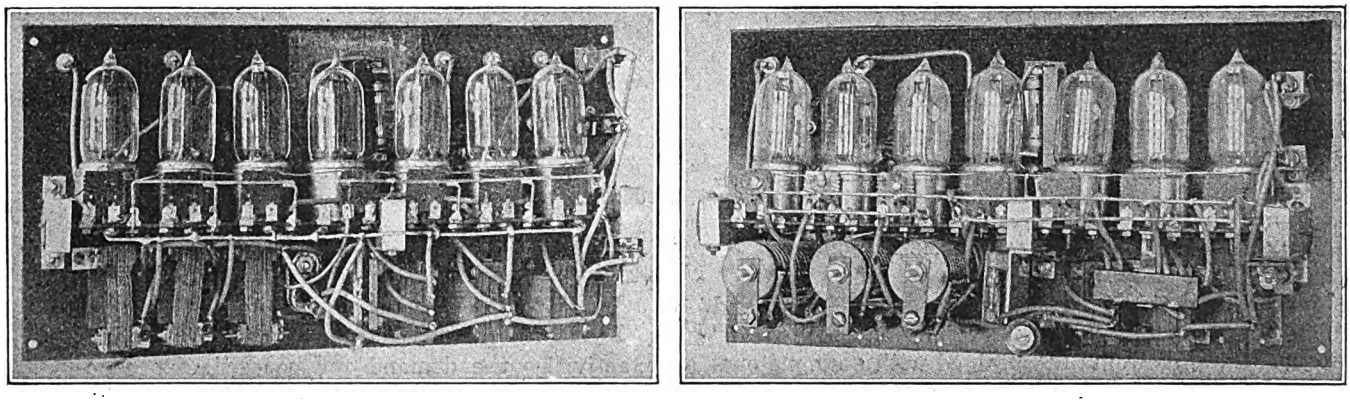


FIG. 7 AND 8—SEVEN-TUBE RADIO-AUDIO FREQUENCY SETS

Audio stages at right; radio stages at left. Note the use of air-core input transformers in Fig. 8

The type of transformer described above, either with silk or paper insulation, is a very efficient one from the

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electrical standpoint and produces negligible distortion in telephonic currents. It is, however, large and heavy, and the addition of two or three of them to an airplane set or a set designed to be carried on the back of a soldier in the field is a serious thing, since in such equipment every possible ounce must be eliminated. After a considerable amount of experimental investigation the Signal Corps engineers have designed a much smaller and lighter transformer which is fully as satisfactory in its electrical characteristics and is in addition easier and cheaper to manufacture. The old and the new types are contrasted in Fig. 4. The former weighs 2 lb. (0.9 kg.) and the latter 7 oz. (0.2 kg.).

RADIO FREQUENCY AMPLIFIERS

The development work on radio frequency amplifiers has been carried out entirely by Signal Corps engineers assisted in its initial stages by information gained from the French and British. The principal use to which these amplifiers have been so far applied is in connection with radio direction finders. In this work the signals are generally so weak (and thus the amount of energy picked up by the small loop antenna is so meager) that extremely high amplification must be employed. To build a reliable, efficient amplifier of more than three stages, at any one frequency, is practically impossible, since very grave difficulties are met with in keeping it from howling or oscillating. It is, however, quite feasible to amplify a radio signal at its radio frequency, pass it through a detector tube and then amplify the resulting audio frequency current. This not only gives the increase due to both the radio and the audio frequency amplifiers, but in addition increases the detector tube efficiency since, within limits, the efficiency of detection increases with the signal strength. Thus the receiver usually works out best in seven stages —three radio, one detector and three audio. Properly

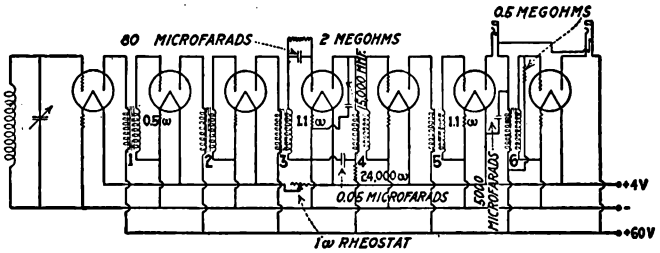

FIG. 9—DIAGRAM OF CONNECTIONS FOR SEVEN-STAGE AMPLIFIERS—LOW-FREQUENCY TRANSFORMERS AT RIGHT

designed sets of this kind, operated non-oscillating and without regeneration, will give signals more than 10^{14} times as strong as would be obtained with a simple one-tube detector. By using a regenerative feed back much higher amplification can be realized but the operation becomes less stable.

Of the several methods which may be used for transferring the output of the plate circuit of one tube of a radio frequency amplifier to the input or grid circuit of the next tube, the iron-core input transformer has been most used. Air-core transformers have also been successfully utilized, but they result in a less stable unit. A picture of an iron-core radio frequency input transformer is shown in Fig. 5. The core is made up of laminations of enameled soft steel 1½ mils thick (0.38 mm.). The primary and secondary windings each consist of a single layer of No. 40 enameled copper wire. The magnetic circuit contains a short air gap. The transformer is approximately the same size as the small audio frequency one and is somewhat lighter. The air-core transformer illustrated in Fig. 6 consists of several pancake windings on a grooved spool of insulating material. Alternate coils are connected in series, one set being primary and the other secondary.

Figs. 7 and 8 show rear views of the panels of seven-stage radio-audio frequency amplifiers made up with iron and air-core radio frequency input transformers respectively. The three radio stages are on the left of the picture, the detector in the middle, and the audio stages on the right in each case. The tube sockets are carried on sponge rubber to reduce vibration. The other parts are carried directly on the panel. The two amplifiers are identical in outside appearance. The filament rheostat provides control of the degree of amplification, and no other adjustment is needed. The particular sets illustrated were designed for use in airplanes. Others of very similar appearance have been made for ground use. The circuit diagram is shown in Fig. 9. The batteries for supplying the plate current are contained in a separate box. It is desirable to have the amplifier box as small as possible because it is more convenient to mount several small boxes in an airplane than one large box. The plate battery consists of three standard 20-volt dry batteries in series. The filament battery must supply 7.7 amp. at 4 volts.

The following radio engineer officers of the Radio Laboratories have contributed effectively to the development of the radio frequency amplifiers: Second Lieut. James M. Cork, Signal Corps, and Second Lieut. Leon T. Wilson, Signal Corps.

The utility of radio frequency amplification in connection with the highly important art of radio direction finding has been demonstrated. It is highly probable that it will find other equally important applications. The high selectivity obtained, together with ability to make easily audible extremely faint radio signals, marks it as a promising aid toward the final solution of the problem of eliminating static interference.

With further development of improved types of vacuum tubes there is certain to be a corresponding improvement in amplifiers. The sizes of the vacuum tubes and the amount of power required for heating the filaments may be reduced, thus making it possible to construct very small, light amplifiers which can be operated with a dry cell for heating the filaments.

I AM of the opinion that from the time we restore ourselves to our normal post-war activities the demand for peace-time production will be so great that there will not be the remotest possibility of securing any reduction in the wage rates from their present basis. I feel further that the manufacturer who fails to take into consideration the prospects of the future, and who, in a hope of securing cheaper labor or cheaper raw material, does not build up his organization and maintain it during the possibly brief period of readjustment, will be handicapped in securing his share of the business afterward; because he will be handicapped through lack of working forces in his factory. —*William B. Wilson, Secretary of Labor.*

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Design of Small Direct-Current Armatures

A Method of Systematically Designing Small Armatures Is Presented Based Upon Both Test Data and Theory Developed for Larger Machines—Progress Has Been Limited by Lack of Experimentation

BY C. R. WYLIE
Consulting Engineer, formerly Director Research Laboratory of the Remy Electric Company

CO-OPERATION, standardization and efficiency are the issues every one must face squarely and promote intelligently during the long period of reëstablishment which has already begun. Electricity is going to serve as one of the greatest industrial agencies in the stabilization of economic conditions, and the electrical profession must prepare to shoulder its approaching responsibility. Chief among the applications of electricity in the revitalizing of industry should be the universal electrification of machinery and all motive processes. The day of the small motor would seem to be at hand, yet many of the smaller machines on the market are by actual test found to have much less excellent characteristics (*i.e.*, efficiency, weight and cost as related to capacity) than they could be made to have. This may mean that the small dynamo is produced too often by imitation.

Problems in Manufacture of Small Dynamos

In the manufacturing of small dynamos the same completeness of individual testing of the finished product as is necessary for large machines can hardly be afforded. For instance, individual heat runs in small factories are out of the question. However, there should be some attempt at general supervision in the matter somewhere between the designer and the customer. Heat runs should at least be made from time to time on typical machines. It is possible for the designer to calculate from the known properties of his iron and his copper the total watts lost as heat in the armature under load conditions. Standardized manufacture and investigative testing will show how many watts per square inch of armature surface is allowable for safe operation of each size of machine produced. Thus rational ratings may be established. The rating is naturally a function of the ventilation, friction and the durability of insulation, copper, etc., and hence of the size and speed of the machine.

In the designing of direct-current dynamos the basic problem is the dimensioning of the armature. When once the dimensions of this part of the machine, the number of slots and the required flux are known, then it is a comparatively easy matter to determine the field winding, dimensions of the magnetic circuit, etc. Consideration of the armature cannot be, however, altogether independent of the field details. Under some conditions, of course, the details of the whole will have to be "jockeyed" somewhat until the most satisfactory combination is found.

It is the purpose of this paper to review the basis for the standard procedure in armature design and to furnish data providing for the application of these principles to the smaller machines similar to the data published by Gray and others for large machines. It is hoped that this article may stimulate interest in the small dynamo among writers and in the trade.

The data presented have been established by analytical consideration of the magnetic properties of present-day armature iron of excellent quality and checked by the observed properties of about a dozen modern high-class machines of different makes and within the range considered. The data, it must be kept in mind, are definitely related to the magnetic quality of the iron used in the armature core. The curves submitted imply the best iron in use at the present and assume good ventilation and careful mechanical construction. Where a poor grade of iron is used for the armature core, where the laminations are thicker than usual, where the mechanical features are such that undue heating by friction results, or where the machine is to be operated inclosed, a suitable margin will have to be allowed in selecting values from the curves. On the other hand, as the materials used in the construction of armatures are improved the curves will become more and more conservative and ultimately, it may be expected, will require elevation.

Basic Design Data

The limitation to the capacity of the armature of a dynamo (motor or generator) is the heating that may be safely allowed. The heating of an armature results from the armature copper loss ($I^2_a R_a$), the two core losses (hysteresis, $W_h = k_h f \beta^{1.6}_{max}$, and eddy currents, $W_e = k_e t^2 f^2 \beta^2_{max}$), bearing and brush friction and heat transferred from the field. If the sum total of these effects is such that the ventilation to be obtained provides for the dissipation of the heat generated at a rate such that the ultimate rise of temperature may be considered as not endangering the insulation, then the corresponding load conditions may be considered as a proper rating for the machine. Consideration of these matters makes it evident that the efforts of the designer must comprehend as a composite aim: (1) the reduction of the resistance of the armature to a minimum; (2) the use of the best magnetic iron, *i.e.*, that which has the lowest hysteretic and eddy current constants; (3) mechanically excellent bearings and minimum heating of the commutator; (4) excellent ventilation; (5) minimum heat loss in field; (6) the most durable insulating material with due regard to mechanical and electrical requirements, and (7) at the same time the ultimate cost must be kept within economic limits.

Obviously the joint influence of the various factors involved in heating an armature can be properly regarded only by the use of one or more empirical constants. Core losses and copper loss produce by far the greater part of the heating; ventilation and mechanical friction can be pretty well standardized. Thus a suit-

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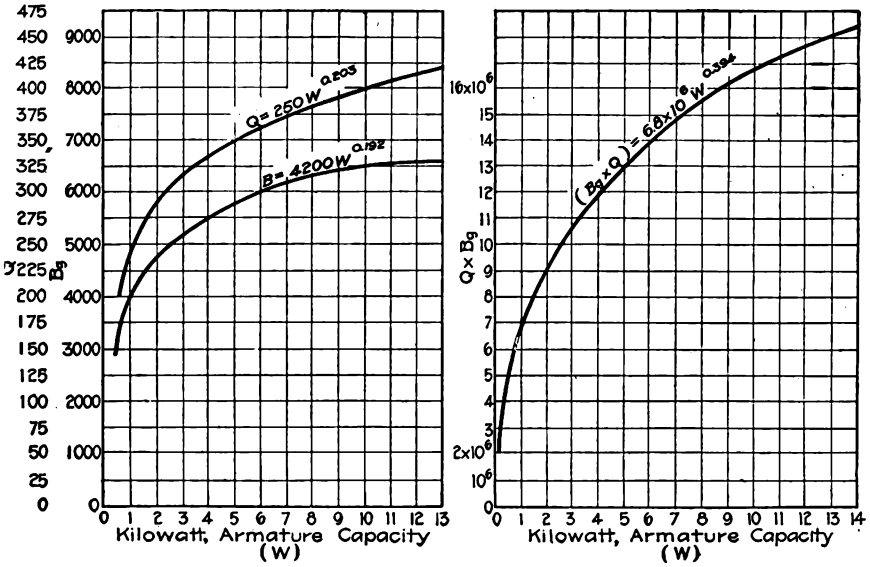
able method of supervision may be based upon empirical flux density and specific copper loss as a function of the required armature capacity. Such factors can be approximated by the application of thermal principles and the consideration of the properties of magnetic iron, checked by data deduced from experimental observation of high-class machines already constructed. Curves exhibiting values obtained in such manner have been constructed; they appear as Fig. 1. Fig. 2 is a composite of the two curves of Fig. 1.



FIGS. 1 AND 2—EMPIRICAL CONSTANTS FOR USE IN THE DESIGN OF SMALL ARMATURES

(1) Loading factor (amp. cond. per in.) and average air-gap flux density (gauss) as a function of armature capacity.
(2) $Q \times Bg$ as a function of armature capacity, Q = amp. cond. per in. Bg = air-gap flux density, maxwells per square inch.

Before the curves can be satisfactorily understood and utilized the manner in which the empirical factors relate themselves to the armature dimensions must be determined. A simple analysis based upon the fundamental equation of the generator leads to this understanding showing how the volume of the armature is a function only of capacity, speed and these constants.

The fundamental equation for the direct-current dynamo is familiar. It is:

$$E_a = \frac{\varphi Z N P 10^8}{60 p} \qquad (1)$$

Here:

E_a = the generated emf. in volts (back emf. in the case of the motor).
φ = the magnetic flux in maxwells.
Z = the total number of inductors about the periphery of the armature.
N = r.p.m.
P = number of poles
p = number of paths in parallel in the armature winding.

Since the designer knows the capacity, speed voltage and type of winding for a given machine before he seeks to determine dimensions, the electrical capacity of the armature in watts may be written:

$$W_a = pE_aI_p \qquad (2)$$

where I_p = the current in amperes per armature path. Let it be assumed that B_g is the average flux density in the air gap in maxwells per square inch (apparent air-gap flux density), and let L_a be the length of the armature in inches and D_a its diameter in inches; then:

$$\varphi = B_g L_a \frac{\pi}{P} D_a \rho \qquad (3)$$

Where:

$$\rho = \frac{\text{pole arc}}{\text{pole pitch}} = 0.7 \text{ on the average.}$$

Substituting (3) in (1):

$$E_a = B_g L_a \frac{\pi}{P} D_a \rho Z \frac{N}{60} \frac{P}{p} 10^{-8} \qquad (4)$$

Then substituting (4) in (2)

$$W_a = E_a I_p p = B_g L_a D_a \pi \rho Z \frac{N}{60} I_p 10^{-8} \qquad (5)$$

It is certainly true that the amount of allowable armature current is related to the size of the armature and the number of inductors because of the limit to the heat that can be safely radiated per square inch (with standard insulation and good ventilation). The copper loss is proportional in any given machine to the number of inductors, and the amount of heat loss allowable is proportional to the radiating surface of the armature. In other words, heating is proportional to CZI^2_p, and the heating per square unit of surface may be taken as an index for the acceptable armature capacity.

The radiating surface of an armature comprises the cylindrical surface and the two irregular ends. It is safe to assume that the increased surface in the ends over that of the projected cross-section of the armature corresponds approximately to the increased lengths of wire.

Hence, since heating is proportional to the length of wire, the amount of heat to be radiated may be considered as independent of the shape of the ends of the arma-

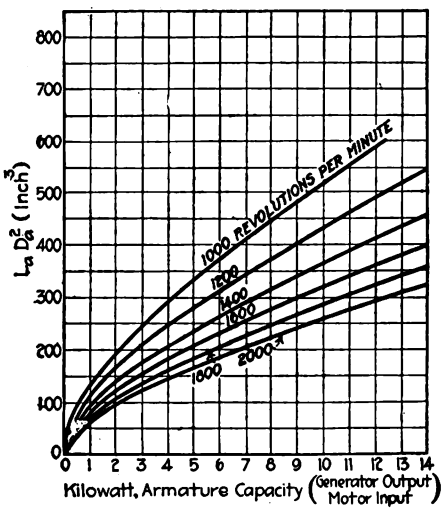


FIG. 3—VARIATION OF $L_a D_a^2$ WITH ARMATURE CAPACITY AND SPEED
Based on Fig. 1. $= 0.7$

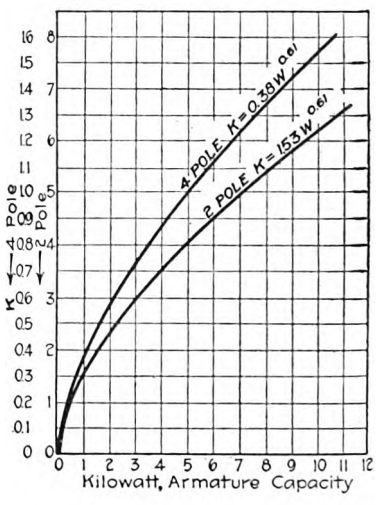


FIG. 4—VARIATION OF CONSTANT K WITH ARMATURE CAPACITY AND NUMBER OF POLES

From equation $L_a = \sqrt[3]{\frac{K \times 10^5}{N}}$.

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ture. In other words, the total radiating surface may be considered as

$K_1 \times$ cylindrical surface of armature $= K_1 \pi D_a L_a$,

and the total heating as:

$K_1 \times$ heat generated in the inductors $= K_1 Z R_z I_p^2$.

Thus the heating per square inch may be written:

$$\frac{k_1 Z R_z I_p^2}{k_1 \pi D_a L_a} = \frac{Z I_p}{\pi D_a}\left(\frac{R_z I_p}{L_a}\right)$$

$R_z I_p$ is clearly the potential drop in each inductor. R_z is proportional to the length of the armature L_a; hence:

$$\frac{R^z I_p}{L_a} = \frac{k L_a I_p}{L_a}$$

This expression will be constant for a given machine and will depend upon the specific resistance of the copper used. Calling such constant K_z, the heating per square inch becomes:

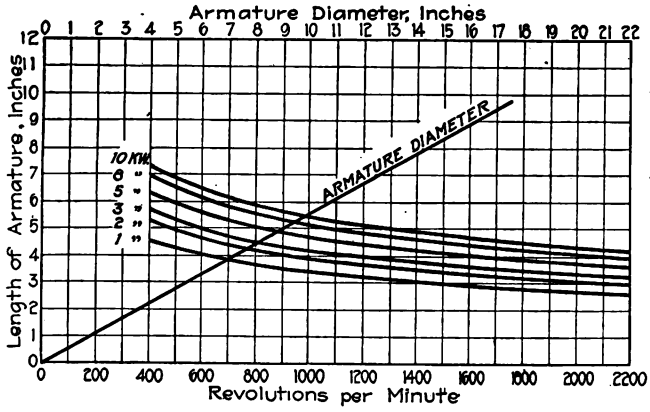
$$H_a = K_2 Z I_p / \pi D_a;$$

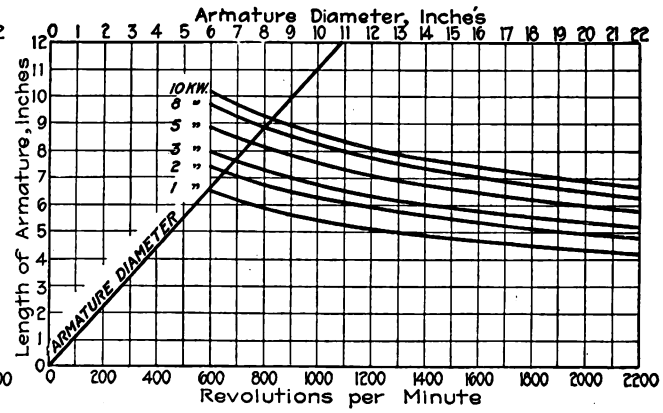
or

$$H_a/K_2 = Z I_p/\pi D_a.$$

H_a/K_2 may be regarded as definitely related to the size of a machine, since H_a, the allowable heating per square inch of radiating surface, is established by practice in relation to dimensions, ventilation and durability of insulation.

H_a/K_2 is thus a specific constant depending upon the length and specific resistance of the copper, specific core losses for the iron used, ventilation and insulation. It may be approximated by investigation.





FIGS. 5 AND 6—ARMATURE LENGTH AS A FUNCTION OF SPEED ($\rho = 0.7$)

Fig. 5—For four-pole machine $L_a = \frac{33.6\ W^{0.203}}{\sqrt[3]{N}}$, $D_a = \frac{L_a}{0.55}$.

Fig. 6—For two-pole machine $L_a = \frac{53.5\ W^{0.203}}{\sqrt[3]{N}}$, $D_a = \frac{L_a}{1.1}$

Calling

$$\frac{H_a}{K_2} = \frac{Z I_p}{\pi D_a},\ Q, \qquad (6)$$

and substituting in (5):

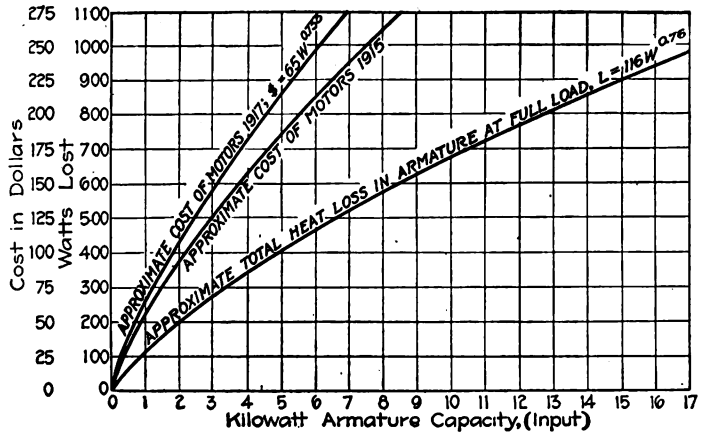
$$W_a = B_g Q L_a D_a^2 \pi^2 \rho \frac{N}{60} 10^{-8} \qquad (7)$$

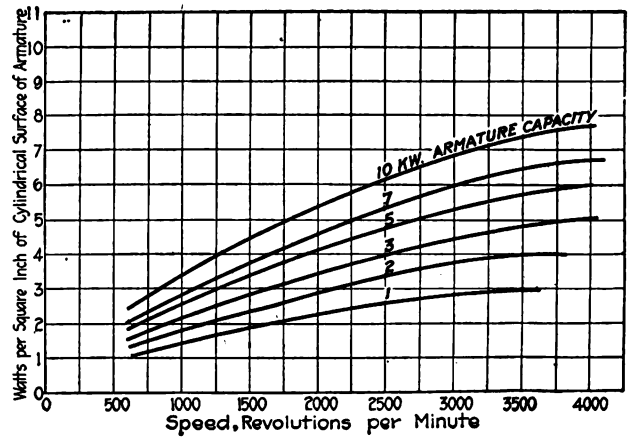
$= B_g Q L_a D_a^2 N 1.15 \times 10^{-9}$ (when $\rho = 0.7$)

$= B_g Q L_a D_a^2 N 7.42 \times 10^{-9}$ (where B_g is in gauss).

The amount of heating to be allowed per square inch of radiating surface must of course be less in small machines than in large. Also the eddy current losses and hysteresis tend to be greater in proportion to capacity on smaller machines. So Q and B_g increase as the capacity of armatures increases.

On the basis that the analysis here reviewed may be satisfactorily applied to the design of direct-current armatures ranging from 1 kw. to 10 kw. in rating, values for B_g and Q have to be deduced. As noted before, this work may be done theoretically or it can be accomplished by studying the properties of various high-class machines of modern type (those which upon test show excellent efficiency and consistent rating).





FIGS. 7 AND 8—ARMATURE LOSS AND COST OF SMALL MOTORS

Fig. 7—Shunt motors, 1200 to 1800 r.p.m., 115 volts.

Fig. 8—Safe allowable losses.

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An example of the second method as used in preparing the curves follows:

Machine Data:

Make, T—— E—— Co.	Arm. diam., 8¾-in.
Type, D.-C. shunt.	Arm. length, 4¾ in.
Capacity, 7½ hp.	Arm. inductors, 252.
Output, 5 kw.	Arm. res. ————
Speed, 1100 r.p.m.	Arm. capacity, 6 kw.
Voltage, 125.	$\rho = 0.7$.

At normal full load the efficiency was found to be 82 per cent.

The rise in temperature at the surface of the armature after six hours' run at full load was found to be 35 deg. C. from an initial temperature of 22 deg. C.

Determination of $B_g \times Q$:

From equation (7) of analysis

$$B_gQ = \frac{W_a \times 10^9}{1.15 \times L_a \times D_a^2 \times N} = \left(\frac{5\ 00}{0.82} \times 10^9\right) \div [1.15 \times 4.75 \times (8.75)^2\ 1100] = 14 \times 10^6$$

for B_g in maxwells per square inch.

Determination of Q: Number of slots = 63; number of conductors per slot = 252/63 = 4; periphery = 8.75π = 28 in.; ampere conductors per inch = (252 × 40)/28.0 = 360 = Q. B_g then may be deduced as: 14 × 10^9/360 = 39,000 maxwells per square inch = 39,000/6.45 = 6050 gauss.

Other points are checked by similar study of the selected dynamos.

The curves in Fig. 1 exhibit the determined values for B_g and Q as functions of the capacity. When plotted on logarithmic paper these curves give straight lines. Empirical equations were thus readily obtained for the range studied. These are:

$$B_g = 4200\ W^{0.192} \quad (8)$$

$$Q = 250\ W^{0.203} \quad (9)$$

$$B_gQ = 6.8 \times 10^6 W^{0.394}\ (B_g \text{ maxwells per sq.in.}) \quad (10)$$

This last equation is that shown graphically in Fig. 2.

It is evident from equation (7) that the capacity of an armature is a function of speed (N) and volume ($L_aD_a^2$).

From a consideration of Fig. 2 and equation (7) curves were calculated and plotted showing the relationship between size of armature in kw. and the volume index ($L_aD_a^2$) for varied speeds for polar arc ρ = 0.7). This family of curves appears in Fig. 3. These curves provide for finding what value the product of armature length and armature diameter squared should be for a dynamo of given capacity and speed. Having found such a value, it remains to separate the variables.

Evidently the peripheral circumference of the armature times 0.7 equals the length of pole face times the number of poles; *i.e.*,

$$C = \pi D_a = (L_{pole\ face}P)/0.7.$$

Since the width of pole face $W_{p.f.}$ may be regarded as equal to length of armature L_a, there need only to be established a relationship between length and width of pole face to be able to state length of armature in terms of its diameter. The ratio $W_{p.f.}/L_{p.f.}$ varies with different manufacturers and with different sizes of machine. Practice, however, shows that on small dynamos a ratio of 1 is in the end the most economical. This assumption is made in the present analysis. Thus:

$$D_a = PL_a/\pi\rho.$$

Inserting this value of D_a in equation (7) and solving for L_a:

$$L_a = \frac{W_a\pi^2\rho^2 60}{B_gQL_a^2P^2\pi^2\rho N}10^8$$

Whence.

$$L_a^3 = \frac{W_a\rho 60}{B_gQP^2N}10^8$$

and

$$L_a = \sqrt[3]{\frac{W_a\rho 60}{B_gQP^2N}}10^8. \quad (11)$$

With a given value of ρ, a given number of poles and a given armature capacity, length of armature depends only upon the speed; *i.e.*:

$$L_a = \sqrt[3]{K/N} \quad (12)$$

Where K is the combined value,

$$\frac{W_a\rho 60}{B_gQP^2}10^8.$$

ρ was taken as 0.7 and for successive values of W_a, ($B \times Q$) was taken from Fig. 2 and combined with 60 × 10^8 to give K as a function of armature capacity. Data for both two-pole and four-pole armature were calculated and curves plotted. These appear in Fig. 4.

In Fig. 5 is given a family of curves exhibiting directly the length of armature as a function of speed for any capacity of armature for four-pole dynamos. The data for these curves were calculated by substituting the proper values for K (as shown in Fig. 4) in equation (12).

Fig. 6 gives the corresponding family of curves where the machine is bipolar.

The total heat loss curve in Fig. 7 gives typical values for the copper and core losses in different-sized armatures. The curve was plotted with data secured from tests made on the motors studied in the preparation of this paper.

The remaining two curves in Fig. 7 show the approximate cost of small dynamos during 1917 and during 1915. The data were obtained from quotations, manufacturers' price lists and from a number of actual transactions. These curves are of interest in indicating prices which the manufacturer must reckon with in putting high-class machines in the market.

A factor of considerable interest and importance to the armature designer is the allowable heating in watts per square inch of radiating surface. The handbooks give various empirical constants varying with the size, speed, etc., from 0.5 watt to 10 watts per square inch of total radiation surface.

The faster a machine runs the more effective will be its radiation (within limits), and the larger the machine the more the heat that may be allowed to be radiated per square inch of surface. However, no data seem to be available showing reasonable values graduated with respect to capacity and speed for small armatures.

It has been attempted, in the curves of Fig. 8, to provide such data. These curves show heating densities suitable for well-built, well-ventilated dynamos. Since it is often hard to decide upon the total radiating surface of an armature, the values have been established in terms of the cylindrical armature surface, which area can be obtained definitely in every case.

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Methods and formulas based upon the theory of heat radiation, conduction and convection have been developed by various investigators expressing the degree of temperature rise of armatures in terms of dimensions, peripheral velocity and room temperature. The writer has tried to reconcile values computed by the use of such methods with the actual performance of small motors without any measure of success. As a result methods somewhat tentative were used in locating the curves of Fig. 8. The curves were constructed from combined data supplied by four methods of analysis:

1. Selection of consistent values calculated by use of theoretical formulas.
2. Calculation by use of the total heat-loss curve of Fig. 7 in conjunction with armature dimensions taken from curves in Fig. 5.
3. Calculation from measured dimensions and the calculated heat loss of actual machines.
4. Calculation from measured dimensions and the resulting data from actual heat runs on a number of motors.

These curves are offered as exhibiting the approximate allowable heat in watts per square inch of cylindrical armature surface for armatures of different capacities and different speeds. The basis for the plotting of the curves, it is readily seen, precludes the assumption that the values read therefrom represent a standard temperature rise. But, being based to a large extent upon data from high-grade machines giving satisfactory service, they represent safe heating values. In plotting, the curves were deliberately lowered a little in the smaller sizes at the lower speeds, in order to be conservative. On the other hand, heat-run data indicated that at the higher speeds and in the larger sizes the temperature rise within the core may be as much as, if not more than, 50 deg. C. It is believed that the curves may be regarded as corresponding to an approximate temperature rise of 40 deg. C. above a room temperature of 25 deg. C. for the smaller machines at lower speeds and gradually increasing to a maximum temperature rise of about 50 deg. above a room temperature of 25 deg. C. for the larger machines at the higher speeds.

These curves, taken together with the total-heat-loss curve of Fig. 7, will be found useful in checking up the performance of dynamos designed from the data given in the preceding curves or in selecting armature dimensions where it is desired to deviate from the values given by the design curves.

Street Lighting in a City of Average Size

Features of Ornamental System Installed at South Norwalk, Conn., with Small Initial Cost and Operated with a Low Maintenance Expense—Excellent Illumination Obtained with Simple Fixtures Which Assure Safety

BY C. D. GRAY AND E. HAGENLOCHER
of the J. G. White Engineering Corporation

AT SOUTH NORWALK, Conn., is a rather novel street-lighting system the building of which involved the solution of problems that are of vital interest to a large number of small cities where good and ornamental lighting is desired at a small initial cost and low maintenance expense. The layout chosen was selected after a study of many existing installations had been made in which it was found that equipment of the desired characteristics was not available on the market. Special diffusing and refractory glassware, together with a modification of a standard fixture and a bracket, was designed and used in this installation. This equipment is now available in a standard form.

The old system consisted of arc and incandescent lamps supplied by two 5-amp., 5000-volt circuits which received their current from a Thomson-Houston brush-arc machine. Owing to the difficulty of obtaining incandescent lamps rated at 5 amp. it was necessary to use standard lamps built for 5.5-amp. circuits, which, of course, gave low intensity of illumination. Another factor which still further decreased the illumination was that trouble with the windings of the arc machine reduced its capacity so that the circuits were supplied with only 4.8-amp. and 4.9-amp. respectively. The result was that the total effective illumination was reduced about 50 per cent from what should have been expected from the candlepower rating of the lamps. The 5-amp. arc lamps received more nearly their rated current than the incandescents but did not operate satisfactorily.

The first step toward improvement was the installing of three constant-current transformers rated at 15 kw. each and arranged so that one would be a spare and each of the others would supply two 6.6-amp. circuits. The old arc lamps were removed and replaced by 250-cp. power incandescent lamps with prismatic-band refractors mounted on temporary brackets. All the old incandescent fixtures were fitted with 6.6 amp. lamps. The change-over from the old arc machine to the constant-current transformers was made without any interruptions in the street lighting by taking one circuit at a time. The increase in the illumination was very noticeable, owing to the candlepower of the lamps being brought up to normal.

Lamp Fixtures.—The type of fixture employed is a product of the ideas of A. E. Winchester, general superintendent of the South Norwalk Electric Works, and D. M. Diggs, of the General Electric Company, and was developed after it was found that no fixtures were available on the market that would fulfill the required conditions satisfactorily.

A standard prismatic-band refractor gave a good distribution, but an effort was made by the men named to improve its appearance and to reduce the glare when viewed from a point near the pole. A visit to the factory resulted in combining a frosted bowl with an 8-in. (20-cm.) band refractor, which gives the desired effect. A 2-in. (5-cm.) hole in the bottom of the bowl gives ventilation and permits dust and insects to fall out. Col-

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lection of dust on the inside is avoided by the smooth and steep interior surfaces. For a similar reason it is difficult for dust or rainwater to collect or birds to find a resting place on the outside of the glassware or casing. A standard series socket with film cut-out is used for the lamps, the greater number of which are of 80 cp. By means of an elongated latch and removable globe holder and a pole with a lamp remover at one end the lamps can be easily changed and the glassware cleaned by any one standing on the street.

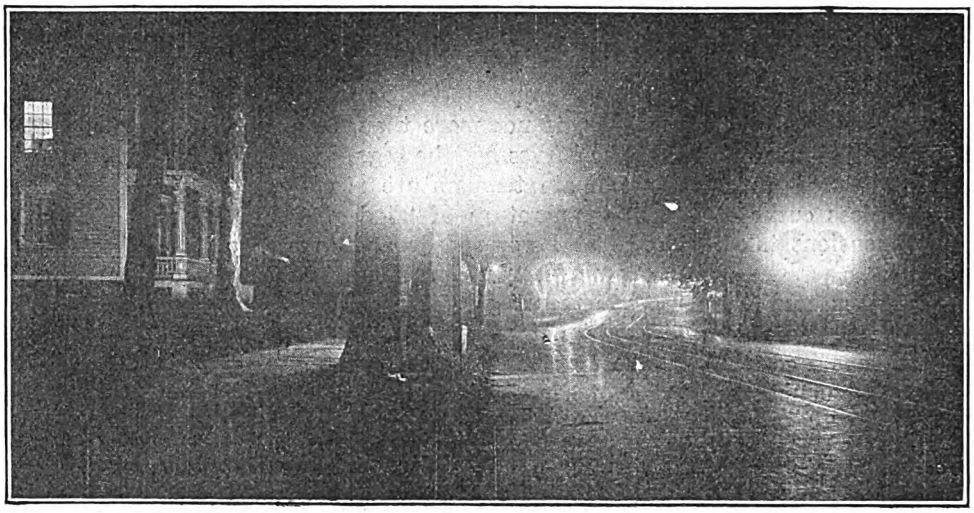

FIG. 1—NIGHT VIEW ON RESIDENCE STREET AFTER IMPROVING LIGHTING

The casing of the fixture was also specially made with the following objects in view: (1) To give a good balanced appearance in conjunction with the glassware and bracket; (2) to shape it so that birds could not alight thereon; (3) to provide a body large enough to accommodate a compensator for use with larger lamps, and (4) to facilitate access* to the lamp and globe for replacement and cleaning. No insulator is needed between the metal hood and the fitting for the pipe bracket on account of the low voltage (300 volts maximum) of the secondary circuit. (See Fig. 4 for outline of fixture.)

Since the glassware described above was put on the market an improvement has been made which adds a great deal to the appearance of the inclosing globe both in the daytime and the night-time, also bettering the distribution of the light. New dies have been developed which form the inner prismatic band and frosted bowl in one piece, and outside this a prismatic bowl is used which is continuous the full length of the glassware instead of stopping at the lower edge of the band. The smooth appearance of the fixture is thus enhanced, the frosted part of the glassware is not exposed to dust, and in the daytime the shoulder of heavy glass noticeable on the original fixture between the refractor and bowl is not seen and the fixture when lighted is of uniform brilliancy. The original glassware was fitted with ground joints at the top and bottom of the band refractor, whereas gaskets are now used to take up the greater expansion in the new arrangement. In Fig. 3 is shown the distribution curve for the fixture, when used with reflectors. It will be noted that the shape of the curve is such as to give uniform illumination on the street level with just the right amount below the lamps to avoid a dark or over-illuminated spot.

The brackets are made specially of 1½-in. (3.8-cm.) wrought-iron pipe with a cast scroll and the pole bands are made hollow. The wires from the lamps pass into the pole at a point in the bracket even with the lower pole band and are thence carried upward inside the pole to the cap, where they emerge from two outlets and are then brought down outside to tap on the proper service wires. A small amount of wire could have been saved by bringing the lamp leads through the upper pole band, but the hole which would have been necessary in the bracket pipe would have made the fixture weak at this point.

Circuits.—The city was laid out in four separate circuits and the lamps so arranged in the business district that in case one circuit became disabled the streets would not be in darkness. To do this the lamps on each side of the main streets are placed on separate circuits.

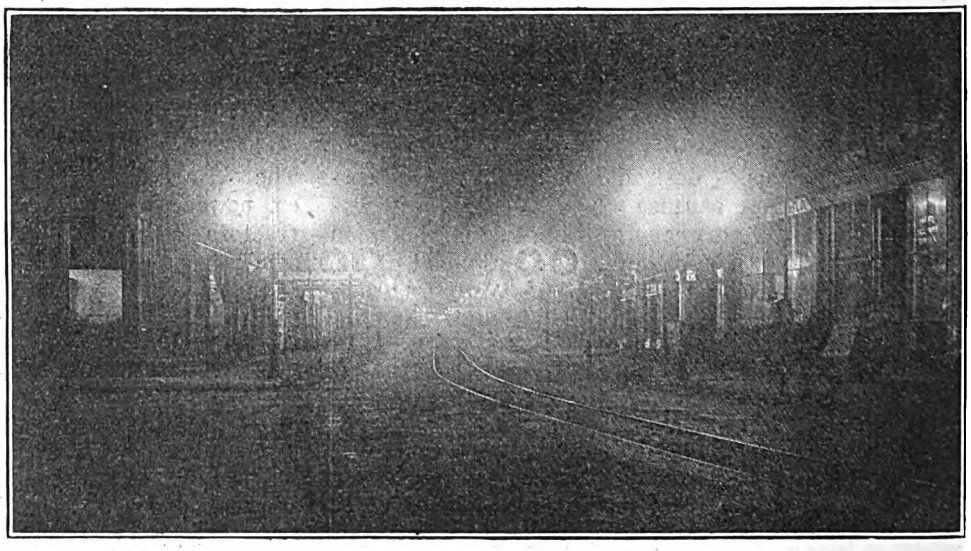

FIG. 2—NIGHT VIEW ON BUSINESS STREET AFTER REHABILITATING LIGHTING

It was also considered desirable to keep the high-tension lighting circuits away from the ornamental zone, which was done by placing General Electric type street-lighting transformers on side streets. These transformers are rated at 2 kva., 6.6/6.6 amp., and were inserted to reduce the potential of each secondary circuit to less than 300 volts. The lamps are fed in groups, thirteen pairs being connected on each transformer. Although the secondary circuit is a low-voltage one, the wire used in-

*Glassware holder can be opened by stick from ground.

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side the poles has an insulation thickness suitable for 2500 volts working pressure to avoid insulation breakdown where the leads pass around the sharp bends. Lighting in the outlying and less important sections was

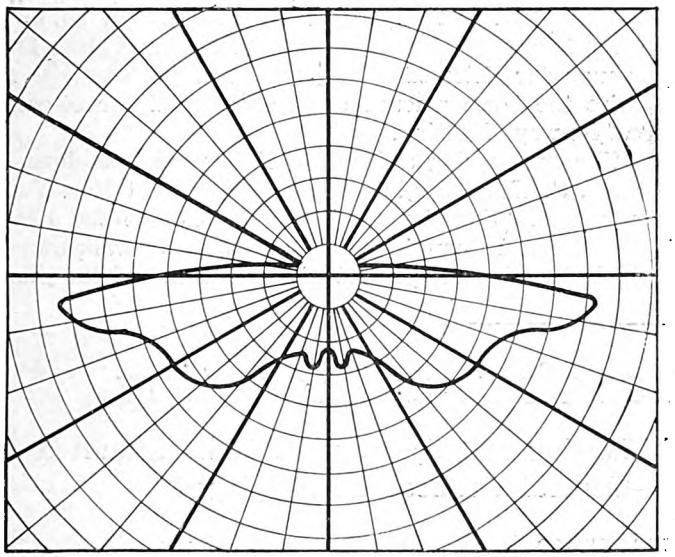

FIG. 3—DISTRIBUTION CURVE OF LIGHTING FIXTURE EMPLOYED IN SOUTH NORWALK INSTALLATION

improved by installing new brackets and band refractors. Most of these lamps were cut in directly on the secondary circuits of the constant-current transformers and were properly safeguarded. The total number of lamps are distributed as follows among the four circuits:

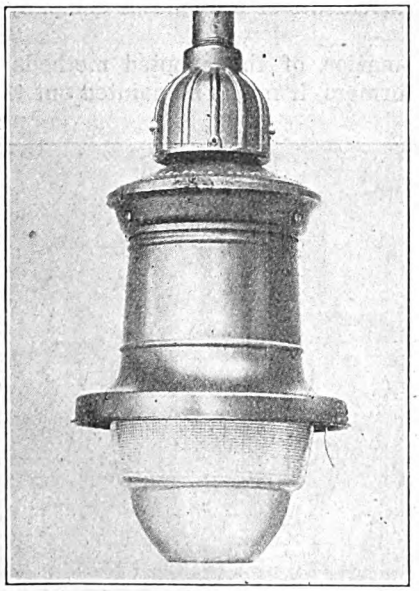

FIG. 4—FIXTURE USED AT SOUTH NORWALK

Circuit No.	80-Cp.	250-Cp.	No. of S. L. Transformers	Lamp Kw.
1	67	0	3	4.02
2	45	0	2	2.70
3	108	0	5	6.48
4	117	1	5	7.18
—	—	—	—	—
4	337	1	15	20.38*

*Of this total 286 lamps compose the ornamental lighting system.

Lamp Locations.—In the main business district the steel poles are spaced approximately 100 ft. (30 m.) apart on both sides of the street and placed opposite each other in order to carry the span wires for trolley lines where these exist. Double fixtures were placed on all the poles in the business district and on half the poles (usually staggered in position) in the residential section. The heavy foliage required many small units closely spaced to give good illumination.

As most of the residences were some distance back from the sidewalk line, it was considered advisable to have the new illumination extend back so as to light the residences. To fulfill this requirement the double fixture was especially effective, besides giving a balanced appearance to the ornamental pole during the daytime.

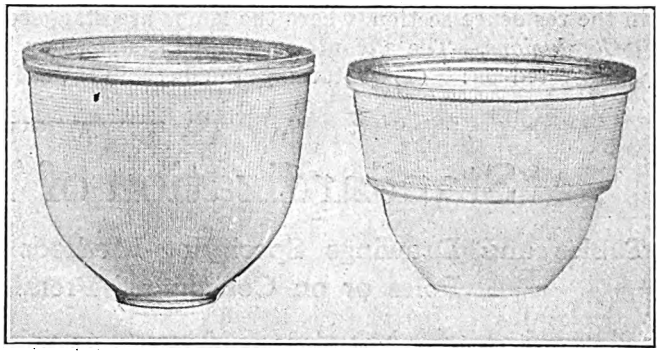

FIG. 5—IMPROVED STREET-LIGHTING FIXTURE GLASSWARE AND TYPE INSTALLED AT SOUTH NORWALK BEFORE DEVELOPMENT

The light that was reflected from the houses was not too intense to lessen the effect and added greatly to the attractiveness of the street at night. In the business

FIG. 6—DAYLIGHT VIEW OF INSTALLATION ON RESIDENCE STREET

The portion of the pole extending about 18 in. above and below the center of the filament is painted white to improve the appearance at night, as it was found that with a dark pole the sources of light did not appear to have a visible means of support. The appearance in the daytime is also improved.

district, where the stores are close to the sidewalks, it is desirable to have intense light on the building fronts.

The general effect of the illumination is very pleasing, as the light is well distributed over the surface of the street and there is no glare at any point. The lamps are placed at a height of 15 ft. (4.6 m.) above the road surface, and it has been noted by motorists and others that the intensity and distribution are so good that

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lamps on the machines are not required to avoid accidents. This is one great test of the utility of any illumination.

The illumination obtained from two 80-cp. lamps on each pole was found to be quite satisfactory, but in some cases 100 cp. was used to give extra light where needed. The installation is very economical as to power requirements, two 80-cp. lamps, rated at about 60 watts each or 120 watts per pole, being installed on poles averaging 100 ft. (30 m.) apart. This makes only 240 watts per 100 ft. (720 watts per 100 m.) of streets in the business section, and 120 watts per 100 ft. (360 watts per 100 m.) in the residence section, where the lamps are staggered.

Conclusions.—The advantages of this system may be enumerated as: (1) Obtaining the best illumination possible with available design of fixtures at an initial and operating cost much less than is usual with ornamental systems; (2) the system is ornamental both day and night; (3) safety from the wireman's and passer-by's standpoint—no part of the electrical circuits is within 14 ft. (4.2 m.) of the ground and the climbing space is clear; (4) the intensity of illumination is high enough for cities of average size and yet does not require the large amount of power needed for so-called "white-way" lighting.

The engineering and construction work was done by the J. G. White Engineering Corporation of New York, working in accordance with the wishes of the Board of Electrical Commissioners of South Norwalk and of A. E. Winchester, general superintendent of the plant.

Standardization of Transformer Mounting

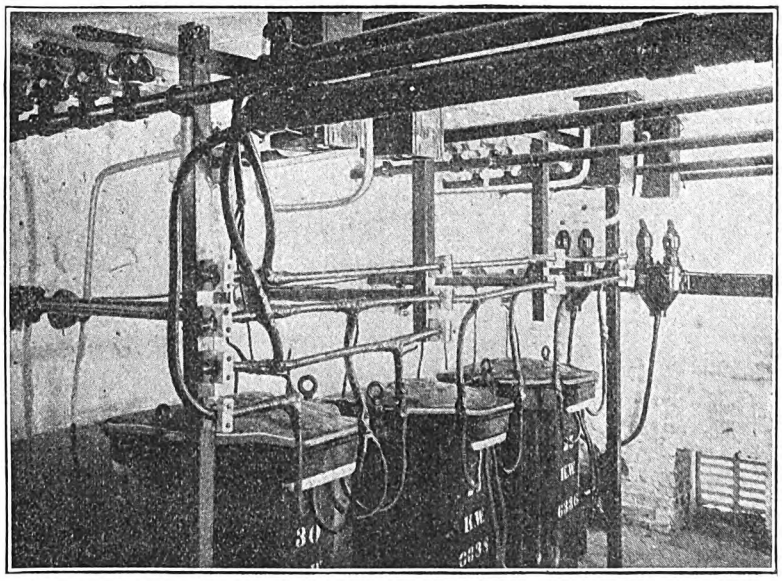
Tables and Drawings Specifying Methods of Hanging and Spacing the Units Mounted on Poles or on Consumers' Premises—General Connections Employed

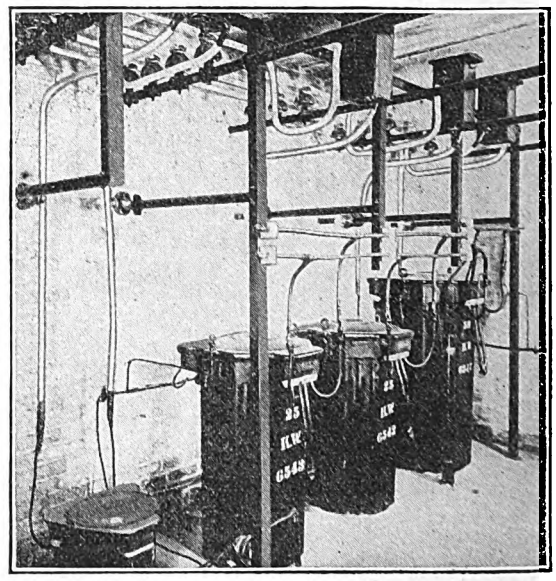
BY W. C. BLACKWOOD
Electrical Engineer New York & Queens Electric Light & Power Company

STANDARDIZATION, when it is not carried to the degree which prevents development, has usually been entirely beneficial. No exception exists in the borough of Queens, New York City, where the New York & Queens Electric Light & Power Company requires the following of specifications when transformers are installed on poles or on consumers' premises. No attempt has been made to provide detailed specifications for connections, as a diagram is made for each job, but the standard specifications show the method of hanging and spacing the transformers and the general method of making connections. The size of transformers hung on poles is limited by municipal regulations to 30 kva. for single transformers and 25 kva. for two or three transformers, and all larger transformers are placed in transformer rooms. Transformer-room installations are divided into two classes—(1) where the service is metered on the primary side, in which case a main oil-switch is installed, and (2) where the service is metered on the secondary side and the transformers are protected by fuses.

The practice, while it is not new, results in conservation of the engineering department's time, reduction of construction labor, speeding up of erection, and fewer stock parts, as well as other advantages, so the requirements of the Queens company will be outlined.

In explanation of the adopted methods of hanging the transformers, it might be pointed out that the present specifications have been in existence more than a year, or since the distribution system was changed from two-phase four-wire to three-phase four-wire.





FIGS. 1 AND 2—TRANSFORMER-ROOM INSTALLATIONS ON CONSUMERS' PREMISES

The location for hanging transformers of various sizes and groupings and the type of cross-arm to be used are specified on page 580. In selecting the gain in which to hang the transformers attention was given

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to difficulties which might be encountered in hoisting, to the stresses in the pole, to the accessibility of the cut-outs and to appearance. It will be noted that only single transformers up to and including 10 kva. are permitted on the top cross-arm and that transformers over 5 kva. are permitted on the top cross-arm only when that arm is not more than 40 ft. (12 m.) above ground.

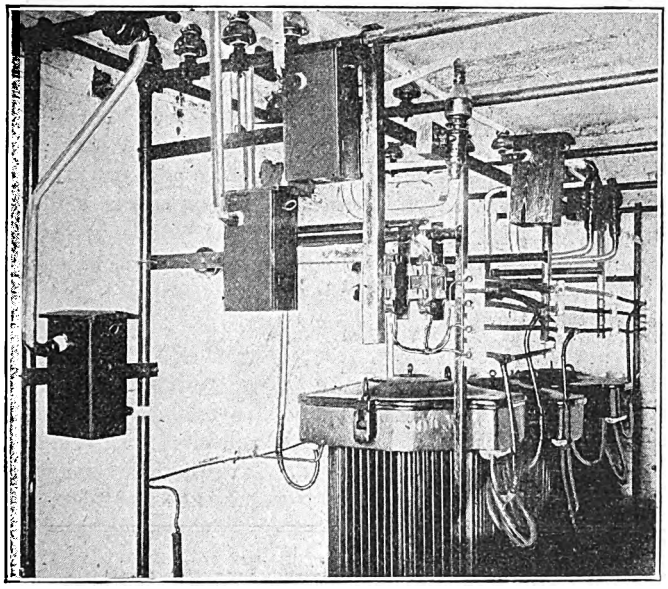


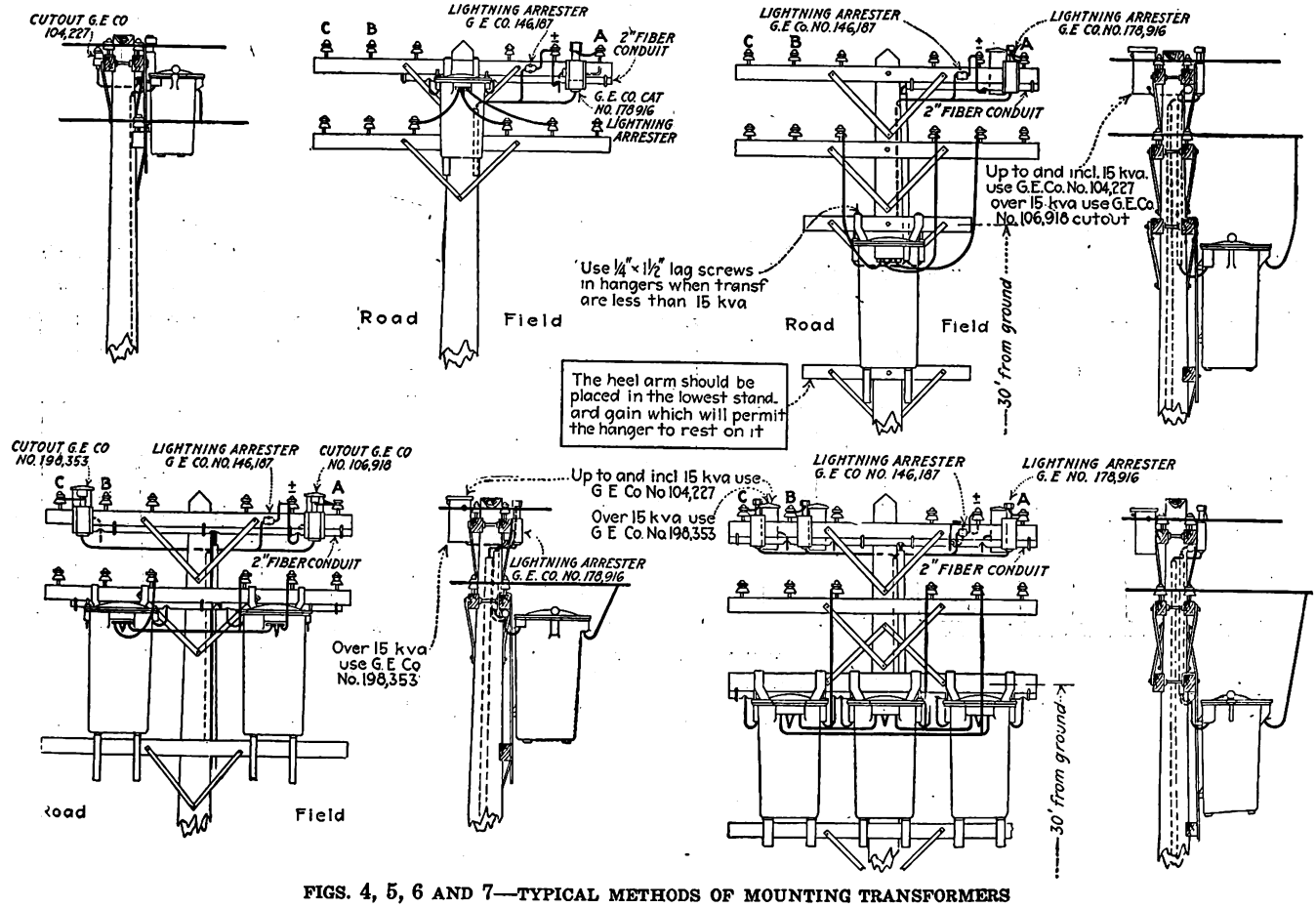
FIG. 3—ANOTHER TRANSFORMER-ROOM INSTALLATION

The limit of 10 kva. on the top cross-arm is made because of difficulty in hoisting larger transformers, and the limit of 5 kva. at a height greater than 40 ft. above ground is made to reduce the stresses in the pole. Groups of two or three transformers are hung either on the secondary cross-arm or on a transformer cross-arm 30 ft. (9 m.) above ground. They are not hung on the primary cross-arm because in such a location they would interfere with secondary wires on the arm below.

Standard cross-arms with a 3½-in. by 4½-in. (8.8-cm. by 11.3-cm.) section are used in all installations except those where three transformers of 15 kva. to 25 kva. capacity are hung, when a special arm 3½ in. by 6 in. by 8 ft. (8.8 cm. by 15 cm. by 2.4 m.) is used.

Lightning arresters are placed on the primary cross-arm on the same side of the pole, and the transformers and the cut-outs are placed on the opposite side, in which location they are more accessible for renewals. No cut-out is used in the neutral connection except in installations of three transformers, when a cut-out without plug is used to allow the connection of the neutral wire and the operation of two transformers as an open-delta bank in the event of the failure of one phase or the burning out of one transformer.

Primary connections are made with No. 8 B. & S. wire made up of thirty-seven strands, insulated with $\frac{4}{32}$ in. (3 mm.) of 30 per cent Para rubber and covered with two weatherproof braids. This wire is run, wherever possible, in 2-in. (5-cm.) fiber conduit strapped under the cross-arms and to the pole. The wire enters



FIGS. 4, 5, 6 AND 7—TYPICAL METHODS OF MOUNTING TRANSFORMERS

The table on the following page indicates whether the transformers must be mounted on the primary, secondary or transformer cross-arm and also the size of arm required. Fig. 4 is the arrangement used for single transformers of ratings up to and including 10 kva. when mounted on the primary arm. Fig. 5 indicates the mounting of a single transformer rated at 7.5 kva. to 30 kva. on a transformer cross-arm. Fig. 6 shows two transformers mounted on the secondary arm and is typical of the arrangement for the same number of units. When the rating exceeds 25 kva. they cannot be mounted on poles. Fig. 7 is the arrangement employed for three transformers rated at 7.5 kva. to 25 kva. when mounted on a transformer arm as shown.

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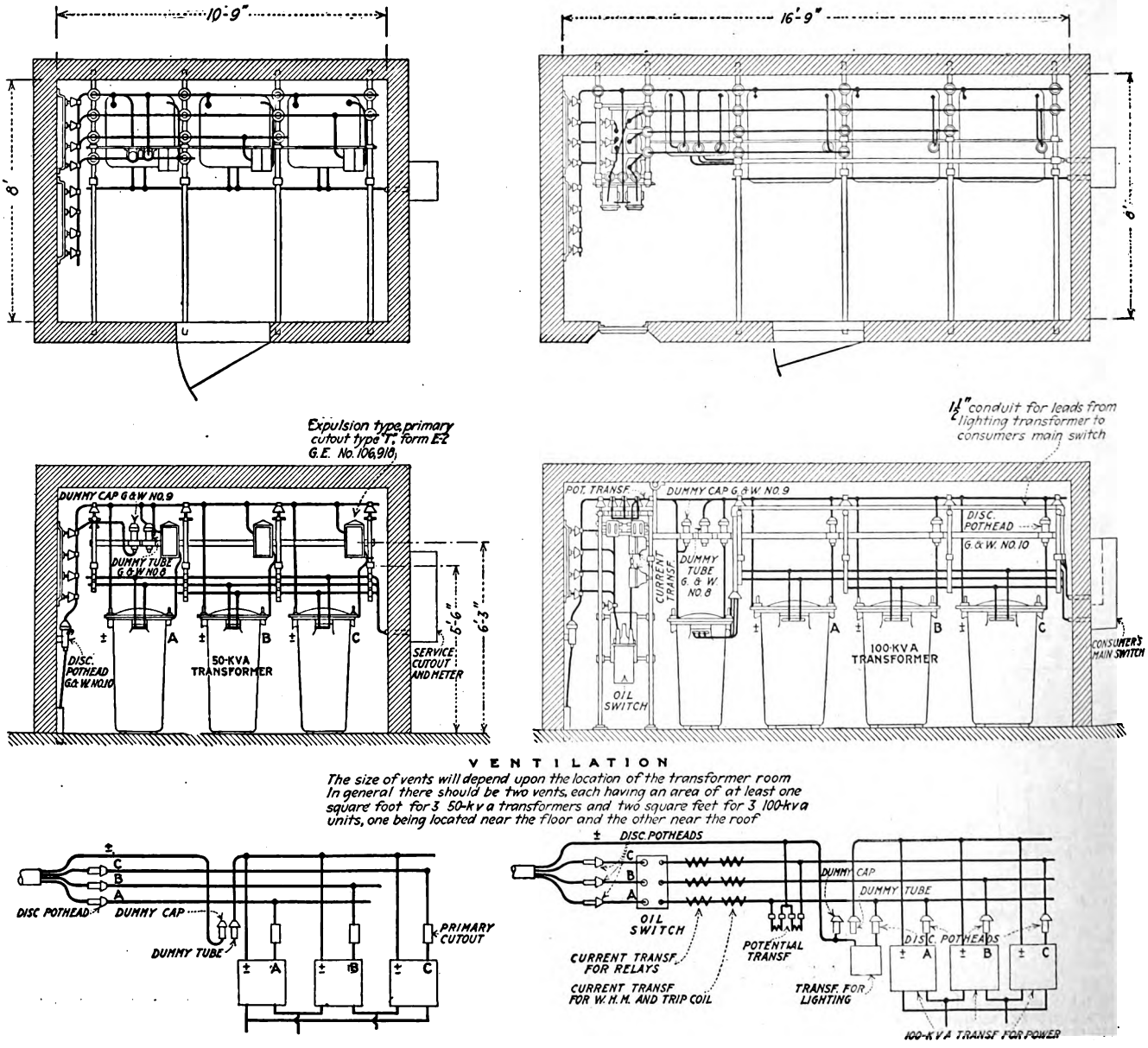
LOCATION FOR TRANSFORMER AND SIZE OF CROSS-ARM

Number of Transformers	Size	Hang Transformer On	Type of Cross-Arm
Single transformer.....	Up to and including 5 kva....	Primary arm, any height pole.....	Standard
Single transformer.....	7.5 to 10 kva., inclusive.....	Primary arm, when not more than 40 ft. above ground.....	Standard
		Transformer arm, 30 ft. above ground when primary arm is more than 40 ft. above ground.....	Transformer arm 3½ in. by 4½ in. by 4 ft. 6 in. long
Single transformer.....	1.5 to 30 kva., inclusive.....	Primary arm, when not the top arm and when not more than 40 ft. above ground.....	Standard
		Secondary arm, when not more than 40 ft. above ground and when primary arm is the top arm....	Standard
		Transformer arm, 30 ft. above ground when secondary arm is more than 40 ft. above ground.....	Transformer arm 3½ in. by 4½ in. by 4 ft. 6 in. long
Two transformeers.....	Up to and including 5 kva....	Secondary arm, any height pole.....	Standard
Two transformers.....	7.5 to 25 kva., inclusive.....	Secondary arm, when not more than 40 ft. above ground.....	Standard
		Transformer arm, 30 ft. above ground when secondary arm is more than 40 ft. above ground.....	Standard
Three transformers.....	Up to and including 5 kva....	Secondary arm, any height pole.....	Standard
Three transformers.....	7.5 to 10 kva., inclusive.....	Secondary arm, when not more than 40 ft. above ground.....	Standard
		Transformer arm, 30 ft. above ground when secondary arm is more than 40 ft. above ground.....	Standard
Three transformers.....	15 to 25 kva,. inclusive.....	Transformer arm, 30 ft. above ground.....	Transformer arm, 3½ in. by 6 in. by 8 ft. long



FIGS. 8 AND 9—TYPICAL ARRANGEMENT OF TRANSFORMERS, BUSBARS, AND PROTECTIVE AND SWITCHING EQUIPMENT INSIDE TRANSFORMER ROOMS

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and leaves the conduit through notches sawed in the under side. No attempt is made to make a fitted joint where the horizontal runs meet the vertical conduit and the ends of the conduit are left open. In all cases the neutral wire is connected to the left-hand terminal of the transformers and the transformers are arranged and connected in the same order as the primary wires on the cross-arm. The detailed methods of hanging transformers and the general method of making connections are shown in the accompanying drawings.

Where transformers are installed on consumers' premises the consumer is required to furnish a fireproof room properly ventilated to the outside air. The size of typical rooms and the arrangement of apparatus are shown in the accompanying drawings. The smallest room specified will accommodate three 50-kva. transformers and the largest will accommodate three 100-kva. power transformers and a smaller transformer for lighting. Consumers having a greater load than 300 kva. are usually supplied at 6600 volts.

Primary service is brought into the transformer rooms underground, single-conductor cables being used. The cables terminate in disconnecting potheads, and from the potheads a primary bus is carried over the transformers on a pipe framework. When an oil switch is installed the control for the switch, the relays, meters, etc., are installed on a panel immediately outside the transformer room. In such installations no fuses are used on the power transformers but potheads are installed for use as disconnectives.

The secondary wiring is run on cleats in a vertical plane in front of and above the transformers.

The drawings for both the pole and transformer-room installations are reduced to letter size, and copies, together with a set of general specifications, are supplied to each foreman so that all work is carried out according to the standard plan and in an economical way.

SHORT COURSE PROVIDED FOR ELECTRIC METERMEN

Iowa State College Does Practical Work for Electric Service Companies in the State by Assisting in Education of Employees

To comply with the requests of a number of the electric companies of the state, the engineering extension department of the Iowa State College, Ames, offered a four days' course, Feb. 18 to 21 inclusive, for electric metermen. This course was the first one of its kind offered in Iowa, if not in the United States. It proved of special interest to employees of those companies which do not find it possible to provide training for meter testers. There were, however, many plant owners among those registered. Thirty-five men, representing nearly as many different companies, attended the meetings. The engineering extension department had direct charge of the course. Prof. F. D. Paine of the electrical engineering department had charge of the instruction work. He was assisted by Prof. A. B. Campbell, of the engineering extension department, and C. C. Crawford, formerly of the meter department of the Upper Iowa Power Company.

The instructional work consisted of lectures, discussions, demonstrations and laboratory work. The lectures and discussions were based on a list of questions which applied to the construction, operation, testing and repair of the important makes of meters. The laboratory work followed this same plan, and the men were able to put into practice the important points which they were studying. Rotating standards were used.

In connection with the short course the different manufacturers placed on exhibit the latest types of meters and loading devices. Specialists from these companies gave very interesting talks on the development, construction, testing and manufacturing of the induction type of meter. The electrical engineering department had a historical exhibit showing the many stages of development from the lamp-hour meters to the present types. Special emphasis was placed on the benefits of accurate registration, the results obtained through good service, and the relation of the meterman to the consumer. Those in attendance have asked for a more advanced course for another year.

At the last session held by the metermen those in attendance formed the Iowa Electrical Metermen's Association. Prof. F. D. Paine, of the electrical engineering department of Iowa State College, was elected the first president. George T. Gibson, of the Gibson Electric Company, Des Moines, Iowa, was elected to the combined offices of vice-president and secretary-treasurer. The primary purpose of the organization is to place before its members the important features relative to the operating, testing and repairing of meters and to form a closer relationship with the business and operating part of the central-station business. At least annual, if not semi-annual, conventions will be held. Committees are being appointed to complete the organization.

CLASS ORGANIZED FOR STUDY OF ELECTRIC METERS AT IOWA STATE COLLEGE

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ELECTRIC GENERATION AND DISTRIBUTION IN CANADA

Leo G. Denis, of Canadian Commission of Conservation, Shows High Standard of the Country in Electric Development—Utilization of Water Power

"IT IS sometimes stated that the degree of progress and civilization of a country may be gaged by its electric development; in this respect, and with due regard to population, the results of the investigation shown in this report demonstrate quite clearly that Canada stands in the front rank." This is the introduction to a report by Leo G. Denis, hydroelectric engineer of the Commission of Conservation of Canada, on "Electric Generation and Distribution in Canada." Following are extracts from the report:

"The information shows that there are a total of 565 electric generating plants in Canada, with an aggregate capacity of 2,107,743 hp. and supplying not less than 752 distributing systems of varying importance, which cover some 973 places. There are 270 hydroelectric plants aggregating 1,806,618 hp., 201 steam plants aggregating 288,202 hp., 49 gas plants aggregating 8157 hp. and 45 oil or gasoline engine plants aggregating 4766 hp., making the total of 2,107,743 hp.

"Usually the large hydroelectric installations are of most substantial construction, and the most expert engineering advice has been obtained, while the equipment is in keeping and comprises both hydraulic and electrical machinery of the most efficient type. The same, unfortunately, cannot be said of many of our small plants, and, particularly in the older ones, there is undoubtedly great room for improvement.

"The same comment applies to our steam plants; the large ones, although a number of them are only used as auxiliaries, are very efficiently equipped and operated, but many of our small plants show much room for improvement. There are many small plants in the prairie sections, where the price of fuel is high, the majority of them using oil, gasoline or producer gas. Considering such municipalities and others in their vicinity which desire electric service, it would seem to be worth while to generate energy in large steam plants, situated at suitable distribution centers, and thus supply transmission systems extending to the various communities within economic radius.

Ratio of Municipal and Privately Owned Plants

"The ownership of the various plants is divided into 207 municipal or publicly owned plants of 452,508 hp. total rating and 358 privately owned plants of 1,655,235 hp. total rating.

"Our largest hydroelectric development is 488,800 hp. in the three larger power plants at Niagara. The large installations are not all confined to this site, however, there being five plants of over 100,000 hp. and thirty-six plants of over 10,000 hp. rating. The average head of water utilized is not exceedingly high, but many of our large hydroelectric plants operate under fairly high heads, such as 140 ft. to 180 ft. (42 m. to 54 m.) at Niagara, 145 ft. (44 m.) at Shawinigan, 83 ft. (25 m.) at Grand'mere and 400 ft. (122 m.) at the Coquitlam-Buntzen plants near Vancouver.

"The plant at Hamilton, Ont., 26,667 hp., is the largest steam-power plant in Canada and is used as an auxiliary, while the plant at Edmonton, Alta., 14,234 hp., is the largest steam plant operated continuously.

"The cost of generation for hydroelectric plants is usually given in dollars per horsepower-year, and among the lowest reported is a cost of $8.50 per horsepower-year, the plant being only of about 10,000 hp. rating, but operating under a 90-ft. (27-m.) head. For very large plants the cost should be even substantially lower, while for plants of the same order it varies from $8.50 to $15 per horsepower-year; in smaller hydroelectric plants $30 to $40 per horsepower-year may be reached.

"Lines of various voltages from 10,000 upward aggregate 5490 miles (8835 km.) and are as follows: 10,000 to 30,000 volts aggregate 2428 miles (3907 km.); 30,000 to 99,000 volts aggregate 2485 miles (4010 km.); 100,000 volts and upward aggregate 577 miles (925 km.).

"The cost per mile of the different lines naturally varies with the mode of construction, size and number

GREAT GROWTH OF OUTPUT OF ELECTRICAL ENERGY SHOWS HIGH STANDARD OF DEVELOPMENT IN CANADA

of conductors and voltage for which constructed. For voltages of from 10,000 to 50,000 the figures given show a wide variation of from $600 to $11,000 per mile, while on 100,000-volt lines and more we have from $7,500 to $14,000 per mile.

"Of the 752 distribution systems in Canada, 389 are municipally or publicly controlled, while 363 are under private ownership. The systems included cover a total of 11,852 miles of streets and supply 730,697 consumers with an estimated connected load of 497,846 kw. for lighting and appliances and 970,505 hp. for power."

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

OUTDOOR TRANSFORMERS

Made Standard for Self-Cooled Units with Certain Exceptions to Meet Demand

During the past two or three years the demand for outdoor-type construction has been extended to cover self-cooled units in power sizes quite generally. Water-cooled transformers are not so much affected, and in no case has this tendency extended to air-blast transformers. In view of this tendency the Electric Power Club, which is representative of transformer manufacturers, has approved the standardization of outdoor construction for self-cooled distribution and power transformers under the following conditions:

Single-Phase.—When ratings are the same as those listed in the Electric Power Club's rules as standard for light and power service or where the voltage rating is above the limits of the 33,000-volt class and where the low-voltage rating is identical with or higher than the standard low-voltage rating listed in the rules mentioned.

Three-Phase.—Where ratings are equivalent to the single-phase ratings mentioned. This rule is intended specifically to exclude transformers for special service such as those for operating synchronous converters, electric furnaces, etc., where the low-voltage currents are very heavy, making the outdoor construction difficult and expensive to obtain and where the outdoor construction is not usually required because of the practice generally to install such transformers indoors.

PECULIAR CASE OF TROUBLE WITH POLYPHASE MOTORS

They Kept Three-Phase Supply Line Energized So Other Motors Could Be Started Even When Normal Polyphase Supply Was Cut Off

BY L. E. BROWN
Superintendent Distribution Springfield Light, Heat & Power Co.

A peculiar case of trouble recently was called to the attention of the service department of the Springfield (Ohio) Light, Heat & Power Company by one of its larger factory customers. This factory is supplied with 220-volt, three-phase alternating current from a bank of transformers. Practically all of the machinery in a new building is operated from line shafting driven by a 50-hp. motor supplied through a No. 3/0 line in conduit. A number of other motors in other parts of the factory operate from the same supply line. The transformers are protected against overload by main-line secondary fuses, and each motor has a set of fuses, switch and compensator.

About 5 o'clock the factory called up the company and complained of low voltage, stating that the big motor and its line had been running very hot for an hour or more, and that in fact the conduit was smoking. The factory closes soon after 5, and by the time the trouble man reached the location all but one of the other motors were shut down. A test lamp showed voltage on all three phases, both ahead of and behind the 50-hp. motor fuse, although it was noticed in a casual way that the light burned brightly only on two phases. No importance was attached to this at the time. However, the motor would not start the line shafting, although it would attempt to do so. The compensator was held to the starting position for some time in an attempt to start the motor by idling the belt, and during this period the factory electrician noted that the other motor, which was already running, stopped. Following this, the 50-hp. motor would not attempt to start. The main-line fuses were at once examined, and one of them was found blown.

An analysis of the situation led to the following conclusion: During the time when the heating occurred and up to the hour of closing all motors had been operating from a single-phase supply following the blowing of one of the main secondary fuses. During this time the 50-hp. motor was started and stopped a number of times, and the other motors had of necessity supplied polyphase power for so doing, they being themselves driven and excited from the single-phase supply. The prolonged attempt to start with only one motor running proved too much for it, and it died down, depriving the 50-hp. motor of anything but single-phase power.

THE ESTIMATED COST OF OVERHEAD INTERCONNECTION

Data Refer to Lines Linking the Edison Illuminating Company of Boston and the New England Power Company

The proposed tie line between the system of the Edison Electric Illuminating Company of Boston and the New England Power Company, to which reference has been made in the ELECTRICAL WORLD, will begin at the "L" Street station in South Boston and extend underground to Forest Hills, thence by overhead route, chiefly along the right-of-way of the New York, New Haven & Hartford Railroad, to Baker Street, with a connection to the Dedham substation of the Edison company. At Baker Street it is proposed to install transformers to raise the pressure from 25,000 volts to 66,000 volts for transmission to the Metropolitan Water Board's plant at the Sudbury dam, in Southboro. At the latter point connection will be made with another 66,000-volt line built by the Metropolitan board and tying the Edison line, Sudbury and Wachusett plants into the New England Power Company's system at Clinton.

The estimated cost of the overhead-line construction as recently prepared totals $302,084. The details of this estimate are shown in the accompanying table. It may

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be seen that for the 66,000-volt section the estimated cost is about $10,000 per mile. Steps are now being taken to secure locations for early construction.

FOREST HILLS—DEDHAM SECTION

Length	5.9 miles
Line pressure	25,000 volts
Type of line	Wooden pole
Number of pole lines	1
Number of circuits per pole (three-phase)	2
Range in pole lengths	35 ft. to 65 ft
Type of insulators	Pin
Type of cross-arms	Steel
Average pole spacing	120 ft.
Size of conductors	Equivalent to No. 3/0
Estimated cost (two circuits):	
Superintendence, timekeeping, surveys, etc	$3,507
Poles erected	17,012
Clearing	3,430
Cross-arms, insulators, etc	18,735
Conductors erected	56,500
Right-of-way rental, basis $400 per mile per year	.....
Total section	$100,084

BAKER STREET—SOUTHBORO SECTION

Length	20 miles
Line pressure	66,000 volts
Type of line	Wooden poles
Number of pole lines	1
Number of circuits per pole (three-phase)	1
Type of cross-arm	Wishbone steel
Type of insulators	Suspension
Location of line, chiefly on private right-of-way:	
Maximum width of right-of-way	125 ft.
Average pole and spacing	225 ft.
Size of conductors	No. 3/0
Estimated cost (one pole line):	
Superintendence, timekeeping, surveys, etc	$7,450
Poles erected	27,400
Clearing	13,040
Cross-arms, insulators, etc	39,550
Conductors, erected	47,360
Camp operation	3,200
Right-of-way	64,000
Total section	$202,000

THE REPAIR OF DAMAGED COILS IN TRANSFORMERS

Method Which Does Not Require Rewinding and Is Permanent Enough for Continued Operation Is Recommended

BY G. A. ILER

Superintendent Operation, Tests and Repairs, Georgia Railway & Power Company

Quite often lightning and other electrical disturbances enter a transformer and only damage one spot in a coil. Sometimes only one wire is burned in two, other times a dozen, leaving a hole the size of a dinner plate. In this case the usual practice is to order a new coil from the factory or make one in the shop.

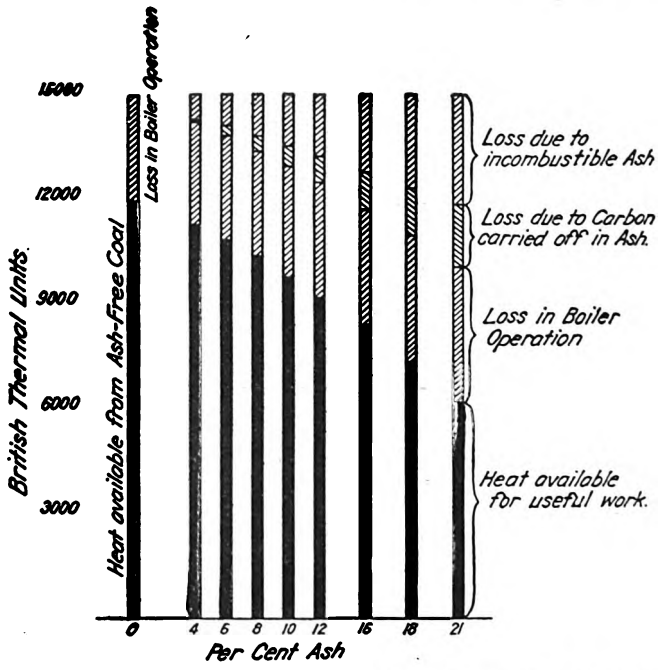
The writer has adopted a new method, which is to separate all the burned ends and clean them carefully, tagging the ends that belong to each other. After the charred insulation is removed from adjacent wires and surfaces, the ends are prepared for welding by beveling them a little, and a new piece of copper of proper length and cross-section is welded in this open gap between each set of ends, care being taken not to get any of the flux on other parts of the coil.

These wires are then carefully reinsulated with silk ribbon used as tape and some baking varnish. The reason silk is used is because it has a closer weave and is thinner than anything else, which allows more plies to be put on a wire before the wires become so large they will crowd each other out of place. Where large copper ribbon is burned open several strands of the equivalent cross-section have been used. Precaution must be taken, however, to transpose the strands if they are long enough to make several turns of the coil of which they are a part. This is necessary to make each wire the same length as the others with which it is in parallel and thus carry equal current.

FUEL HEATING VALUE REDUCED BY PRESENCE OF ASH IN COAL

As Percentage of Ash Increases Percentage of Combustible Lost with Ash Also Increases, Thus Still Further Reducing Boiler Efficiency

The heating value per pound of combustible (*i.e.*, ash and moisture-free coal) of all coals approximates 15,000 B.t.u. (1710 cal. per kg.). There are some variations from this figure, but as a general average it is about correct. The variation in the heating value of coal is consequently largely due to the varying percentage of the ash, the effect of moisture being less important except in a few cases of unusual moisture content. If an



REDUCTION OF HEAT VALUES DUE TO PRESENCE OF ASH IN COAL

ash-free coal could be obtained a heating value of about 15,000 B.t.u. per pound would be expected.

The percentage of ash has a distinct influence on the boiler efficiency. As the quantity of ash increases in percentage it becomes more difficult for the fireman to burn combustible completely. With a low percentage of ash and good firing it is expected that the ash removed from the boiler will contain approximately 25 per cent of its own weight of unconsumed combustible. As the percentage of ash increases the percentage of combustible lost in the ash also increases very rapidly. With coal containing a high ash percentage it is rarely possible to reduce the percentage of combustible in the ash to under 50 per cent of the weight of the ash.

This information was taken from a report of the engineering committee of the National Research Council to the National Coal Association as prepared by the J. G. White Engineering Corporation of New York City.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INTEREST IS GROWING IN FARM-LINE EXTENSIONS

Farmers, Besides Being More Prosperous than Formerly, Are Learning the High Comparative Cost of Isolated Plants

One electric lighting company in the Middle West reports a very active inquiry in the matter of farm-line extensions to serve the farmers in the vicinity, and other companies are no doubt experiencing a very considerable amount of interest along this line. This, it is stated, is brought about principally by two causes: First, the farmer is more prosperous than he has ever been and has the ready means for providing himself with modern necessities, and electricity is in this class; second, the existing high cost of isolated installations has caused him to give consideration to the question of extensions for his service.

DETAILS OF CONNECTED LOAD IN SOUTHERN CALIFORNIA

Although 3030 Customers Were Added in 1918, Restrictions and Daylight Saving Kept Down Increase in Energy for Lighting

Some interesting figures on the details of connected load in horsepower of the Southern California Edison Company and subsidiary companies are given below:

	1918	1917
Lighting	219,111	210,078
Pumping plants for irrigation	104,786	93,218
Cement manufacturing and rock crushing	22,721	25,076
Railway	102,132	89,838
Municipalities, for resale	4,367	3,667
Municipalities, pumping, sewers, etc.	7,714	6,831
Ice making and refrigeration	4,379	3,501
Motion-picture industry	2,935	2,328
Industrial heating	2,036	1,741
Electric cooking	18,867	13,918
Industrial and miscellaneous	113,884	100,730
Total	602,932	550,926

The daylight-saving law and orders issued by the Fuel Administration limiting the use of electric energy for street, sign and window lighting had a marked effect on the amount of energy used during the year for lighting purposes. Notwithstanding that there were added to the company's lines during the year 3030 lighting consumers, the total number of kilowatt-hours distributed for lighting purposes increased only 2.29 per cent over the previous year, but, owing to the fact that the company's schedules for lighting service provide that with a decreased consumption the rate per kilowatt-hour automatically increases, the revenue from lighting service shows an increase over the previous year of 4.09 per cent. With the withdrawal of the restricting orders, lighting revenue from existing consumers may be expected to increase substantially.

"As after-war readjustment progresses in southern California the demand for electric energy for all practical purposes is greater than ever before," the president of the company states in his annual report. "The strenuous work of the past twelve months has further demonstrated and emphasized the utility, flexibility and economy obtained by the use of electric motive power, and many power users who formerly were wedded to other prime movers are now converted and ready for a change to electricity. A large power, heating and lighting load is now ready to be taken on in territories relatively close to existing lines."

THE ELECTRIC HEATING OF RESIDENCES A DREAM

The Costs Which Would Be Involved in Heating a Five-Room House Are Shown to Make the Project Prohibitive

At the conclusion of a paper devoted to the principles involved in heating houses electrically, presented before the Idaho Public Utilities Commission a short time ago, Joseph F. Merrill, director of the School of Mines and Engineering of the University of Utah, outlined the expense involved in a typical case of house heating by electricity.

"Let us assume a five-room or six-room bungalow cottage," said Professor Merrill, "of the design common in the smaller towns (and also in the cities) of Utah and southeastern Idaho. It would have a heating exposure of about 25 ft. by 15 ft. by 40 ft., or 15,000 cu.ft., and would require, to be comfortably heated in zero weather, an installation of 15 kw. delivered to the house. With 25 per cent line and transformer losses from the plant to the house, this would require 20 kw. capacity at the central station. At a cost of $200 per kilowatt, this would require $4,000 investment in plant capacity alone, to which line, substation and distribution capacity would add at least $100 per kilowatt of station capacity, thus giving a total investment of $6,000 for heating plant for this house. If we assume, as we have heretofore done, that this capacity could be otherwise utilized for one-half of the year, we would still have an investment of $3,000 in heating plant for the house with fixed charges at 12 per cent, amounting to $360 per year, to which operating costs must be added. To state accurately what these operating costs would be would require a careful analysis of modern station practice which I have not had an opportunity to make. The larger part of these costs are incurred beyond the plant switchboard in transmission and distribution, and they vary with the particular transmission and distribution systems. Station output costs are disclosed by operating reports of various stations.

"The thirteenth annual report of the Reclamation Service, page 35, gives the output cost of the Minidoka plant for the year 1913 (multiplying the kilowatt output by the cost per kilowatt-hour and dividing by the rated capacity) at a trifle over $5 per kilowatt. (This low cost is possible because no interest, taxes or in-

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surance is charged.) The actual costs of distribution per kilowatt sold would probably be at least three times this amount.

"If we charge but half of an aggregate cost of $20 per kilowatt delivered to the heating load, the cost of delivering 15 kw. to residence heating appliances is increased by $150, giving a total cost of $510 for heating a five-room cottage. The same quantity of heat would be produced by direct heating apparatus in the house from approximately 10 tons of coal, at a cost of about $80.

"In this statement I have assumed the fixed charges to aggregate 12 per cent. This would allow 6.5 per cent interest, 3.5 per cent depreciation and 2 per cent taxes and insurance. If the state should own and operate power plants and could finance such plants with money borrowed at 4.5 per cent, it could save about 4 per cent in interest and taxes, or about $16 per year per kilowatt of capacity delivered, in fixed charges. This, however, would affect our heating load on the assumptions made above only by one-half of this amount, or $8 per year per kilowatt, or $120 per year per residence having 15 kw. demand, giving us a net heating bill for one of these residences of about $390 as against $510. So too, if it be contended that the installation costs assumed here are too high, it would make very little difference, from a practical standpoint, if the percentage of error should be as high as 50 per cent in the total installation, because that would decrease the fixed charges only by one-third, or to $240, for a 15-kw. heating plant in private ownership, or $160 under state ownership. The operating expense would still remain the same, giving a heating cost of $310 to $390. However, I am confident that my former figures are much more nearly correct for continuous-load capacity of stations as distinguished from mere rated capacity of machines, or mean flow of streams, than my latter.

"Another way of attacking the problem is to find the electric heat equivalent of one ton of bituminous coal and to find at what price electric energy would have to be sold to make electric heat the same price as heat from coal.

"Let us assume a house-heating plant to have 60 per cent efficiency, that a ton of coal costs $10 and that 1 lb. of coal has 12,000 B.t.u.'s. Then there would be delivered from one ton of coal $12,000 \times 2000 \times 0.6 = 14,400,000$ B.t.u.'s, which divided by $3412 = 4220$ kw.-hr., equivalent to a ton of coal. This would have to be sold at the electric heater for $10, or 0.23 cent per kilowatt-hour, which is impossible, commercially considered.

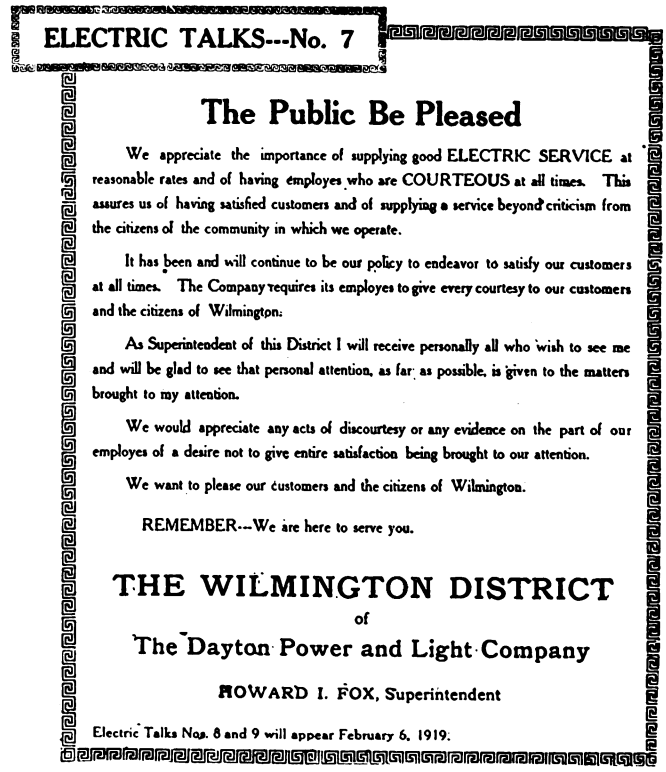
"The problem of heating on any extensive scale would be much complicated by the very sparse use of heating appliances. If it be assumed that a few well-to-do people in the town could pay from $375 to $650 a year for heating a small residence, they would be so very few that the installation required for their service would be rendered still more disproportionate in cost to the value of the service rendered by the lack of use of these facilities by their poorer neighbors, so that the heating costs must be recalculated again to a figure where even the favored few would find the heating service too costly to be practicable.

"Electric heating is, from an economic standpoint, a sort of alchemist's dream. We all know that electricity does produce heat, and we all realize and appreciate what a wonderful thing it would be to dispense with our coal piles and ash pits, our smoke, dust and cinders, and would therefore fain think it practicable. But a most cursory study of the subject, from the standpoint either of thermal dynamics or social or economic science, shows that it is utterly impossible."

INJECTING PERSONALITY INTO PUBLIC POLICY ADVERTISING

Series of Twelve Advertisements Strengthen Position of Local Superintendent with His Own Community

One of the objects of the Dayton (Ohio) Power & Light Company in running a series of twelve advertisements in the newspapers of Wilmington, Ohio, was to put the local superintendent, a new man, before the people in the right light. All of these advertisements were signed "Dayton Power & Light Company, Howard I. Fox, superintendent." Topics discussed included the character and quality of the service of the company,



ELECTRIC TALKS---No. 7

The Public Be Pleased

We appreciate the importance of supplying good ELECTRIC SERVICE at reasonable rates and of having employes who are COURTEOUS at all times. This assures us of having satisfied customers and of supplying a service beyond criticism from the citizens of the community in which we operate.

It has been and will continue to be our policy to endeavor to satisfy our customers at all times. The Company requires its employes to give every courtesy to our customers and the citizens of Wilmington.

As Superintendent of this District I will receive personally all who wish to see me and will be glad to see that personal attention, as far as possible, is given to the matters brought to my attention.

We would appreciate any acts of discourtesy or any evidence on the part of our employes of a desire not to give entire satisfaction being brought to our attention.

We want to please our customers and the citizens of Wilmington.

REMEMBER---We are here to serve you.

THE WILMINGTON DISTRICT
of
The Dayton Power and Light Company

HOWARD I. FOX, Superintendent

Electric Talks Nos. 8 and 9 will appear February 6, 1919.

TYPICAL PERSONAL-RELATIONS ADVERTISEMENT

the relation of the utility company to the prosperity of the community, rates, and the sale of stock to customers. One of the advertisements which is typical of the personal flavor injected into these announcements is reproduced. The result of the campaign was quite gratifying. The idea of square dealing and courteous treatment expressed in the advertisements has won for the company and the new superintendent a host of friends, which, in the words of the superintendent, "make the advertisements worth to the company ten times what they cost." This effect was noticed not only in the town itself but in the surrounding rural community. As to direct returns in new business resulting from the advertisements, the effort was also quite successful in this way. The net increase in meters during January and February, 1919, which was the month in which the advertisements were run, is 200 per cent more than it was in the corresponding month of 1918. The appliance sales were also better.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Efficiency Curves of a Continuous-Current Motor.—THOMAS CARTER.—In order to determine the influence of the distribution of losses on the efficiency curves of a continuous-current motor the author divides these losses into constant losses and variable losses, assuming that the variable losses vary with the square of the current and that the constant losses change only with speed and flux density. He derives in the first article of the series equations which show the dependence of efficiency on the various losses and presents some curves showing the variation of efficiency for various values of the variable k, which is the ratio between variable losses and total losses.—London *Electrician*, Feb. 21, 1919.

Power and Torque in Electric Motors.—JUSTIN LEBOVICI.—The author presents a discussion of power and torque of different kinds of motors based on the principles of the direct-current motor and of the static transformer. In the present installment he takes up the direct-current motor and begins discussion of the polyphase induction type.—*Electrical Review*, Jan. 11, 1919.

Effect of Interpoles on Commutation of Direct-Current Machines.—R. L. WITHAM.—The author deals with the purpose of the interpoles. How they operate to effect commutation and how one interpole may be used in each pair of main poles to serve the same purpose as an interpole for each main pole are explained.—*Power*, March 4, 1919.

Lamps and Lighting

Fundamentals of Illumination Design.—J. R. COLVILLE.—The writer considers the fundamental principles in illumination design and gives several tables which should be useful in connection with laying out a lighting system. In these tables may be found the foot-candle requirements in various types of buildings, shops and offices, and data are given on types of lamps and reflecting units.—*Central Station*, February, 1919.

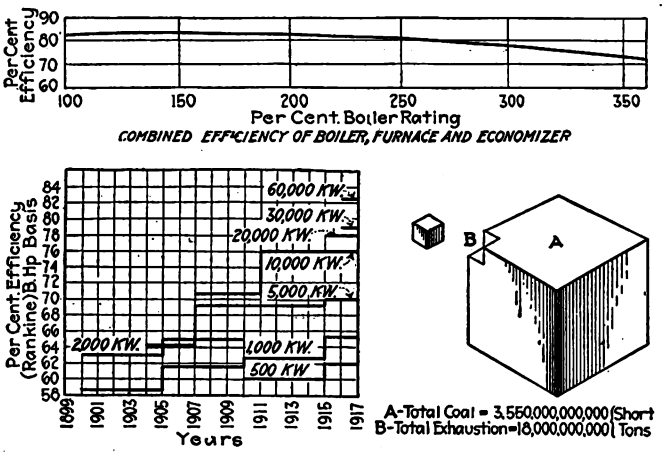
Generation, Transmission and Distribution

Calculation of Plant Efficiencies and Fuel Costs.—J. T. FOSTER.—The author presents two charts with which the engineer may readily determine the efficiency of boilers, evaporation and fuel cost per 1000 lb. of steam in mills per kilowatt-hour.—*Power*, March 4, 1919.

Logarithms of Hyperbolic Functions to Twelve Significant Figures.—FREDERICK E. PERNOT and BALDWIN M. WOODS.—The tables presented are given logarithms to the base 10 of the three principal hyperbolic functions, *i.e.*, the sine, cosine and tangent for the range from 0.000 to 2.000 with a tabular interval of 0.001 and auxiliary tables of log sinh x/x and log $x/\tanh x$ for the range from 0.000 to 0.500, with the same tabular interval as for the other tables. These tables were prepared primarily to fill a gap existing in Gudermann's tables of the logarithms of the hyperbolic functions. These tables should be useful in transmission line calculations.—*University of California Publications*, Nov. 16, 1918.

The Larger Undeveloped Water Powers of Tennessee.—J. A. FLETCHER.—In a comprehensive report on the undeveloped water powers of Tennessee the writer has given a number of curves showing the variation of stream flow and the drop in elevation along some of the streams in the state. Tables are also given in which water-power developments in various parts of the country are analyzed to show, among other things, what percentage of mean annual flow is required by the plant at its maximum capacity. The author states that within a radius of 80 miles (125 km.) of Knoxville the undeveloped water powers aggregate 800,000 hp. and within 50 miles (80 km.) nearly 700,000 hp. He also indicates many raw materials which can be used to advantage for chemical and metallurgical industries near this undeveloped water power.—*Proceedings American Electrochemical Society*, April 30, 1918.

Getting Better Economy in the Power House.—G. H. KELSAY.—The writer calls attention to the fact that substantial savings are possible in the boiler room by the use of some simple expedients which have been widely published in the technical press and in government publications. He shows what progress has already been made in improving boiler efficiency and gives curves



PROGRESS IN BOILER ECONOMY AND STATUS OF COAL SUPPLY

indicating what performances may be expected of boilers of various sizes at the present time. It is also shown that if the use of coal increases year by year as it has in the past the present supply will be exhausted in a period of about a hundred years. About one-half of 1 per cent of the available coal in this country has been used up to the present time.—*Electric Railway Journal*, March 8, 1919.

Development of Hydroelectric Resources in Eastern United States.—D. H. COLCORD.—The writer outlines in considerable detail the influences which have held back the development of water-power sites in this country. He also shows the urgent necessity for further development and outlines the advantages that may be realized

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from the more extended utilization of water-power resources.—*Electrical Review*, Feb. 8, 1919.

Development of the Two-Phase-Three-Phase Transformation.—CHARLES F. SCOTT.—The author gives an interesting background, showing how two-phase-three phase transformation was developed.—*Electric Journal*, January, 1919.

Features of Three-Phase-Two-Phase Generating Station.—Additions to the Sheboygan company's plant are of interest on account of the fact that it involves three-phase-two-phase transformation.—*Electrical Review*, Jan. 18, 1919.

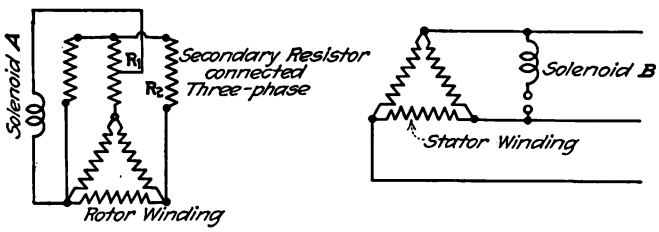
Installations, Systems and Appliances

Use of Electric Power in the Mining of Anthracite.—J. B. CRANE.—This paper gives figures for the power cost and energy consumption of anthracite mines and the reasons for these being in excess of the requirements of bituminous mines. Estimates are also given as to the additional coal that will be released by the electrification of the anthracite mines. Illustrations are included showing representative installations of electric drive.—*General Electric Review*, February, 1919.

Operating Details of an Electrically Operated Cement Mill.—The writer traces the progress of material through the mill and shows what apparatus and what size of machines are necessary for the various processes of cement manufacture.—*Electrical Review*, Feb. 8, 1919.

Electrically Welded Steam Lines.—H. R. WOODROW.—On account of the scarcity of extra heavy flanges during the war recourse was had to electrically welding a great length of 12-in. (30-cm.) steam pipe for the United States government explosives plant at Nitro, W. Va. The process is described in this paper.—*Power*, March 4, 1919.

Speed Control of Induction Motors by Solenoid Load Brakes.—R. H. MCLAIN and H. H. VERNON.—A few years ago practically all crane hoists were equipped with automatic mechanical load brakes, but to-day a very



MOTOR EQUIPPED FOR SOLENOID LOAD BRAKING

large number of cranes equipped with direct-current motors use dynamic braking instead. The development of the solenoid load brake for alternating-current wound-rotor motors makes possible the elimination on an alternating-current crane hoist of the more or less troublesome mechanical load brake. Practically the same speed-torque characteristics obtain with an alternating-current motor equipped with a solenoid load brake as with a direct-current motor with dynamic braking. There are only a small percentage of applications that cannot be met by either a multiple magnet brake, which gives two degrees of braking, or a solenoid load brake, which gives a variable amount of braking responsive to the speed of the motor with which it is used. The multiple magnet solenoid brake is made up in the form of one brake operated by two or more independent magnets. This brake is especially adapted for stopping apparatus which is moving in a horizontal plane. Where many varieties of load are to be lowered by the same hoist the solenoid load brake may be used. This brake consists essentially of an ordinary solenoid brake in which the solenoid is of such weight that very little braking action is obtained from the operating solenoid. But, in addition to this operating solenoid, there is another solenoid which is connected to the circuits of the rotor. If this second solenoid is de-energized, it applies heavier weight to the brake levers and consequently greater braking torque. If it is energized, its weight is almost raised from the levers and it exerts practically no braking torque. For intermediate values of excitation intermediate amounts of braking will be obtained. Since the voltage which is generated by the rotor of an induction motor varies directly as the slip of the motor, this arrangement is an ideal one, because when the motor is standing still a high voltage is induced in the rotor and consequently a small amount of braking would be obtained, whereas when the motor is running at high speed a low voltage is induced in the rotor and consequently a greater amount of braking is obtained.—*General Electric Review*, February, 1919.

Electrophysics and Magnetism

Conductivity of Sea Water.—H. R. RIVERS-MOORE.—The purpose of the investigation was to ascertain whether the resistance of sea water could be regarded for practical purposes as constant over a wide range of frequency and for very small current densities. The apparatus used in these investigations is fully described.—London *Electrician*, Feb. 7, 1919.

Note on Losses in Sheet Iron at High Frequencies.—MARIUS LATOUR.—In this article the author determines the power expended separately by eddy current and by hysteresis in a sheet of iron, on the assumption that there exists a constant angle of lag between the magnetic induction in the sheet and the magnetizing field producing it. He deduces the thickness which should be given to the iron sheets of an apparatus supplied by a high-frequency current in order that the total power expended shall be a minimum and then calculates the angle of lag between the voltage and the current in the circuit of an inductance coil.—London *Electrician*, Feb. 21, 1919.

Electrochemistry and Batteries

The Electron Spectrum of Iron.—It is said that while spectroscopic analysis has given an excellent means for the determination of high temperatures, such as in furnaces for the treatment of steel and iron, much care must be exercised in interpreting data of this sort. It has been shown that the iron spectrum depends on so many physical and electrical circumstances that considerable study must be devoted to this subject before the data can be interpreted with confidence.—London *Engineering*, Feb. 21, 1919.

Ionization and Resonance Potentials for Electrons in Vapors of Arsenic, Rubidium and Caesium.—P. H. FOOTE, O. ROYNLEY and F. L. MOHLER.—Two types of inelastic collision between the electron and atom occur in vapors of arsenic, rubidium and cæsium. The potential differences through which an electron must fall to attain sufficient energy or velocity to produce these collisions are known as the resonance and ionization potentials for the particular metal in question. Experimentally determined values of the resonance and ionization potentials for rubidium were 1.6 volts and 4.1 volts respectively; for cæsium, 1.48 volts and 3.9 volts respectively; for arsenic, 4.7 volts and 11.5 volts re-

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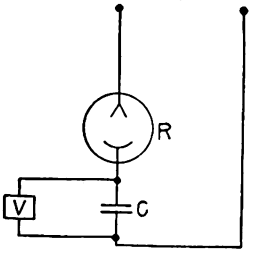
spectively. No ionization whatever could be detected at the resonance potentials of rubidium, cæsium and arsenic.—*Physical Review*, January, 1919.

Effect of Lithium Upon the Capacity of the Edison Storage Battery.—L. C. TURNOCK.—Experiments upon a very small cell are described in which the electrolyte consisted of a 21 per cent solution of caustic potash and varying amounts of lithium hydrate. These amounts were 10, 20, 30, 40 and 50 gm. per liter. In the commercial cells it appears that the last-named quantity is employed. It was found that although the lithium hydrate increases the internal resistance, it also increases the available capacity. This increase amounted to 12 per cent (with an increase of 21 per cent in the resistance) by the addition of 50 gm. of the hydrate.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Transactions A. E. S.*, 32, 1917.)

Units, Measurements and Instruments

Industrial Reconstruction and the Metric System.—HARRY ALLCOCK.—The writer points out that there are many objections to the adoption of the metric system in Great Britain: (1) It is already permitted to use it side by side with the British systems, which should lead to the survival of the better system in the long run; (2) the obligation to supply their part in the renewal of machinery made to British measurements prevents British manufacturers from now adopting the metric system; (3) the opposition of the textile trade; (4) if the metric system should be adopted at this time the British would be at a disadvantage in competition with Germany; (5) the United States and many other countries still use the British system.—London *Electrical Review*, Jan. 17, 1919.

Measurement of the Crest Voltages.—J. R. CRAIGHEAD.—An ingenious arrangement of kenotron, condenser and voltmeter which has been developed for measuring the crest values of alternating voltage embodies in



CIRCUIT OF RECTIFIER, CONDENSER AND VOLTMETER

one instrument a combination of good qualities not possessed by previous devices for the purpose, according to the author. The theory and construction of the crest meter may be understood from the diagram, in which a valve type of rectifier is connected in series with a condenser of negligible leakage. The condenser is charged to a voltage dependent upon the crest valve of the voltage wave and cannot be discharged through the rectifier. A voltmeter which does not draw current measures the condenser voltage. Tests of the accuracy of this device are recorded, and its advantages and limitations set forth in this article.—*General Electrical Review*, February, 1919.

Checking Calibration of Thermocouples and Pyrometers.—After stating the desirability for accuracy in furnace and other high-temperature measurements, the writer suggests the following equipment for carrying on systematic testing: The method provides for the maintenance of standards of temperatures in the plant and for convenient comparison of these standards with the works instruments. The standard of temperature for the works should, it is said, consist of at least one platinum/platinum-10 per cent-rhodium thermocouple calibrated by the Bureau of Standards and a potentiometer. While one platinum couple does suffice, it is most desirable that three platinum couples be available for comparison, one against the other. If one couple only is available, such change will not be manifest to the operator until the damage due to faulty temperature determinations has been done. The writer also discusses the sources of error in thermocouples and pyrometers, and remedies. The choice of calibrating equipment and directions for setting up and using the thermocouple checking equipment are given.—*Electrical Review*, Jan. 11, 1919.

Telegraphy, Telephony and Signals

Multiplex Telegraphy and Telephony.—In this paper is found a description of the means by which five telephone conversations and two telegraph messages may be transmitted over one pair of wires at the same time.—*Wireless Age*, March, 1919.

The Weagant Oscillation Valve.—In this article a description is given of the improvements made by R. A. Weagant on the original Fleming oscillation valve. The physical constructions and diagrams of connections, showing the use of the Weagant valve, are given in this article.—*Wireless Age*, March 1919.

Wireless Telegraphy in the French Colonies.—G. ALIX.—An article abstracted from the *Economiste Français*. Outside of the mother country there are thirty-five French radiotelegraphic stations in service, twenty-five in course of construction and twenty others projected. These include installations in Algeria, Madagascar, the Congo, Timbuctoo, Indo-China and the other colonies. The author holds that the still unexecuted project of circling the globe by a chain of wireless posts in French territory, reaching from the South of France and Tunis to the Marquezas Islands, thence under the Pacific to Central America and Martinique, is quite feasible. The Eiffel Tower sometimes receives signals from Panama, San Francisco and Honolulu, and it makes itself heard in New Zealand.—*Revue Générale de l'Electricité*, Feb. 8, 1919.

Propagation of the Current in a Telegraphic Line.—J. B. POMEY.—Article concerning the integration of the "telegraphers' equation." After recalling the general principles affecting the case of variable emf.'s, illustrating them by a simple example, the author demonstrates the formula of Heaviside, known as the theorem of development, and gives a more general formula applying to cases where the system does not start from a state of repose.—*Revue Générale de l'Electricité*, Feb. 8,1919.

Miscellaneous

Electricity on Dairy Farms.—The value of good lighting and ventilation in stables of dairy farms is pointed out.—*Electrical Review*, Dec. 28, 1918.

Extensive Use of Electricity for San Francisco Harbor.—Among the uses for electricity at the San Francisco Harbor are included pier, dock and street lighting, an electric system, harbor lights and fog signals, fire-alarm and telephone system. The electric repair and maintenance service is also described.—*Electrical Review*, Dec. 28, 1918.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

ELECTRICAL MANUFACTURERS' EXPORT ASSOCIATION FORMED

Thirty Manufacturers Join New Organization to Handle Non-Competing Lines in Export Markets— F. E. Watts Is President

The Electrical Manufacturers' Export Association of the United States of America was formally organized at the Hotel Manhattan, New York, on Tuesday of this week.

A preliminary meeting of the manufacturers was held at the University Club, New York, on Feb. 27, and a plan for the organization of the association was outlined by F. E. Watts. A committee was appointed to draft the constitution and by-laws and to incorporate such an institution under the New York laws. This was done and the constitution and by-laws were adopted at the meeting this week. At the same meeting the following officers were elected: President, F. E. Watts of F. E. Watts, Inc.; vice-president, H. H. Cudmore of the Argus Lamp & Appliance Company; treasurer, D. R. G. Palmer of the A. A. Wire Company; secretary, W. B. McCurdy of the Good Manufacturing Company.

A board of nine directors, who will act as the governing body of the association, also was chosen. This association is for membership only and is composed of electrical manufacturers in non-competing lines. Its purpose, as stated in the constitution, is as follows:

(a) By coöperative effort to facilitate the exportation of electrical apparatus, appliances and materials, as manufactured by the several members of the association, from the United States to foreign countries.

(b) To investigate the commercial conditions in foreign countries as affecting trade, to secure all data, statistics, samples of competitive goods and prices of same, to enable the members of the association to compete more intelligently for trade in foreign markets.

(c) The protection and perpetuation of trademarks of the members in foreign countries and the maintenance of a line of direct contact and service plan from maker to user.

Over thirty prominent electrical manufacturers have joined the association, and a number of others have applied for membership. A roster of manufacturers who are already members is being prepared and will shortly be ready for publication.

The primary object of the association is to consolidate the export work of the several members, to investigate the possibilities of sales and to develop foreign interest in the electrical products of the manufacturers, while, on the other hand, giving to the foreign buyer a complete line of electrical products from one source, so that he may make his purchases with one selling agency rather than a great many.

F. E. Watts, Inc., New York, has been made the selling representative for the individual members of the association, and all sales will be conducted through its organization. This company has already established agencies in the Scandinavian countries, Holland, France, Italy, Rumania, Spain, South Africa, China and Japan and will have its own branches in England, Australia, New Zealand, Cuba and Mexico. F. E. Watts will start in April for a three months' trip to Europe, making a personal investigation of the possibilities of sales.

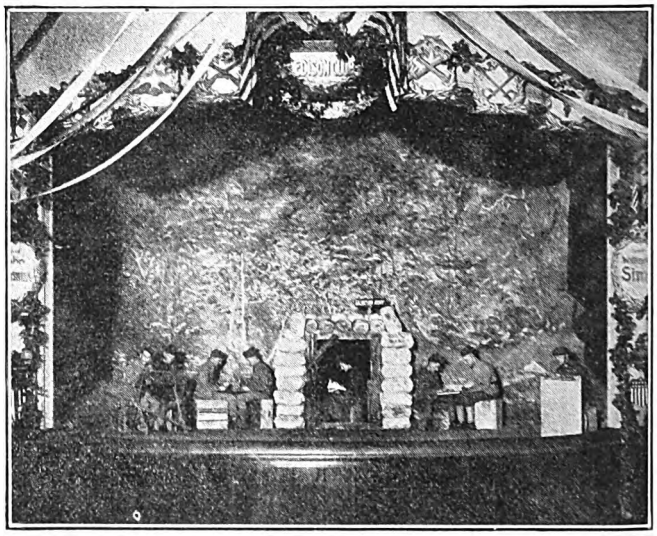
TELEPHONE RATE CASE IN THE SUPREME COURT

Highest Tribunal Gives State of Kansas Permission to Institute Original Proceedings to Test Authority of Postmaster-General

A decision of the United States Supreme Court, rendered on March 17, gives the State of Kansas permission to institute original proceedings against the Postmaster-General to test whether he has power to make rates under the order of Dec. 13. A return in the case was ordered to be made at the next term of the court in October. The question involved concerns the various states whose authorities have contested the increase in telephone rates.

In taking the suit to the highest court the Kansas authorities contended that the Postmaster-General is without authority to fix the rates and that so far as such authority was apparently granted by the resolution of Congress and the proclamation of the President it was unconstitutional.

The Boston Edison Company Welcomes Returning Service Men



Several hundred employees of the Boston Edison company assembled at the Welfare Buildings of the company on the evening of March 10 to welcome home Edison men returning from military and naval service. The feature of the evening was a series of "Victory" tableaus under the direction of L. D. Gibbs, superintendent of the advertising department. Nearly 500 of the company's approximately 2000 employees entered the service during the war, about twelve of whom made the supreme sacrifice.

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BUSINESS DURING 1918 OF WESTERN ELECTRIC COMPANY

Rapidly Increasing Costs of Production Resulted in Lower Rates of Profit—Report of President H. B. Thayer

Details of operations of the Western Electric Company, Inc., in 1918 are given in the report to stockholders. Total sales for the year were $145,226,000 as compared with $150,340,000 in 1917, $106,987,000 in 1916 and $63,852,000 in 1915. Of the total $67,860,000 were to associated Bell telephone companies, $21,825,000 were to the United States War and Navy Departments, and $55,541,000 to other customers.

H. B. Thayer, the president, reports that the net earnings, after meeting the high costs of labor and material prevailing throughout the year, after writing down the inventory at the end of the year on account of the decreasing values of materials then on hand, and after providing for the very heavy taxes and for other necessary reserves, amounted to $5,050,849. This is 6 per cent on the average investment for the year, $84,600,000. Mr. Thayer adds:

The rapidly increasing costs of production which we experienced in common with other manufacturers during the year resulted in lower rates of profit than usual on our own standard products. This was offset only in part by increased selling prices.

On our contracts with the government final settlement has not at this date been made, but it is expected that the net earnings when definitely determined will be about 5 per cent on the sales.

Our net earnings on our other manufactures and on our sales of merchandise not manufactured by us were satisfactory.

No return from foreign investments has been included in our earnings for 1918 (our information thereon being incomplete). It is believed, however, that the earnings of some of the foreign allied companies in which we are interested were sufficient to offset losses on others, so that no net loss was sustained on the whole.

The Antwerp factory, which had been in the hands of the Germans throughout the war, came again under our control in November, 1918. Although the buildings were not much damaged, it is necessary to replace large amounts of machinery and material which had been taken away by the enemy. This rehabilitation is now in progress, and it is expected that operations will be resumed there within a few months.

For the purpose of handling our export business to the best advantage it has been found advisable to segregate it from the domestic business directly conducted by this company. Accordingly, a subsidiary corporation, the International Western Electric Company, Inc., was organized during the year and has been operating since June 1 with satisfactory results.

Mr. Thayer then takes up the prospects for business and indicates that additions to plant will bo continued. He says:

The unfilled orders of your company at Dec. 31, 1918, after deducting those canceled or likely to be canceled by the government because of the cessation of hostilities, aggregated about $26,265,000, a decrease of $2,491,000 as compared with Dec. 31, 1917. It is probable that the total sales in 1919 will be considerably less than in 1918, although active efforts are being made to stimulate our trade and to develop new business.

During the immediate period of adustment to peace conditions, of falling prices and of uncertainty in every direction, we must expect unusual variations from our normal business, but it seems reasonable to look forward to a resumption of activity in manufacturing and trade at no distant date. We are continuing the additions to our shop buildings and equipment which were started last year, in the expectation that by the time they are completed we shall be able to get enough business to fill them.

The additions to plant during 1918 aggregated $2,925,000 while the increase in reserve for depreciation on plant was $2,139,000. In addition to providing for the depreciation of plant according to our usual and normal practice, the excess costs of construction in process under war conditions over the normal costs to be expected under peace conditions have been charged off.

Regarding other matters, the report says:

The merchandise on hand Dec. 31, 1918, was inventoried as shown on the balance sheet at $45,047,000. In arriving at this valuation, the principal raw materials have been taken at their market cost on March 1, 1919, which include copper at 15¾ cents per pound and lead at 4.7 cents per pound. Overstocks of various finished and partially finished articles have also been carefully depreciated, and in addition the sum of $1,000,000 was carried into the reserve for contingencies. Various charges against this reserve, chiefly for patents purchased and for contributions to war relief organizations, have, with sundry adjustments, amounted to $349,299, resulting in a net addition to this reserve of $650,701 for the year.

Our Hawthorne shop force at the end of the year was 17,021 employees, as compared with 21,549 at the beginning of the year. The total number of employees at Dec. 31, 1918, was 26,126.

The number of employees who entered the military and naval forces of the United States was 5881. Of these our latest information shows forty-one lost their lives and thirty-seven were wounded. Up to March 1, 1919, 1443 had been honorably discharged and had applied for reinstatement, of whom 1259 had been reëmployed and the remainder are to be given employment as soon as the conditions of the business make it possible. In the meantime, their rights under the employees' benefit plan are preserved to them.

The payments from the employees' benefit fund during 1918 amounted to $258,184 and were made to 3673 beneficiaries, including pensioners, who numbered ninety-two at the end of the year.

The company has continued its long-established policy of using its credit with its regular bankers to finance expanding stocks of merchandise and unusually large accounts receivable whenever necessary because of increased business. Its general bills payable amount to $10,600,000, which was the amount outstanding at the end of the previous year. To March 1, 1919, these bills payable have been reduced to $8,100,000, and it is expected that the decreasing volume of sales will make further reduction possible during 1919.

In addition to these general bills payable there were outstanding at Dec. 31, 1918, the company's notes for $2,172,250, incurred for the purchase of Liberty loan bonds, mostly for account of employees who are paying for them in monthly installments, and this amount is being reduced accordingly from month to month; 92.7 per cent of the company's employees subscribed to the third Liberty loan and 98 per cent to the fourth Liberty loan.

The engineering staff and laboratories of the Western Electric Company, Inc., have been devoted during the year almost entirely to activities in connection with this country's participation in the war.

Earnings of the company for 1918, including the owned subsidiaries, Western Electric Company, Inc., of Delaware, and Western Electric Company of California, follow:

Sales		$145,226,119
Other income		664,919
		$145,891,038
Cost of merchandise	$128,219,691	
Expenses	9,999,965	
Taxes	1,520,533	
Appropriated for:		
Reserve for employees' benefit fund (subsidiary companies)	100,000	
Reserve for contingencies	1,000,000	140,840,189
Available for interest and dividends		$5,050,849
Interest paid	$1,540,528	
Dividends	3,300,000	
Carried to common stock	210,321	$5,050,849

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Good Meeting of A. I. E. E. in Boston

Importance of Railroad Electrification as a Means of Conserving the National Fuel Resources—Secretary Lane's Super-Power Project Favored—Telephone Receiver Theory —Raising the Plane of Engineering Education

IN THREE intensive sessions at the Copley-Plaza Hotel, Boston, Mass., on March 14, the 348th meeting of the American Institute of Electrical Engineers covered a wide range of subjects. About 300 members and guests were on hand Friday morning to receive a cordial welcome from Governor Calvin Coolidge of Massachusetts, and from the time President Adams called upon the first speaker to the closing words of the educational session following the banquet Friday evening the program was packed with interest.

In the morning session Calvert Townley, Westinghouse Electric & Manufacturing Company, read a paper upon the possibilities of steam railroad electrification, which was followed by a discussion in which practically all speakers affirmed their belief in the extension of electrical service in many special cases in the not distant future. Fuel saving received much attention as a by-product of the discussion. In the afternoon problems of the telephone receiver were considered, with contributions by Dr. A. E. Kennelly, H. Nukiyama, Dr. A. G. Webster and others, with a protracted technical discussion. At the banquet in the evening President Adams officiated as toastmaster, and a brilliant discussion of engineering education and the relations of the scientist to the engineer was enjoyed. The speakers were Prof. H. E. Clifford of the Harvard Engineering School, Prof. E. B. Wilson of the Massachusetts Institute of Technology, President Emeritus Charles W. Eliot of Harvard University, Dr. Arthur Gordon Webster of Clark University, and Dr. Saul Dushman of the General Electric Company's research laboratory, Schenectady.

An enjoyable luncheon was given to the board of directors and guests Friday noon at the Copley-Plaza by the members of the executive committee of the Boston Section of the Institute, a feature of this occasion being the exhibition of the tablet to W. D. Weaver, former editor of the ELECTRICAL WORLD, which is to be placed in the near future in the directors' room at the Engineering Societies Building, New York, in appreciation of Mr. Weaver's great services to the American Institute of Electrical Engineers and to the progress of electrical science.

ELECTRIFICATION SESSION

The electrification session opened with a paper on "Some Possibilities of Railroad Electrification as Affecting Future Policies," by Calvert Townley, Westinghouse Electric & Manufacturing Company, New York. The war has retarded development, but as railroad conditions become more settled there is ground for hoping that electrification can again be studied on its merits. The author stated that the various systems of electrification agree on fundamentals. All offer the possibilities of unlimited electric power, which means longer trains and higher schedule speeds. Once the railroads escape from the financial Slough of Despond and are again able to get capital there will not be enough engineers or electric factories in the country to serve them.

Frank H. Shepard, Westinghouse company, said that every "hard-shelled" railroad man will concede that electrification means better service and a better railroad, that transportation service is the greatest railroad problem to-day, and that the development of the United States is dependent upon adequate transportation. Electrification will enable double the traffic of a railroad to be handled with the same or virtually the same plant in roadway and tracks; it is a tool and offers practically unlimited power for transportation service.

W. S. Murray, consulting engineer, New York City, expressed high appreciation of Mr. Townley's paper, with which he was in full agreement. He pointed out that in future a composite railroad-electrical man will be needed to meet electrification requirements properly—a man with one eye for railroad and the other eye for electrical conditions.

Mr. Murray then discussed at some length the project of Secretary of the Interior Lane to develop a system of trunk-line power supply for the Atlantic seaboard district from Boston to Washington.

W. B. Potter, chief engineer of electric traction, General Electric Company, contributed a written discussion pointing out that electrification operated from hydraulic power offers the only known method of conserving our limited supply of coal and oil. Even when hydraulic power is not available, a saving of over two-thirds of the fuel and much of the fuel haulage can be obviated by the erection of steam-power plants suitably located and furnishing electrical energy from the coal burned in modern practice.

The coal and equivalent oil used on the steam locomotives of the United States in 1914 totaled 140,000,000 tons. The ton-miles moved in the same period, excluding the tonnage of locomotive tenders and 75 per cent of the railway coal, amounted to 930,000,000,000. If the same tonnage had been moved electrically, basing figures on an energy consumption of 40 watt-hours per ton-mile, the annual energy consumption would have been 37,200,000,000 kw.-hr. If this energy had been obtained from steam-power houses at 2.2 lb. of coal per kilowatt-hour, instead of the 140,000,000 tons actually used there would have been required 40,000,000 tons of coal. This shows a net saving of 100,000,000 tons in one year. A still greater saving would have been accomplished in proportion to the amount of hydroelectric power available.

If the tonnage moved in the United States on steam railroads could have been handled by the expenditure of 37,200,000,000 kw.-hr., this would be equivalent to an average load of 4,250,000 kw. This is not an exorbitant amount compared with the power plants already installed. In 1917 the power-station capacity in the United States, including central stations, electric railways and isolated plants, was about 20,000,000 kw. Thus there is installed electric power-station capacity equivalent to four or five times the power which would be required for operating all the railroads in the United States electrically.

The further development of central-district stations

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with either fuel or water as their source of power will afford the most direct means of conserving coal. The existence of such large central stations at strategic points throughout the country, even if primarily installed for railway use, would of itself further and develop the use of electricity for various industrial purposes, and by so doing would affect the coal consumption more widely than the item of railway coal alone.

George Gibbs, chief engineer Pennsylvania electrification, New York City, also presented a written discussion. He maintained that it is most important to combine the advantages of electric operation with improved railroad practice and that something besides the purely electrical specialist is needed to solve such problems. The question has really now changed from technical to financial feasibility. The attention of our government was directed in the war toward the electrification of railways as a possible way of increasing their capacity for emergency service; also as a means of fuel conservation. It may be that some important electrical projects in this way would have been launched as war measures, especially as results and not costs were all-important.

N. W. Storer, Westinghouse company, Pittsburgh, expressed keen appreciation of Mr. Townley's paper. He felt that the ultimate results of electrical operation are too broad for present vision; that years of evolution will follow the initial development. The opportunities of the future are very great, and all that need be considered at present are cases where the need for electrical operation is a crying one, as in the case of tunnels, large terminals, etc.

The speaker characterized Mr. Murray's vision of a super-power supply system as most inspiring and easily within the range of possibilities. He contended that we owe it to future generations to conserve natural resources. The need of being open-minded on these problems is large. The cost of electrification is large, but compared with the expenditures of the fighting nations for destruction during the war, it is far less large in appearance than before. The United States spent in four or five days of war enough money to electrify all the terminals in Chicago. "Why, then," said the speaker, "should we hesitate to spend money for such a constructive improvement as electrification?"

Major George F. Sever, New York, spoke briefly of the importance of fuel conservation on the Pacific Coast, where coal is an almost unknown quantity. Oil and water are there the chief sources of electrical energy. The railroads are now using about 40,000,000 barrels of oil yearly and the public utilities of California 1,000,000 barrels. The United States shipping now needs 30,000,000 barrels yearly, and other users in California consume 40,000,000 barrels per annum. California produces 110,000,000 barrels of oil yearly, compared with 350,000,000 barrels in the entire country, 42 gal. per barrel. Hydroelectric power development is therefore absolutely necessary in California for both railroad and public utility operation. In 1914 oil cost 40 to 50 cents per barrel; it is now $1.60 at the California wells and at some other points on the Pacific Coast is $1.85.

More than $3,500,000 can easily be saved in California yearly by interconnection and hydroelectric supply; the mountain passes are well suited to electrical operation of trains, and the increasing scarcity of oil deserves close consideration. In closing, Major Sever commended the fuel-saving work done in New England during the past year and pointed out that there is little if any surplus of water power available for exportation from this section of the country as at present developed.

Carl Schwartz, electrical engineer, New York Central lines; John Murphy, electrical engineer, Department of Railways, Ottawa, Can., and Dr. Arthur Gordon Webster, Clark University, Worcester, Mass., also contributed to the discussion.

Prof. Charles F. Scott, Yale University, then introduced a resolution indorsing Secretary Lane's "superpower" project, and it was unanimously voted that the board of directors prepare and transmit it.

TELEPHONE SESSION

Dr. A. E. Kennelly of Harvard University and H. Nukiyama presented a paper on "The Electromagnetic Theory of the Telephone Receiver," in which the mmf. and flux and the diaphragm vibratory displacement in the magnetic field were taken into account, carrying the mathematical investigation further than certain previous papers on the subject have done. The theory is based upon the motional impedance circle. The motional power is shown to be derived partly from the testing alternating current and partly from changes in the magnetic circuit. Previous papers on the motional impedance circle failed to reveal the power expended parasitically (by both hysteresis and eddy currents) in the magnetic circuit.

The authors sought to supply this omission and thus to offer a closer approximation between the theory and the observed behavior of the telephone receiver as an electromagnetic motor. The theory was presented with relation to a series of impedance measurements already published on a particular Bell bi-polar receiver. The small amplitude and single frequency of the current applied establish various limitations to the new theory, which were outlined by the authors. According to the theory, however, the changing of the winding of a receiver, other things being equal, increases the mechanical output at resonance in proportion to the resistance, for a fixed excitation, but for a given amount of I^2R power loss in the winding this mechanical power output remains substantially constant.

An illustrated lecture on "The Absolute Measurement of the Intensity of Sound" was then given by Prof. A. G. Webster of Clark University. Dr. Webster exhibited an apparatus in which, by utilizing the principle of the interferometer, the performance of any type of horn can be predicted and sound standards established. By the Webster phonometer actual force values can be given to sounds hitherto unmeasured; the absorption of fabrics can be studied, and telephone receiver performance analyzed. To produce the pure tones desired in demonstration, a quartz bar was used instead of a steel tuning fork. By this apparatus the pressure of air corresponding to a millionth of an atmosphere can be measured over a range of about two octaves. Dr. Webster said that in recent experiments he had determined the coefficient of sound reflection from the ground to be about 95 per cent.

The foregoing paper and lecture were discussed by J. B. Taylor, General Electric Company; Dr. R. L. Jones, Western Electric Company; H. S. Osborne, American Telephone & Telegraph Company, T. E. Shea and H. Nukiyama. Dr. Jones derived the following equation of gross efficiency for the telephone receiver, where μ_{12} represents the true efficiency; Z_{1m} the motional impedance at any frequency stated; B_{12} the force-factor;

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b_3 the mechanical resistance; B_1 the free resistance of the driving circuit:

$$\mu_{13} = \frac{Z_{1m}^2}{(B_{13}^2/b_3)B_1}$$

At resonance, this reduces to about $\mu_{13} = Z_{1m}/B_1$.

Dr. Jones also described various tests with a special receiver having a Portland cement case, laminated core pieces and high-resistance diaphragm. This outfit had such a small eddy-current displacement that the angle β (mean angle of lag in degrees between magnetic flux and mmf.) was only 1 deg. to 2 deg. When a small coil was wound near the pole tips of the receiver the angle β graphically determined was 25 deg. and the calculated angle was 23.5 deg. With two parallel windings on another receiver with large eddy-current losses the angle of lag was 65 deg.

Mr. Osborne pointed out that electrical engineers prefer to read indications on electrical instrument scales to measuring mechanical displacements. Dr. Webster defended the simplicity and accuracy of his equipment, which has a dampening coefficient as low as 1.5. This, Dr. Kennelly declared, represents an experimental miracle. Mr. Nukiyama called attention to the similarity of results reached by Dr. Jones's analysis of telephone receiver efficiency to those of himself and Dr. Kennelly. Mr. Shea touched upon the limitations of the new theory of Dr. Kennelly and Mr. Nukiyama.

EDUCATIONAL SESSION

"The engineer is to be even more important in peace than he was in war," declared President Adams in opening the evening session. The necessity of high-grade training for engineers was recognized by all the speakers, the first of whom, Prof. Harry E. Clifford of the Harvard Engineering School, discussed "Science and the Engineer." A résumé of Professor Clifford's remarks is printed elsewhere, a notable feature of his address being a plea for the realization of higher ideals in engineering education, with less opportunism and more real encouragement to the younger instructors and assistant professors, many of whom are shockingly underpaid in comparison with the compensation accorded in ordinary trades.

In introducing the next speaker, Prof. E. B. Wilson, head of the department of physics, Massachusetts Institute of Technology, President Adams maintained that about 75 per cent of the men who come to our engineering schools do not belong there. "Our whole educational system 'just happens'," he said. "Is there not some method by which the men who come to our engineering schools can come by right of intellectual power and not by right of pocketbook?"

Professor Wilson gave a whimsical talk on "Mathematics and the Engineer," discussing the evils of "the rigors," a disease which breaks out in the educational body politic where a desiccated and rigid philosophico-mathematical curriculum is followed. The speaker stoutly defended the average student and maintained that attempts to give a post-graduate type of instruction to the great run of student minds are needless as a part of the training of the engineer. Without attacking post-graduate educational methods in their proper place, the speaker pointed out that if super-engineers were needed to any extent there would be a corresponding demand for "super-instruction." The great importance of practical problems in engineering mathematics was emphasized.

"We have 860 freshmen at Massachusetts 'Tech' this year," said Professor Wilson, "and you can't make 500 good engineers in one year. Could your engineering profession absorb 500 budding Lord Kelvins if you had them?" Professor Wilson pointed out that the greatest living superman to-day in electrical engineering is Oliver Heaviside, whose great talents, however, are not readily utilized in the world of affairs. The demand is strong to-day for men who can handle others.

PRESIDENT EMERITUS ELIOT PAYS HIGH TRIBUTE TO THE ENGINEERING PROFESSION

Dr. C. W. Eliot, president emeritus of Harvard University, was then introduced. He spoke at length on "University Training for Engineers," emphasizing the importance of maintaining educational continuity in families as well as giving opportunities to individuals who cannot look back along an unbroken line of culture and training. The advantages of looking to teachers for results rather than specifying or ordering methods in detail were touched upon. A medical teacher recently stated that the standards of medical education have suffered during the war, as Professor Clifford had deplored with regard to engineering education. On account of the rigidity of military training it has been unfortunately the case that in a vast number of instances the military commanders have not known how to utilize the services of engineering specialists in their commands.

Dr. Eliot felt that American army officers as a class have received insufficient scientific training. It is a great public disaster that at this moment no provision has been made for maintaining an army with men adequately trained from the scientific standpoint. Dr. Eliot said that there is a small demand for engineers of the first-class type, but that demand must be met. How to do this is one of the most important problems of American universities and teachers. As Lowell has said, unless a democracy develops the highest type of men it will fail. Scholars, research men and geniuses of the highest type must be developed. The real need is to change completely from bottom to top the methods of instruction in the elementary and secondary schools. The speaker commended the use of practical problems in mathematical teaching, along the lines utilized in the Lincoln School, New York City. He said that the profession of teaching has grown less attractive, partly because of the relatively small remuneration now accorded. University training is desirable for boys who are to become engineers of the first order. These need modern languages, economics and government as well as the highest special training. The engineer needs contact with people, to learn how to deal with men. The great engineer should possess these human sympathies; his power over human beings is great, and in addition to sympathy with their motives he must be able at any rate to inspire the leaders of the working multitudes.

"We are threatened with a great degradation," said the speaker, "in limitation of output. I attach no importance to threats of violent socialism in this country, but I look with grave disquiet on voluntary restriction of production."

Dr. Eliot said that engineers need to know how to tell corporation employers the way to overcome these evil tendencies. The need of persuasive powers on the part of engineers is very great. An immense change for the better has come over American industry in the

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past half century. The increased power exercised over nature by the engineer is extraordinary, and in the coming years this is to be extended greatly. Despite the shortcomings of our airplane program, airplane progress was really only started when the war closed. An enormous field of opportunity and usefulness lies ahead of the engineer. Engineering is the most serviceable of all the professions in raising the comfort of the people as a whole, in facilitating the pursuit of happiness. Closing, Dr. Eliot said that engineering used to be considered a materialistic profession, but that he knew of no profession which involves a greater use of the imagination and what may be called truthfulness of mind.

Dr. Arthur Gordon Webster, Clark University, Worcester, Mass., then gave an address on "The Place of Science in Engineering." He instanced various cases where the knowledge and training of the expert physicist had proved of great value in workaday affairs. Dr. Webster cited the success of the German long-range gun as an example of the value of theoretical knowledge, and pointed out various war demands for physical laboratory experts' services, notably in connection with the design of guns, calculation of trajectories and other mechanical problems. The speaker closed with a strong plea on behalf of the highest technical education and the maintenance of graduate courses for qualified men.

Dr. Saul Dushman, General Electric Company research laboratory, spoke briefly on the value of ideals and the importance of cultivating breadth of imagination in research work. There is a great dearth of men trained to research. In such work it is the frame of mind rather than the problems themselves that is of paramount importance. Inspiration cannot be regulated by rule of thumb. The joy in solving the problem must be a labor of love in which there is an intellectual and spiritual pleasure because some new light has been cast upon the infinite variety of nature's secrets.

In a paper for the educational session which was not read in the absence of the author, B. G. Lamme, Westinghouse company, the great importance of more thorough fundamental training was emphasized.

RAISE THE STANDARD OF ENGINEERING EDUCATION

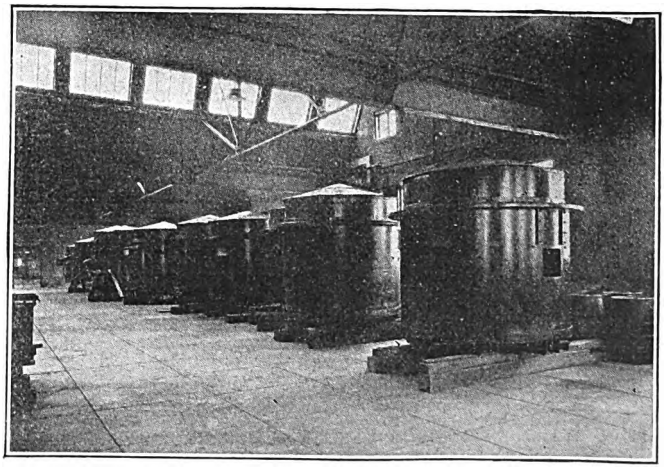
Professor Clifford Declares Too Much Opportunism Exists in Present Methods of Instruction and Advocates Higher Plane of Technical Pedagogy

A vigorous plea for the establishment of higher standards in engineering education was made by Prof. Harry E. Clifford, Gordon McKay professor of electrical engineering at the Harvard Engineering School, at the three hundred and forty-eighth meeting of the American Institute of Electrical Engineers, held at Boston March 14. He pointed out that complacency has always been a foe to progress and that during the war there has been a distinct lowering of engineering educational standards through attempts to substitute hasty "intensive" training for logical, well-planned work. This training, Professor Clifford declared, might fit a man to go "over the top" and meet a fair measure of the military needs of the time being, but it by no means suffices for the production of first-rate engineers. The man who goes over the top possesses qualities that entitle him to all praise, but these are not necessarily the qualities which fit him to solve the complex problems of present-day civilization.

Professor Clifford said that it is going to be difficult to put engineering education back upon its proper plane. For many years the standards have been set by the needs of intellectual mediocrity—the educator has dealt with the lump and not with the leaven. The time has come to consider the needs of men of superior intellectual power. The result of catering to the man of "middle-low" power is to fail to bring forward the great engineer through high-grade engineering education. With the ordinary lump of mediocrity it is impossible to insist on the importance of fundamentals. Teachers are apt to relax in the face of the pressure of numbers and the insistence that quantity counts for so much. The responsibility is partly that of the instructor and partly that of those higher up. As a result engineers capable of broad work are not being turned out. There is a lack of historical background; our engineers are too much men of trial and error, not those who think out the problem ahead. The idea seems to be that if the result is secured, that is all-sufficient. Whether it is the best result does not count.

"The engineer should be able largely to eliminate needless trials," said Professor Clifford. "A prominent educational leader said to me not long ago: 'I train my engineers to *do*, not *think*.' 'I should adopt a slogan, then, if I were you, "Do not think!" ' " said Professor Clifford. The time is here to do something for the abler men. In so doing the plane of education will be raised for all. It is entirely unjust to expect young assistants to enter teaching at salaries of $500 a year, to maintain a cultivated standard of living, marry and raise families on pay often below that of a rivet boy at a shipyard. To drive such men to pot-boiling—to tutoring, which is worse—is pitiful, the speaker said. It is the task of the leaders of the educational world and of the engineering profession to see to it that standards are raised.

Electric Furnaces for Mexico



Electric furnaces, it is said, are destined to be one of the chief items of electric export from United States to the Spanish-speaking countries. This is true because of the large amount of low-priced scrap metal there available and because of the abundant supply of hydroelectric power in most of these countries. Ten Bailey brass furnaces are here shown partly ready for shipment to Mexico. The furnaces are of the tilting type and are rated at 105 kw., 1500 lb. hearth capacity and 600 lb. per hour melting rate.

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MEETING TO DISCUSS THE ENGINEER AS A CITIZEN

Three Associations Unite to Hold a Symposium on This Topic and Invite Other Societies to Participate

An "engineers' symposium" will be held on Wednesday, March 26, at 8 p. m., in the auditorium of the Engineering Societies Building, New York, under the general auspices of the local sections of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the Society of Automotive Engineers. The members of the following societies are cordially invited to participate:

American Institute of Electrical Engineers, American Society of Civil Engineers, American Chemical Society, American Electrochemical Society, American Institute of Chemical Engineers, American Society of Heating and Ventilating Engineers, American Society of Refrigerating Engineers, Brooklyn Engineers' Club, Illuminating Engineering Society, Institute of Radio Engineers, Municipal Engineers of the City of New York, Société de Chimie Industrielle, Society of Chemical Industry and Society of Naval Architects and Marine Engineers.

Gano Dunn will preside, and the following addresses will be made:

"The Civic Responsibility of the Engineer," Philip N. Moore; "The Relation of the Engineer to Legislation," Calvert Townley; "The Relation of the Engineer to Administration," Nelson P. Lewis; "The Relation of the Engineer to Public Opinion," Spencer Miller; "The Relation of the Engineer to Production and Distribution," Comfort A. Adams.

To secure constructive suggestions for the several committees on development a general discussion will follow the addresses.

HEARINGS ON AMENDMENT OF ILLINOIS COMMISSION LAW

Eighty-seven Cities Represented at Springfield Hearing in Support of Bill Giving Cities Home Rule of Utilities if They Desire

Further hearings before the Senate committee on public utilities of the Illinois Legislature were held at Springfield on Tuesday of this week on the bills amending the public utilities law and especially the Home Rule Municipal League bill giving cities the power to elect by ordinance and referendum whether they will come under the Public Utilities Commission or govern their own utilities.

Two hundred and six mayors, city attorneys and aldermen, including thirty aldermen from the city of Chicago, appeared, representing eighty-seven cities, in support of this bill. Numerous speakers addressed the committee on the desire for home rule and criticised the action of the commission in a number of instances. No attempt was made to discuss the provisions of this bill, and the hearing was adjourned until March 26, at which time the proponents were informed that they would be expected to discuss the bill section by section. The chairman further said that before any action was taken the Public Utilities Commission would be requested to appear and advise the committee relative to the criticisms and charges made by the speakers.

At the hearing before the House committee on Wednesday of this week, a sub-committee of eleven was appointed to hold hearings and investigate all bills before the committee to abolish or amend the public utilities act.

ONLY SMALL INCREASE IN DOMESTIC LIGHTING COST

National Industrial Conference Board Shows that Household Consumer Was Affected Slightly by Advances in Rates for Electricity

Reviewing "War-Time Changes in the Cost of Living," the National Industrial Conference Board says in Research Report No. 14, dated February, 1919:

The average increase up to November, 1918, in rates charged for gas and electricity for domestic use was small. Few if any changes were made within the war period prior to 1917. The National Electric Light Association reported in June, 1918, that of 173 cities having a population of 40,000 or over there had been rate increases in 96 in the sixteen-month period ending May 1, 1918. Many petitions for further advances were pending before public utilities commissions. These increases for the most part were in rates charged for power, however, and affected the domestic consumer but little. A study of eighty-two cities by central stations showed that in only twenty-three had the advanced rates resulted in higher cost of electricity for wage earners. The average increase in these twenty-three cities was less than 10 per cent. Contracts specifying an automatic advance in the charge for electricity with an advance in the price of coal had affected small consumers only slightly up to November.

The American Gas Association reported on the 1029 companies in the United States manufacturing and supplying artificial gas. The districts served by these companies had a population of 45,000,000. Between Jan. 1, 1917, and Nov. 15, 1918, 453 companies, or 44 per cent of the total, had raised their rates to domestic consumers; the increase averaged 18.3 per cent. The average increase for the country as a whole would, of course, be less.

From these data it appears that the average advance in the cost of electricity and gas the country over between July, 1914, and November, 1918, was small. The relative importance of these items in the family budget, moreover, is less than that of fuel. In estimating the increase in the combined cost of fuel, heat and light these facts must be considered.

The increase in the cost of fuel, heat and light combined between July, 1914, and November, 1918, is placed at 55 per cent. This is a fair average, taking into account the large advances in the prices of bituminous coal, wood and oil, which are important fuels in certain sections of the country. While increases in some localities have varied considerably from the average, this is of no great importance since fuel, heat and light together require less than 6 per cent of the total family expenditure and a difference of as much as 20 per cent would cause only about 1 per cent change in the total budget.

War Record of Byllesby Utility Properties

The third edition (Jan. 1, 1919) of the "National Service Record" of H. M. Byllesby & Company and affiliated companies has been issued. It shows an increase of 256 men in the service since July 1, 1918, making a total of 951 so engaged, or 19.7 per cent of the organization's male employees. Only twenty casualties are recorded, nine deaths, ten wounded men and one man missing in action. More than $2,500,000 was subscribed by the organization and its employees to the four Liberty loans, and they gave more than $500,000 to various charities.

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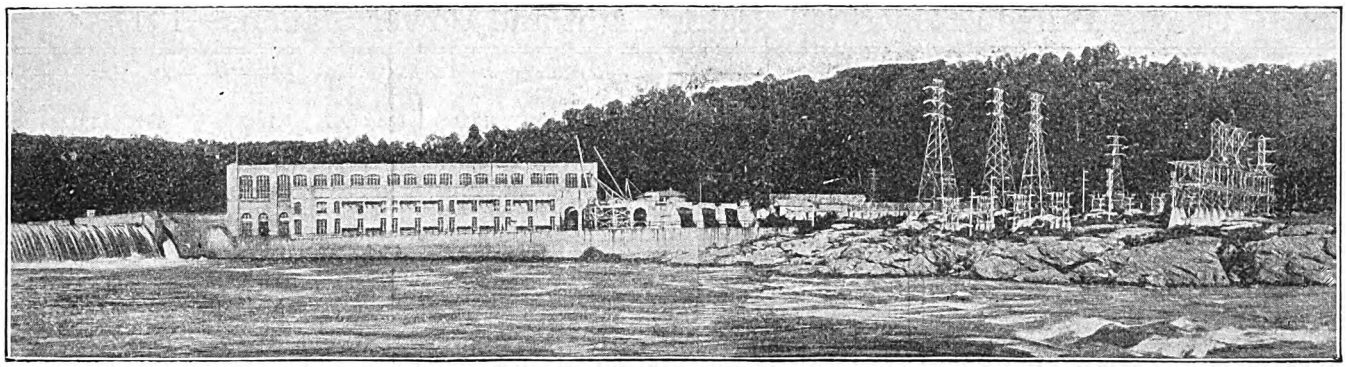


PENNSYLVANIA WATER & POWER COMPANY SERVICE IN WAR

Favorable Opportunity for Established Hydroelectric Developments in Present Cost Conditions—Useful Work in War Exigency

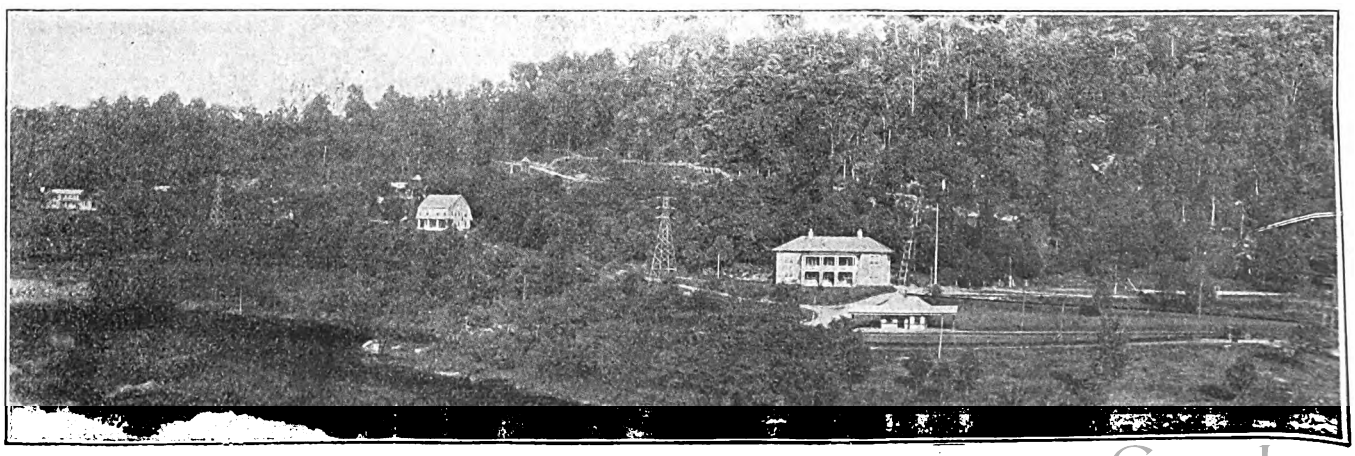
Reporting on the operations of the Pennsylvania Water & Power Company for the fiscal year 1918, President Charles E. F. Clarke illustrates the favorable position of established hydroelectric developments under present high-cost conditions.

"Your company, in common with other businesses, has experienced the effect of high prices of material and labor," he says; "however, with your company these have been of minor effect, since it is the fixed capital charges which play the predominant part of the running expenses of hydroelectric development, and the investment in this particular development was incurred during the pre-war period of low prices. The increase in the cost of labor, coal and generating equipment, which particularly affects production of energy by steam, can scarcely be expected to recede to previous lower levels, and there is thus apparent a favorable opportunity to those hydraulic developments now established on a going basis for the negotiation of more favorable power contracts as the present contracts terminate. In this connection it should be understood that two of your companies' contracts expire within the next three years. The greatest element of increase in the expense of conducting the company is, naturally, that of federal taxes, which now constitute a large factor in that expense."

Mr. Clarke said that the load requirements of the company's customers, particularly that of the Consolidated Gas, Electric Light & Power Company of Baltimore, have shown such a favorable increase that now less than 60 per cent of the total load requirements of the customers is being supplied from the hydroelectric development, the rest having to be generated by steam. The market for hydraulic power in the district covered by the transmission lines thus considerably exceeds the supply available. In speaking of the service of the company in war work Mr. Clarke said:

"During the year the furnace plant of the Shawinigan Electro Products Company (owned by your company) contributed a considerable amount of ferrosilicon to the supply required by this country for war work. The unusual quantities of steel being manufactured made this product especially in demand, and the furnace plant was taxed to produce its utmost output. Nevertheless, at one period the requirements for power in the district were so acute that the furnace plant was reduced in its allotment of electrical energy, in order to devote the energy so released to certain war industries. The furnace plant layout was such as to lend itself particularly well to rendering this assistance, indicating in a new direction the special utility of this addition to the equipment of your company.

"The establishment near Baltimore in 1918 of a large government plant for handling of materials for gas warfare brought forth a demand for power—immediate and urgent. The situation was met by the Consolidated Gas, Electric Light & Power Company of Baltimore arranging to furnish this demand from its steam stations and to transmit the same over the Baltimore transmission lines of your company, while for its part your company, as a patriotic duty, lent its services to construct without profit a high-tension transmission line tapping its main Baltimore circuits, so as to carry the energy to the government arsenal at Edgewood. Your company was glad to have this opportunity of proving its added usefulness in the war situation. The availability of a large supply of hydraulic power from your development has in the situation proved of advantage to the nation and in a very direct manner of advantage to Baltimore."



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Census Bureau Report of Electric Light and Power Stations—1917

	Maine			North Carolina and South Carolina			Georgia		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	93	79	....	241	155	55.5	176	126	....
Commercial	87	75	....	120	85	....	48	42	....
Municipal	6	4	....	121	70	....	128	84	....
Income †	†$3,169,388	†$2,118,508	49.6	‡$9,911,925	‡$5,958,586	66.3	¶$3,447,235	¶$1,968,599	75.1
Electric service	$2,910,645	$1,815,086	60.4	$9,482,231	$5,670,150	67.2	$3,375,221	$1,881,985	79.3
All other	$258,743	$303,422	—14.7	$429,694	$288,436	49.0	$72,014	$86,614	—16.9
Total expenses, including salaries and wages	$2,404,786	$1,577,938	52.4	$7,626,168	$3,896,878	95.7	$2,698,730	$1,655,420	63.0
Number of persons employed	772	629	22.7	1,640	1,136	44.4	915	697	31.3
Salaries and wages	$619,739	$402,394	54.0	$1,165,775	$713,534	63.4	$583,891	$417,959	39.7
Total horsepower	98,248	89,683	9.5	495,023	283,479	74.6	125,674	87,951	42.9
Steam engines:									
Number	52	58	....	191	157	21.7	174	156	11.5
Horsepower	22,478	19,610	14.6	95,274	54,438	75.0	50,055	35,274	41.9
Internal-combustion engines:									
Number	7	3	....	30	6	....	17	4	....
Horsepower	180	135	33.3	993	535	85.6	518	720	—28.1
Waterwheels:									
Number	192	175	9.7	165	140	17.9	58	45	....
Horsepower	75,590	69,938	8.1	398,756	228,506	74.5	75,101	51,957	44.5
Kilowatt capacity of dynamos	63,242	58,757	7.6	311,915	175,507	77.7	84,330	56,232	50.0
Output of stations, kilowatt-hours	165,504,379	117,092,565	41.3	872,142,636	427,324,494	104.1	184,136,059	87,571,815	110.3
Stationary motors served:									
Number	3,890	2,258	72.3	6,082	7,328	—17.0	4,238	1,964	115.8
Horsepower	56,985	32,535	75.1	97,013	188,215	—48.5	81,517	50,633	61.0
Number of street lamps:									
Arc	322	1,411	—77.2	2,893	4,083	—29.1	480	2,370	—79.7
Incandescent, etc	17,918	9,839	82.1	21,441	8,407	155.0	14,590	7,283	100.3

* A minus sign (—) denotes decrease; percentages omitted where base is less than 100.
† Exclusive of $1,068,302 in 1917 and $789,166 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $2,500,345 in 1917 and $1,206,248 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $4,880,551 in 1917 and $2,305,083 in 1912, reported by street and electric railway companies as income from sale of electric energy.

	Illinois			Washington			Iowa		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912†	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	303	269	12.6	88	70	....	325	223	45.7
Commercial	182	170	7.0	74	60	....	181	159	13.8
Municipal	121	99	22.2	14	10	....	144	64	....
Income	$46,245,976	$30,045,297	53.9	‡$4,295,845	‡$3,087,721	39.1	¶$10,240,235	¶$4,405,365	132.4
Electric service	$45,402,293	$27,376,119	65.8	$4,201,216	$2,976,297	41.2	$9,785,509	$4,078,167	139.9
All other	$843,683	$2,669,178	—68.4	$94,629	$111,424	—15.1	$454,726	$327,198	39.0
Total expenses, including salaries and wages	$37,921,833	$23,557,887	61.0	$3,433,747	$2,270,132	51.3	$8,669,600	$3,328,740	160.4
Number of persons employed	9,294	8,036	15.7	1,112	1,078	3.2	2,083	1,329	56.7
Salaries and wages	$8,636,523	$6,223,882	38.8	$1,093,365	$880,309	24.2	$1,679,790	$921,096	82.4
Total horsepower	1,046,386	645,631	62.1	151,038	95,884	57.5	263,804	77,131	242.0
Steam engines:									
Number	503	576	—12.7	46	55	....	265	308	—14.0
Horsepower	982,740	605,227	62.4	36,270	18,128	100.1	90,675	67,444	34.4
Internal-combustion engines:									
Number	119	35	....	16	3	....	158	52	....
Horsepower	4,661	3,042	53.2	600	165	263.6	7,251	2,658	172.8
Waterwheels:									
Number	90	92	....	70	64	....	92	58	....
Horsepower	58,985	37,362	57.9	114,168	77,591	47.1	165,878	7,029	2259.9
Kilowatt capacity of dynamos	737,621	477,917	54.3	99,875	57,283	74.4	184,506	53,237	246.6
Output of stations, kilowatt-hours	2,210,372,750	1,150,900,306	92.1	242,370,956	71,414,473	239.4	614,808,584	67,166,647	815.3
Stationary motors served:									
Number	20,559	46,278	—55.6	5,678	2,279	149.1	13,039	8,773	48.6
Horsepower	1,079,652	315,659	242.0	64,694	28,148	129.8	89,902	43,820	105.2
Number of street lamps:									
Arc	15,002	35,399	—57.6	1,047	2,661	—60.7	2,479	3,637	—31.8
Incandescent, etc	132,380	41,065	222.4	26,594	20,223	31.5	49,652	27,479	80.7

* A minus sign (—) denotes decrease. Percentages are omitted where base is less than 100.
† Many of the companies operate both light and power stations and electric railways, and their systems of bookkeeping will not always permit the preparation of separate reports. For this reason, a number of establishments reported as in the light and power station industry in 1907 were treated as belonging to the electric railway industry in 1912; but some of these establishments were restored to the light and power industry for 1917. In every case the establishment was assigned to that industry to which the greater part of its operations pertained.
‡ Exclusive of $5,556,757 in 1917 and $4,422,080 in 1912, reported by street and electric railway companies as income from the sale of electric energy.
¶ Exclusive of $2,487,981 in 1917 and $1,144,220 in 1912, reported by street and electric railway companies as income from the sale of electric energy.

	Montana			Arkansas			Indiana		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	60	29	....	96	74	....	237	201	17.9
Commercial	54	27	....	71	56	....	147	130	13.1
Municipal	6	2	....	25	18	....	90	71	....
Income	†$9,695,196	†$3,883,410	149.7	¶$1,801,889	¶$1,053,763	71.0	$12,976,059	$7,711,223	68.3
Electric service	$7,947,011	$3,292,385	141.4	$1,737,999	$1,016,664	71.0	$12,114,801	$7,417,484	63.3
All other	$1,748,185	$591,025	195.8	$63,890	$37,099	72.2	$861,258	$293,739	193.2
Total expenses, including salaries and wages	$5,474,003	$2,411,668	127.0	$1,450,358	$749,029	93.6	$11,009,764	$6,028,909	82.6
Number of persons employed	732	514	42.4	459	360	27.5	2,897	2,269	27.7
Salaries and wages	$969,498	$625,918	54.9	$338,417	$242,267	39.7	$2,371,606	$1,525,875	55.4
Total horsepower	345,004	115,710	198.2	36,599	25,860	41.5	301,150	185,503	62.3
Steam engines:									
Number	39	38	....	130	115	13.0	351	352	—0.3
Horsepower	8,684	12,750	—31.9	31,498	22,599	39.4	270,219	159,888	69.0
Internal-combustion engines:									
Number	39	1	....	44	5	....	46	17	....
Horsepower	1,403	75	....	2,561	221	1058.8	3,268	1,700	92.2
Waterwheels:									
Number	82	64	....	10	10	....	90	90	....
Horsepower	334,917	102,885	225.5	2,540	3,040	—16.4	27,663	23,915	15.7
Kilowatt capacity of dynamos	182,079	74,398	144.7	24,913	16,335	52.5	227,825	135,801	67.8
Output of stations, kilowatt-hours	965,453,777	379,212,617	154.6	38,644,801	17,786,660	117.3	441,063,385	236,944,000	86.1
Stationary motors served: ‡									
Number	7,374	1,962	275.8	1,112	994	11.9	14,268	14,005	1.9
Horsepower	306,241	75,184	307.3	11,533	5,283	118.3	139,724	91,897	52.0
Number of street lamps:									
Arc	1,966	1,560	26.0	1,138	1,045	8.9	11,610	14,989	—22.5
Incandescent, etc	10,664	2,791	282.1	9,302	4,731	96.6	46,109	19,873	132.0

* A minus sign (—) denotes decrease. Per cent not given where base is less than 100.
† Exclusive of $319,671 in 1917 and $242,305 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ The number of the motors for which the total horsepower is given was not fully reported.
¶ Exclusive of $653,592 in 1917 and $612,953 in 1912, reported by street and electric railway companies as income from sale of electric energy.
§ Exclusive of $2,453,624 in 1917, and $1,144,774 in 1912, reported by street and electric railway companies as income from sale of electric energy.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Conference Club of New York.—A meeting of the Conference Club of New York, which consists of the larger electrical contractors, will be held at White Sulphur Springs, Va., from May 1 to May 3.

Jovian Electric League, Kansas City.—The Kansas City Light & Power Company was the host to Jovians, city officials and newspaper men at the Feb. 21 meeting of the Jovian Electric League of Kansas City. F. S. Dewey, assistant general manager, explained slides showing the progress of construction of the new plant.

St. Louis Electrical Board of Trade.—On March 4 the St. Louis Electrical Board of Trade was addressed by W. A. Layman, president of the Wagner Electric Manufacturing Company, on "Future Possibilities of the Electrical Industry," particular attention being paid to the subject as it applied to St. Louis and surrounding territory.

N. E. L. A., Philadelphia Electric Company Section.—This section of the National Electric Light Association announces the following activities: B. Frank Day spoke before the Meter Branch Section March 11 on "The Paymaster's Office"; F. H. Brick was the speaker at the Engineering Section March 18, his subject being "The Controller's Department." C. J. Russell will address the Commercial Branch Section March 25 on the progress made by the Philadelphia Electric Company during 1918.

Association of Iron and Steel Electrical Engineers.—Electric brass furnaces have replaced fuel-fired crucibles for melting brass in a number of mills because of the great reduction in spelter loss from brass melted in the electric furnace. Metallurgical efficiency is of prime importance in an electric brass furnace, and some have failed because, in their design, electrical and thermal characteristics were considered to the exclusion of the practical problems of the brass melter. These points were brought out by W. H. Clark, works manager of the Bridgeport (Conn.) Brass Company, when he told of his successful experience with induction-type brass furnaces in an illustrated paper entitled "Applications of Electricity to the Brass Industry," presented at the March 15 meeting of the association at Pittsburgh, Pa. M. H. Bennett, Louis Sadler, E. Friedlander, Sol. Levine and W. E. Moore contributed to the discussion, which centered around the use of electric furnaces in the brass industry.

Synchronous Club, Los Angeles.—The subject of oxy-acetylene welding was taken up by Le Roy Andrews at a meeting the Synchronous Club of Los Angeles held on March 11.

N. E. L. A., Portland Section.—Dr. W. C. Morgan, head of the department of chemistry, Reed College, Portland, Ore., spoke on "Chemistry of the War" before a recent joint meeting of the Portland Sections of the National Electric Light Association and the American Institute of Electrical Engineers.

Boston "Get-Together" Luncheons Are Resumed.—On Feb. 28 New England electrical men began again their "get-together" luncheons in Boston. Dr. R. L. Jones, transmission engineer of the Western Electric Company, gave a talk on "Voices from the Sky, or the Inside History of the Development of Wireless Telephony for Airplanes During the War." Four luncheons are planned for the spring months under the general auspices of the New England Section, National Electric Light Association.

American Association of Engineers.—The New York Chapter of the American Association of Engineers will hold a meeting on the evening of March 28 at the Hotel McAlpin, New York City. C. E. Drayer, national secretary of the association, will speak on the "Aims and Accomplishments of the American Association of Engineers." On March 13 John Ericson, city engineer of Chicago, addressed the engineers in Madison, Wis., on "The Engineer in Public Service." These officers have been elected by the Philadelphia Chapter: President, F. P. Roth, Belmont Iron Works of Philadelphia; recording secretary, M. F. Frick, Emergency Fleet Corporation; corresponding secretary, H. F. Kuzel, David Lupton Sons Company.

American Institute of Electrical Engineers

Fort Wayne Section.—An address by E. A. Barnes on "The Industrial Derelict" was given on Feb. 20.

Denver Section.—W. H. Bullock of the Westinghouse Electric & Manufacturing Company had for his subject "Building Lighting" at the meeting held on March 15.

San Francisco Section.—"The Unification of Manual and Automatic Telephone Systems at Los Angeles" was the subject of B. C. Wiseman's talk before the Feb. 7 meeting.

Detroit-Ann Arbor Section.—"Modern Applications of the Electron Theory" was the title of an address given by Dr. Saul Dushman, research laboratory, General Electric Company, at the March 21 meeting.

Fort Wayne Section.—"An Engineering Discussion of Fractional-Horsepower Motors" will be the subject for the April 17 meeting. It will be discussed by engineers of the Fort Wayne Works, General Electric Company.

Pittsfield Section.—"A Trip to California" was the title of a lecture, illustrated by many lantern slides and feet of moving pictures, given before this section on Feb. 27 by John P. Clum, Bureau of Service, United States Railroad Administration.

Spokane Section.—Dr. C. E. Magnusson, professor of electrical engineering, University of Washington, had for his subject "A Plan for the Development of Our National Electric Power Resources" at a joint meeting of the Spokane Engineering and Technical Association and the Spokane Sections of the American Society of Civil Engineers, the American Institute of Mining Engineers and the A. I. E. E.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Contract Rates.—In a recent decision approving an increase in rates by the Lincoln Water Company the Maine Public Utilities Commission presents an unusually exhaustive discussion of the regulatory powers of the state over public utility contract rates. Extracts from the decision follow: "It may be suggested that the company ought to be held to its bargain whatever the hardship. This is neither expedient nor altogether just. The company cannot continue indefinitely to render service at a loss. It cannot discontinue the service at its pleasure, nor is it desirable that it should. The town has been placed at no disadvantage by reason of the contract. The only loss suffered is that suffered by the company. The town has gone to no expense by reason of it. The only thing it has parted with is the franchise, and this is a liability under the present rates, not an asset. . . . The most that can be said in behalf of remonstrants' contention in respect to the attempted regulation of the domestic rates is that the state had not then entered that field; that the municipality, with the consent of the company, assumed jurisdiction, and that its right to do so had not been questioned until the present time. That certainly is not a delegation by the state of its police power in the manner required to make it irrevocable. It amounts at most only to a sort of tacit recognition by the state of the city's right to contract for rates, subject, however, to the paramount authority of the state whenever it chooses to exercise its sovereign power of rate regulation. . . . Unquestionably, we think, the domestic rates are not affected by any lawful contract, and are subject to the jurisdiction of this commission just as though they had not been mentioned in the agreement invoked in this case."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

United States Department of Public Works.—The Association of Engineers, acting through the committee on engineering coöperation, of which F. H. Newell of Urbana, Ill., is chairman, is endeavoring to promote sentiment in favor of a United States Department of Public Works. In the interest of its work the committee has written a letter on the subject to all engineering societies in the United States.

Public Utility Digest of Indiana.—The "Public Utility Digest," published by the Publication Service Company, Indianapolis, is being issued to review and digest temporary surcharge and rate rulings and all other matters of interest which come before the Public Service Commission of Indiana, federal bodies and various courts. It gives a summary of all Indiana public utility cases. Will B. Smith is president and A. S. Blakeley vice-president of the company. Alex. R. Holliday is treasurer and head of an advisory committee, composed of representatives of the various state utility associations.

Ice Business of Commonwealth Edison Company.—During the year 1918 the Commonwealth Edison Company took on seven new ice plants, making a total of thirty-two plants which are now operating over the company's lines. In these plants during 1918 there were produced 643,000 tons of ice and 1,543,000 gal. of ice cream. The ice and refrigeration plants connected to the company's lines used 33,000,000 kw.-hr. of electricity. Sixty-five per cent of all the artificial ice manufactured in the city is made by central-station electric service, and 28.5 per cent of all the ice used, including both natural and manufactured ice, is manufactured by central-station service.

Methods of Classifying Army Personnel.—Employers and others interested in personnel work will have an opportunity to examine the methods developed by the committee on classification of personnel in the army at an exhibit to be shown on the third floor of the Engineering Societies Building, New York City, April 1 to 12, 1919. This exhibit consists of a collection of wall charts, forms, photographs and models showing how the army finds out what men can do best and how it uses that information, how soldiers are trade-tested, and how officers are rated and fitted into place; how the work is checked and supervised, and its results in the war. The collection is being shown under the auspices of the National Association of Corporation Schools and the United Engineering Society, representing the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. It was on exhibition for several weeks at Washington, where it excited so much interest that in response to many requests the Adjutant General consented to its display in other cities. Two commissioned officers accompany the exhibit to explain its various features.

Rates for Keokuk Energy.—The Missouri Senate committee on private corporations has reported favorably a bill intended to settle a question as to the power of the Missouri Public Service Commission over the rates charged the United Railways Company of St. Louis and the Union Electric Light & Power Company, St. Louis, for electrical energy generated at Keokuk. While members of the commission believe that it now has that power, there has been some uncertainty because the energy comes from another state. Senator Gardner has said that he is confident that if the bill should become a law the commission could set aside any unjust or unfair contracts which St. Louis public utilities might have made for Keokuk electricity.

"Public Service Rates Based on Cost."—Charles H. B. Chapin, secretary Empire State Gas & Electric Association, discusses this new plan for determining fair rates in a recent issue of *State Service*. He says that the method of procedure which apparently meets with the greatest favor consists of the company and the municipality or municipalities served entering into a contract, the enforcement of which is left largely in the hands of the state commission. Among the specific provisions which Mr. Chapin says such a contract should include are these: "A bonus to be payable to the company in consideration of increased efficiency in operation. . . . The public would agree to assume responsibility for the entire cost of the service, including cost of capital as well as cost of labor and of materials. Provision would be made for a conference early in each year between the representatives of the municipalities, the commission and the company, at which the financial situation would be gone over and the budget of cost of service for the ensuing year decided upon. The company itself should be given considerable latitude in arranging its rate schedule, as this involves both technical skill and experience, in order that the efficiency of operation be not impaired with consequent increase in cost. The contract should contain some provision under which other conferences could be called as conditions might make them necessary. For example, the public as a partner is interested in the question of wages, . . . or an expensive extension might be desired which would not be immediately self-supporting."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Municipal Regulation of Rates Provided by Contract.—Where an ordinance is passed by a municipal corporation granting to a gas company the right for the term of twenty-five years to furnish natural gas for heating, lighting and power purposes, through its mains and appliances in the streets and public places, on terms and conditions contained in the ordinance, which include a provision that the grant is subject to the right of the city to regulate the price of natural gas from time to time as provided by law, the acceptance of the ordinance by the company constitutes a valid contract, and the rights of the parties are to be determined by the contract itself, according to the Supreme Court of Ohio (121 N.E. 688). In such case the grant to the company is subject to and dependent on the right reserved to the city to fix the price of gas from time to time as provided by law. Statutes in force at the time a contract is made by a municipality enter into and become part of the contract. Its obligation is to be measured and performance is to be regulated by the rules which they prescribe.

Rights of City Over Poles and Wires in Streets.—An ordinance prohibiting erection or repair of poles and wires in streets and alleys is prima facie within the city's power, according to the Supreme Court of Illinois (121 N.E. 565). Where a city enacts an ordinance licensing a public service company to maintain poles and wires in its streets for the necessary and reasonable conduct of its business, the ordinance, when accepted and acted upon, becomes a contract which the city cannot arbitrarily abrogate. The mere fact that ordinance prohibiting erection and repair of wires and poles in streets and alleys could not be enforced against company holding franchise so to use the streets and alleys would not invalidate ordinance as to others. Where ordinance prohibited erection and repair of wires and poles in streets and alleys court could not presume, from the fact that a company had wires and poles in streets, that it had a franchise to keep them there, however unusual such use without a franchise. In prosecution for violating ordinance prohibiting wires and poles in streets and alleys, defendant had burden of showing that his employer had a franchise so to use the streets, if that were the fact. In prosecution for violating ordinance prohibiting wires and poles in streets and alleys, defendant could not make the point that no employees of any other telephone company had been arrested.

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

F. A. Noyes is now acting as superintendent of the southern as well as the eastern district of the Consumers' Power Company, Jackson, Mich.

Harry Hart, for the past twenty years with the Commonwealth Edison Company, has joined the electrical staff of the Coyne Trade and Engineering Schools, Chicago.

Col. H. M. Byllesby, president of H. M. Byllesby & Company, has been elected president of the Chicago branch of the National Security League, succeeding H. H. Merrick.

Lorne C. Webster has been elected president of the Quebec Railway, Light, Heat & Power Company to succeed Sir Randolphe Forget, deceased. Mr. Webster was vice-president of the company.

E. A. Luney has been appointed divisional assistant superintendent of the Public Service Company at Morris, Ill., to succeed H. H. McCullom, resigned. Mr. Luney recently returned to the employ of the Public Service Company from the army, where he obtained the rank of captain.

E. W. Doty, who was formerly a member of the Public Utilities Commission of Ohio, has opened an office as public utility consultant, to undertake work involving service-at-cost franchises, rate investigations, appraisals and land valuations, at 16 South Third Street, Columbus, Ohio.

F. K. Woodring has been elected a director of the Northwestern Ohio Railway & Power Company, Toledo, Ohio, to succeed George H. Tuttle; vice-president of the company, to succeed J. B. Taylor, resigned, and general manager of the company, to succeed E. A. Burrill, resigned.

B. C. Edgar has succeeded F. W. Hoover, vice-president, in active charge of the affairs of the Tennessee Power Company and the Chattanooga Railway & Light Company. Mr. Hoover retains his position as vice-president and remains as a member of the board of directors. Mr. Edgar will retain the position which he has held previously as general superintendent of the Nashville Railway & Light Company. Prior to going to Nashville he was assistant general superintendent of the Columbus (Ohio) Railway, Power & Light Company.

Fred V. Underwood has reëntered the service of the Birmingham (Ala.) Railway, Light & Power Company as assistant general manager. Mr. Underwood was with the company in various positions for many years. He was troubleman, installation man, meter reader, meter tester and inspector in charge of the meter and arc-lamp department. He was promoted to the position of chief engineer at the power house and later became assistant superintendent of the electric department and finally superintendent of the electric department and electrical engineer for the company. Last October Mr. Underwood resigned to become superintendent of production for the Alabama Power Company.

Herman Russell, assistant manager of the Rochester (N. Y.) Railway & Light Company, has been appointed general manager to succeed James T. Hutchings, recently elected president of the company.

Frank Glosser has resigned as manager of the lighting department of the Columbus, Delaware & Marion (Ohio) Railway Company to become general manager of the Commercial Steel Castings Company, Marion.

S. A. Redding has resigned his position as general superintendent of the electrical department of the Georgia Railway & Power Company, Atlanta, to return to the Republic of Brazil, where he previously resided from 1897 to 1903.

Calvert Townley, assistant to the president of the Westinghouse Electric & Manufacturing Company, has been reappointed by the Engineering Council chairman of the water conservation committee. He was also reappointed a member of the reconstruction committee.

L. C. Stacy has succeeded Frank Glosser as manager of the lighting department of the Columbus, Delaware & Marion (Ohio) Railway Company. Mr. Stacy has been an electrical engineer in the chemical warfare division of the army. Prior to going into the service he was an electrical engineer with Sargent & Lund, consulting engineers, Chicago.

Thomas F. Johnson, who has been assistant superintendent of the electrical department of the Georgia Railway & Power Company, Atlanta, Ga., has been appointed to succeed S. A. Redding, resigned, as general electrical superintendent of the company. Mr. Johnson before becoming assistant superintendent of the electrical department last summer was superintendent of transmission and distribution. He is particularly well known in the field for his work on live lines.

W. H. Sawyer, vice-president of the E. W. Clark & Company Management Corporation, has been elected president of the East St. Louis Suburban Railway Company, East St. Louis Railway and Alton, Granite & St. Louis Traction Company and vice-president of the St. Louis & Belleville Electric Railway, Alton Gas & Electric Company and St. Louis & East St. Louis Electric Railway. Mr. Sawyer has been associated with the E. W. Clark Company and interests since the summer of 1914. Prior to that he was engineer in charge of the New York office of Ford, Bacon & Davis, consulting engineers, New York City. Mr. Sawyer was born forty-five years ago at Schoolcraft, Mich. In 1894 he was graduated from the University of Nebraska and for two years was with several street railway companies. He then entered the employ of the General Electric Company in the railway and engineering departments, where he continued for nine years. The next nine years he spent with Ford, Bacon & Davis.

Obituary

Charles Hall, manager of the William Hall Electric Company, electric supply jobbing, Dayton, Ohio, died on Feb. 22, following an operation.

Edward Soukup, commercial engineer for the Iowa Railway & Light Company, Cedar Rapids, Iowa, died on Feb. 23 at the age of thirty-two years. Mr. Soukup upon graduation from the Iowa State College in 1907 entered the employ of the General Electric Company. Two years later he joined the commercial department of the Iowa Railway & Light Company, where he remained until his death.

J. O. Hardin, electrical engineer in the Southeast for Lockwood, Greene & Company of Boston, died in Atlanta, Ga., on Feb. 28, of peritonitis, following a sudden attack of appendicitis. Mr. Hardin before being associated with the Boston firm was engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, with which company he had been associated since 1912. Prior to that he had been employed by the General Electric Company.

Philip S. Dyer, who was an associate of Thomas A. Edison for thirteen years, died March 10 at his home in New York City in his sixty-third year. Mr. Dyer left the lumber business in 1879 to work in the Edison laboratories. For ten years he was European representative of the Edison Electric Company. In 1892 he returned to the United States to enter business for himself. At the time of his death he was a director of the Chamber of Commerce of the United States and a member of the Engineers' Club, besides having a number of other affiliations of a similar nature to these.

James M. Poyner, a well-known electrical engineer, for ten years connected with the Baltimore office of the General Electric Company, died at Charleston, W. Va., on March 3 at the age of thirty-seven from influenza. Mr. Poyner was born in Alabama and was a graduate of Auburn College of Alabama and a member of the Engineering Club of Baltimore and the American Institute of Electrical Engineers. He went to Baltimore from the Lynn Works of the General Electric Company and remained there until Jan. 15 last, when he resigned to take up new work in Charleston, W. Va.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

CO-OPERATIVE STOCK LIQUIDATION BY JOBBERS

Local Market Made More Stable and Profitable by Preventing Price Cutting to Move Overstock

The practice being followed in a few places in the country by electric supply jobbers with long stocks, of disposing of their surplus to competitors, is meeting with favor. There is hardly a sizable jobbing locality where some jobber is not long on one or more items. To liquidate this stock by quoting a price low enough makes the local market extremely unstable besides engendering bad feeling in the trade.

The plan followed in some places is for the other jobbers to take the overstock at current prices. This places the entire trade on a common basis and makes it possible to do more business at a profit.

As a further means of liquidating local stocks many jobbers are placing small orders with competitors rather than with the manufacturer. The manufacturers, however, are not all unfavorable to this scheme. By keeping the market stable the manufacturers reap certain benefits. Nor is the least benefit that of keeping their distributers in a strong credit position.

CURRENT VOLUME OF BUSINESS SATISFACTORY

Manufacturing Output Exceeds That Prior to War, Jobbing Sales Are Ahead of Last Year and Retail Sales "Best Ever"

Four months ago every one viewed the general business situation with alarm. Buying was expected to fall flat and prices to drop to low levels. Now it is gradually dawning upon people that this situation was merely a state of mind. To be sure, there is not the volume of purchasing going on that prevailed during the last year of the war. Moreover, some prices have dropped, principally of raw materials.

Considering the electrical trade as a whole, however, conditions are good. The output of electrical manufacturers is running on the whole probably not more than 25 per cent behind the maximum rate during 1918. While the manufacturers are not running to capacity, it is probably true that on the whole they are turning out to-day a volume of goods fully as great as they were turning out in March, 1916, and greater than at any time prior to the war.

Electrical jobbers did on the whole a business from 8 to 10 per cent larger in January and February of this year than during the first two months of 1918. Typical of this condition is a statement by a prominent Minnesota electrical jobbing house:

"Our business during January was larger than for any previous January in the history of our company, and it looks very much as if we should be able to say the same thing about February too.

"Our telephone customers are already beginning to carry out their plans for extensions that the war held up for so long. January is usually not a good pole-setting month, on account of inclement weather; still, our telephone friends placed more carload orders for poles during January than they did during any month last year, and with the poles went the usual supply of pole-line hardware, wire and telephone equipment.

"Our central-station customers are also figuring on extensions to their lines and plants. Inquiries and orders for line material, wire and wiring devices, generating equipment, transformers, meters and so forth are coming in in great shape. Evidently the central stations are fully determined to make up for lost time.

"An analysis of our dealer-contractor business also brought out similar facts. The demand for electrical home labor-saving devices is increasing right along. Washing and ironing machines, vacuum cleaners, portable sewing machines, heating devices, to mention only a few of the many electrical appliances, are being sold by our dealer-contractor customers in a way that makes us feel highly optimistic."

Retail sales are probably larger than they ever were. People have money and are spending it. High-priced electrical appliances are moving fast.

It is true that sales are not being made in the large quantities to-day that they were last year, but that is natural. In the first place, it is not logical to suppose that distributers and retailers are going to lay in large stocks the price of which may fall. They prefer to place smaller and more frequent orders. And from the wholesaler's standpoint that is good business because it minimizes the outstanding credit risk at a time when it is really essential to have outstanding credit in the position where it is most easily collected. In the second place, it is no longer necessary to order in such quantities as were placed last year because deliveries are better and goods may be had to-day very quickly.

With the spring just coming and all of the construction that goes with it, the outlook for the electrical trade is far from being dark.

ELECTRICAL MATERIAL IS COMING BACK ON MARKET

Reports Indicate Numerous Instances Where Supplies Have Been Sold at Prices Considerably Under the Current Market Price

Reports come in from scattered sources that electrical materials are coming back on the market from the government and from industrials no longer engaged in war work at prices ridiculously low.

For instance, at Camp Dodge it is reported that approximately a quarter of a million feet of No. 14 rubber-covered wire was sold at $5.50 per 1000 ft. when the jobbers' cost was around $10.50. The wire was purchased in partial lots by local contractors, and the first intimation which local jobbers had of the situation was when a contractor with whom they were doing business found that a competitor had underbid him to the extent of about $1,000. It then developed that the low bidder was using government wire.

As another instance the sale which has been made by the government aviation school at St. Paul, Minn., to the Chicago House Wrecking Company has been cited. This material has been listed by the Chicago House Wrecking Company in a mail-order catalog which is distributed among electrical dealers. Another instance is cited by a jobber from the South, who states that he had seen bills of sale for conduit in which ½-in. conduit changed hands at $3.10 per 100 ft. and in which the larger sizes sold at even cheaper prices. It is also stated that a line erected to serve Camp

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Beauregard at a cost around $68,000 was offered for sale for around $3,000.

A representative of one of the larger electrical manufacturing concerns points out that a large amount of used material, particularly motors, is finding its way back on the market at low prices. The intention of the government, of course, so far as government material is concerned, is to prevent the material from coming on the market through junk channels at prices that would tend to demoralize the market. Only a couple of weeks ago the spruce division refused bids on material, among which were a number of motors, because the bids were too low.

It has been announced that the manufacturers would have an opportunity to bid on their own material in order to prevent it coming on the market at demoralizing prices. The electrical jobbers are putting into motion a plan for absorbing small electrical material as it is released by the government. The jobbers feel that otherwise it would be easy for a junk dealer to bid in a supply of conduit and later maybe some wire and to this add other electrical supplies, all at very low prices. This dealer could quickly become a jobber and by quoting low enough prices, while still making a handsome profit, would underbid all dependable electrical supply jobbers on current business.

METAL MARKET SITUATION

Meeting of Steel Leaders Expected to Help Market—Copper and Brass Products Lower

A very quiet market characterized the past week. Much interest is centered in the meetings of the leaders of the steel trade and government officers. The schedule of reduced prices, on which an agreement is expected so as to stabilize industry, was discussed by the steel trade leaders at their meeting, and it is expected that the government will follow the decision with an order for 1,600,000 tons of rails. This cut in steel is expected to be followed by similar action in other industries.

A more confident and stronger undertone was evident in the copper trade last week. Sales were about 12,000,000 lb., the most of it at from 14¾ cents to 15 cents a pound; some went at 14½ cents, and one lot for export is reported at 14⅝ cents. The larger interests still hold more firmly at 15 cents.

One favorable development is the reduction in price of finished brass and copper products, the base price of copper wire being down about 1¼ cents, the base price of copper sheets 2 cents, and the average reduction in the price of other copper-rolled products and of brass being 2½ cents a pound.

In the old-metal market the only activity appears to be for lead and type scraps and aluminum scraps.

NEW YORK METAL MARKET PRICES

	March 11	March 18
Copper:	£ s d	£ s d
London, standard spot	77 0 0	77 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	15.50	15.25 to 15.50
Electrolytic	14.87½	14.87½
Casting	14.75	14.75
Wire base	18.75 to 19.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	7.00 to 7.12½	6.90
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.50	6.50
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	30.00	30.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.75	12.75 to 13.25
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.25
Lead, heavy	4.75 to 4.87½	4.75 to 4.87½
Zinc, old scrap	4.50 to 4.75	4.50 to 4.75

THE WEEK
IN TRADE

A CONSIDERABLE volume of business is being done in electrical lines. Orders generally are smaller, indicating caution on the part of the buyer. For January and February retail and jobbing sales on the whole exceed those of the first two months of 1918. In fact, the retail trade is probably better to-day than it ever was. As retail stocks become depleted a much better trade can be expected by the manufacturers.

Some building projects are coming to light, and more are expected during the next few weeks. As soon as the new iron and steel prices are announced a large amount of building contracts should be released.

Prices are being shaded a bit here and there, but the producers generally feel disinclined to reduce their prices just yet.

Labor shows fewer disturbing conditions this week than last. While non-employment is probably increasing, it seems probable that there is no more non-employment to-day than there is normally during the winter months.

NEW YORK

Market conditions have changed very little. Prices on many articles are shading off, but the drops are very small and there is little indication that appreciable reductions will be put in force for some time to come. Labor is still very unsettled and shows little inclination to become stabilized, and wages are showing an upward rather than a downward tendency.

By liquidating overstocks through competitors local jobbers have been able to reduce stocks on hand in a very satisfactory way. There does not seem to be such a tendency toward price cutting locally as there was prior to the war. Dry goods stores have been having sales in which the prices of electric lamps and heating devices have been badly slashed.

Regardless of the cost of building materials, many buildings would to-day be under way were it not for the hold that labor has on the building market. Contractors and real estate operators are holding off until such time as labor can be depended upon. The risk is too great for contractors to tie up their money in materials for a partly constructed building only to find a strike on their hands at a crucial point in the operation.

OUTLET BOXES.—A decrease of approximately 20 per cent is noted in outlet boxes, bushings and nuts.

RIGID CONDUIT.—Sales are greater, and the unfinished orders from one factory have been reported as increasing.

CROSS-ARMS.—Some sizes have decreased 5 to 7½ per cent on all quantities from stock.

METALLIC FLEXIBLE CONDUCTOR.—Two manufacturers have increased their discount from 33 per cent to 35 per cent.

ELECTRIC SIGNS.—The market is well under way and some very large units are coming through. Flashers are being used to a greater extent than formerly. Deliveries are about four weeks.

FANS.—Although prices, including the tax, average about 20 per cent higher, more business is expected than last year. Very vigorous campaigns are being mapped out to carry this through.

ELECTRIC TOOLS.—Considerable activity has been found in this market.

WIRE.—Rubber-covered is slightly lower this week. Of twelve manufacturers two are quoting on a 23-cent base, one on 22 cents, seven on 20 cents, one on 19 cents and one on cost.

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CHICAGO

The commercial electrical field in the Middle West appears generally to have borne up very well under the conditions imposed since the first of the year. Sales have totaled more than most of the jobbers expected them to do. In fact, twenty-six jobbers in Ohio report that their total sales for the first two months of 1919 were ahead of the first two months for 1918. A similar situation is said to prevail among the important jobbers in the Chicago district. This statement, however, should not be viewed too optimistically in view of the fact that January and February of 1918 were probably the worst months of that year.

There is considerable optimism as to the prospects for central-station business. Conditions indicate that this business will not be in the nature of a few large jobs but will consist of a multitude of small extensions, additions and betterments. This makes an ideal kind of a market for the jobber. That there will, however, be some large construction work undertaken is apparent from the fact that the best estimates show about 1500 small elevators and 75 large grain elevators now projected or under way. The small elevators may take from 25 hp. to 100 hp. apiece, while each of the large elevators will take several thousand horsepower each.

Nearly all electric supply jobbers are beginning to appreciate the immense volume of business in heating appliances and small motor-driven devices which may be secured by soliciting the accounts of farm-lighting plant agents.

No sales of electrical goods by the government to consumers have been noted in the immediate district around Chicago, according to jobbers who have been endeavoring to watch the situation.

POLE-LINE HARDWARE.—Steel pins, brackets, braces and all other items of hardware included in this group have been reduced 10 per cent in price.

STEEL OUTLET BOXES.—These have been reduced in price slightly.

CROSS-ARMS.—The price of cross-arms has been reduced about 5 per cent, largely on account of changes in freight conditions. Some of the change is also attributed to the fact that the demand for airplane spruce has fallen off.

COPPER WIRE.—Both rubber-covered and weatherproof copper wire is selling at 20 cents. There are apparently plenty of inquiries, but most of these seem to be merely feelers. All of the prospective customers appear to be holding off in spite of the fact that they know they must purchase wire in order to fill the requirements of the many small jobs which central stations will have to do to meet the demands of customers that have been held off by commission rulings, etc., during the war period.

MOTORS.—The Emerson motor price book No. 46, issued on Feb. 5, 1919, shows prices approximately 10 per cent lower than those in effect from Oct. 5, 1918, to Feb. 4, 1919. The Emerson company states that the new prices have been based on manufacturing economies and efficiency.

SMALL MOTORS.—The small-motor delivery situation in some factories is still far from perfect. Manufacturers of small motor-driven devices who have been endeavoring to get shipments of small motors in weekly lots of 100 and 200 are still having their requirements scaled down to one-quarter of this amount.

CONTROL APPARATUS.—Business is reported to be dull in this line.

VACUUM CLEANERS.—One electric vacuum sweeper company has received an order amounting to $120,000 from a single central-station company.

ELECTRIC CHURNS.—Motor-driven electric churns for operation on 32-volt direct-current farm-lighting systems are enjoying excellent activity. Distributers in the southern part of the United States are ordering these from Middle Western manufacturers in car-load lots.

ELECTRIC RANGES.—The season for electric cooking equipment is opening up this year earlier than usual. The demand is expected to be more brisk than last year or the year before. Several of the larger cities which dropped the electric range business during the war period are coming back into the field and the number of small central stations which will take up the active work of selling ranges again apparently will be large.

FARM-LIGHTING PLANTS.—The price of Delco farm-lighting plants will not be changed during the year of 1919 from the figure existing at present, which is $495 for the larger model.

ELECTRIC FLATIRONS.—Manufacturers making electric flatirons for 32-volt farm-plant service are all changing their designs somewhat to prevent the cord being disconnected from the iron at the base of the iron. It is thought that bolting the plug to the handle of the iron will eliminate some trouble from burning of contacts.

BOSTON

Business holds up fairly well in electrical lines. A leading jobber reports that his February trade considerably exceeded that of a year ago and that diversified orders are coming in at a good rate. Improved business is beginning to be seen in electrical contracting circles. Nothing like a building boom has opened as yet, but considerable public building work is in sight, notably in the schoolhouse field. The Worcester Pressed Steel Company is planning to build a 90-ft. by 150-ft. rolling mill near Barbers Crossing; the Aberthaw Construction Company, Boston, has received a contract to design and construct a hundred-thousand-dollar storehouse and office at Rochester, N. Y., and construction work has begun on a new wire factory for C. O. Johnson & Sons, Jamesville, Mass. Keen interest in electrical accessories for automobiles is being displayed this week at the Boston show, storage batteries being featured.

Jobbers' stocks are beginning to run considerably lower. Ordering still reflects a hand-to-mouth policy, which the open winter and greatly improved deliveries encourage. Collections are fair, although some troublesome delays in government payments are being experienced. Central-station advertising is opening up, but the lid is still tightly clamped as to extensions in some large companies. One of these reports a total loss of about 13 per cent in load due to curtailment of war work, and it is expected that this loss will be regained in the comparatively near future. Some meritorious interconnection plans are held up at present by right-of-way difficulties, but as soon as these are cleared away construction will go forward.

WASHING MACHINES.—These outfits are selling finely, and orders are being placed on a very optimistic basis. Some large individual sales are being carried through. So far the supply of washers holds up well, and deliveries are good. Little price movement is reported.

MOTORS.—The market reflects a waiting attitude, with improving stocks in standard types and sizes. Distributers are maintaining firm prices, barring occasional slight recessions to close deals, especially in work where competition is keen.

LAMPS.—These are in good supply, and a fair trade is being handled for residential service.

SEWING-MACHINE MOTORS.—Trade is quite brisk, and the appearance of competitive makes in the New England market is stimulating inquiries.

VACUUM CLEANERS.—Stocks are now plentiful. The prospects of a good spring business are favorable, but by and large the trade in cleaners has not developed as yet to the expected magnitude.

INDUSTRIAL ELECTRIC TRUCKS. — Inquiries are coming in at a fair rate, but sales are somewhat below previous levels. Deliveries are good. New price sheets reflecting the recent reduction in alkaline batteries have not yet reached all distributers.

WIRING MATERIAL.—The demand is relatively small and manufacturers are in shape to make exceedingly prompt deliveries. Fair stocks are being carried by the jobbing houses, but little new business is coming through at the moment. This year there is little slack to be taken up between the factory and the jobber's storehouse; in other words, orders are now being placed much nearer delivery dates than in 1918.

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ATLANTA

The strike of the railway clerks tnis week, covering most of the railroads entering Atlanta and other Southern cities, has tied up shipments, as the railroads are not receiving any freight. Industry, except in a few lines, and these chiefly textile, shows a slightly better pace and many readjustments appear to have been satisfactorily completed. Perhaps the most notable advance visible is the swelling of the building trades into a modified form of preparatory activity. Collections have slightly improved, and it is expected that this condition will be maintained, at least until the Victory loan is floated.

The increasing number of men being discharged from the various Southeastern cantonments has tended to increase non-employment. Certain industries still report a shortage of labor, however, and it is hoped that a large portion of the idle labor will soon be absorbed.

The bond for a municipal electric plant at Atlanta did not pass, as was originally reported, and it is expected that another election will be held in April. The War Department has definitely decided to go ahead with construction at Camp Benning, Columbus, Ga., on a slightly reduced scale. Souther Field, Americus, Ga., has been selected as a permanent camp for aviation. It is reported that the Mobile Electric Company, Mobile, Ala., contemplates spending $1,000,000 on a new electric plant.

MOTORS.—Manufacturers report a slight improvement in the demand this week covering capacities up to 150 hp. There has been no change in price. Factory promises of shipment have greatly improved, and all current requirements can be taken care of in a reasonable time.

TRANSFORMERS.—On the whole, the volume of transactions appears to be well sustained, with an increased demand in a few of the smaller capacities. Prices are holding up remarkably well, and stock conditions of the distributing 2300-volt type are improving weekly.

METERS.—The call continues quite steady, and the buying element does not seem to pay much attention to rumors of substantial cuts in prices. Local stocks are not up to quantities recorded last week. Labor trouble affecting incoming shipments is in a measure responsible for the decrease for this week.

PANELBOARDS.—Movement is only moderate. Shipments are much better. Prices remain firm and the local demand shows no change.

CONDUIT FITTINGS.—A slight increase in movement has been noted for this week, following a weakening in market prices. Stocks are ample.

STAMPED STEEL BOXES.—There was very little response in the way of increased demand when a decrease of approximately 8 per cent in price was recorded. Stocks are about normal.

WIRE.—The volume of sales for both rubber-covered and weatherproof is very satisfactory, and little change is to be recorded over last week. Rubber-covered and lamp-cord base is around 20 cents. Weatherproof is still clinging to an 18-cent base.

CONDUIT.—Compared with the last few weeks activity has ceased. Indications are that requirements will be much greater shortly, but the big buyers are still holding off, anticipating further reductions in steel.

SEATTLE—PORTLAND

As a result of the ruling made by the industrial division of the United States Shipping Board in Tacoma on March 15 controversies over the reinstatement of shipyard strikers have been amicably adjusted. Plants are rapidly resuming normal working conditions, and it is believed that the end of the week will find them operating at full blast.

Seattle jobbers report that sales are slightly in excess of those reported last week owing to the reopening of shipyards and industrial plants. The volume of sales to these plants is expected to increase rapidly. The lumber situation is showing a slight improvement, with prospects bright for spring work. The industry has heavy orders for spring delivery. It is predicted that a large number of plants which have been engaged in government work exclusively will reopen for general business. A number of inquiries for motor equipment are expected to develop into orders. It is believed that considerable business from small towns will be placed for extensions to plants, etc. It is generally known that numerous small projects that have been held up by the war are now being revived. Report says that the farmers of the Northwest will have the largest acreage in grain ever known. Employment conditions in eastern Washington are excellent. Indications point to an early opening of Yukon and northern Alaska trade. The State Board of Control, Olympia, announces that work on new buildings at thirteen state institutions, to cost approximately $750,000, will be started shortly. Yakima, Wash., reports plans formulated for an expenditure of $500,000 on buildings this spring.

The Portland district reports the industrial situation practically unchanged during the past week. Sales are small but consistent. Non-employment is increasing rapidly and wages remain practically the same as before the signing of the armistice.

Many commodities are gradually increasing in price. Virtually all lines of building material are unchanged. This has a deterrent effect on new construction. However, there has been an appreciable increase in the number of residence permits during the past week. Retail electrical sales show no change over last week, the volume keeping up to normal. It is predicted that the coming spring weather will bring a heavy buying of household equipment fixtures and wiring devices.

SAN FRANCISCO

Building continues rather light with no especially heavy jobs reported. The February, 1919, building permits reported were as follows: San Francisco, 281, value $650,044; Oakland, 252, value $492,598; Los Angeles, 400, value $1,008,195. From all indications 1919 will be a wonderful electrical appliance year, especially in big household appliances. At present the effort is rather feverish than methodical, and there is no doubt that the careless merchandising methods of a few dealers will have to be smoothed over later. One cannot help noticing the marked change in appearance of dealers' stores, the number of big devices on sale, the noticeable public interest in such devices and the newspaper and other forms of advertising that are seen on every hand.

WASHING MACHINES.—Sales are large, and to the list of those paying attention to this line must be added department stores. The demand seems to be very evenly divided between cheap machines of a dolly pattern and machines which sell for perhaps a third more, the average price locally being from $100 to $130 for the average family size. Deliveries are much better than last year.

SEWING MACHINES.—There are now nearly as many makes of electric portable sewing machines either on the market or shortly to be brought out as there are washing machines.

VACUUM CLEANERS.—Here at least is one device where the public almost unanimously demands quality at the expense of cheapness, for in the past year a fair demand for exceedingly cheap machines that sold below $30 has almost entirely disappeared, and certain makes or certain qualities regardless of their first cost are demanded. When this demand is analyzed it is found that it is almost entirely for a machine with a motor-driven brush. Deliveries are very poor from the factory and orders are usually snapped up long before their arrival.

HEATING DEVICES.—The great question among dealers seems to be as to how long the present small-device prices will prevail, but whereas it has been almost unanimously believed that they will shortly drop, it is now held by the majority of dealers that labor, which cuts such a high figure in the prices on account of the infinite details in assembling, will be the determining factor in the maintenance of prices. In fact, radiator advances have been tentatively announced, the socket style to list at $10 instead of $9 each.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	List to +20%
1/5 to std. pkg	20% to list
Std. pkg	17% to 36%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
⅜	250	7.50
½	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
-in. single trip	$75.00	$63.75— 69.75
-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
¼-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$60.00	$30.00	$26.00–26.50
¼-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft.	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft.	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$25.00 to $51.33

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $20.00
1/5 to std. pkg.	12.00 to 17.00
Standard package, 2200. List per 1000,	$21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$22.00
1/5 to std. pkg.	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41–$0.66
No. 18, full spools	.39– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.50–$25.00	$10.50–$17.00	$10.50–$15.00
12	20.20– 27.09	18.18– 23.22	15.15– 23.22
10	27.00– 32.40	24.30– 32.40	19.44– 27.45
8	33.12– 45.72	30.36– 45.72	26.50– 38.10
6	52.50– 72.36	48.13– 60.30	42.00– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$26.75 to $34.75
25 to 50 lb.	26.75 to 34.75
50 to 100 lb.	25.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb.	23.75 to 37.35

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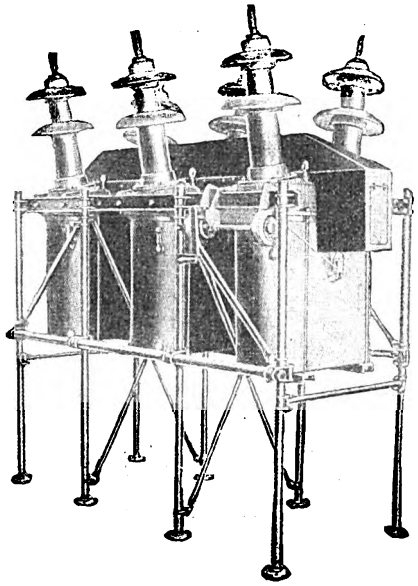
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Oil Circuit Breakers for Outdoor Applications

For controlling and protecting transmission lines, transformer banks and similar apparatus where the normal operating voltage is 44,000 volts or less, type D-16 oil switches and circuit breakers have been developed by the Condit Manufacturing Company of South Boston, Mass. They are of the three-pole type, arranged for manual direct or electrical remote control, and are furnished in these ampere capacities: 300 amp., 44,000 volts or less, and 300, 500 and 800 amp., 25,000 volts or less. Two forms of mounting are procurable—floor type, where the tanks rest upon the floor, and frame mounting, where the tanks are supported by a frame structure, as illustrated.

These switches and breakers essentially comprise three separate and identical units arranged in such relation to a common operating mechanism that simultaneous operation of the contact members is obtained. These switches are characterized, the maker states, by rugged construction, large expansion chamber with baffle gas vents, substantial tank construction, reversible and easily renewable arcing



FRAME MOUNTING, MANUAL DIRECT CONTROL, 300 AMP., 44,000 VOLTS

tips, and an efficient laminated brush, whose strong spring action facilitates rapid acceleration of the moving contact members upon the initial opening of the circuit.

Depending upon whether bushing type or oil-insulated type current transformers are used, trip coils are calibrated to trip at 5, 7 and 10 amp. or at 4, 5, 7 and 10 amp.

Inclosed Lighting Fixture for Gas-Filled Lamps

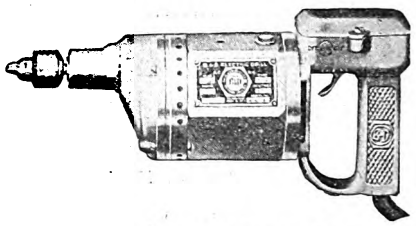
Instead of designing a lighting fixture to meet the requirements of several sizes of lamps and thereby effecting a compromise, Young & Egan of New York have developed units for each of the standard gas-filled lamps. This provides, the makers say, lighting of the finest-graded intensity and diffusion to fit individual requirements. As a result of thus designing the unit around the bulb, perfect diffusion is

INDIVIDUAL LIGHTING UNIT FOR EACH SIZE OF LAMP

said to be obtained, since the lamp filament in each unit is placed in the correct position. The unit is made in one piece of frosted glass between layers of clear glass. The light source is concealed, eliminating glare, and the fixture is shaped to give a minimum of light absorption with a maximum of illumination. The Sibley-Pittman Electric Corporation, Sixth Avenue and Thirteenth Street, New York City, is distributing this unit, which is known as the "Ray-O-Day."

High-Speed Drills with Pistol Grip and Trigger

Pistol grips and trigger switches are now obtainable on the $\frac{3}{8}$-in. and $\frac{1}{4}$-in. (4-mm. and 6-mm.) portable electric drills made by the Black & Decker Manufacturing Company of Baltimore, Md. Heretofore these features have been procurable only on the $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$ and $\frac{3}{4}$-in. (9, 12, 15 and 22-mm.) sizes of this company's drills. These models are one-hand drills, the current being controlled by pulling the trigger, without any necessity for changing the position of the hand holding the tool. In



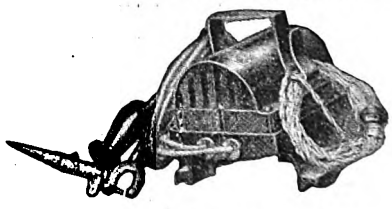
MAY BE HELD AND OPERATED WITH ONE HAND

addition, it is pointed out, this convenient control prevents breakage of drill bits frequently caused by the drill sagging on the bit when the operator changes the position of his hands to switch off the current.

These drills have $\frac{1}{3}$-hp. General Electric Company motors with series-compensated windings and operate on any current from direct to 60 cycles alternating. A vane impeller mounted on the armature shaft cools the machine by causing a forced circulation of air through the entire housing. The energy consumption of both models is 175 watt-hours. The no-load speed of the $\frac{3}{16}$-in. (4-mm.) model is 1600 r.p.m. and that of the $\frac{1}{4}$-in. (6-mm.) drill is 1200 r.p.m. Both drills weigh about $6\frac{1}{2}$ lb. (3 kg.) and come equipped with 15 ft. (4.5 m.) of duplex cable and a separable attachment plug.

Transformer for Welding Battery Connections

In order to afford convenient means for burning or welding straps and posts on storage batteries, the General Electric Company of Schenectady, N. Y.,



LIGHT IN WEIGHT AND PORTABLE

has developed a small lead-burning transformer, designed on the arc-welding process principle. It consists essentially of a small transformer wound for connection to the usual 110-volt, 60-cycle lighting circuit or 50-40

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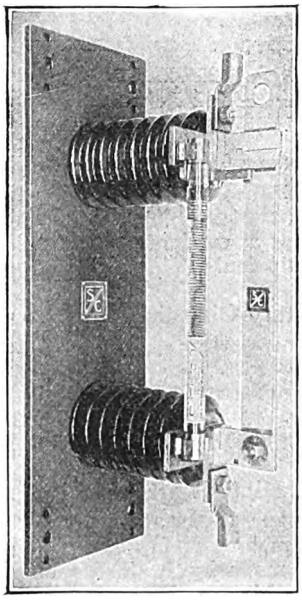
cycle circuits and with a low-voltage secondary of limited short-circuit capacity. The primary leads are a standard lamp cord with a separable attaching plug at each of its ends, one for connecting to the lamp socket and the other for attaching to the transformer. The secondary leads are light flexible cable, one being provided with a clamp for grounding to the battery plate and the other with a carbon fixed in a suitable wooden-handle holder.

After the transformer has been connected to the lighting circuit by the attaching plug, the ground side of the secondary is attached by means of a clamp and thumbscrew to the battery. This connection can be made on the strap, post or at any point on any of the plates electrically joined to the one where the welding operation is to take place. The lead is then fused as soon as it comes in contact with the carbon and can be "puddled" and worked with the carbon and the customary sticks of pig lead. This equipment requires between 500 watts and 600 watts when operating and when the operator is not working uses but 4½ watts. It is portable and weighs only 25 lb. (11 kg.) complete.

Safe Disconnecting Switches

Hazards attending the opening of disconnecting switches that are alive when the operator thinks they are dead have been eliminated in a type of disconnecting switch now being sold by Schweitzer & Conrad, Inc., 4431 Ravenswood Avenue, Chicago. It consists of a disconnecting switch shunted by a low-amperage "S. & C." fuse and provided with a lock so arranged that



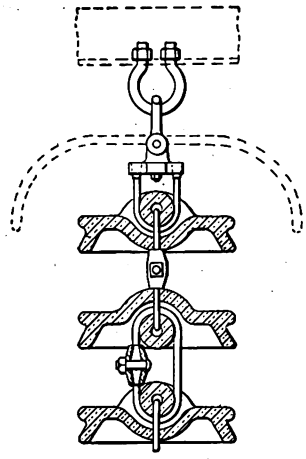
FUSE INTERRUPTS CURRENT IF SWITCH IS OPENED ON LIVE CIRCUIT

the disconnecting switch cannot be opened unless the fuse is in place. If the switch is opened when carrying energy, the current is shunted through the fuse and there interrupted when the fuse blows. The fuse, of course, only blows in case the disconnecting switch is carrying current when opened. This feature, it is pointed out, allows a low maintenance cost.

The manufacturers state that this idea can probably be applied elsewhere with good results. For instance, a field exists for an inexpensive method of interrupting load currents at moderate and high voltages without the use of expensive oil circuit breakers where opening the circuit is necessary only at rare intervals.

Connector Loops for Suspension Insulators

While the link type of insulator, typified by the Hewlett insulator, has always been attractive, it has not received as extensive use as might exist because the devices for connecting the disks have not quite met practical requirements. Lately, however, the Maxwell Engineering & Manufacturing



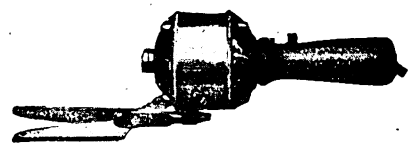
UPSET ENDS OF CONNECTORS CAN BE SECURELY HELD IN CLAMP

Company, 61 Broadway, New York City, has developed a fitting, illustrated herewith, which it claims overcomes this limitation. It consists of a flexible steel connector loop with upset ends which are gripped in a split clamp in such a manner that the greater the load the more firmly the ends are gripped. The sections of the split clamp are held together by a bolt and nut which is easily accessible even when the units are assembled. Because of these features it should be possible to assemble link-type insulator units quickly or even replace a unit in a string. In this type of insulator all stressed parts are in compression instead of tension, so that the danger of rupturing is greatly lessened.

Oscillating Motor-Operated Shears

Although not intended to compete with large rotary or knife-type power-driven cloth cutters, the electrically operated shears recently developed and placed on the market by the Sperry Gyroscope Company of Brooklyn, N. Y., are said to have a large field of application in cutting and trimming material of many kinds.

The shears, which are controlled by means of a push switch, consist of an electric motor and the shear blades, arranged so that the lower blade of the shears is stationary, being rigidly attached to the end frame of the motor. The upper blade is connected by a link and eccentric with the motor shaft.



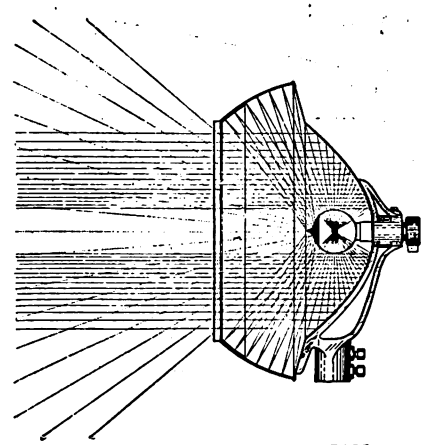
CUTTING EDGE IS WELL BACK ALONG THE BLADES, MAKING OPERATION SAFE

The motor runs at approximately 9000 r.p.m. and oscillates the movable blade at the same frequency. In cutting cloth and other fibrous materials, the effect of the rapid oscillation is said to be such that practically every fiber is individually severed and that tough materials, like canvas or linoleum, may be cut with nearly the same ease as silk.

Perhaps the most noteworthy feature of the shears, the maker says, is that although they will cut any material from silk to asbestos, they afford safety to the operator. The reason for this safety in operation is that the blades move only about $\frac{1}{16}$ in. (1.6 mm.) at the actual cutting edge. This cutting edge is well back along the blades, the ends of the blades being unsharpened.

Double-Reflector Light Projector

An intense main beam of light projected on the road ahead of the car for a distance of a quarter mile, a secondary beam covering the sides of the roadway and a third subdued illumination diffused immediately in front of the lamp are the three beams of illumination claimed for the automobile



PROJECTS QUARTER-MILE BEAM

headlight now being marketed by J. T. Roffy, 340 Lewis Avenue, Brooklyn, N. Y. Two reflectors are used instead of one, the main one reflecting the rays from the bulb directly ahead, while the secondary or return-ray reflector facing

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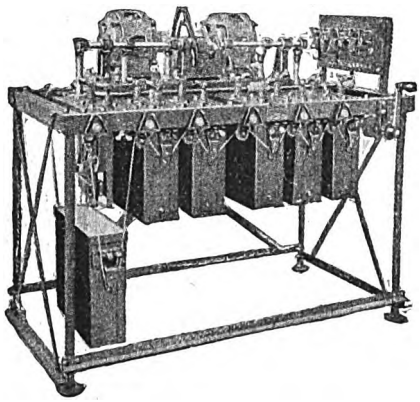
it aids in obtaining the diffused general illumination and the secondary wide-angle beam. As can be seen from the illustration herewith, direct visibility of the lamp filament is obscured. With the switch at "dim" this lamp is said to project an effective light having the same triple illumination characteristics as the "full" burning of the bulb, though, of course, in a less intense degree.

The maker points out that coupling the one reflector against the other of different angularity produces an I-section effect of great strength against warping. Thus the geometrical lines of reflectors act as the body of the lamp, permitting it to be assembled of fewer parts and eliminating considerable weight. Since lamp filaments vary not only in focal strength but in deviation of axis, an adjustment of the bulb is sometimes necessary. In the Roffy lamp adjusting the focus as well as turning the bulb and aligning the entire headlight can be done while the lamp is burning, without the necessity of opening the casing.

Oil Reversing Switch for Large Motors

A primary oil reverse switch has just been brought out by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., for high-voltage slip-ring motors such as are used in steel mills, mine hoists and similar service. It is designed for use with installations where it is desirable to have a remotely controlled oil switch to connect the primary winding to the lines for either reversing or non-reversing service. The switch consists principally of two three-pole switch units each operated by a high torque motor.



UNIT-TYPE CONSTRUCTION

Among the interesting features of this switch indicated by the maker are the unit tank construction and the means of lowering the tanks for inspection, repairs and renewal of oil. Unit tank construction increases accessibility and saves time and labor in locating trouble and making repairs. Construction of the stationary and moving members is such that the arc is broken horizontally rather than vertically.

This construction, it is pointed out, allows the arc to rise to the point of rupture without burning parts not designed for such duty, and since the rupture takes place near the top of the oil, it is well away from all sediment. Hence frequent inspections and renewals are unnecessary. In case of serious damage to any single-pole unit it may be removed without disturbing any of the others. The tanks are lined with a heavy asbestos material to prevent grounding of any live parts should the tank be pushed out of place and also to serve as an additional safeguard in case of oil sludging.

The contactor panel at the extreme right of the switch is controlled from a master switch or push buttons. Very little current is said to be required as the motors used have high resistance rotors.

Notes on Recent Appliances

Desk and Wall Fans

Three desk and bracket models have been added to the line of fans marketed by the Kendrick & Davis Company, Lebanon, N. H.

Deflection Potentiometer

For measuring any voltage up to 1 volt the Northrup "millivolter," a portable potentiometer, has been developed by the Pyroelectric Instrument Company of Trenton, N. J.

Safety Switch

For use in installations not requiring a comparatively large amount of current a 30-amp., 125-volt inclosed safety switch has been placed upon the market by the Square D Company, Detroit, Mich.

Portable Conveyor

Loading, unloading, piling, storing and similar operations in handling bulk material and light articles may be accomplished by the scoop conveyor being manufactured by the Portable Machinery Company, Inc., Passaic, N. J.

Utility Stove

A small flat electric stove for boiling, frying and toasting is a recent addition to the line of heating devices manufactured by the National Electrical Heating Company, Ltd., of Toronto, Canada.

Light-Weight Cleaner

The "Torrington" electrically operated vacuum cleaner made by the National Sweeper Division of the Torrington Company, Torrington, Conn., has been supplemented by the "Miss Domestic," a new light-weight suction cleaner.

Electric Haulage System

To transport material in mines and similar locations the Electric Carrier Company, 220 Broadway, New York City, is manufacturing an electric hauling system consisting of cars and tracks.

Commercial Electric Furnace

Temperatures of 200 to 1100 deg. Fahr. (90 to 1090 deg. C.) are obtainable in the oven-type electric furnace recently put on the market by the Modern Equipment Company, Taunton, Mass., for annealing, enamel baking, drying and kindred operations.

Motor-Driven Lubricant Pumps

Centrifugal-type motor-driven lubricant pumps have been placed on the market by the Fulflo Pump Company, Blanchester, Ohio.

Heavy-Duty Safety Switches

Heavy-duty safety switches of the quick-break type are being made by the Palmer Electric & Manufacturing Company, Boston, Mass.

Laboratory Heater

An electric heater for use in chemical laboratories in heating round-bottomed flasks has been developed by the Wachtel's Physician Supply Company, Savannah, Ga.

Demagnetizer

To demagnetize gages, bearings, rings, cutters, etc., the "Bulldog" demagnetizer is being made by the Electric Brazing & Welding Machine Company, 30 Church Streeet, New York City.

Refillable Fuse

The "Yankee" refillable fuse is being made by the Metropolitan Electric Manufacturing Company, East Avenue and Fourteenth Street, Long Island City, N. Y.

Condenser for Radio Equipment

The Dubilier Condenser Company of 217 Center Street, New York City, is marketing a condenser for use with radio equipments.

Battery-Charging Rectifiers

For automatically charging storage batteries two types of rectifiers are being manufactured by the U. S. E. M. Company, 301 West Thirty-fifth Street, New York City.

Flexible-Shaft Machine

Equipped with scraping and cleaning burrs, a motor driving a flexible shaft is being made by R. S. Haskins, 547 West Washington Boulevard, Chicago.

Electrically Heated Water-Filled Radiators

Having current consumptions of from 638 to 935 watts, various sized water-filled radiators heated by electricity are being manufactured by Rapid Raditors, Ltd., Toronto, Ont., Canada.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Captain George Sykes, who has been in the United States nearly four years, attached to the British War Mission in a commercial capacity, sails for Europe in May. He has joined the Dutilh-Smith-McMillan Company, an international house, as London manager of its engineering and railroad departments. For many years prior to the war Captain Sykes was connected with electrical manufacturers in the sales and engineering departments and with power and traction corporations. He will be glad to hear from firms wishing to introduce their electrical products in Europe. His New York address is 50 Broad Street, and his London office is Central Buildings, Totehill Street, Westminster.

Captain Neale, civil engineer-in-chief's department, room 1004, Admiralty, London, S. W. 1, desires catalogs from manufacturers of electrical apparatus for purpose of reference.

A man in Denmark (No. 28,653) desires to secure an agency for the sale of electrical accessories, armatures and railway equipment.

A firm in Norway (No. 28,656) desires to secure an agency for the sale of electrical materials, such as cable, wire and accessories, and insulating materials. Correspondence may be in English.

A man in Belgium (No. 28,663) desires to secure an agency for the sale of material and supplies for tramways and electric lighting. Correspondence should be in French.

A firm in Norway (No. 28,680) wishes to purchase electric fixtures and electrical appliances (light, heat and power service). Payment, banker's confirmed credit in New York. Correspondence may be in English.

A merchant in Switzerland (No. 28,684) desires to secure an agency or to purchase electrical appliances. Correspondence should be in French.

A merchant in England (No. 28,688) desires to buy outright or to secure an agency for the sale of gramophone motors, flashlamps, bulbs and refills. He will pay cash for first order.

A merchant in Italy (No. 28,703) wishes to purchase a plant for the manufacture of caustic soda and carbonate soda by electrolytic or other cheaper system, to begin with a capacity output of from 3 to 5 tons of caustic soda per day. He also wishes to purchase machinery for the manufacture of soda drums. He desires to receive information as to the amount of electric energy required, cost of plant and the cost of manufacture per ton of soda. Correspondence may be in English.

A man in Australia (No. 28,705) whose business gives him a commanding position among mining, timber and other enterprises states that there is a great need for electrical generators and electrical equipment of all kinds, and he wishes to secure agencies for same.

A commercial association in Belgium (No. 28,697) wishes to communicate with manufacturers of electric motors in order to establish business connections.

CONSOLIDATION OF ENGLISH ELECTRICAL CONCERNS.—The English Electric Company, Ltd., Abchurch Yard, Cannon Street, London, E. C. 4, has been formed to consolidate under one direction and management the various interests of the following companies, in all of which a predominating control exists: Coventry Ordnance Works, Ltd., Dick, Kerr & Co., Ltd., Phoenix Dynamo Manufacturing Company, Ltd., United Electric Car Company, Ltd., and Willans & Robinson, Ltd.

FEDERAL TRADE COMMISSION CITES BATTERY CONCERN.—Declaring it has reason to believe from preliminary investigation that James B. Schafer, Detroit, operating under the trade name Universal Battery Service Company, with the intent, purpose and effect of misleading the public, adopted the trade name of a previously established competitor, the Universal Battery Company, Chicago, with only the word "service" added, and moreover imitated that competitor's advertising in style and color scheme, the Federal Trade Commission announces that it has issued formal complaint of unfair competition against Mr. Schafer. The Universal Battery Company, the complaint points out, had an established business in Michigan at the time that Mr. Schafer began to operate as the Universal Battery Service Company. Mr. Schafer was cited to appear before the commission in Washington on April 17.

THE OKONITE COMPANY, Canal Street, Passaic, N. J., manufacturer of insulated wires, etc., has filed notice of an increase in its capital from $600,000 to $1,500,000, to provide for expansion.

THE GASTON, WILLIAMS & WIGMORE ELECTRICAL ENGINEERING CORPORATION, 39 Broadway, N. Y., has filed notice with the Secretary of State of an increase in its capitalization from $500,000 to $1,000,000.

CAPT. A. U. WETHERBEE, who recently received his discharge from the Chemical Warfare Branch of the service and who was formerly chief engineer and assistant works manager of the Niagara Alkali Company, has become chief mechanical engineer of the Powdered Coal Engineering & Equipment Company of Chicago.

THE MORSE CHAIN COMPANY, Ithaca, N. Y., announces that it is advised by P. A. Morse of the Morse Engineering Company, its Western representative, St. Louis, Mo., that the Kansas City offices have been removed from the R. A. Long Building to more commodious rooms, Suite 211-212, Finance Building, with W. V. Warner as office district manager.

THE WAR TRADE BOARD announces that export licenses to Bulgaria, Turkey and the Black Sea ports will be granted only in exceptional cases for electrical appliances adapted for use in war and their component parts. For Bulgarian ports the same holds for telegraph and telephones and their component parts and materials for use therein.

THE GENERAL ELECTRIC EDISON CORPORATION OF CHINA has filed notice of a change in its corporate name to the China General Edison Company, Inc.

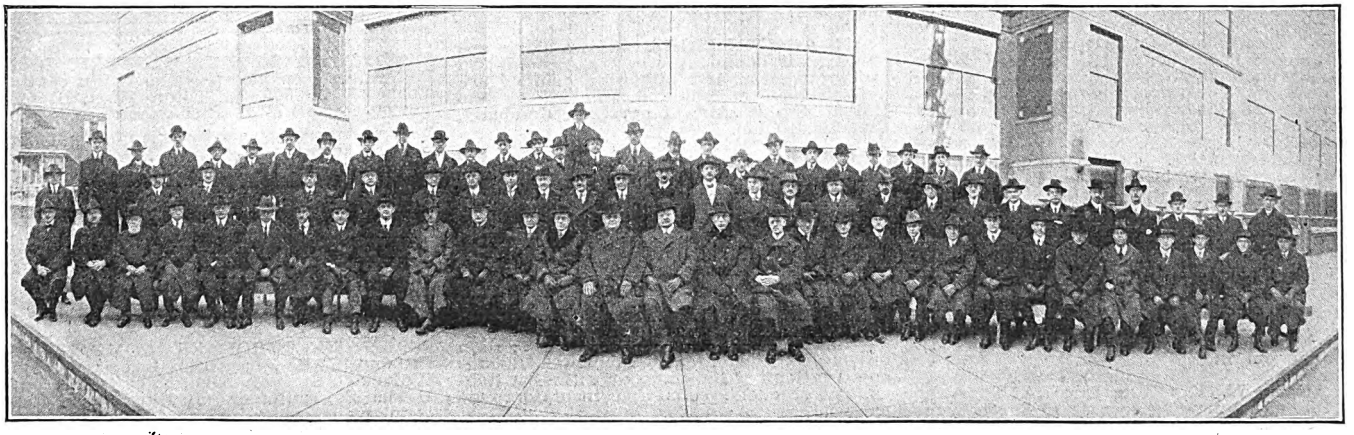
THE SHEPARD ELECTRIC CRANE & HOIST COMPANY has opened an office in the new Lexington Building, Baltimore, Md., with Norman P. Farrar, formerly district manager of the Philadelphia territory, in charge.

THE NORTH COAST ELECTRIC COMPANY, electrical jobber, Seattle and Tacoma, has opened a branch at 331 Everett Street, Portland, Ore., where a large stock of electrical supplies will be carried. L. S. Ruble, formerly with the Northwestern Electric Company and later with the Coast Steel & Machinery Company, has taken charge.

E. V. ADAMS succeeds G. K. Heyer as railway sales engineer of the Western Electric Company. He has been a Western Electric man since 1910, when he began in the railway sales department of the Chicago house. He was transferred to St. Louis in 1912 and the following year went to New York, where his headquarters will remain.

H. MOE AND C. A. BRIDGES, who were with the Phoenix Light Company of Milwaukee, Wis., have organized the Moe-Bridges Company at 60-64 Third Street, that city. The new company will manufacture lighting fixtures for the trade and will job glassware. Sample fixtures are now ready. It is not planned to sell electrical supplies or fixture parts.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, recently concluded a five-day "Victory" convention at the Bellevue-Stratford Hotel. Officers, branch office sales managers and department heads discussed and formulated plans to meet the increased demand for batteries for commercial purposes. A banquet at the Germantown Cricket Club closed the convention.



OFFICERS, SALES MANAGERS AND DEPARTMENT HEADS AT "VICTORY" CONVENTION OF ELECTRICAL STORAGE BATTERY COMPANY

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of the P. I. Perkins Company, 141 Milk Street, Boston, Mass., as its agent in Massachusetts, Connecticut and Rhode Island. The P. I. Perkins Company will handle in this territory the Roller-Smith Company's line of instruments, circuit breakers and meters and has arranged to have W. A. Blachford give his special attention to this line.

ROBERT L. STILES of Wilkinsburg, Pa., until recently connected with the Westinghouse Electric & Manufacturing Company, has purchased the stock of I. N. Butterworth in the Tri-City Electric Company and the Tri-City Electric Supply Company and is now actively engaged with E. M. Kunkel in the management of the two interests in Davenport, Ill. W. J. Ball, president of the Tri-City Electric Company and manager of the Moline house, has as his assistant as engineer and estimator J. H. Wright, who had charge of all electrical construction work for the C., B. & Q. railroad shops until the war.

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and who has since then been with one of the large ammunition plants in the same capacity.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, New York City, has arranged to handle Emerson and "Northwind' Fans at its several Manhattan stores.

THE HARGREAVES BATTERY COMPANY, Kansas City, Mo., will occupy the new two-story building being erected by H. L. Tomlin on McGee Traffic Way.

THE WESTERN DRY BATTERY COMPANY, Seattle, Wash., manufacturer of "Bulldog" dry cells, has just moved into its two-story factory at Fifteenth Avenue West and Wheeler Street.

LAWFORD GRANT, who has severed his connection with the Eugene F. Phillips Electrical Works, Ltd., Montreal, was on Feb. 8 entertained at dinner at the Engineers' Club in that city by the staff of the company and presented with a mahogany clock.

JAMES M. BROWN, formerly Western sales manager of the Electric Cable Company, has recently been appointed special representative of the automotive equipment and electrical departments of the H. W. Johns-Manville Company, with headquarters in Chicago.

R. J. PARVIN, who for some time past has been connected with the Vulcan Soot Cleaner Company at Du Bois, Pa., has severed his connection with the home office and is now Wisconsin sales representative for both that company and the Vulcan Fuel Economy Company, with headquarters in the Collins Building at Fond du Lac, Wis.

THE ILLINOIS ELECTRIC COMPANY, Chicago, did not inclose a discount sheet with the new issue of its catalog which is just being distributed. As soon as price conditions become normal the discount sheet will be issued regularly and a copy will be sent to all those who received the catalog.

THE GENERAL ELECTRIC COMPANY has recently opened building No. 4, Fort Wayne, Ind., which will be devoted to the small-motor production department of the works. When the departments are completely installed, they will have an output of thousands of motors a week and the building will be the largest in the world devoted exclusively to the construction of small motors, it is reported.

THE TERRY STEAM TURBINE COMPANY makes the deferred announcement that since the death of Charles E. Hague in April, 1917, its interests in the Philadelphia district have been under the supervision of V. L. Sanderson, with headquarters at 605 Widener Building. James H. Weir has recently become associated with the company as assistant to Mr. Sanderson in that district.

PAUL W. KOCH & COMPANY is the name of the new concern at 19 South Wells Street, which is a combination of the former firm of Koch & Sandidge and the Electrical Sales Engineers, Inc. The new company, of which Paul W. Koch is president, is capitalized at $25,000. Formerly the Electrical Sales Engineers, Inc., handled the Condit, Esterline, Lewis and Roth lines. The Jiffy cutter was the principal line formerly handled by Koch & Sandidge. The new firm will specialize in labor-saving devices, particularly those which find application in industrial plants.

THE DAYTON (OHIO) FAN & MOTOR COMPANY announces its reorganization, and new officers as follows: Edwin O. Waymire, president; Lee Warren James, vice-president; Clyde C. Miner, secretary and treasurer. Mr. Waymire has been connected with the Dayton Fan & Motor Company in an official capacity since the very beginning of its business twenty-eight years ago. Mr. James is a Dayton attorney and financial man, and Mr. Miner has been connected with the Robbins & Myers Company for the past twenty years as general auditor and credit manager. It is the intention of the company to build immediately new factories, with a floor space of approximately 100,000 sq.ft., to accommodate its expanding business. Plans have already been laid to engage in the production of small motors, both alternating-current and direct-current, for the resale manufacture of household electrical appliances. An organization is being perfected, adequate buildings will be erected, and the company confidently expects that within six months it will be ready to produce these motors in large quantities.

Trade Publications

FANS.—A pocket-size booklet containing descriptive matter about its fans has been issued by the Century Electric Company of St. Louis, Mo.

FUSES.—A folder issued by J. H. Faw, 37 Warren Street, New York City, has for its subject "Fawsco" auto fuses, which are procurable in glass, fiber and link types.

LIGHTING FIXTURES.—A broadside describing and illustrating its line of lighting fixtures has recently been issued by the Perfeclite Manufacturing Company, Seattle, Wash.

TOGGLE BATTERY SWITCHES.—Harvey Hubbell, Inc., Bridgeport, Conn., has issued bulletin No. 16-7, covering Hubbell toggle battery switches and superseding bulletin No. 16-I.

FUEL ECONOMIZER.—Bulletin No. 151 has been brought out by the Green Fuel Economizer Company, 90 West Street, New York City, to tell about the advantages and construction of Green's fuel economizers.

LAMP GUARDS. — Flexco-Lox lamp guards and split-handle portables are the subject of a circular recently prepared by the Flexible Steel Lacing Company, 522 South Clinton Street, Chicago.

RAZOR-BLADE SHARPENER. — The Green automatic safety-razor-blade sharpening machine is the subject of a folder distributed by the American Sharpening Machine Company, 184 West Washington Street, Chicago.

PORTABLE DRILLS.—Information about six models of portable electric drills, all equipped with pistol grips and triggers, is contained in a new folder from the Black & Decker Manufacturing Company, Baltimore, Md.

AIR COMPRESSORS.—A two-stage automatic air compressor and a combination air compressor and buffer or grinder are described in a folder distributed by the United States Air Compressor Company, Cleveland, Ohio.

MAZDA LAMPS.—Information about Edison Mazda lamps, written in question and answer style, has been prepared and is being issued in booklet form by the Edison Lamp Works of the General Electric Company, Harrison, N. J., for users of its lamps.

HIGH-TENSION EQUIPMENT. — The Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago, has issued in its Bulletin No. 108 information on outdoor switching equipment. Various combinations of lightning arresters, switches, fuses, choke coils and insulators are shown.

MOTORS.—Superseding Bulletin No. 39, No. 45 has been issued by the Electro-Dynamic Company, Bayonne, N. J., and gives ratings and dimensions of type "S" interpole constant and adjustable speed motors. Bulletin No. 100 is also available, describing type "S" interpole direct-current motors.

BUSBAR AND WIRING SUPPORTS.—The Delta-Star Electric Company, 2433 Fulton Street, Chicago, has just prepared bulletin No. 34, a forty-eight-page publication having for its subject unit-type outdoor-form busbar and wiring supports. More than 200 illustrations and line drawings are included in the new bulletin, which will be of special value to designers of outdoor substations.

ELECTRIC STEEL FURNACES.—The Pittsburgh Furnace Company of Pittsburgh, Pa., and Milwaukee, Wis., has issued a bulletin entitled "Electric Arc Furnace." The advantages of the arc type of electric steel furnaces for melting steel are compared with the crucible, the open-hearth furnace and the converter. The use of acid or basic-lined electric steel furnaces is also discussed.

POCKET-SIZE WIRING CHARTS.—A wiring chart for determining the proper wire size for use on circuits of 110-125-volt country-home lighting systems has just been prepared by the National Lamp Works of the General Electric Company, Cleveland, Ohio. It is similar to the low-voltage, 28-32-volt wiring chart for country homes distributed in July of last year. To aid in distinguishing the two charts, the new one is salmon-colored and is contained in an envelope on which the printing is done in dark red.

HEATING DEVICES. — A thirty-two-page illustrated list of American Beauty electrical heating appliances has been prepared by the American Electrical Heater Company, Detroit, Mich.

DIRECT-CURRENT AMMETERS AND VOLTMETERS.—The 4-in. "Imps," direct-current ammeters and voltmeters, made by the Roller-Smith Company, 233 Broadway, New York City, are described in bulletin No. 410, recently distributed.

TRANSMISSION TOWERS, ETC.—The Blaw-Knox products-booklet enumerates the variety of products manufactured by the Blaw-Knox Company, Pittsburgh, Pa. These products fall under main headings of fabricated steel, plate work, transmission towers, furnace equipment, buckets, steel forms and mixers.

ELECTRICAL SUPPLIES.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., is now distributing its annual catalog of electrical supplies for 1919 in bound form instead of as loose leaves. The book is cloth-bound, contains 1276 pages and is thumb-indexed. Some of the sections in this very complete catalog cover lightning arresters, fuses and switches, carbon circuit breakers, safety switches, oil circuit breakers, switchboards, voltage regulators, switchboard accessories, meters, instruments and relays, distribution transformers, feeder regulators, transformer apparatus, insulating materials, line materials, railway accessories, lighting material, rectifier outfits, fans, heating appliances, ranges, industrial heating appliances, motors and controllers, etc.

New Incorporations

THE DALLAS (TEX.) ELECTRIC COMPANY has been incorporated with a capital stock of $10,000 by Elton Hoyt, R. H. Townsend and F. L. Richardson.

THE KESTING-KOPP-KEYSTER COMPANY of Philadelphia, Pa., has been incorporated with a capital stock of $25,000 to manufacture electric wire, etc. Edward Kramer is interested in the company.

THE FORT WAYNE (IND.) ELECTRIC EQUIPMENT COMPANY has been incorporated with a capital stock of $15,000 to buy and sell Delco light products. The incorporators are: Edwin H. Walker, Harry W. Meyers and A. Meyers.

THE ELECTROLABS COMPANY of Pittsburgh, Pa., has been incorporated by Waldes G. Swaney, Allen T. C. Gordon and David E. Ballinger of Pittsburgh. The company is capitalized at $25,000 and proposes to manufacture and deal in electrical appliances.

THE MORAN (IND.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by Nicholas E. White, John C. Weida and J. White. The company is capitalized at $25,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

THE CALAIS (ME.) POWER COMPANY has been incorporated by William F. Hanson, Reed V. Jewett and Ashley St. Clair. The company is authorized to construct dams and power plants on Howard Mill stream in Calais. The capital stock of the company is not to exceed $50,000.

THE HARRIS ZINC PROCESS COMPANY of Michigan has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $125,000 and proposes to manufacture electric equipment of all kinds. The local incorporators are: George G. Steigler, J. H. Dowell and W. F. Keefe, all of Wilmington, Del.

THE FLORIDA BATTERY COMPANY of Jacksonville, Fla., has been incorporated with a capital stock of $10,000 to manufacture, buy and sell, recharge, repair, etc., electrical batteries of all kinds, and also to own and operate battery service stations and garages, and to deal in autos and motor vehicles. The officers are: Julian Perivitte, president; Fred Volz, vice-president, and Daniel B. Howes, secretary and treasurer.

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New England States

PLYMOUTH, N. H.—A bill has been presented to the State Legislature for a charter for the Kineo Electric Company for the purpose of distributing electricity for lamps and motors in the towns of Rumney, Campton, Ellsworth, Thornton and Plymouth. The incorporators are Ezra C. Chase, Edward A. Chase, William J. Randolph, Alvin F. Wentworth, George P. Loveland and others.

LENOXDALE, MASS.—The Lenox Electric Company has secured a site in Lenoxdale on which it proposes to erect an emergency substation, which will be connected with the high-tension wires of the Pittsfield Electric Company. This will give the Lenox company two sources of supply, the other being from the power plant of the Monument Mills at Glendale.

LUNENBURG, MASS.—At the annual town meeting it was voted to sell the municipal electric lighting plant. Energy to operate the system is purchased from the Fitchburg (Mass.) Gas & Electric Company.

SPRINGFIELD, MASS.—The city property committee is considering the installation of an electric generator in the heating plant of the municipal group to furnish electricity for illuminating the city hall, the auditorium, the police station and fire department headquarters.

WESTFIELD, MASS.—Plans are under consideration by the officials of the Crane Company, paper manufacturer, for the installation of electric power to replace its present steam-power plant.

WESTFIELD, MASS.—Application has been made to the Municipal Light Commissioners by residents of Southwich to extend the municipal lighting service to that town. The officials of the Russell Falls paper mills have petitioned the commissioners for an extension of the power lines to Russell Falls to furnish power to operate the paper mills. Work is nearly completed on the installation of electric equipment at the municipal plant for utilizing energy from the power plant of the Turners Falls (Mass.) Power & Electric Company. The local plant will soon be closed down.

WATERBURY, CONN.—The Connecticut Light & Power Company has petitioned the State Legislature for extensive amendments to its charter giving it further control of the water power of the Housatonic River. The proposed amendments authorize the Housatonic Company to take water from the Ten Mile River at a point where it discharges below the dam of the New Milford Power Company. The company also asks for authority to install apparatus to draw up excess water of the stream to use it for the development of electricity, and also for permission to develop a water power at Shepaug and for the right to take land by eminent domain as the Rocky River Power Company was privileged to do, with the approval of the Superior Court. The company has a right to construct a series of dams between Shepaug and New Milford, and now it desires to build one dam which will best develop the power of the river.

Middle Atlantic States

BABYLON, N. Y.—The Babylon Railroad Company is negotiating with the town officials for a franchise permitting the company to furnish electricity for lamps and motors to the municipality. At present the service is furnished by the Long Island Lighting Company.

ELMIRA, N. Y.—The Elmira Water, Light & Railroad Company, it is reported, contemplates extensions to its power plant on East Water Street.

PERRY, N. Y.—The installation of an additional 500-kw. turbo-generator set is reported to be under consideration by the Perry Electric Light Company.

ROME, N. Y.—Plans are under consideration for improvements at the Rome State Custodial Asylum, including extensions to the electric power plant, to cost about $20,000; new stokers and other equipment at the boiler plant, $10,000, and new machine and repair shops, $20,000. Charles Bernstein is superintendent.

TOMPKINSVILLE, N. Y.—Bids will be received by the superintendent of lighthouses, Tompkinsville, N. Y., until March 28 for furnishing and installing on present runways one 10-ton, 28-ft.-span electric traveling crane, operated from the floor in plate shop at the general lighthouse depot, Tompkinsville.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

WATERTOWN, N. Y.—Plans are being prepared by the Northern New York Utilities, Inc., for an addition, 30 ft. by 38 ft., to its electric generating plant at Effley Falls, construction of steel penstock, 120 ft. long, revamping present dam, etc. J. B. Taylor is president.

SOUTH AMBOY, N. J.—Preparations are being made by the Pennsylvania Railroad Company for rebuilding the boiler plant and auxiliary steam buildings at its local railroad yards.

BLAIRSVILLE, PA.—Plans have been prepared by the Schwarzenbach-Huber Company of Allentown for an addition to its local plant, including a factory building, addition to engine room, etc., to cost about $95,000.

DENTON, MD.—Work will soon begin on improvements to the plant of the Peninsular Light & Power Company, controlled by the Eastern Shore Gas & Electric Company of Salisbury, including driving wells, installation of boiler, steam piping, etc. The boiler has already been purchased. F. W. Woodcock of Salisbury, general superintendent, will have charge of the work.

MYERSVILLE, MD.—Preparations are being made by the Hagerstown & Frederick Railway Company for the construction of a substation, car barn and freight station in Myersville, to cost about $10,000. Paul Smith of Frederick is superintendent of transportation.

ST. ALBANS, W. VA.—The St. Albans Water & Electric Company and the Campbell Brothers Ice Company have been consolidated under the name of the St. Albans Light, Water & Ice Company. The company is capitalized at $100,000 and proposes to improve and increase the output of the plants.

NORFOLK, VA.—The Bain Peanut Company, it is reported, would like to receive prices on 200-hp. Corliss engines and generators.

North Central States

BATTLE CREEK, MICH.—At an election to be held in April the proposal to issue $400,000 in bonds to establish a municipal electric light plant in Battle Creek will be submitted to the voters. The contract for street lighting will not expire for three years.

DETROIT, MICH.—The American Blower Company has secured a site along the Detroit Terminal Railroad tracks near Gratiot and Grinnel Avenues on which it proposes to build a plant, to cost about $750,000.

HIGHLAND PARK, (DETROIT P. O.). MICH.—Bids will be received by the city of Highland Park about May 1 for the construction of a hospital building and also a power and heating plant to cost about $300,000. M. J. Strum, 114 South Michigan Avenue, Chicago, Ill., is architect.

HUDSON, MICH.—Arrangements have been completed by the Southern Michigan Light & Power Company of Hudson for the erection of an electric transmission line from Hudson to Rollin and Manitou Beach. The contract price is $4,500 and $300 per mile for stub lines.

MARQUETTE, MICH.—Extensions are contemplated to the municipal electric light plant, to cost about $100,000.

YPSILANTI, MICH.—The City Council is considering drilling a new well, rebuilding wheel pit, installing twelve hydrants and new pumping machinery with electric auxiliary equipment. The cost is estimated at about $32,000. W. R. Caldwell is city engineer.

CLEVELAND, OHIO.—The Cleveland Automobile Company, East Thirty-first Street, is contemplating the construction of a factory, to cost about $500,000. E. McGeorge, 1900 Euclid Avenue, architect.

CLEVELAND, OHIO.—Plans have been prepared by A. A. Lane & Company of Cleveland, architects, for the erection of a battery building for the Willard Storage Battery Company, 246 East 131st Street, to cost about $150,000.

CLEVELAND, OHIO.—Plans have been prepared by Lockwood & Green, architects, 60 Federal Street, Boston, Mass., for an electric substation to be erected by the Mechanical Rubber Company, 8616 Lisbon Street, Cleveland. The cost is estimated at $160,000.

LIMA, OHIO.—The City Council has authorized bids advertised for an ornamental lighting system for North Main Street from the Public Square to the Pennsylvania Railroad. Bids will be received for both electric and gas lamps.

SANDUSKY, OHIO.—The Matthews Engineering Company, it is reported, has been awarded contract for furnishing 200 electric plants for Y. M. C. A. buildings.

BLUFFTON, IND.—The City Council is considering the purchase of a 1000-kw. turbo-generator for the municipal electric light plant. Extensions to the plant are necessary to meet the increasing demand for electrical service, including the sale of electricity to the Linn Grove Light & Water Company, recently organized.

EAST CHICAGO, IND.—Contract has been awarded by the Indianapolis Water Company to the Warner Construction Company of Chicago, Ill., for a water filtration plant in East Chicago for the East Chicago & Indiana Harbor Water Company. Chemical and filter houses will be erected and extensions made to the boiler house and also to the pumping station. One new boiler and two new pumps will be installed.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company is considering improvements to its building at 744 Washington Avenue.

PIERCETON, IND.—The Pierceton Light & Water Company, recently incorporated with a capital stock of $35,000, proposes to furnish light, power and water service in Pierceton. J. T. Brosnahan of Pierceton is interested.

CERRO GORDO, ILL.—The Central Illinois Electric Company of Decatur has applied to the Public Utilities Commission for approval of sale of its Cerro Gordo system, including the villages of Cerro Gordo and Oakley and intervening territory, to the Cerro Gordo Electric Light Company. The latter company has petitioned for a certificate of convenience and necessity to operate an electric light, heat and power system in Cerro Gordo and Oakley and for authority to issue $20,000 in capital stock. The company contemplates extensions to its plant equipment, transmission lines and service.

GALENA, ILL.—The Interstate Light & Power Company is contemplating the installation of a 5000-kw. steam turbine to replace the 2000-kw. turbine now in use.

ROCK ISLAND, ILL.—Arrangements have been made by the People's Power Company whereby the work of equipping the 180 houses for the United States Housing Corporation for electric and gas service, which was started last fall, will be completed.

GREEN BAY, WIS.—Manufacturers and others using electricity in Kewaunee, Algoma, Casco, Luxemburg and New Franklin have petitioned the Wisconsin Public Service Company of Green Bay to extend its electric transmission lines to those towns to furnish electricity for lamps and motors. Municipal plants are furnishing electrical service in Kewaunee and Algoma. C. R. Phenicie is general manager.

DALTON, MINN.—A franchise has been granted to Rude & Olsen to construct and operate an electric light plant in Dalton.

HAMPTON, IOWA.—The City Council is considering establishing a municipal electric light plant in Hampton.

MARSHALLTON, IOWA.—At an election to be held March 30 the proposal to issue $400,000 to establish a municipal electric light plant will be submitted to the voters.

KANSAS CITY, MO.—A large amount of electric wiring and fixtures, etc., will be required in connection with the erection of the new building for the Electric Theater.

ST. LOUIS, MO.—Plans have been prepared by the McQuay, Norris Manufacturing Company, 2803 Locust Stweet, for the erection of two or three factory buildings and power plant, near Oak Hill Railroad tracks and Cooper Street. A. J. Mummert is engineer.

FARGO, N. D.—At an election to be held April 1 the proposal to issue $150,000 in bonds for the construction of a municipal electric light plant will be submitted to the voters. F. L. Anders is city engineer.

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LISBON, N. D.—Improvements are contemplated by the Lisbon Electric Light & Power Company, involving an expenditure of about $15,000.

SIOUX FALLS, S. D.—Work, it is understood, will soon be started on the erection of a 60,000-volt electric transmission line to connect the Sioux Falls division of the Northern States Power Company with the company's transmission system in southwestern Minnesota, between Pipestone and Dell Rapids, a distance of 35 miles. A new 3500-kw. steam turbine will be installed at the Sioux Falls power house to take care of the increased loads, which will be secured over the new line.

HOLDREDGE, NEB.—Bonds to the amount of $68,000 have been voted for the installation of an electric light plant in Holdredge. The equipment for the proposed plant, it is understood, will include one 220-kw. and one 110-kw. generator, driven by Corliss steam engines. About 70 miles of distribution lines will be erected. The installation of an ornamental lighting system in the business district is included in the plans.

OSHKOSH, NEB.—An election will soon be called to vote on the proposal to issue $45,000 in bonds for water works, electric lighting and sewers.

JUNCTION CITY, KAN.—The city has rejected all bids submitted for a generator set in connection with waterworks improvements. Power, it is understood, will be purchased. Burns & McDonnell, Interstate Building, Kansas City, Mo., are engineers.

OTTAWA, KAN.—Bids will be received by the city of Ottawa until March 24 for a 500-kw., two-phase, 60-cycle, steam-engine-driven electric generating unit.

SCRANTON, KAN.—An election will be held March 27 to vote on the proposal to issue $12,000 in bonds for the erection of a transmission line from Scranton to Burlingame.

Southern States

ALBANY, GA.—The Dougherty County Power Company, recently incorporated, is reported to have acquired the Porter Shoals property of the Albany Power & Manufacturing Company. Herman Riddell, J. A. Watson and Blair Foster are interested in the new company.

ATLANTA, GA.—Bonds to the amount of $1,000,000 have been voted by the city of Atlanta, the proceeds to be used as follows: For construction of an electric generating plant, $300,000; waterworks, $500,000; cyclorama and museum building, $100,000, and motorizing fire department, $100,000. H. L. Collier is chief of construction.

AUGUSTA, GA.—A site has been selected for the proposed municipal electric light plant.

PENSACOLA, FLA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 31 for improvements to the power plant at the local naval air station. The cost is estimated at about $85,000.

TAMPA, FLA.—Bids, it is reported, will soon be received by the McElroy Engineering Company, Giddens Building, for the construction of a sugar mill, including a 20-mile tramway. The cost of the project is put at $800,000. Owner's name not given.

PORT GIBSON, MISS.—At an election held recently the proposal to issue $25,000 in electric light bonds was carried.

EUREKA SPRINGS, ARK.—The Ozark Light & Power Company of Eureka Springs, recently organized with a capital stock of $100,000, is contemplating the construction of an electric light and power plant. James Bowen is president of the company.

NEW ORLEANS, LA.—A bond issue of $8,000,000 has been authorized by the Port Commissioners to complete the New Orleans industrial canal and to equip it with loading machinery and to install other mechanical apparatus.

NEW ORLEANS, LA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 11 for bedside call systems (annunciator system) in two buildings at the United States marine hospital at New Orleans, La.

SHAWNEE, OKLA.—The City Council is considering calling an election to submit to the voters the proposal to issue $500,000 in bonds for the construction of a municipal electric light plant.

CARBON, TEX.—Funds have been raised by the Commercial Club of Carbon for the installation of an electric light and power plant.

CLEBURNE, TEX.—The installation of an electric light plant in Cleburne is under consideration by E. J. Zimmerman of Cleburne and associates.

DALLAS, TEX.—The residents of Mount Auburn and Parkview additions have voted to establish a street car system to serve the needs of residents of both districts as well as that part of Dallas located east of the State Fair Grounds. The cost is estimated at about $125,000. Henry G. Wills is chairman of the committee.

DE LEON, TEX.—George H. Ford of Dallas, owner of the local electric light plant, contemplates the installation of new machinery and equipment, to cost about $40,000.

FORT WORTH, TEX.—The Board of Commissioners of Tarry County is considering the construction of an electric light and power plant in Fort Worth.

FORT WORTH, TEX.—Plans are under consideration by the Navy Department, Washington, D. C., for the construction of an electric transmission system and a one-story boiler and pump house in connection with the proposed argon production plant to be erected in North Fort Worth.

SAN ANGELO, TEX.—At an election to be held March 29 the proposal to issue $500,000 in bonds for the installation of an electric light plant and waterworks system will be submitted to the voters.

WICHITA FALLS, TEX.—The Wichita Falls Electric Company is contemplating extensions to its plant and system.

Pacific and Mountain States

BELLINGHAM, WASH.—The Whatcom County Commissioners have granted the Whatcom Railway, Light & Power Company permission to erect electric transmission lines along the county roads to Ferndale. Under the arrangements made electricity will be furnished to the county poor farm free of charge.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company is planning to extend its service to the McKinley Hill district. The cost is estimated at $3,600.

YAKIMA, WASH.—The Pacific Power & Light Company contemplates the erection of a 6600-volt, single-phase transmission line at once to furnish electricity to the ranchers in the Selah district. George C. Sawyer is local manager.

NEW PINE CREEK, ORE.—Preparations are being made by N. P. Jensen, owner of the local electric power plant, for the installation of a new power plant on Pine Creek, near the Taylor place, as soon as the weather will permit. Part of the machinery, it is understood, has already been purchased. The combined plants will have an output of 300 hp.

LOS ANGELES, CAL.—The Public Service Commission has authorized E. F. Scattergood, chief electrical engineer, to employ the power consulting board of engineers to assist in preparing plans for the proposed municipal power plant No. 2 to be erected in the San Francisquito Canyon. Contract for the steel penstock has been awarded.

LOS ANGELES, CAL.—The Southern California Edison Company of Los Angeles has started work on its hydroelectric construction project which will require an ultimate expenditure of $125,000,000. Bonds to the amount of $16,000,000 have been disposed of to carry on the first part of the work. During the next three years the company plans to expend $20,000,000 and in that time will develop 150,000 hp. in new hydroelectric plants. Work is now under way for a new plant on Kern River, 150 miles from Los Angeles, which will develop 40,000 hp., in addition to the Big Creek plants. The Big Creek plant No. 2, in Fresno County, now consists of two plants with a total output of 88,000 hp., each plant containing two 22,000-hp. generators. It is proposed to install an additional generator of the same size in plant No. 2, which will necessitate the construction of an additional pipe line, requiring 1100 tons of steel. Later a similar unit will be required at power plant No. 1 under practically the same conditions. The development of Big Creek plant No. 3, which will be next in order, will use all the water supplied by Huntington Lake and will utilize it after it passes through the two present power houses. The combined head of power houses Nos. 1 and 2 is 4000 ft. The first development at power house No. 3 at Big Creek provides for 68,000 hp., to be ultimately increased to 200,000 hp., and includes the diversion of the waters of Pitman Creek into Huntington Lake, increasing the amount of water available for storage purposes. The company is carrying out the recommendation for hydroelectric development made by Major George F. Sever of the War Industries Board of the United States government last fall. W. A. Breckenridge of Los Angeles is president and general manager.

OAKDALE, CAL.—The Oakdale Irrigation District, it is reported, has decided to join with F. B. Pattee and Burton Smith in connection with a hydroelectric development on the north fork of the Stanislaus River, to cost about $1,000,000. The project includes the construction of a dam 1000 ft. long and 200 ft. high, to impound 15,000 acre-ft. of water and to develop 15,000 hp. B. Smith of Oakdale is engineer.

BURKE, IDAHO.—The power plant of the Federal Mining & Smelting Company near Upper Burke was recently destroyed by fire, causing a loss of about $20,000.

RONAN, MONT.—The installation of an electric light plant is under consideration. Stephen Walner of Butte is reported interested.

NUCLA, COL.—The installation of an electric light plant in Nucla is under consideration. Lincoln Vestal is interested.

SEDGWICK, COL.—Plans are being prepared by the Henningson Engineering Company, National Bank Building, Omaha, Neb., for the construction of an electric light plant and waterworks in Sedgwick. An election will soon be called to vote on an issue of $30,000 in bonds for same.

Canada

SQUAMISH, B. C.—Contracts, it is understood, will soon be awarded by the Department of Railways, Victoria, for construction of dam, intake water supply system, hydroelectric power plant and transmission system in Squamish. A. E. Proctor of Victoria is engineer.

BARRINGTON, N. S.—The installation of an electric lighting system in Barrington, to cost about $10,000, is under consideration.

MARKHAM, ONT.—A by-law has been approved by the ratepayers authorizing an appropriation of $5,000 to secure power from the Hydro-Electric Power Commission.

TODMORDEN, ONT.—The Amalgamated Ratepayers' Association of York Township is negotiating with the Hydro-Electric Power Commission of Ontario for the installation of an electric lighting system throughout the township. S. D. Durham is chairman.

BRODERICK, SASK.—The Town Council is considering the question of establishing a municipal electric light plant in Broderick.

ESTEVAN, SASK.—The neighboring municipalities have petitioned the provincial government to request the Dominion Power Board to investigate the development of power at the coal fields in southern Saskatchewan for the purpose of transmitting power to Moose Jaw, Regina, Weyburn and intervening points near Estevan. C. A. Manlove of Estevan is interested.

MELTFORT, SASK.—The purchase of electrical equipment is under consideration by the Town Council.

MILDEN, SASK.—Plans are under consideration by the Town Council for the installation of a municipal electric light plant in Milden.

Miscellaneous

HONOLULU, HAWAII.—At the annual meeting of the Hawaiian Electric Company the stockholders will be asked to vote on the proposal to increase the capital stock of the company to $5,000,000. It is proposed to issue $500,000 immediately to provide funds to take care of improvements now under way and contemplated.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until April 7, under circular 1264, for furnishing boilers, cable, rope, wire, lamp cord, etc. Bids will also be received until March 27, under circular 2206, for furnishing 7500 ft of cable, 600 lb. plate washers, etc. Further information may be obtained at the above office.

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Record of Electrical Patents

Notes on United States Patents

(Issued Jan. 28, 1919)

1,292,884. BAKER'S-OVEN-LAMP ELECTRIC CONNECTION; Charles P. Robson, Philadelphia, Pa. App. filed Oct. 17, 1917. Will withstand without short-circuiting conditions of high heat and presence of steam.

1,292,888. AUTOMATIC CURRENT REGULATOR FOR SEAM-WELDING MACHINES; Charles D. Ryder, Covington, Ky., and Ralph B. Kersey, Cincinnati, Ohio. App. filed Oct. 24, 1918. Produces seam weld substantially uniform in character throughout its length.

1,292,892. ELECTRIC WELDING MACHINE FOR FORMING ELECTRICAL CONTACTS; William F. Hosford, Oak Park, Ill. App. filed Sept. 24, 1915. Used particularly with switch contact springs.

1,292,911. ATTACHMENT PLUG; William A. Stacey, Chicago, Ill. App. filed April 27, 1918. For heavy duty.

1,292,921. ELECTRIC WELDER; Carl H. Thornblade, Seattle, Wash. App. filed Aug. 4, 1917. Contact terminals through which application of current to yielding terminals is controlled may be applied only for limited time.

1,293,010. CONVERTIBLE ELECTRIC SADIRON AND HEATING AND COOKING STOVE AND LAMP; Jacob Bloch, Cincinnati, Ohio. App. filed Jan. 7, 1918. Simple in construction and easy to manipulate.

1,293,038. BRUSH HOLDER; Emerson L. Clark, Lakewood, Ohio. App. filed April 19, 1916. Brush applied firmly to commutator.

1,293,117. PRODUCTION OF METALLIC TUNGSTEN; Frederick G. Keyes, Cambridge, Mass. App. filed Feb. 11, 1914. Tungsten compound dissolved in ionizing medium at approximately 1200 deg. to 1400 deg. C. and solution thus formed electrolyzed.

1,293,052. ELECTROMAGNETIC MECHANISM; John L. Dinsmoor, Brooklyn, N. Y. App. filed Aug. 1, 1914. Useful in controlling feed of arc-lamp carbon or carbons.

1,293,060. TELEPHONE SYSTEM; George D. Edwards, East Orange, N. J. App. filed Jan. 4, 1918. Efficiency of transmission between plurality of connected stations not materially affected by variations in number of stations involved.

1,293,098. RELAY; Abraham N. Hovland, Christiania, Norway. App. filed May 1, 1913. Using one or more photo-electric cells.

1,293,112. METHOD OF AND APPARATUS FOR CONTROLLING ELECTRIC MOTORS; Arthur C. Keller, Milwaukee, Wis. App. filed Feb. 25, 1918. Applicable in hoisting and lowering loads and where dynamic braking is utilized.

1,293,120. COMBINED BELL AND BUZZER; William J. Klein, Buffalo, N. Y. App. filed May 1, 1917. Common return wire utilized.

1,293,141. CLOSET; Alexander McGary, New York, N. Y. App. filed Aug. 4, 1913. Incinerates refuse.

1,293,164. ELECTRIC METALLURGICAL FURNACE; William E. Moore, Pittsburgh, Pa. App. filed July 30, 1917. Combines advantageous features of both induction and arc type.

1,293,171. HAIR-WAVING DEVICE; Josephine Nimmerfroh, Lenox, Mass. App. filed Sept. 4, 1918. Hair may be readily entered or removed without entangling.

1,293,193. COMMUTATOR WIPER; Karl H. Poyas, Los Angeles, Cal. App. filed March 23, 1918. For Ford's timing systems.

1,293,195. SWITCH-CONTROL SYSTEM; Ralph L. Quass, Hawthorne, N. J. App. filed July 5, 1916. Primarily for telephone systems.

1,293,205. AUTOMATIC CUT-OUT; Oliver A. Ruff, Dayton, Ohio. App. filed Feb. 23, 1915. Adapted for use in charging circuit of storage battery.

1,293,296. DEVICE FOR AUTOMATICALLY CONTROLLING THE MOVING OF HEAVY OBJECTS; Fridtjov Anderson, Drobak, near Christiania, Norway. App. filed April 12, 1915. By means of comparatively light controlling or sighting apparatus.

1,293,309. SNAP SWITCH; Reuben B. Benjamin, Chicago, Ill. App. filed Oct. 20, 1916. Arcing when contact is broken reduced to minimum.

1,293,310. HIGH-SPEED TRANSMISSION; Erastus S. Bennett, New York, N. Y. App. filed Nov. 8, 1916. For high rotative velocities, whether to reduce speed or otherwise.

1,293,320. SOLDERING IRON; William A. Braun, Dover, Ohio. App. filed June 24, 1918. Resistance coil or heating element may be renewed.

1,293,323. CONTAINER FOR X-RAY FILMS; Arthur W. Buck, St. Louis, Mo. App. filed April 11, 1917. Envelop opaque to ordinary light but has portion permeable by invisible rays.

1,293,328. TIMER; Solomon A. Campbell, Newton, Mass. App. filed July 10, 1918. For internal-combustion engines.

1,293,346. ELECTRICAL SELECTING AND RECORDING APPARATUS; Guy S. Cornish, Cincinnati, Ohio. App. filed July 16, 1917. Single selector common to plurality of printers provided.

1,293,352. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App. filed Dec. 29, 1910. Dynamo or generator may be automatically governed to charge storage battery properly and operate lamps, etc.

1,293,356. APPARATUS FOR REGULATING AUTOMATICALLY THE CUTTING OF HOLES IN JACQUARD CARDS; Arvid G. Damm, Ronninge, Sweden. App. filed June 24, 1918. For textile purposes.

1,293,387. ELECTROMAGNETIC SIGNALING DEVICE; Charles J. Erickson, Chicago, Ill. App. filed Dec. 15, 1916. Of type comprising polarized ringers for substation telephone sets.

1,293,388. CIRCUIT BREAKER; James E. Evans, Artesia, Cal. App. filed Sept. 27, 1917. Thermostatically controls electric heating circuits in incubators.

1,293,390. TELEPHONE SIGNALING SYSTEM; Samuel H. Everett, Brooklyn, N. Y. App. filed March 11, 1915. May be associated with sources of ringing current of widely different frequencies, and relays for tripping or disconnecting ringing current from called line upon response of subscriber.

1,293,415. TELEPHONE TRUNKING SYSTEM; Bernard C. Groh, Chicago, Ill. App. filed March 6, 1915. Automatic toll switching system provided.

1,293,419. STORAGE-BATTERY GRID; Eugene Handler, Newark, N. J. App. filed May 5, 1916. Of the Faure type.

1,293,428. AUTOMATIC REGULATOR; Clark T. Henderson, Milwaukee, Wis. App. filed Nov. 22, 1913. For use in automobile lighting systems employing generator and storage battery to supply energy for lamps.

1,293,440. RESISTANCE; Albert J. Horton, White Plains, N. Y. App. filed May 24, 1916. For phonographs and other mechanisms.

(Patented Feb. 4, 1919)

1,293,446. FUEL-SUPPLY REGULATOR FOR STEAM BOILERS; Emil J. Hugo, Philadelphia, Pa. App. filed July 18, 1918. Electrically operated ball valve gives accurate control.

1,293,456. VAPORIZER; William D. Johns, Seattle, Wash. App. filed April 11, 1917. Combined vaporizer and carburetor for internal-combustion engines allows use of kerosene, wood alcohol, etc.

1,293,458. TELEPHONE CIRCUIT; Kenneth S. Johnson, Jersey City, N. J. App. filed Aug. 16, 1917. Independent potential opposes drop of potential through transmitter. Eliminates use of infinite-capacity condenser.

1,293,462. GALVANIC CELL; Morduch L. Kaplan, Brooklyn, N. Y. App. filed July 11, 1918. Manganese peroxide depolarizer for Leclanché type cells used for portable lights and pocket lamps.

1,293,463. GALVANIC CELL; Morduch L. Kaplan, Brooklyn, N. Y. App. filed July 11, 1918. Depolarizer combines high efficiency of the hydrate with density of the anhydrous kind.

1,293,467. SYSTEM OF SELECTIVE ELECTRICAL DISTRIBUTION; Charles F. Kettering and William A. Chryst, Dayton, Ohio. App. filed Nov. 20, 1912. Vibrating-spark effect secured only when timer of internal-combustion engine is off contact.

1,293,494. MACHINE-SWITCHING TELEPHONE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed April 24, 1917. Common trunks increase load factor of system.

1,293,499. AUTOMATIC TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Feb. 18, 1914. Rotary-magnet interrupter common to a plurality of switches.

1,293,510. SAFETY LOCKING DEVICE FOR VEHICLES; Edward R. Moores, Albany, N. Y. App. filed July 25, 1917. Alarm is sound if safety device is disturbed.

1,293,532. CONTROLLING MEANS FOR ELECTRIC MOTORS; Frederick G. Peck, Philadelphia, Pa. App. filed Sept. 25, 1916. Field current of motor controlled by snap switch actuated by part of controller.

1,293,538. ARC-WELDING ELECTRODE HOLDER; James E. Pierce, Albion, Mich. App. filed Nov. 12, 1918. Readily and easily opened to receive electrode.

1,293,545. CALLING DEVICE; Osvalt E. Rasmussen, West Hoboken, N. J. App. filed July 24, 1917. For automatic and semi-automatic telephone systems.

1,293,547. MECHANICALLY OPERATED ELECTRICAL SWITCH; Edward B. Reese, Indianapolis, Ind. App. filed Nov. 8, 1915. Fluid pressure in an internal-combustion engine utilized to operate electrical switch.

1,293,562. METHOD OF MAKING JACKETS FOR ENGINE CYLINDERS; Frederick Seigel, Irvington, N. J. App. filed July 12, 1917. Jackets electrolytically deposited directly on cylinders.

1,293,574. TIMER FOR INTERNAL-COMBUSTION ENGINES; Ira T. Swartz and Alvie T. Wallace, Indianapolis, Ind. App. filed Oct. 22, 1917. Timer held in place against accidental or intentional change.

1,293,587. REVERSE-CURRENT AND LOW-VOLTAGE CIRCUIT BREAKER; Albert E. Weaver, Indianapolis, Ind. App. filed July 20, 1914. Apparatus contained in tubular iron shell acts without arcing.

1,293,597. TELEPHONE SYSTEM; Bernard D. Willis, Chicago, Ill. App. filed Nov. 28, 1913. For systems in which connection is established in whole or in part through automatic switches.

1,293,620. AUTOMATIC TELEPHONE SYSTEM; Winfred T. Powell, Chicago, Ill. App. filed Feb. 14, 1916. For systems made up in part of poly-station lines equipped for prepayment service.

1,293,630. TELEPHONE-EXCHANGE SYSTEM; Gerald Deakin, London, Eng. App. filed Aug. 16, 1917. Automatic switching means provided.

1,293,649. FILTERING APPARATUS; Carolyn S. Smith, Brooklyn, N. Y. App. filed May 10, 1913. Galvanic action aids in purifying water.

1,293,651. FILTERING APPARATUS; Carolyn S. Smith, Brooklyn, N. Y. App. filed April 6, 1914. See above patent.

(Patented Feb. 11, 1919)

1,293,689. APPARATUS FOR THERAPEUTICALLY APPLYING DIATHERMIC CURRENTS; Gustav Bucky, Berlin, Germany. App. filed June 4, 1914. Heating at electrodes prevented by periodically weakening or interrupting current.

1,293,691. CIRCUIT BREAKER AND SWITCH; George A. Burnham, Saugus, Mass. App. filed Aug. 23, 1915. Controlling circuit opened when circuit-breaker becomes closed.

1,293,692. TRANSFORMER; George A. Burnham, Saugus, Mass. App. filed Sept. 28, 1916. Plates composing core held in fixed relation to each other, independently of windings.

1,293,697. OVERLOAD DEVICE; Harry R. Canfield, Cleveland, Ohio. App. filed April 19, 1916. Time-interval elements hermetically sealed in container to exclude dust, dirt, moisture, etc.

1,293,698. ELECTROMAGNETIC DEVICE; Harry R. Canfield, Cleveland, Ohio. App. filed April 22, 1916. Operates switch only when current is within predetermined limit.

1,293,717. SPEED MEASURING AND CONTROLLING DEVICE; James H. Core, Nashville, Tenn. App. filed Oct. 10, 1917. Centrifugal device controls ignition of internal-combustion-engine vehicles.

1,293,718. INTAKE-MANIFOLD GASKET; Louis E. Cornu, Enid, Okla. App. filed April 15, 1918. Electric resistance wires heat fuel as it passes through gasket opening.

1,293,720. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App filed Feb. 16, 1912. For variable-speed generators.

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1,293,744. APPARATUS FOR LOCALIZING SUBMERGED SUBMARINES; Bradley A. Fiske, United States Navy. App. filed May 23, 1917. Submerged microphone detects presence of submarine.

1,293,747. BATTLE TRACER; Hannibal Ford, Brooklyn, N. Y. App. filed Aug. 4, 1914. Instrument moves over chart and indicates at each instant both nautical position of ship on which instrument is placed and of another ship or object.

1,293,764. REGULATING MEANS FOR DYNAMO-ELECTRIC MACHINERY; David Hall, Wilkinsburg, Pa. App. filed Oct. 6, 1916. Brushes can be placed under the center of off-set tips of interpole to provide denagnetizing turns in the armature.

1,293,767. PROTECTIVE MEANS FOR BRIDGE-TYPE PHASE SPLITTERS; Max Hartenheim, Pittsburgh, Pa. App. filed Feb. 10, 1916. Guards against excessive voltage stresses or strains at unbalanced loads.

1,293,770. COMMUTATOR CYLINDER FOR DYNAMO-ELECTRIC MACHINES; Rudolph E. Hellmund, Swissvale, Pa. App. filed Sept. 27, 1916. High-voltage commutator cylinder has safe creepage path, although length is decreased.

1,293,781. INCANDESCENT ELECTRIC LAMP; Milton A. Hoyt, Bloomfield, N. J. App. filed July 11, 1916. Rapid method of forming connections between incandescent elements and leading-in wires.

1,293,794. ELECTRICAL SWITCH; William Kaisling, Chicago, Ill. App. filed Oct. 27, 1913. Particularly for ignition and light circuits on automobiles.

1,293,817. CALL-DISTRIBUTING TELEPHONE SYSTEM; John H. Levis, Jr., Rochester, New York. App. filed Oct. 25, 1916. Special apparatus for different classes of subscribers.

1,293,818. ELECTRIC IRON; Cyril N. Lewis, Ridgefield Park, N. J. App. filed Aug. 1, 1917. Circuit of heating element automatically interrupted when iron is not in use.

1,293,842. CIRCUIT INTERRUPTER; Howard G. MacDonald, Murraysville, Pa. App. filed March 9, 1918. Common operating rod for several contact members prevents transmission of arc explosive forces.

1,293,862. WIRE CONNECTOR; Joseph Moore, Baltimore, Md. App. filed Dec. 20, 1917. Wire held firmly between spring clips.

1,293,825. TESTING SYSTEM; Eric R. Lundius, Brooklyn, N. Y. App. filed April 6, 1918. For separately testing portion of telephone lines.

1,293,872. METHOD OF ELECTRICALLY UNITING METAL BODIES; Thomas E. Murray, New York, N. Y. App. filed April 27, 1918. Only one body is electrically fused for the joint.

1,293,881. VAPOR RECTIFIER; Harold A. Newcomb, Wilkinsburg, Pa. App. filed May 6, 1915. Arcs and electrical discharges readily controlled in vacuum electric apparatus.

1,293,896. ELECTRIC FLUID HEATER; Jens A. Paasche, Chicago, Ill. App. filed Oct. 25, 1915. Heats air and coating material in pneumatic coating apparatus.

1,293,912. REMAGNETIZING DEVICE; James L. Porter, Los Angeles, Cal. App. filed March 20, 1918. For remagnetizing permanent magnets of Ford motors.

1,293,929. SYSTEM OF CONTROL; Lynn G. Riley, Wilkinsburg, Pa. App. filed April 23, 1915. Relates to automatic series-parallel control of electric railway vehicle motors.

1,293,930. SYSTEM OF CONTROL; Lynn G. Riley, Wilkinsburg, Pa. App. filed March 4, 1916. Prevents undesirable rushes of current and too sudden acceleration of electric railway vehicle during predetermined portion of its accelerating period.

1,293,943. TROLLEY HANGER; William Schaake, Pittsburgh, Pa. App. filed June 30, 1915. Simple and effective clamping device.

1,293,945. MEANS FOR MINIMIZING INDUCTIVE INTERFERENCE; Charles F. Scott, New Haven, Conn. App. filed Jan. 2, 1915. Return flow of trolley currents of railway system may be substantially confined to track rails.

1,293,964. ELECTRIC HEATER AND COOKER; Perl M. Spink, Worthington, Minn. App. filed Feb. 23, 1918. Automatically varies distance between electrodes in accordance with heat developed.

1,293,970. SIGNAL-CONTROL APPARATUS; George Stickels, Astoria, N. Y. App. filed Jan. 31, 1918. Electrically operated by steering gear on clutch of vehicle.

1,293,973. SWITCH AND BRUSH MOUNTING FOR ELECTRIC MOTORS; Edward Strohacker and Louis Strohacker, Freeport, Ill. App. filed May 18, 1917. Novel pole changer and reversing switch for use on small horsepower motors.

1,293,989. LAMP SOCKET; Frank W. Turner, Kansas City, Mo. App. filed Nov. 6, 1916. Switch mechanism operated either by pull chain or ordinary switch key.

1,293,991. INDICATING MEANS; Louis J. Vandermyde, Morrison, Ill. App. filed Jan. 14, 1918. Gages amount of liquid in tank or container.

1,294,015. ELECTRIC HEATER FOR HUMIDIFIERS; Daniel H. Young, Manchester, Iowa. App. filed Feb. 2, 1918. Supplies steam or mixture of steam and electrolytically separated oxygen gas.

1,294,020. ARC LAMP; Christian Aalborg, Wilkinsburg, Pa. App. filed March 20, 1913. Has control mechanism in which frictional resistance is substantially minimized.

1,294,045. LOCK SWITCH; John F. Cavanagh, Meriden, Conn. App. filed March 14, 1918. Particularly for use on motor vehicles.

1,294,053. ELECTRIC SWITCH; Frederick W. Cole, Newton Highlands, Mass. App. filed Jan. 3, 1916. For use as shunt switch for fire-alarm signal boxes.

1,294,072. ELECTRICAL INSTRUMENT; Harry A. Ewen, London, Eng. App. filed May 16, 1917. Inclosed in vacuum bulb and operates on thermic principle.

1,294,176. ELECTRIC SWITCH; Joseph Sachs, Hartford, Conn. App. filed Dec. 19, 1916. Live circuit inaccessible when replacing fuses.

1,294,177. WAVE DETECTOR; Wilhelm Schloemilch, Berlin, Germany. App. filed March 13, 1912. Operating without auxiliary source of current.

1,294,185. PANELBOARD AND PANELBOARD CONSTRUCTION; Henry F. Starrett, Chicago, Ill. App. filed May 11, 1917. Assembled from stock units.

1,294,197. TELEPHONE MOUTHPIECE; Olaus Thokle, Mandal, Norway. App. filed Aug. 16, 1916. Inner opening communicates with diaphragm chamber through plurality of separate channels.

1,294,204. TROLLEY; Artemas B. Upham, Malden, Mass. App. filed March 31, 1915. Two trolleys of trackless car simultaneously engage two wires.

1,294,207. FIRE ALARM; William H. Vogtlander, Alexandria, Va. App. filed May 15, 1918. Detectors when fused close an electrical circuit.

1,294,213. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; George H. Whittingham, Bancroft Park, Md. App. filed Oct. 15, 1915. Sensitiveness of relay increased after lapse of sufficient time to permit initial rush of starting current to subside.

1,294,250. ARC-WELDING ELECTRODE; Clarence V. Elliott, Schenectady, N. Y. App. filed July 22, 1918. Welding metal combined with small quantity of material having high electron emissivity when heated.

1,294,269. ELECTRIC OVEN; Julius W. Hopkins, Cleveland, Ohio. App. filed May 8, 1918. Uses bulb-type grids.

1,294,277. MAGNETO-STARTING MECHANISM; Lancelot Johnson, Islington, London, Eng. App. filed Nov. 12, 1918. Separately operated parts eliminated.

1,294,282. MAGNETO IMPULSE STARTER; Benjamin Lawrence, Leyton, Eng. App. filed Nov. 12, 1918. Magneto armature has rapid angular movement given to it when engine is slowly cranked.

1,294,295. AUTOMATIC TELEPHONE EXCHANGE; George W. Lorimer and James H. Lorimer, (deceased), Piqua, Ohio. App. filed Nov. 26, 1901. Relates to employment of central energy for talking, signaling and adjusting central-exchange apparatus.

1,294,296. AUTOMOBILE HORN; Ernest Monteleone, Jersey City, N. J. App. filed Feb. 21, 1917. Sounding diaphragm has anvil and electromagnet operating in presence of anvil.

1,294,305. INVERSE TIME-LIMIT RELAY; Lewis T. Robinson and Clyde V. Hardy, Schenectady, N. Y. App. filed Sept. 15, 1914. Minimum time of engagement of contact members simply, conveniently and accurately adjusted.

1,294,326. ELECTRICAL OSCILLATION GENERATOR; Joseph Methenod, Paris, France. App. filed Nov. 28, 1917. Power and the stability of generator increased.

1,204,342. COMBINATION IGNITION AND LIGHTING SWITCH; William Kaisling, Chicago, Ill. App. filed May 6, 1914. Has interlocking features to control various operations.

(Patented Feb. 18, 1919)

14,593. (Reissue.) METHOD OF LOCATING SPECIAL TRANSPOSITION POINTS; Hughes Mouradian, Philadelphia, Pa. App. filed Jan. 2, 1917. Obtains substantial neutralization of disturbances, especially those due to electrostatic induction.

1,294,409. APPARATUS FOR UNITING METAL BODIES; Lawrence P. Crecelius, Cleveland, Ohio. App. filed April 30, 1915. Adapted particularly for rail bonding purposes.

1,294,432. SAFETY FUSE; Alfred L. Eustice, Chicago, Ill. App. filed March 14, 1917. Refillable plug type; may be opened for examination or removal without disturbing fuse link.

1,294,444. ATTACHMENT PLUG; William Goetzelman, Chicago, Ill. App. filed May 4, 1917. Firm and stable connection of plug and socket provided.

1,294,471. CIRCUIT BREAKER FOR IGNITION APPARATUS; Albert G. Karkau, Cleveland, Ohio. App. filed July 23, 1917. Bearing is not affected by action of current passing through arm carrying roller.

1,294,482. STOP-MOTION DEVICE FOR LOOMS; Peter P. C. Kremers, Philadelphia, Pa. App. filed Nov. 19, 1917. Upon breaking of a warp thread, signal is actuated to notify operator.

1,294,484. AUTOMATIC GAS CUT-OFF OF ALARM; Alexander I. Krynitzky, Philadelphia, Pa. App. filed April 24, 1918. Stops flow of gas or sounds alarm should flame become extinguished.

1,294,498. TELEPHONE-EXCHANGE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Nov. 26, 1917. Automatic switch mechanism released after starting but before completing its operation to interconnect subscribers' telephone lines.

1,294,514. PROCESS OF TREATING METALLIC OXIDES; James W. Moffat, Toronto, Ontario, Canada. App. filed April 30, 1918. Reduction of ore and melting of deoxidized material conducted in separate operations.

1,294,555. INDICATING SYSTEM; Richard F. Spamer, New York, N. Y. App. filed Sept. 8, 1914. For remote control of power generating and distributing systems.

1,294,557. MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM; Arthur B. Sperry, New York, N. Y. App. filed June 6, 1918. Pair of brush sets simultaneously hunt for desired line in two groups of line terminals.

1,294,575. INDICATING DEVICE; Frank D. Uomini, Palo Alto, Cal. App. filed July 12, 1917. For use on vehicles.

1,294,587. AUTOMATIC TELEPHONE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed Aug. 25, 1914. Relates to part of system by which calling line is automatically selected and associated with remainder of office-selecting apparatus.

1,294,590. ELECTRICAL BALE-TIE WELDER; Lewis B. Wygant, Vincennes, Ind. App. filed Feb. 6, 1915. Welds bands and then severs wire ends.

1,294,597. ELECTRIC HEATER; Philip F. Apfel, Seattle, Wash. App. filed Aug. 27, 1917. Heated air within element used for igniting cigar.

1,294,599. POLE-CHANGING SWITCH; Edward E. Bair and James E. Stout, Hanover, Pa. App. filed Dec. 1, 1916. Allows current to flow in any direction.

1,294,607. ELECTRICAL HEATING DEVICE; Francis Boardman, New York, N. Y. App. filed July 13, 1916. For melting snow and ice in vicinity of railway switches, movable-point frogs, etc.

1,294,621. METHOD OF AND MEANS FOR SWITCHING CURRENT FLOW AT HIGH POTENTIAL; Nicholas J. Conrad, Chicago, Ill. App. filed Feb. 26, 1917. Replaceable switch used which is capable of only one operation and must then be renewed.

1,294,627. PROCESS FOR MAKING AND APPLYING JAPAN; Wheeler P. Davey, Schenectady, N. Y. App. filed Aug. 18, 1917. Risk attending use of inflammable solvent obviated.

1,294,644. ELECTRIC CONNECTOR; Charles H. Fischer, Cincinnati, Ohio. App. filed July 17, 1914. For vehicle electric lamps.

1,294,656. CONNECTOR; William P. Hammond, Passaic, N. J. App. filed April 18, 1914. Formed from single piece of sheet material.

1,294,664. SAFETY APPLIANCE FOR ELECTRICALLY DRIVEN MACHINE; Harvey E. Howey, Granite City, Ill. App. filed Nov. 19, 1917. Operates as a switch throw-out and dynamic brake.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Practical Way to Save Coal

EVER since 1917, when the industries of the country were brought face to face with the acute coal situation, there has been a lot of loose talk on coal conservation. Whenever an effort was made to save fuel, the policy of the administration was—and it still is—one of repression, such as heatless days, lightless nights and curtailed production of the less essential manufactures. These were drastic yet effective measures. The statistics on the large generating systems of the country which are published in this issue reveal a more democratic method of conserving fuel; that is, through water-power development. The energy generated in 1918 by the hydroelectric companies represented an equivalent saving of over 30,000,000 tons of coal, and the transmission of the energy represented a saving in the hauling of approximately 750,000 carloads, not to mention the use of thousands of cars and the labor involved in mining and transporting the coal, or the enormous amount of fuel which would have had to be burned in the locomotives to pull the coal from the mines to points of distribution. Considering the rapidity with which our coal reserves are being depleted and the increasing demands for power by the expanding industries of the country, the necessity for more water-power development is apparent.

If reconstruction is to bring the greatest possible measure of comfort and happiness to the individual, electrical engineers must dedicate themselves to new and national purposes founded upon fellowship and love, so that the new social order shall not be based on antiquated notions but on scientific investigation.

Standardization and Its Limits

THE movement to replace the British standards of weights and measures, which are also the American, by the metric system used by the people of the other Western nations and favored by engineers all over the world has against it only human inertia and the inconveniences inseparable from the act of change. Once in operation and with right-of-way in the elementary schools, it would vindicate itself so quickly that the loud protests of the conservative would dwindle to murmurs and the murmurs be swallowed up in an approving chorus. For in the field of mathematics no one ever favored a more difficult as against an easier method of accomplishing the same result, and it would be as reasonable to clamor against decimal coinage or the Gregorian calendar as to oppose, after the accomplished fact, a change so manifestly in the interest of science and of economy in time and labor.

The metric system, if it shall become universal, will make easier the work of any league of nations that the future may have in store, for it will remove the one element needing translation in the science of mathematics, which otherwise has ever since the universal adoption of the Arabic notation needed no interpreters to make it international; and in modern civilization mathematics plays at least an equal part with literature. It is, however, vastly significant that what took place so spontaneously and rapidly in the mathematical world not all the efforts of ardent advocates have been able to accomplish in the world of language. Volapük and Esperanto, artificially procreated, were born dead, and no one has been able to galvanize their infant corpses into life. Language mirrors a nation's soul. It is the medium of imagination and poetry. It expresses the nice differentiations of race and history, of climate and environment. It will change with the slow procession of the centuries, but not even for the purposes of business communication can it be standardized.

Turn from the international to the national arena and analogy holds its own. In the sphere of tangible, ponderable things standardization keeps step with the march of civilization. In a nation where every railroad used a different gage for its tracks, where no two gas or water pipes had the same diameter or no two electric-lamp sockets the same thread, where no tool could be easily duplicated and no part of a machine, a vehicle or an appliance readily replaced, every fresh invention would bring in its wake fresh sources of annoyance and expense. Even private monopoly, if that be the price of mechanical uniformity, will be welcomed in order to obtain it. But when, building on this truth, would-be standardizers reach out their dead-leveling hands toward the intangible and the inscrutable, they are proceeding by a false minor premise to a conclusion at variance with wisdom. Human hands and human brains cannot be standardized nor the personal equation ignored. To standardize education is to sterilize it. To standardize literature or music, art or architecture, is to destroy it. To take mental or manual endeavor on less ambitious lines and set a pattern, a system or a pace to which all doing similar work in a laboratory, an office or a workshop must conform is to discourage ability and subserve mediocrity. Some so-called "efficiency engineers" have been guilty of this mistake in an effort to increase production; many leaders of trade unions have been guilty of it in a desire to keep production down. Man is not a machine. Procrustes with his rule-of-thumb method for standardizing human stature has no place in modern industry. Attempts to emulate him, especially in a great individualistic democracy, are foredoomed to failure, though unhappily not free from harm.

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What a horrible mess the administration has made of the operation of the transportation and communication systems and how typical of municipal ownership are the results! To paraphrase the epitaph of Sir Christopher Wren, "If you seek a monument to government inefficiency in ownership and operation, look around."

Continuous-Wave Land Radio Sets

EVERY great war brings some new weapon to the front. If we except the airplane, this war has given birth and permanent use to the tank, which was the reply to the machine gun. Once the tank was launched or set going, means had to be found to maintain communication between it and its base. Radio communication is the only kind of communication which can at present hope to meet all the requirements. Nevertheless, the difficulties in the way of providing tank radio communication are very great. A tank is a very near approach to Faraday's hut, or metallically inclosed chamber, which he showed to be a complete electromagnetic wave-proof receptacle. Special pains have to be taken to bring radio signals into its sheltered interior. A radio system developed by the Signal Corps for meeting, among other needs, the exigencies of the wayward tank is described in this number by Lieut. Paul T. Weeks and Lieut. Donald G. Little. This system is very interesting and involves for its successful application the vacuum tube, both in the transmitting and receiving sets. The system is indeed a good illustration of the great importance of the vacuum tube in modern radio communication.

Daylight saving becomes effective again next Sunday at 2 a.m.; and it is expected that every one, including central-station managers, will make the best use of the extra hour of daylight. Whatever benefits humanity benefits the central station also.

The Super-Transmission Plan

THE discussion by W. S. Murray of the plans of the Secretary of the Interior for supply of power on the Atlantic seaboard which we present this week is both inspiring and instructive. As regards the necessity of developing great power networks to take care economically of our needs, we have hammered away in season and out of season, and it is somewhat encouraging at last to have the practical side of the matter taken up in a way which affords at least a possibility of results. The conception of a great transmission system reaching from Portland, Me., to Richmond, Va., as Mr. Murray presents it, is certainly an appealing one. It involves no technical difficulties of any material account, the only question being the financial one, which in government hands would easily be settled, and the administrative one, which might involve serious conflicts of interest with privately owned enterprises. We do not believe that the government will be permitted by the people, even if it wished, to seize the power transmission systems as it has already grasped the communication systems. There is a limit to government ownership in principle and in practice, so long as this country holds to the ideals of its founders; but there is no reason why a government-owned—or, better, government-controlled—system linking the great power enterprises of the Atlantic coast could not and would not be a success. Its installation should mean that it would tap every distributing network all along the line on a system of exchange of power which would enable the steam-driven and the hydraulic stations to coöperate to the best possible advantage in utilizing the diversity factor of the whole system.

That very great gains in the saving of fuel and expense could be made by electrification of many of the railway lines is now indubitable. Mr. Murray's own experience is sufficiently conclusive on this point, and it is thoroughly backed by the results of others. The enormous cost of the necessary changes and the fact that most railroads are up to their eyes in debt have been the two stumbling blocks in the way of general electrification. The condition of the railroads, under whatever ownership, must be greatly stabilized before one can talk seriously of an addition in any form to the already huge interest charges, even for the purpose of effecting economies; but, with a firmly established power linkage all along the Atlantic coast, the task of electrification will become vastly easier. The only point on which we are disposed to call in question Mr. Murray's admirable statement of the case is the proposition of tying up this huge enterprise to 25 cycles. Why depart from the usual frequency of 60 cycles in an attempt to tie together the electrical developments along the Atlantic seaboard? At best choice between the two is a somewhat difficult matter of quantitative investigation with an eye to the future as well as to the past, and it should be considered an open question until the real rôle of the super-transmission system is finally determined. One matter with respect to transportation itself has a direct bearing in this connection, and that is the desirability of taking care of the distributed floating load of a railroad system from existing power networks backed up by the super-transmission scheme. The solution of the power problem of distribution for transportation involves too elaborate and complete a study of the situation as to load distribution to be solved, even approximately, offhand. This, however, constitutes no reason why the project should in its earlier stages be delayed.

The obligation to improve service rests on every public utility operator. There is little virtue in remedying defects brought to one's attention. First-class service is expected, and it is better to merit the praise of customers through continual improvements rather than their censure because of shortcomings.

Technical Education

IT SEEMS to be generally accepted that the pupils who graduate from the technical colleges are not so proficient in their cultural, scientific, economic and practical attainments as might be desired. Here all agreement seems to end. All manner of suggestions are forthcoming as to the causes, remedies and consequences of this admitted fact.

It is doubtful whether the technical colleges could ever satisfy the desires of the engineering profession, under any set of conditions that are within reasonable hope of fulfillment. Leading engineers are apt to forget how many years ago they themselves graduated from college, and how much hard work, study and self-development they have undertaken since that event. It is but natural that in their aspirations for the prestige of their profession they should be impatient with

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the young fellows just commencing at the bottom of the ladder of toil and should hold the colleges to blame for not producing genius full-fledged and competence complete.

From the standpoint of the colleges, they meet the need of criticism with a stare of astonishment. Of all the students who enter their portals with the avowed intention of becoming engineers, only about one-third succeed in graduating into the profession. The two-thirds either revoke their purpose or fail. The colleges are apt to wonder what the professional comment might be if the whole band of original endeavorers were to receive diplomas. Moreover, the colleges witness so great a change, growth and development in the students during the customary four years of study that they wonder what the professional judges would say to the freshmen, if they have so little praise for the graduates.

In a democracy the avenues to all of the professions lie open to all pretenders. Nevertheless, native ability sufficient to win professional distinction is allotted to only a small minority. Many are called but few are chosen. Let us rather be content that the many who are ungifted offer themselves for training. No matter how ungifted the student, he gains something by the training. Why should the cup of gratitude be filled with discontent? In the vast world of business, of engineering and constructive accomplishment there is abundant room for every grade of engineering talent and technical ability. It would even be a great misfortune if all of the graduates of all of the technical colleges were great engineers. As in the army, to every commissioned officer there must needs be at least several non-commissioned officers. To every leading engineer in the profession there should probably be at least a dozen honest and worthy engineering aides of lesser capability and skill, whose work is nevertheless vital and essential to the enterprise in which all are engaged.

Scoffers at theory should ponder the devastating results secured in the bombardment of Paris by the German long-range artillery, now that the censorship has been lifted on this matter. "Cut-and-try" methods have their place, but in the long run the ability to predict performance on paper is worth a vast amount of "educated guesswork."

Compensated-Type Potential Regulators

IN ORDER to hold the voltage automatically constant in an alternating-current circuit at some point remote from the generator, under varying conditions of load, an automatic regulator must be introduced which shall be capable of responding not only to the strength but also to the phase of the current supplied by the generator to the circuit. A. H. Ford, P. E. Mead and G. W. Thomas present in this number a graphical outline of the conditions which have to be met to bring about automatic regulation at a remote point.

An interesting case under the general rule of automatic regulation is that of a synchronous motor so controlled by the regulator as to keep the power factor constant in the system to which it is connected. Two aspects of a self-regulating system call for consideration. The first is that which relates to the conditions under which a regulator can perform its assigned functions. This is the aspect dealt with in the article here considered. The second is that which relates to what may happen in the system if the automatic regulator should accidentally suspend its functions and cease to operate effectively. Accidents may occur in the best regulated systems. It is important to make sure that, in the worst case, the regulation cannot become defective beyond a definitely assigned limit should the regulator become deranged. In some cases this particular aspect of the system has been overlooked, with unfortunate results.

The harbor strike has threatened the operation of public utilities in New York by depriving them of coal. This is one reason, and a very good one too, for storing coal, and no public utility manager can shirk the responsibility with impunity.

Opportunity and the Associated Manufacturers

NOW starting on its fifth year, the Associated Manufacturers of Electrical Supplies faces opportunities just as great for its members as those which led to the organization of this body. The proceedings of the annual meeting which is reported in this issue are only a partial presentation of the real work which has been done and is planned for the future. They relate more particularly to the general activities of the association than to the detailed affairs of the sections. It is through the twenty-five sections that results are accomplished which touch directly the individual lines manufactured by the members. The central organization of the association serves to weld the sections together firmly. It also acts to supervise or criticise, if criticism be needed, the sections. Its approval is required before the action of sections becomes final. Through this effective method of organization the sections conduct intensive work on the lines approved by the general counsel of the association and by the board of governors and the main body carries on the general affairs which touch all members. Last year these affairs were of course very largely matters of national war service. There was also, however, the subject of international trade, which is in charge of an efficient committee that is getting results. The extensive efforts of the association to render service to the country during the war illustrate effectively what can be accomplished through true coöperation. And the comprehensive program of the international trade committee is a conspicuous example of what can be done to safeguard and extend the electrical manufacturing industry.

Certainly there is more need than ever before that an association of this character shall exist and grow. Its record in accomplishment is the best index of what it may do in the future years. Its grasp of problems, its recognition of conditions, is the arrow pointing to the way in which it will face the issues of these times. With many minds meeting there is always the chance of conflicting views as to detail. But on the large questions of principle the members of the association have stood together. Conceived and launched at the moment of psychological advantage, the association has been ably directed from the beginning. It has foreseen changes in conditions, it has been ready to meet new situations. It is to-day keenly aware of the economic tendencies of the era and appreciative of the opportunities arising in them. There is no evidence of desire to ignore or minimize the adverse factors or to exaggerate the favorable influences. The association seeks the facts as a foundation for its policy.

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Compensated-Type Potential Regulators

Correct Connections for Using Compensated Potential Regulators for Power Factor and Voltage Correction at Load Are Discussed—Action of Regulator Also Depends Upon Line Constants as Shown by Tests

BY ARTHUR H. FORD, PAUL E. MEAD AND GUY W. THOMAS
State University of Iowa, Iowa City

THOUGH automatic potential regulators have been in general use for a number of years, it is a common experience to find them unused on power-station switchboards, and still commoner to find the compensated type of regulator with the compensating winding out of use. Upon investigation of unused regulators it is usually found that the compensating winding is incorrectly connected or adjusted.

In this article an analysis of the principles of operation of this type of regulator is set forth, showing the necessity for correct connection. It is also shown that exact regulation at the load may only be realized when line resistance and reactance bear a definite ratio. In some instances it may be advisable to add to the line reactance to improve regulation. Test data obtained with a Tirrill regulator bear out the conclusions.

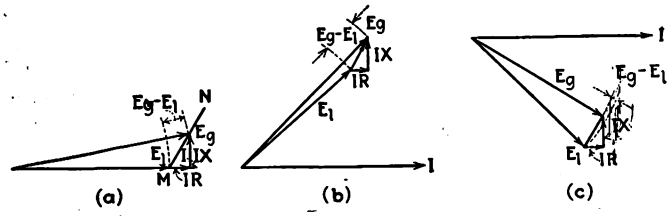

FIG. 1—VECTOR DIAGRAM FOR SINGLE-PHASE SYSTEM
(a) Non-inductive load. (b) Lagging current. (c) Leading current.

A necessary part of most automatic potential regulators is the contact-making voltmeter. This consists essentially of a magnetizing coil connected in series with a non-inductive resistance, the two being connected across the line the voltage of which is to be regulated. Where a single coil voltmeter is used, without a line drop compensator, it should be connected to the line at that point at which it is desired to have the voltage held constant. This commonly requires that the regulator be placed at such a location that it is not easy of access. Ease of inspection makes it desirable that the regulator be installed either in the power station or a substation, such a location being necessary in the case of a regulator which controls the line voltage by controlling the exciter of generators or synchronous motors.

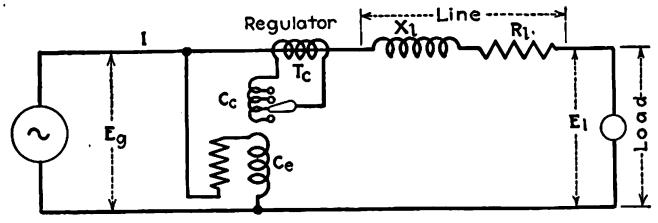

FIG. 2—CONNECTION OF REGULATOR IN SINGLE-PHASE LINE

The limitation of the point at which the voltage is controlled to that location at which the contact-making voltmeter is connected can be obviated by making use of some device which will automatically take account of the line drop in its correct phase position. This condition is commonly brought about by adding a series or compensating coil to the contact-making voltmeter and connecting this coil to the secondary of a current transformer connected in the line to be regulated. The widely used compensated Tirrill regulator is of this type.

Regulation of Single-Phase Lines

The connection diagram for the voltmeter coil of a Tirrill regulator, a generator and a single-phase transmission line are shown in Fig. 2. C_e is the voltage coil of the regulator and C_c the current or compensating coil, both being wound so as to act on the same core.

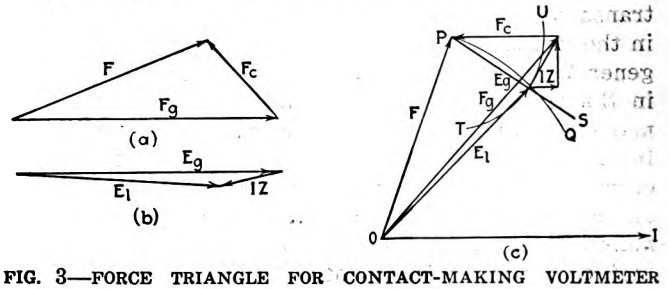

FIG. 3—FORCE TRIANGLE FOR CONTACT-MAKING VOLTMETER AND VOLTAGE VECTOR DIAGRAM

T_c is the current transformer supplying current to the compensating coil. X_l and R_l represent a line having reactance X and resistance R. E_g is the generator voltage and E_l the load voltage.

The voltage and current relation for the above line and loads of various power factors are shown in Fig. 1, when the line is composed of No. 000 copper spaced 3 ft. (90 cm.) apart, having a resistance drop of 15 per cent and operating at 60 cycles. Fig. 1 (a) shows the relations for non-inductive load, (b) for lagging current and (c) for leading current. If it is assumed that the load potential E_l and the power factor remain constant as the current changes, the locus of E_g in the line MN and the necessary change in the generator potential is $E_g - E_l$. This is seen to be proportional to I only in case the line reactance is negligible as compared to the resistance and the power factor is unity, or in case the ratio of reactance to resistance of the load is equal to the ratio of reactance to resistance of the line.

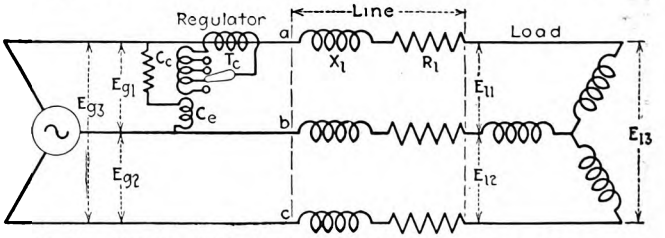

FIG. 4—CONNECTION OF REGULATOR IN THREE-PHASE LINE

For any other values of the line and load constants the difference between the generator and load voltages

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is less than the line drop and does not vary directly with the current.

The compensated regulator, when connected as shown, will hold the voltage at a distant point constant only when the above conditions are fulfilled, making the pull

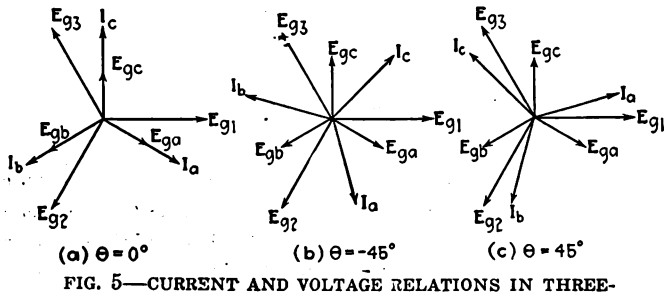

FIG. 5—CURRENT AND VOLTAGE RELATIONS IN THREE-PHASE LINE

on the voltmeter core proportional to the voltage at the distant point. This requires that magnetizing action due to the compensating coil shall be directly opposed to that due to the voltage coil.

The general condition is shown in Fig. 3, where *a* represents the force triangle for the contact-making voltmeter and *b* represents the voltage triangle for the transmission line. F_g is the force due to the current in the voltage coil, which is directly proportional to the generator voltage. F_c is the force due to the current in the compensating wind, which varies in phase and magnitude with the phase and magnitude of the current in the line. It may be changed in magnitude for a given current by changing the number of turns in the compensating coil. F is the resultant force, which must remain constant with a constant adjustment of the control spring or counter weight of the regulator.

Since F_g is proportional to E_g, these two triangles can be combined as shown in Fig. 3c, if the scales are properly chosen. F being constant, the condition of E_l being constant is fulfilled if the locus of the end of E_l is the circumference of the circle PQ having O as its center. F_c and IZ being both directly proportional to I and not changing their angular position, as long as the power factor remains unchanged, the locus of E_l is the straight line PS, when the current changes without change in power factor, and the circular arc TU, having P as its center, when the power factor changes without change in current. Since the length of F_c can be varied, by changing the number of turns in the compensating coil, it is possible to make the circular arc TU and the straight line PS cut the circular arc PQ at the same point and thus make the compensation perfect for a given current and power factor. E_l will be too low for currents or power factors less than these and too high for currents or power factors greater than these.

CONNECTION FOR THREE-PHASE LINES

When a compensated regulator is used to regulate the voltage on a three-phase line the action is similar to that just described, provided the voltage coil is connected so as to have the Y voltage of the line in which the current coil is connected impressed on it. This is seldom done, the common practice being to connect the voltage coil so as to have the delta voltage impressed on it, as indicated in Fig. 4. This complicates the problem of making proper connections, because the line currents are not in phase with the delta voltages, and raises the question which line should have the current transformer supplying current to the compensating coil connected to it. The current and voltage relation for a three-phase circuit with unity power factor, lagging and leading current are shown in Fig. 5. Of the three possible locations, the placing of the current transformer in the lead to which the potential coil is not connected is obviously incorrect; for this current I_c will be at approximately 90 deg. phase displacement from the voltage E_{g_1} when the power factor is about unity, and therefore it can change a large amount without affecting the pull on the voltmeter core to an appreciable extent. Of the currents in the other leads, I_b lags behind E_{g_1} by 150 deg., while I_a reversed leads E_{g_1} by 150 deg. with the power factor unity. Where the load has unity power factor and the line has a negligible reactance, either of these currents is equally effective in compensating for line drop.

When the line reactance is negligible, the current transformer should be placed in line *b* in order to obtain the best results. This is shown by reference to Fig. 6, which is similar to Fig. 3 except that at unity power factor the current I_b is 150 deg. behind E_g and the line reactance is such that the angle between IZ and IR is 30 deg. The magnitude of E_l is $E_g - I_aZ + I_bZ$. With the above constants this makes the angle between E_g and the total line drop equal to 30 deg. when the load is non-inductive and balanced among the phases.

This can be proved from the geometry of the figure as follows: The angle between $-I_aX$ and $-I_aZ$ is 60 deg. The angle between $-I_aR$ and I_bR is 60 deg. Therefore $-I_aX$ and I_bZ form a straight line. The angle between E_g and I_bZ is equal to 60 deg. $-I_aZ = I_bZ$ in magnitude, and therefore the triangle $-I_aZ$, I_bZ, $(I_b - I_a)Z$ is isosceles and the angles next to $(I_b - I_a)Z$ are equal and have their sum equal to the angle between E_g and I_bZ. This makes the angle between E_g and $(I_b - I_a)Z$ equal to 30 deg.

Now, drawing the force triangle for the contact-making voltmeter, it is seen that the angle between F_c and F_g is 30 deg., if the current coil is connected in lead *b*. The magnitude of F_c can be so adjusted that F_c coincides with $(I_b - I_a)Z$, when F will coincide with E_l. The voltage at the far end of the line will therefore be constant for all loads, no matter what the power factor, as long as the adjustment of the contract-making voltmeter is unchanged.

TESTS OF REGULATION OF THREE-PHASE LINE

The above deductions were checked experimentally by the use of a three-phase generator and an artificial transmission line.

The accuracy of control of the voltage by the Tirrill regulator was checked by connecting the voltage coil only and measuring the busbar voltage when the load was changed. It was found that the voltage remained constant, within the limits of accuracy of the ordinary

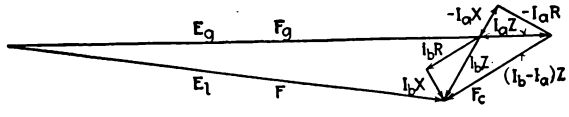

FIG. 6—DIAGRAM OF FORCES ACTING ON CONTACT-MAKING VOLTMETER

switchboard-type voltmeter, for various loads and power factors.

A line having sufficient resistance to give a drop of 14 per cent at 25 amp. load and having no reactance was then connected to the generator busbar. The compen-

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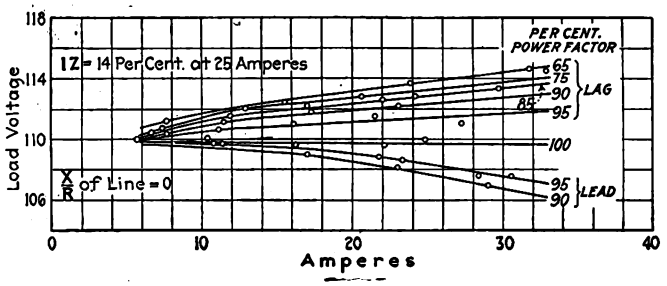
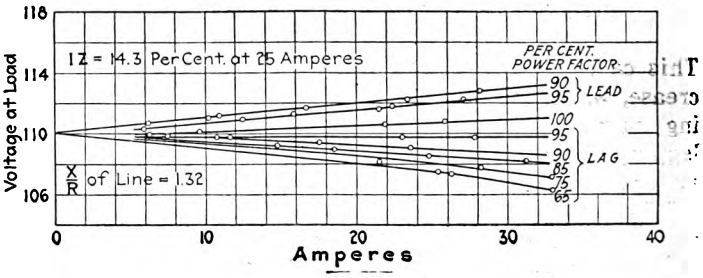
sating coil on the regulator was then adjusted so as to make the no-load and full-load voltages at the load end of the line equal, the load being non-inductive. The load current and power factor were then varied and the load voltage was read. The results indicated in Fig. 7 were obtained. This shows that exact regulation is obtained only for loads having substantially 100 per cent power factor.

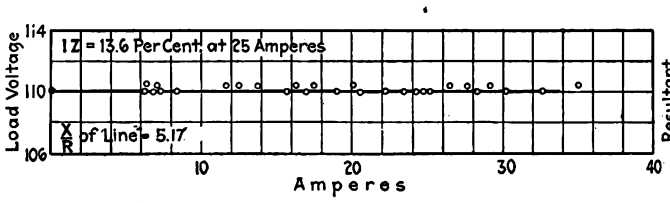
The resistance of the line was then reduced to 0.385 ohm and a reactance of 0.199 ohm added. This makes the angle between resistance drop and impedance drop in the line essentially 30 deg. The line drop is 13.6 per cent at 25 amp. The adjustments were made as before, and the load and power factor varied through the same range as before. The results are plotted in Fig. 9. This gives exact regulation for all loads and power factors.

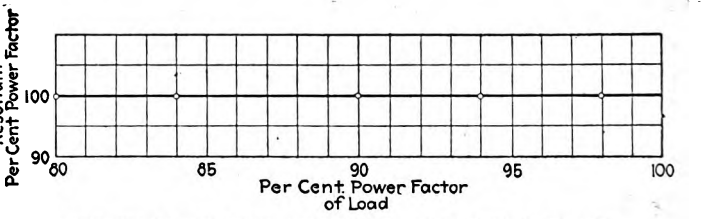
The resistance was then decreased to 0.272 ohm, and the reactance increased to 0.358 ohm. These values give a line drop of 14.3 per cent at a load of 25 amp. Similar adjustment and tests give the results shown in Fig. 8.

A comparison of these results with the theoretical deductions shows exact agreement. One peculiarity which warrants special attention is the fact that the voltage is too high for a lagging current when the line reactance is less than $0.5R$ and for a leading current when the line reactance is greater than $0.5R$. This brings out the fact that a compensated regulator of the type investigated cannot be adjusted to hold the voltage exactly constant at the far end of a transmission line unless the line reactance, including that of the step-up and step-down transformers, is equal to one-half of the line resistance, including the transformers. The insertion of sufficient additional reactance to bring the total reactance up to the figure given would therefore seem to be advisable in some cases.









FIGS. 7, 8, 9 AND 10—TESTS OF REGULATOR UNDER DIFFERENT CONDITIONS OF LINE CONSTANTS AND POWER FACTOR

Fig. 7—Line has zero reactance. Fig. 8—Line has $r = 0.272$ ohm and $X = 0.358$ ohm. Fig. 9—Exact regulation obtained when $x = Z/2$. Fig. 10—Exact power-factor correction is automatically obtained by use of regulator.

THE CONTROL OF POWER FACTOR

When discussing the question of the proper line into which to insert the transformer which supplies current to the compensating coil, it was pointed out that the current I_c, in line c, had such a phase relation to the voltage E_{g_1} that changes in magnitude of the current had little effect on the total force acting on the voltmeter core. A change in phase angle of the current, however, produces a relatively large change in the force acting on the voltmeter core. This fact can be made use of to hold the power factor on a transmission line at about unity by means of a synchronous motor controlled by a compensated regulator. Such a connection can also be used to hold the power factor of one of several synchronous generators, connected to the same system, at unity, which is sometimes a desirable operating condition. An example of this would be the case of a low-speed generator of poor regulation operating in parallel with one or more high-speed machines of good regulation.

The connections of the regulator are shown in Fig. 11. The field control device is connected to the field of the synchronous motor. When so connected the forces acting on the voltmeter element of the regulator are as shown in Fig. 12. Fig. 12a shows the condition when the current and Y voltage are in phase (power-factor unity), b when the current is lagging, and c when the current is leading. F_g is the force due to the current supplied by the shunt transformer and is proportional to the generator voltage E_{g_1}. F_c is that due to the current derived from the series transformer and in proportion to the line current I_c. F is the resultant force and is equal to the vector sum of F_{g_1} and F_c. When the regulator is properly adjusted, it will act in such a manner as to keep F constant in value, for the pull of the solenoid is balanced by the pull of a spring. The internal connections of the regulator are such that the excitation of the motor will be increased when F is reduced in value and decreased when it is increased in value. It should be noted that the current transformer is placed between the synchronous motor and the load having the low power factor. This location is necessary because the leading component of current drawn by the synchronous motor must be equal to the lagging component of the current drawn by the other apparatus. The operation of the regulator should therefore depend on the current for which it is desired to compensate and not on the current taken by the synchronous motor or that supplied by the generator. When it is desired to hold the power factor of a given generator, of a number connected in parallel, at unity, the current transformer must be placed in the circuit of that particular generator.

When a synchronous motor is placed at the end of a feeder supplying a motor load, there will in general be a change in voltage and a change in power factor inde-

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pendent of the operation of the synchronous motor. It is therefore necessary to consider the effect of each of these changes on the operation of the motor when connected as shown in Fig. 11.

When the lag of the current increased, without a change in voltage or current magnitude, as shown in Fig. 13a, the pull on the voltmeter core changes from F to F'.

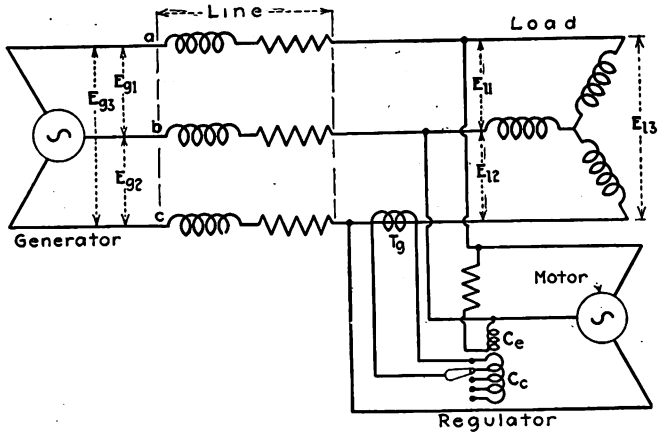


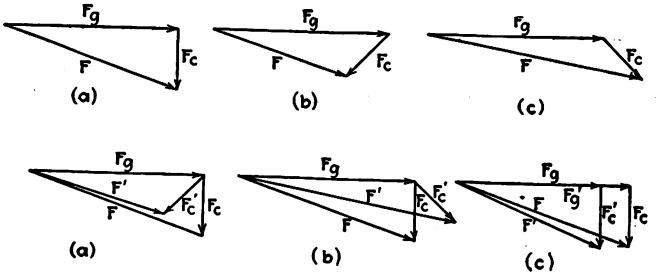
FIG. 11—CONNECTION OF REGULATOR AND SYNCHRONOUS MOTOR FOR POWER-FACTOR AND VOLTAGE REGULATION

This causes the current through the motor field to increase, which in turn causes the motor to draw a leading current from the line and thus correct for the lagging current caused by the operation of the other motors.

When the line voltage decreases without change in lag angle, as shown in Fig. 13c, the force acting on the voltmeter core is decreased from F to F', which causes the excitation of the motor to increase and thus increase the line voltage by drawing a leading current from the generator. An increase in the line voltage produces the opposite effect. A variation in load, power factor and voltage remaining constant, has scarcely any effect on the length of F, as shown in Fig. 13b, and therefore it does not affect the operation of the synchronous motor.

TESTS OF POWER-FACTOR CORRECTION

The above deductions were checked by putting the same load in amperes on a generator and adjusting the power factor to various values. A synchronous motor connected to the Tirrill regulator was then put on the line and the power factor and voltage were noted. An artificial line giving a resistance drop of 4 per cent and a reactance drop of 1 per cent was placed between the generator and the motor and load. The generator field was so adjusted that the terminal voltage was constant throughout the test. The results are plotted in Fig. 10, which shows that the power-factor correction is practically perfect.



FIGS. 12 AND 13—FORCE TRIANGLE FOR VOLTMETER WITH CONNECTIONS OF FIG. 11; EFFECT ON VOLTMETER FORCE TRIANGLE OF POWER FACTOR CURRENT AND GENERATOR VOLTAGE

Maintaining Industrial-Plant Equipment

The Electrical Apparatus of a Large Ohio Mill Has Been Found to Last for a Longer Period and to Give Less Trouble During Its Life Because of the Fact that an Effort Is Made to Remedy Troubles Before They Become Really Serious

A SURPRISINGLY large number of industrial plants in the United States have grown until their electrical equipment is equal in rating to that required to serve completely a city of 100,000 people. Because of the necessary power houses, substations, transmission and distribution lines, the men who supervise the electrical equipment are confronted with the operating problems common to the central station plus all of the problems of central-station customers.

To illustrate the responsibilities falling on the electrical department of an industrial company a specific case in Ohio will be considered and the methods of handling the problems will be discussed. At this plant is an 18,000-kw. generating station serving various mills within a 1200-acre tract of land about 1.6 miles (1.9 km.) long. The station contains three 3000-kw. gas engines, three 1500-kw. turbines and three 1500-kw. cross-compound steam engines, all driving 6600-volt, 25-cycle, three-phase generators. The plant operates at an annual load factor of 57.6 per cent; the load factor of the gas engines is 87.2 per cent. Four rotary-converter substations and one motor-generator substation located conveniently throughout the area receive the energy and convert it into direct current at 230 volts. The connected motor load, which is equal to 2.82 times the generator capacity, is nearly all supplied with direct current, but the 1550 kw. of lighting equipment will soon all be operated from alternating current. The motors number about 2135 and range in size from 3000 hp. down to fractional-horsepower units. These facts help to show how much equipment there is to maintain.

One of the most important factors in maintaining the equipment of the plant is the organization. Complete responsibility for the production of tonnage and high-quality products is vested in the manager of the works. His immediate subordinates are five in number, composed of four superintendents of manufacturing units and a superintendent of engineering and mechanical departments. Reporting directly to the superintendent of engineering and mechanical departments are the superintendent of the electrical department and the superintendent of shops. It is the former who has direct responsibility for the electrical maintenance in addition to his other duties. These other duties con-

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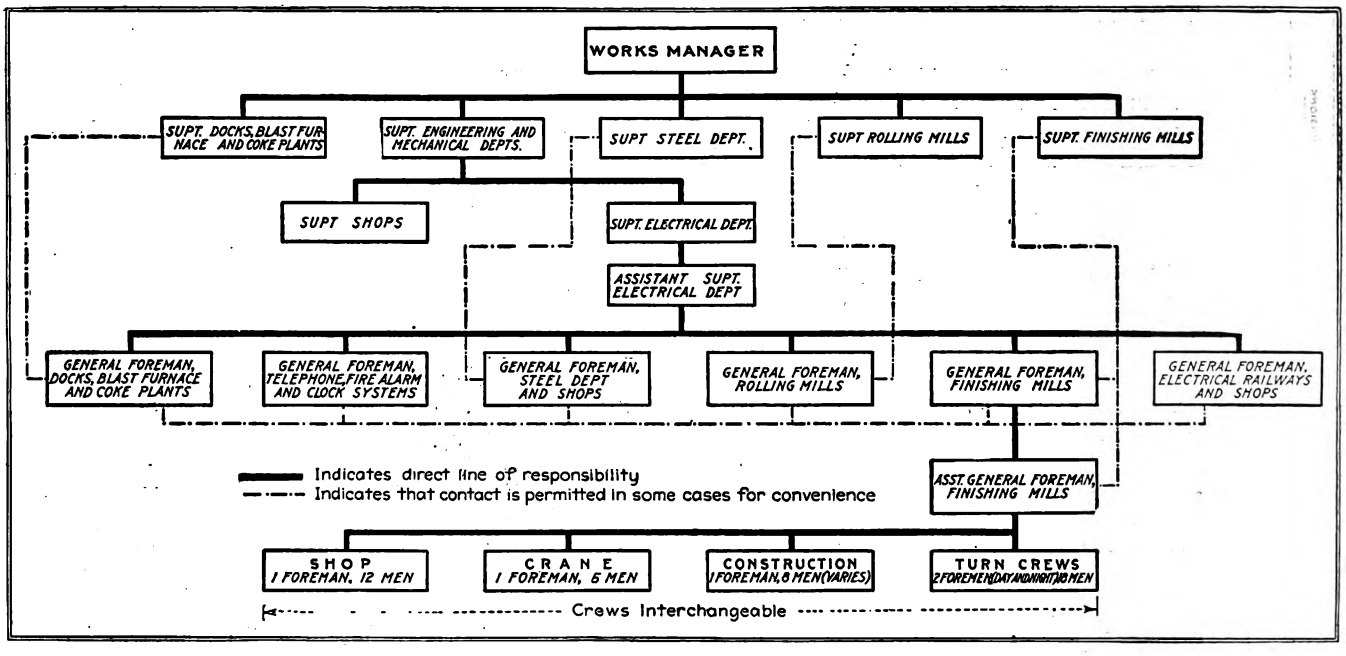
sist of both construction and operation activities. Indorsing designs and general layouts for construction work and supervising the actual installation of large equipment constitute the greater part of his construction work. While the electrical department does all ordinary electrical installation work it does not have an organization of riggers, since these men are supplied by the operating departments. The electrical superintendent's operation activities include passing on rules worked out by the general safety department. The crane operators are not supervised by the electrical department as is the case in some plants. Considered with the organization chart shown herewith, these statements indicate the relation of the electrical department to the mill organization as a whole.

The electrical department consists of about 275 men directed by the superintendent of the electrical department through his assistant and six foremen. The general lines of responsibility are shown on the diagram. From the names given the various foremen it may be observed that the four general foremen are separately responsible for certain physical sections of the plant, as (1) docks, blast furnace and coke plants; (2) steel



ORGANIZATION CHART SHOWING LINE OF RESPONSIBILITIES FOR ELECTRICAL WORK

works, (3) rolling mills, and (4) finishing mills. The other two foremen have charge of special apparatus regardless of location. For convenience and to get the value of direct contact each of the four foremen first named deals directly with the various mill foremen who are in the production departments of his section on problems affecting minor changes and maintenance. The foreman of the electrical repair shops and the foreman of the telephone, fire-alarm and clock systems deal directly with the other electrical foremen and with each other on minor problems. For example, a question of changing a motor in the finishing mill would be settled between the general foreman of finishing mills representing the electrical department and the responsible operating foreman.

Each general foreman has his own organization, that of the general foreman of finishing mills (see diagram) being typical. This general foreman spends a great deal of his time with the general mill foremen and their assistants working out ideas that will assist in improving operating conditions and practice. His assistant is his understudy and follows up all details closely. It is a characteristic of the organization plan that each responsible man is continually training some one to be competent to take his place.

It so happens that the general foreman of the finishing mills is the only one who has a repair shop of his own. However, each of the other general foremen has facilities for making small repairs at his tool and supply room, where he usually has one man in charge. General shop facilities are afforded through the foreman of the electrical repair shop, who in his main shop has a foreman in charge of winding and a total of thirty-six workmen. Of these fifteen are in the winding department and the rest are machinists and bench repairmen.

In the typical organization of the general foreman of finishing mills the crews of the shop foreman, crane foreman, construction foreman and turn foremen are interchangeable on request through the assistant foreman of the finishing mills. Each "turn" foreman, or day and night foreman, has a crew of nine men. These men spend their time around the plant continually, looking for places to prevent trouble before it occurs.

TRAINING AND ENCOURAGEMENT FOR THE MEN

The methods employed for training these men are quite interesting. New men hired for the department are just as apt to be former dry-goods clerks as anything else. The majority know little about electricity, so they are first placed in the construction or shop crews as helpers. Here they become accustomed to seeing what can happen to motors and controllers that will make it necessary to bring them into the shop for repairs. They also learn what each piece of apparatus is for and how the trouble that brought it to the shop could have been avoided. For example, if a motor is brought in because it commutates poorly all of the causes of bad commutation are explained to the new men who are to work on it. Rough commutators, improper brush tension, use of wrong brushes, high mica,

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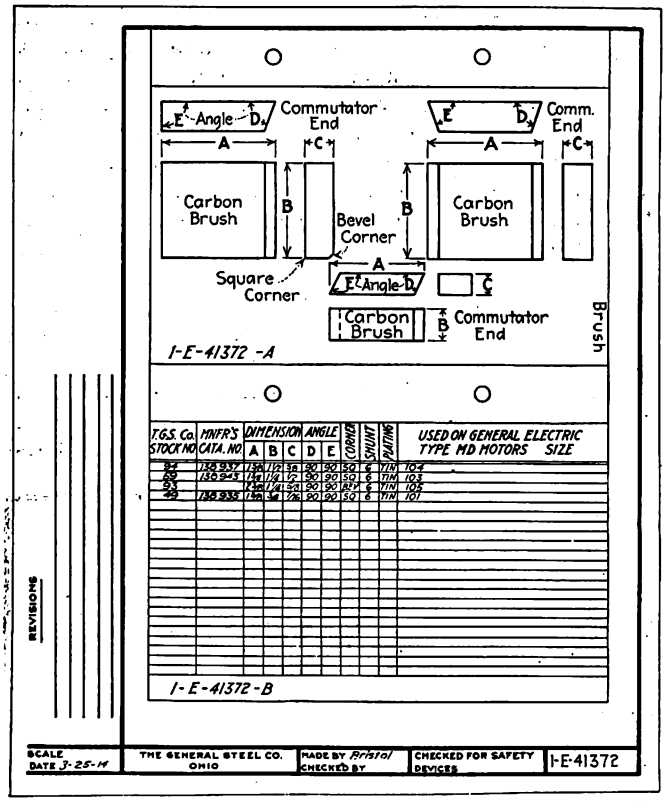
neglect of brushes, are all considered and the real cause of the trouble is discovered and corrected.

At the same time, these men are all encouraged to go to the local Y. M. C. A. school, which is taught by an employee of this industrial company. This man is really a specialist on the types of equipment used in the mills. Most of the new men do attend and are



ONE FORM OF RECORD SHEET USED

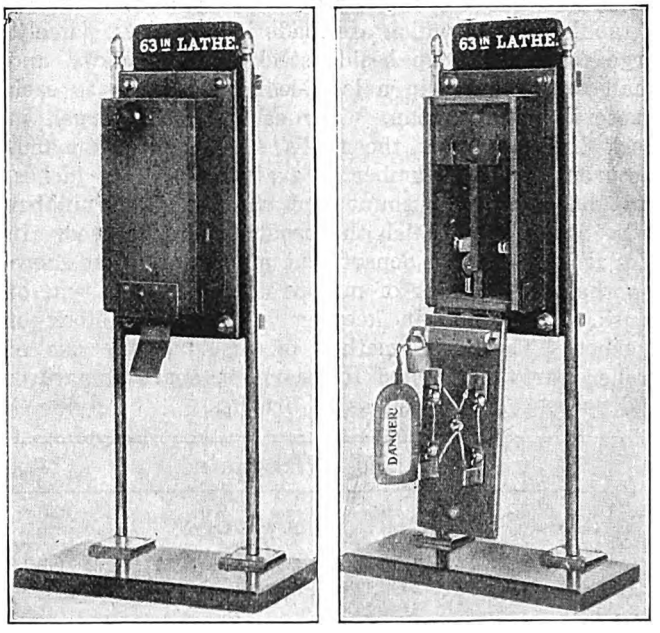
taught how to read blueprints and have opportunities to study existing and new equipment. This combined practical and scholastic educational process goes on continually. Whenever a man is found to have grasped the situation and to have initiative, he is made a motor or a crane inspector. He is then put out in the mill "on his own," where he, of course, has the guidance of his turn foreman. The inspectors oil all motors, which requires that they visit all machines frequently. They know that dirt is the cause of most trouble and hence is their chief enemy. They attempt to keep essential parts clean despite the fact that steel mills are especially dirty. To aid them in this work the company has gone to considerable expense and trouble to make equipment dust-proof. At first there was some question as to the advisability of this preventive, because it was argued that inspectors would neglect to look at housed machinery and that trouble would be detected more quickly on open machines. It is now known that such is not the case. Providing dust-proof electrical machinery has reduced trouble and aided in reducing accidents.

In addition to being trained for maintenance work, the men are encouraged to make suggestions which not only work to their benefit but prolong the life of equipment. So thorough is the belief in this policy that superintendents and foremen are instructed to consider seriously all suggestions from the men, even if they at first doubt the practicability of the suggested idea. There is more back of this policy than a mere desire to please the man who makes the suggestions. The idea may be good and the man may be entirely unable to put it into words. Even if the idea will not work, the company eventually gains because when the suggester has been shown that his idea is impracticable he is encouraged to find a way to remedy the condition which he has said can be improved.

AN IMPROVED SUGGESTION BOX IDEA

The suggestion box system is different from the one ordinarily used. Suggestions are typewritten in duplicate and the originals are dropped in the boxes unsigned. When they are considered by the committee it is impossible for that body to tell whether it is handling an idea of the most skilled employee or of the newest helper in the shops. Each suggestion is considered on its merits. At the end of each six months all accepted suggestions are published in abstract so that the holders of the carbon copies can produce them and claim their awards of $2 to $100 for each idea, depending on the estimated value. This plan helps to fill the suggestion boxes. However, the biggest factor in bringing out ideas that will make equipment last longer is the company's policy of being liberal in trying out ideas.

One of the greatest evils to be guarded against in steel-mill practice is interruption of service. It has been said of the steel-mill electrical engineer: "He buys equipment to run and he runs it until it drops. Then he replaces it." This is almost literally true, but emphasis should be placed on the fact that he *has* to keep it running continuously. For this reason he is equipped with a shop in which to do almost anything in the way of winding. At the plant referred to herein this is particularly important because of the quantities of direct-current motors and control apparatus which cause most of the maintenance work. To get the equip-



FOOL-PROOF INDUSTRIAL SWITCH EMPLOYED IN OHIO INDUSTRIAL PLANT

ment back in operation in the shortest possible time, it has been found advisable to adopt a definite policy as to whether repair parts are to be made on the ground or are to be bought from the electrical manufacturer. Regarding control apparatus it may be said that the electrical department carries a stock of all spare parts except coils, which are wound in the department shops

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wherever possible. For motors the electrical department does all field and armature winding in addition to the major part of all other motor repairs.

To assist in making repairs complete carefully prepared data on every piece of electrical apparatus in the mill are kept. When a new piece of control apparatus is bought, for instance, all of the manufacturer's literature on it and each part of it is secured. Catalog numbers and serial numbers of parts are obtained, and if prints of certain parts of it are not available, they are made by the electrical department. This takes time and involves correspondence, but it saves delay and telegrams at some later date when repairs become necessary. This practice is carried out in connection with even such items as contactors on control panels. Having prints of parts available is especially valuable in case it is necessary to make the parts locally. On the whole, the repair-parts policy is designed to solve the problem of slow deliveries and to obviate the necessity of carrying too many repair parts in stock.

A specific plan has been evolved to afford a check on machines which give an extraordinary amount of trouble. Each mill superintendent sends the electrical department daily a record of "delay reports" where interruptions in service are due to failure of electrical apparatus. Such reports immediately call attention to repeated failures if they occur. They also permit the general foremen to get in touch with bad situations which their assistant foremen may have deemed of insufficient consequence to report.

How Fuse and Brush Problems Are Handled

Some parts of equipment require special provisions to assure their proper replacement. Brushes will serve as an example because they are such a great source of potential trouble. The heart of the scheme lies in sheets of tabulated data which are made in two sizes, namely, large for tacking up beside stock-room windows, and small for carrying in a loose-leaf book given to each inspector and foreman. For each type of brush in stock the data give the mill's stock number, manufacturers' catalog number if available, size in inches, end shape, type of shunt and the type and number of each motor on which the brush should be used. In addition to this, the department maintains a list showing the total number of motors using any one type of brush. This aids in keeping an adequate stock of brushes. The same method of insuring the use of proper parts is applied to bearings, spare armatures and spare coils as well as to brushes.

COPPER FUSE WIRE TABLE

Size of Wire B. & S. Gage Nos.	Rating in Amperes	Size of Wire B. & S. Gage Nos.	Rating in Amperes
22	15 to 25	14	71 to 110
19	26 to 40	12	111 to 160
16	41 to 70	10	151 to 300

The fusing situation has also received careful attention. On all circuits carrying from 15 amp. to 300 amp. special fused switches made by the electrical department are installed. One of these switches is shown on page 625. All switches are fused with tinned copper wire except those rated at 25 amp., on which cartridge fuses are employed. The table published here gives the corresponding sizes of fuse wire and ampere ratings.

Turn foremen have specific instructions to watch for cases of overfusing. The fusing is done chiefly by the motor inspectors. In a few special cases where all delay must be avoided small stocks of links cut to proper lengths are given to mill operators. Even in this case the motor inspector is held responsible for overfusing.

Equipment That Is Easy to Maintain

Aside from these ideas on organization and on proper handling of repairs, the careful selection of proper types of equipment for each application is the one other big factor that helps keep the mill running. A study of performance of different types of motors with this in mind has caused the electrical department to get away from the industrial types of motors in favor of mill types. This has reduced trouble materially. While it has been necessary to take time to persuade manufacturers that a special line of shunt, compound and adjustable-speed motors suitable for the conditions should be developed, the results have justified the effort. The totally inclosed motor is also finding favor rapidly because of its dust-proof construction. While it usually is necessary to install a larger motor of this type than when other construction is used, the extra expense is justified. Selections of control equipment have been limited to standard types, except that dirt-proof construction has been favored and provided where it was not embodied in the original apparatus.

While the high-tension transmission and distribution system is not so extensive as that of some similar industries, nevertheless it compares favorably in extent with that of the average steel mill, which is obvious when the territory covered by the plant is recalled.

All important high-tension feeders are run in duplicate with suitable arrangements for switching to either circuit of each pair at the power plant and the various substations. The flexibility obtained by duplication makes continuity of operation, inspection and repairs so easy that no special ideas have been formulated in connection with the maintenance of this part of the electrical equipment. One of the most important phases in the handling of high-tension equipment is the safety of the workmen, and this has probably received more thought and study than any other one thing since the planning of the original layout.

The control of the entire main distribution system is vested in the switchboard operator at the power plant. No work is permitted at any point on the system between the power plant and the bus at substations without a permit from him having first been issued. It is the operator's duty to arrange for all necessary switching and grounding of lines before permission is given to proceed with any work. The entire transaction is made a matter of written record both at the power plant and substations affected by any switching of the circuits. While this procedure is primarily for safety reasons, continuous service is also assured so far as the human element is concerned.

Summary of Procedure

To summarize, the electrical apparatus is made to last longer by providing methods of preventing trouble or of discovering it as soon as it begins to occur. Not a little of the success of the method is attributed to the care given to educating and to organizing the human forces engaged in the work. Collection and dissemination of data on machines and machine parts before they are needed also assist in reducing delays.

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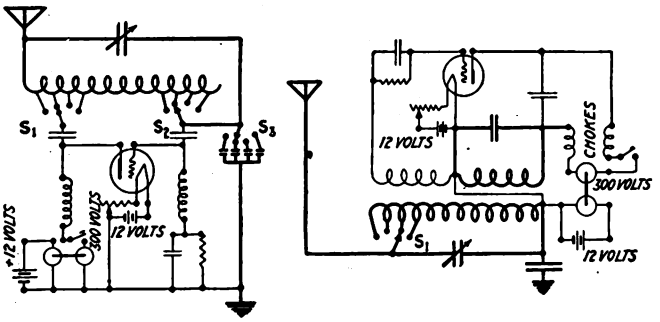
Continuous-Wave Land Radio Sets

Present Development in Radio-Telegraphy Points to Great Usefulness of Continuous-Wave Sets on Account of Freedom from Interference—Extremely Sensitive Receivers and Suitable Transmitting Equipment Have Been Produced by the Use of Vacuum Tubes

BY LIEUT. PAUL T. WEEKS AND LIEUT. DONALD G. LITTLE, SIGNAL CORPS, U. S. A.

THE radio sets described in this article were designed to meet very special requirements, yet they may be taken as indicative of what is the probable trend of development in low-power commercial radio sets in the near future. The outstanding features are the use of vacuum tubes for transmitting, the use of a low power transmitter with a sensitive receiver and the elimination of adjustments. It has been demonstrated that this type of continuous-wave set can be made at least as reliable and simple in operation as the usual spark set of equal range. The greatly increased selectivity and freedom from interference that are characteristic of transmission by undamped waves makes its general introduction in place of spark transmission almost imperative if there is to be any considerable extension of radio communication for commercial purposes. The development of vacuum tubes suitable for power oscillators and reliable and interchangeable in operation has provided a very simple and inexpensive form of continuous-wave generator. The development of an extremely sensitive but simple receiver with the consequent reduction in power required at the transmitting end is another step toward the elimination of interference and the possibility of simultaneous operation of a large number of radio sets in close proximity



FIGS. 1 AND 2—TRANSMITTING CIRCUIT WITH (1) CAPACITY COUPLING AND (2) INDUCTIVE COUPLING

and within a narrow range of wave lengths. The material reduction accomplished in the number of adjustments both of transmitter and receiver has largely eliminated the necessity for a highly skilled operator and has made possible a reliability and convenience in operation second only to that obtained with the wire telegraph. These developments, if properly followed up, will be a considerable step toward the wide commercial usefulness of the lower power radio set.

REQUIREMENTS OF THE SERVICE

In considering the requirements of the service the radio network under the conditions existing on the western front may be divided into three sections. First, there is the forward section where operators and apparatus are subjected to the most severe and unfavorable conditions. Extreme portability and simplicity are fundamental requirements for the radio apparatus. Skilled operators cannot be afforded, and the adjustments must be reduced to the absolute minimum. The antenna is limited to a ground line or a waist-high aërial, and power input to the set must be no more than can be supplied by storage batteries which one man can carry. Under these conditions a range of two or three miles (3 km. to 5 km.) has sufficed. Throughout the war radio communication in the forward sector has been exclusively by spark sets of the simplest type, and no consideration need be given here to the possible use of continuous-wave sets for this purpose, although very important developments along this line have been made.

Continuous-wave radio sets have found application particularly in the intermediate and rear sections of the radio network, where much more favorable conditions obtain. Here the apparatus is set up in semi-permanent stations, better operators can be afforded, and a reasonable amount of adjustment and careful manipulation may be required. However, the sets must still be rugged, simple in operation, portable by hand for short distances and capable of being set up quickly. The power input must be limited because of the difficulty of supplying batteries. The antenna must be of low visibility and easily erected and maintained. This latter requirement applies particularly to the intermediate section. For this section a range of 10 to 20 miles (16 km. to 32 km.) is considered sufficient. In the rear section, where larger and more permanent antennas can be utilized, a range of 50 to 100 miles (80 km. to 160 km.) for communication between army headquarters is required.

The work of the Signal Corps in this field of continuous-wave transmission has consequently been limited almost exclusively to the development of vacuum-tube receiving and transmitting equipment, although the latter had been previously used only in a laboratory or experimental way. What at first appears to be a serious fault in any vacuum-tube generator is the low over-all efficiency resulting in large part from the relatively large amount of power required to heat the filament. In spite of the fact, however, that the high-frequency output of a low-power tube is seldom more than 20 per cent of the total input, the vacuum-tube transmitter can be made to approach or even surpass an equivalent spark transmitter in efficiency in miles per watt of input to the set.

VACUUM-TUBE TRANSMITTERS

The Signal Corps development of low-power vacuum-tube transmitters has been based almost entirely on the standard Signal Corps tube known as type VT-2. This requires a filament current of 1.36 amp. at 7 volts and with a plate potential of 300 volts to 350 volts will give a high-frequency output of 3 watts or 4 watts in a suitable circuit. This tube was first used in radio-telephone sets. Shortly following its development the first Signal Corps vacuum-tube telegraph transmitter was designed.

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It employed an inductively coupled type of circuit with one transmitting tube and was used entirely for instruction purposes. In the meantime the requirements of the service for rear and intermediate communication became more exactly known, and to meet these there were developed the two-way vacuum tube sets of the type represented by the SCR-79 set, which combine to a considerable degree the required characteristics of ruggedness, portability, few and simple adjustments and ability to operate over a variety of wave lengths and on antennas characterized by high resistance and having various capacities.

Details of Transmitting Circuits

The transmitting circuit of the SCR-79 set, shown schematically in Fig. 1, is of the capacity-coupled type. Very satisfactory results had been obtained from this type of circuit in radio-telephone transmitters, and it had proved to be reliable and efficient in operation over a wide range of antenna constants and to require only simple and non-critical adjustments. It is essentially simple, containing only the single oscillating circuit made up of the antenna, transmitting inductance coil and series condenser. Capacity coupling is used, the alternating grid input voltage being obtained from the reactive drop across the series condenser, and the voltage developed in the plate circuit is in effect applied directly to the antenna. Only the one large inductance is required, and the circuit oscillates readily. The three tuning adjustments are indicated in Fig. 1. S_1 is the wave-length adjustment. S_2 is the plate coupling adjustment which is required to give maximum power output. S_3, controlling the input voltage, is necessary to avoid overloading the tube. It is evident that these adjustments are not entirely independent. In the actual set the positions of the inductance taps and the values of the input condensers have been so chosen that the three switches are operated by a single handle without the necessity of individual adjustment of the plate coupling and grid input. The fact that this arrangement secures nearly enough maximum output and prevents overloading the tubes over the wide range of wave lengths and antenna resistances and capacities encountered is evidence both of careful design and of the suitability of this circuit for the purpose. Other details of the circuit may be considered as minor but are essential to proper operation. The plate and grid are insulated from the antenna by blocking condensers. To supply the direct current to the plate without short-circuiting the antenna for high-frequency current, the choke coil is introduced into the plate lead. The high-frequency choke and resistance in the grid lead perform a similar function. The by-pass condenser around this resistance is not essential, and even the choke coil could be replaced by added resistance. This resistance in the grid lead, together with the grid current, performs the added function of producing the negative potential on the grid which is necessary for efficient operation and to prevent overheating the tube. The small variable air condenser which parallels the inductance coil is provided to make the wave-length range continuous. A positive plate potential of 300 volts to 350 volts is supplied by a dynamotor operated from a 12-volt storage battery. In the actual set two transmitting tubes are used, their filaments, plates and grids respectively being connected in parallel. Their filaments are lighted by the same storage battery that operates the dynamotor. To secure proper filament current throughout the discharge range of battery voltage, a filament rheostat is provided. The variation of current output with wave length under the unfavorable conditions of low antenna capacity and high antenna resistance is shown in Fig. 3A. Fig 4A shows the variation of output current with antenna resistance when operating with an antenna of approximately average capacity.

The antenna current is much smaller than would be required from a spark set of equal range, but is more than sufficient to give the required range of 20 miles (30 km.). It is seen that, while the transmitter has a low over-all efficiency, it meets the requirement of fairly uniform output over a wide range of wave lengths and antenna constants.

An inductively coupled type of transmitting circuit employed in the early instruction set was found to possess some valuable features in the way of simplicity of adjustments, and further experimental work led to its substitution for the capacity-coupled circuit in the later models of the SCR-79 set. It is shown schematically in Fig. 2. It will be noted that the input couplings in the grid circuit and the output coupling in the plate circuit are both entirely inductive. The plate coupling coil with the condenser bridged across it forms a reasonant circuit of natural period slightly less than the period of the shortest wave length to which the antenna circuit can be tuned. The coupling is such, however, that this circuit is forced to oscillate at the same frequency as the antenna circuit. The outstanding advantage lies in the fact that if the coils are properly designed, there is required no mechanical change of coupling for different wave lengths and the only tuning adjustments necessary are the antenna inductance switch S_1 and the small variable air condenser, which parallels the antenna and makes the wave-length range continuous.

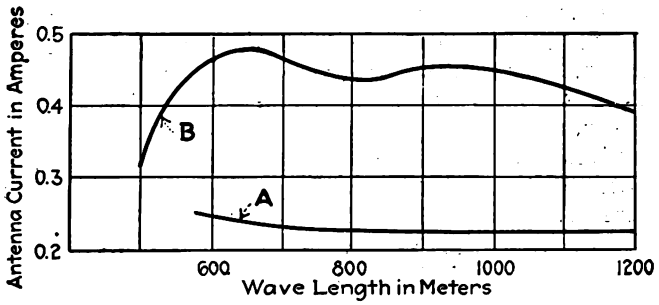

FIG. 3—WAVE-LENGTH CHARACTERISTICS OF ANTENNA CIRCUIT

A—Capacity coupling: C = 300 mmf.; R = 70 ohms; E = volts.
B—Inductive coupling

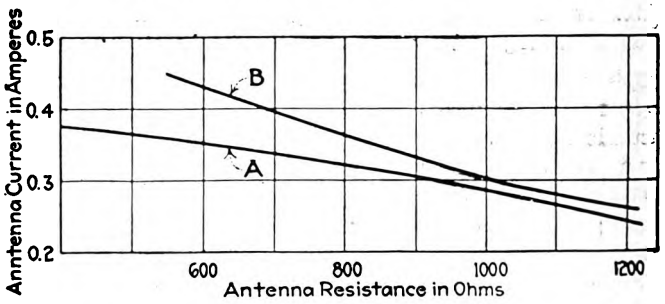

FIG. 4—EFFECT OF ANTENNA RESISTANCE ON CHARACTERISTICS OF CIRCUIT

A—Capacity coupling: C = 400 mmf.; λ = 630 m.; E = 300 volts. B—Inductive coupling: C = 450 mmf.; λ = 600 m.; E = 300-340 volts.

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The design of the inductance coils, which, while fixed in position, will give the proper coupling over a wide range of wave lengths and antenna constants, required some careful experimental work. The other details of the circuit are similar to those of the earlier circuit. A negative grid potential is obtained by means of a grid condenser and leak. The plate potential is supplied by a dynamotor, which is isolated from the high-frequency oscillations by choke coils. The actual set employs two tubes in parallel as in the previous model. The variation of output with wave length when operating on an actual antenna of standard form is shown in Fig. 3B, and the variation of output with antenna resistance in Fig. 4B. It will be noted that the output is somewhat greater than obtained with the capacity-coupled circuit.

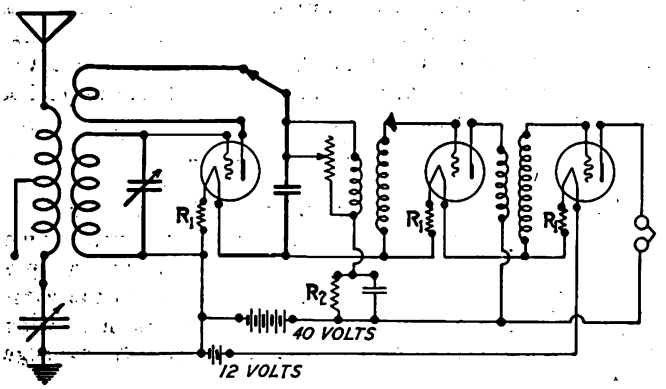

FIG. 5—RECEIVING CIRCUIT OF SCR-79 SET

VACUUM-TUBE RECEIVERS

The employment of vacuum tubes in receiving both damped and spark signals had become very common before the war, and to a much more limited extent this applied also to low-frequency vacuum-tube amplifiers. Great sensitivity was frequently obtained, but the characteristics of the circuits and tubes commonly used were such as to make the successful handling of a sensitive vacuum-tube receiver an art. Aside from the careful tuning of the radio circuits there was required in general the careful individual adjustment of grid, plate and filament potentials of each tube in the set. A receiver of this type was out of the question for field service that was necessarily in the hands of unskilled operators.

The most important part of the problem was solved with the development of a high vacuum tube sufficiently uniform in characteristics and non-critical in adjustment to operate interchangeably under fixed conditions and without being materially affected by small changes in grid, plate and filament potentials. The standard Signal Corps tubes, type VT-1, have been found to give the best results, but other types have been developed which will operate successfully in the same circuit, though with decreased sensitivity in general.

The receiving circuit of the SCR-79 set in effect combines a vacuum-tube detector and heterodyne with a two-stage amplifier. The circuit is shown schematically in Fig. 5. The radio circuit is of a familiar feed-back type, having a tuned grid circuit and a tickler coil connected in the plate lead. The unique feature is the design of the primary, secondary and tickler coils. These are wound on separate forms but are fixed in such relative positions that there is required no adjustment of the coupling either between the primary and secondary or the secondary anl tickler coils over the entire range of wave lengths. For short waves only a part of the primary coil is used. The only other tuning adjustments are the manipulation of the primary and secondary variable air condensers, and the reception of continuous waves is made simpler even than the reception of damped waves by the ordinary coupled receiver. A single-pole switch enables the tickler coil to be cut out for receiving spark signals. The notable features of the amplifier are the absence of all tube adjustments and the use of the specially designed and highly efficient inter-tube transformers. Control of the amplitude of the signals is obtained by the variable resistance which shunts the primary of the first transformer. This, with the sharp selectivity of the heterodyne receiver, permits the elimination of all but exceptional interference.

The negative grid potential to give the best operation of the tubes is secured by the drop in potential in the series resistances, R_1, in the filament circuit. The use of the large resistance R_2 in the plate lead of the detector tube to reduce the plate voltage to a more suitable value for operation of the detector tube has the advantage of insuring a sufficiently high initial voltage to start the oscillations. The plate voltage is supplied by two fifteen-cell miniature dry-battery units that weigh only about 1 lb. (0.5 kg.) apiece and have sufficient capacity to give continuous operation for several weeks.

THE COMPLETE SET

The transmitting and receiving circuits are combined in the set box shown in Fig. 6. The two circuits are entirely separate except that they employ the same filament battery and antenna. Hence they can be tuned entirely separately and the complete change from transmitting on one wave length to receiving on the same or a different wave length can be made by throwing a single switch. The adjustments are the same externally for the sets employing the capacitively and the inductively coupled transmitting circuits. The transmitter is set for the approximate wave length by the wave-length switch and the fine adjustment made with the condenser. The filament rheostat gives control of the filament current. In tuning the receiver the two two-position switches are first set at short or long waves and heterodyne or spark as required. The tuning is then done entirely by the primary and secondary condensers. The amplification switch is operated to reduce the signal strength and to cut out interference. Provision is made for clamping the variable condensers in any position to secure the constancy of wave length and tuning required for heterodyne reception.

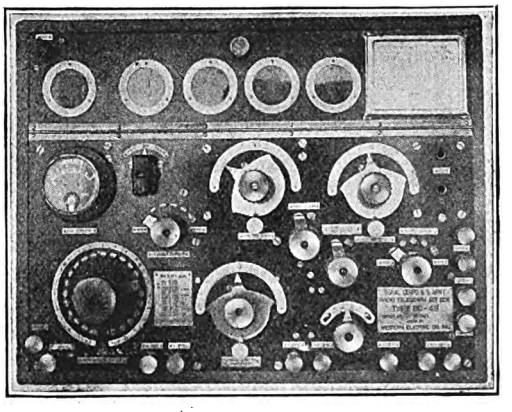

FIG. 6—TWO-WAY CONTINUOUS-WAVE RADIO SET

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Wave lengths are determined by means of a special wave meter carried in the same carrying case as the set box. This wave meter consists of a fixed condenser and variable inductance, and while in over-all dimensions it is approximately only a 5-in. (12.7-cm.) cube, it covers the wave length range of 500 m. to 1100 m. with an accuracy of 1 or 2 per cent. It contains a buzzer for setting the receiving circuit and a miniature incandescent lamp for indicating the resonance point when measuring the transmitted wave length. By reason of this last feature it obviously operates as well with undamped as with damped waves.

The dynamotor which supplies the plate voltage for the transmitter represents what has proved the best solution for a problem which had previously offered serious difficulties in the design of continuous-wave sets for service at the front. It has what would normally be called a low electrical efficiency, but is particularly valuable because of its reliability and light weight. The dynamotor proper is less than 5 in. (12.7 cm.) in diameter by 9 in. (23 cm.) long and weighs 15 lb. (7 kg.). With its water-tight aluminum carrying case it weighs about 25 lb. (11 kg.). Its early and successful production was made possible by the advanced state of development of the automobile starting motor, of which it is a modification.

Design of the Storage Batteries

The storage batteries supplied with the set were designed particularly for the service, especial attention being paid to light weight and ease of repair. They consist of 4-volt, 100 amp.-hr. units which have an

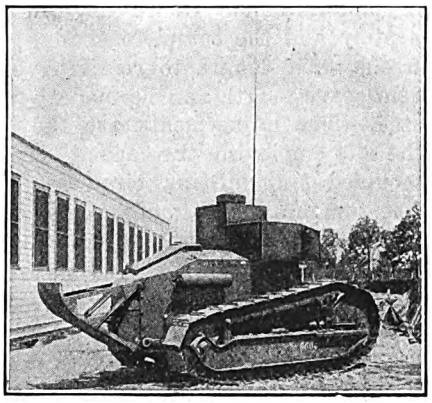

FIG. 7—SMALL SIGNAL TANK

over-all volume of about 1000 cu.in. (16,000 cu.cm.) and weigh less than 40 lb. (18 kg.). An unusual feature is that the separate cells are removable, and those made by some manufacturers have transparent celluloid containers so that the internal condition of the cell can be determined by inspection.

The set when transmitting draws a total of 10 amp. or 12 amp. from the 12-volt battery. The input to the plate circuit is about 30 watts and the high-frequency power delivered to the antenna 5 watts or 6 watts. When receiving a battery current of only a little over 1 amp. is required. The standard antenna is 20 ft. (6.1 m.) high and consists of two 100-ft. (30.5-m.) branches making an angle of 60 deg. with each other. With this antenna the working range between two sets is easily 20 miles (32 km.). The set box, dynamotor, wavemeter and other accessories are contained in a carrying case weighing, complete, a little over 100 lb. (45 kg.). The antenna and ground material weighs complete about the same and is arranged in convenient carrying units. Light bamboo or spruce masts are employed.

For communication over somewhat longer distances and at longer wave lengths a set very similar to the latter model of the SCR-79 set has been developed. This is designed for an antenna of similar form but longer and having larger capacity and lower resistance. With an antenna resistance of not over 30 ohms it gives an antenna current of 0.5 amp. or more over a wave length range of 900 m. to 1900 m. The total input is practically the same as for the SCR-79 set. The reliable working range between two such sets is from 50 to 100 miles (80 km. to 160 km.).

Special Developments

As illustrative of the unusual and difficult radio problems that have presented themselves to the Signal Corps, mention should be made of the problem of designing a two-way radio set for use in tanks. To derive the full benefit from this new arm of the service it is very essential that there be provided some sure means of communication between the advancing tanks and the rear. Experience has abundantly proved that the ordinary means of communication by pigeon, runner or visual signaling are insufficient for this purpose, and resort was had to radio. The inherent difficulties are obvious when it is considered that the antenna must be extremely small and inconspicuous, that operation with the tank in motion is necessary, and that a very loud signal is required on account of the extreme noise within the tank. The fact that the existent radio network necessitated the use of undamped waves only added to the difficulties.

The solution was found in a vacuum-tube set combining a receiving circuit similar to that of the SCR-79 set with a transmitter which was somewhat more powerful.

A transmitter of rather unusual design was required to insure the necessary constancy of emitted wave length, regardless of the motion of the tank, and also to give sufficient antenna current. The necessity for an unusually high antenna voltage is evident when it is considered that the capacity of the antenna is about 60 micro-microfarads as compared with the 400 to 500 micro-microfarads capacity of the antenna of the SCR-79 set. The design of this antenna was no small part of the problem. Two forms are provided, one a jointed fishpole type about 15 ft. (4.6 m.) high and the other an umbrella type about 3 ft. (0.9 m.) high with self-supporting folding arms. Both are arranged to be erected easily from within the tank. An antenna current of about 0.3 amp. is obtained giving a working range of 5 miles (8 km.). The appearance of a small signal tank with special turret and antenna is shown in Fig. 7.

An entirely distinct line of development is represented in the tractor set developed for the Signal Corps for comparatively long-distance work. The notable feature of this set is the employment of a number of high-power General Electric tubes operating at a plate potential of 1500 volts to 2000 volts and giving a high-frequency output of about 200 watts per tube at a high over-all efficiency. While entirely portable and self-contained, this set is designed to have a reliable working range of not less than 200 miles (320 km.)

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A New Era in Power Transmission

Development of Water Power, Establishment of Stations at Mines and Wider Interconnections Necessary for Proper Industrial Development of the Country and for the Social Betterment of Labor.

BY DR. LOUIS BELL

THE close of the world war is ushering in a period which we shall find to differ radically from anything which has immediately preceded it. The convulsion has been so profound in stirring the very roots of human things that we cannot expect anything like settling back in the old lines for many a year to come, if ever. There will be determined and frantic efforts of reactionaries to undo the material and spiritual work of the great revolution in world affairs, but one might as well attempt to stop the sweep of a comet. The old times, however much lamented by those who dwell in the past rather than in the future, will not come back, and it is the part of wisdom to recognize the changes and to take advantage of them instead of wasting energy in trying to turn their course backward.

RADICAL CHANGE IN SITUATION

One of the things which particularly impress the writer is the radical change in the economic situation as regards furnishing the world's supply of power. We find to-day a very serious increase in the cost of labor and consequently a correlated increase in the cost of producing and transporting fuel. We do not stand face to face yet with the rising prices that come from a real shortage of the material, but the factors of labor and transportation—on the whole the dominant ones—are likely to make a permanent change, especially formidable in the case of the relatively low-grade fuels upon which we have more and more to depend. There is, therefore, a greatly increased advantage in the transmission of energy by electricity, as well as by piped gas, as against the transportation of the fuel and its use locally for producing heat and power. Whether by land or by sea the cost of carriage is likely to give permanent advantage to such methods of transportation, in which the labor item as a continuing expense is minimized.

The arguments in favor of transmitted power are driven home by this condition with altogether unwonted force. What are we going to do about it? The water-power bill, near to its passage when Congress adjourned, is held up, and the first step toward the logical development of power for American industries is to pass that bill at the earliest possible moment and bring into play all the available water powers of the country as soon thereafter as may be. At present prices of fuel we need them all without delay.

This, however, is not the whole story; because in examining the economics of the situation the one factor which stands out with startling distinctness is that, under present conditions, a very large amount of hydraulic power cannot be utilized on account of location and cost of development at a figure which will enable it to compete successfully with steam-driven plants at the mine's mouth. The industrial development of the country requires the coöperation of both in the largest possible measure and such legislation as will enable this coöperation to be made effective. As things now stand a state is at liberty to pass laws forbidding the export of hydroelectric power beyond its limits. Whether it could in a similar way interfere with the export of power derived from coal is perhaps a somewhat different question. In either case the policy is a very short-sighted one in view of existing conditions as respects the transmission of power.

The whole secret of efficient and economical development of the power resources of any territory lies in their combined use by physical interlinkage of the transmission systems, and this is especially true of the general case in which hydraulic and steam power must be used together in order to utilize each in the most efficient way. There are many big networks already operated in this country, and in every instance to good advantage, but there are still far more opportunities than there are networks. The diversity factor which comes into play even from block to block in city distribution is vastly more important when one considers a territory covering thousands of square miles. Then the opportunities for carrying increased load and operating the various generating stations efficiently increase with prodigious rapidity.

It is only the overcautions and ultra-conservative who are inclined to fear the results of interconnection on a large scale. As the readers of this paper well know, the government has already taken in hand the problem of linkage mains. To what extent it can take over work of this kind, either legally or with strategic advantage, remains to be seen, but the principle, by whomsoever carried out, is a thoroughly good one. If, as some among informed engineers hold, there is adequate economic reason for the electrification of a large part of the present steam railways, great interlinked networks to supply the power become a necessity, since their existence solves the problems of shifting load and low average load factor which are so serious in case of the electrification of a long through line. The writer has been hammering away at this question of railway electrification since the very early days of the electric railway, when the operation of a 500-mile line by electric power seemed little more than an iridescent dream. The difficulties of supply at a good load factor over so great a distance have remained formidable almost until the present, but, given the existence of interlinked systems for general distribution over the whole area concerned, the serious difficulties disappear.

NETWORK FROM SEABOARD TO MISSISSIPPI

There is already a network extending practically from the seaboard to the Mississippi—over a small extent of latitude, it is true, but still capable of being reinforced by mouth-of-the-mine plants at a dozen different points and by hydroelectric plants at as many more. Given such a linkage of lines as this would imply, the operation of a long railway system becomes relatively easy, for the moving localized loads, instead of having to be supplied by one or a few stations correlated with the

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distance covered, would then merely become floating loads on a system already continuous and supplied from numerous points.

Even this, however, is not the strongest argument in favor of rapid increase of the country's power transmission facilities. As things stand to-day, labor is the dominant factor in industry. Wages have increased to an extent heretofore unknown, and while they will fluctuate, they are not likely to drop to their former level. The eight-hour day is substantially an accomplished fact, and there is little chance that the nine-hour or ten-hour, let alone the eleven-hour or twelve-hour, day will ever come back, at least in the lifetime of the present generation. Now, to make short hours and high wages fit in with a scheme of generalized and successful industry requires the coöperation of high efficiency in production, stability of employment and the good living conditions which make both for efficiency and continuity of work. With a well-nigh universal supply of cheap power, such as can be attained by a thoroughly worked out system of power transmission and distribution, the average effectiveness of labor is greatly increased, as experience has already shown. And it is labor effective, and consequently well paid, that is the source both of continuity of employment and of the living conditions which we all wish to see.

STARTLING SIZE OF LABOR TURNOVER

The turnover in the laboring force of many American industries is something absolutely startling, and continuity of employment, even for those who do not shift about, leaves very much to be desired. If one figures out the actual time of employment per workman per year, it will in many cases be found to be far less than a normal year's work. Steadygoing, efficiently managed industries are necessary to a generally prosperous condition, and the single factor of cheap power supply is here, as elsewhere, extremely important. More than this, it means the possibility of establishing and maintaining successful works without crowding them into regions already crowded, on the hypothesis that they are "good labor markets." A "good labor market" too frequently means a place where many laborers, good and bad, steady and shiftless, have drifted, with the result of finding on the whole unstable employment, low wages and bad living conditions, and such artificially constituted places have not infrequently been evolved around what were then supposed to be locally advantageous points for the supply of power, even though far removed both from the necessary raw materials and from markets.

The "good labor market" is oftentimes really a poor place both for the manufacturer and for the workman. For the former the conditions mean a large turnover in workmen, many men temporarily out of employment, a large influx of the shiftless and ignorant, and perennial labor troubles. For the workman the conditions are bad because the ordinary manufacturer does not realize the losses he incurs through rapid turnover of labor, and because there is therefore constant competition from the shiftless floater, whose presence in increasing numbers also tends to make the general living conditions objectionable. Any force that can encourage the development of manufacturing in localities where workmen will be attracted by good living conditions and where market and raw material are not too distant is one which, on the whole, will tend to better and more stable conditions, likely in the long run to lead to successful developments.

It is this great equalizing capacity of a general and cheap power supply which must be looked to for remedies against some of our most trying social problems. A community under the influence of a well-organized local industry may grow into a very considerable manufacturing center, and that the effect on the workman is beneficent is attested by the comparative rarity of labor difficulties as compared with those found in the congested districts in which manufacturing has, to an extent far too great, tended to collect. One of the biggest things that can be done through the agency of a generalized power distribution is the spreading of industry over far wider territory than at present, bringing with it a higher average degree of prosperity, very much improved permanence of labor and betterment of living conditions. These are things which cannot at the present time be lightly put aside on the theory that things as they are are well enough. For economic and social reasons then, quite aside from purely engineering considerations, the work of developing the power resources of the country ought just now to be pushed with all possible energy by encouraging the development of hydraulic power, the establishment of mouth-of-the-mine plants and their interlinkage to form a reliable general source of energy both for manufacture and transportation.

OUTPUT OF THE LARGEST GENERATING SYSTEMS

Forty-six Companies in the United States and Canada Approximate 25,000,000,000 Kw.-hr., More than Half Developed by Water Power

On the opposite page appear the usual data on the output of the largest generating systems of America. All electric generating companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr. are included. Making an estimate for the output of the Southern Power Company (data on which are lacking), the combined output of the forty-six companies listed is more than 25,000,000,000 kw.-hr., of which 4,500,000,000 kw.-hr. represents the output of companies in Canada—namely, the Ontario Power Company, the Shawinigan Water & Power Company, the Montreal Light, Heat & Power Company and the Toronto Power Company.

Although there was a serious dearth of water both in the Far Western States and in the Southeastern States, so that the ratio of output from water power and from steam power is not so great as it was last year, still more than half of the energy produced was generated in hydroelectric plants. Owing to the consolidation of the Niagara Falls Power Company, the Hydraulic Power Company and the Cliff Electrical & Distributing Company, the present Niagara Falls Power Company tops the list with an output of more than 2,000,000,000 kw.-hr. A most remarkable condition existed on the Niagara frontier, where during the year every bit of hydraulic equipment and of steam equipment was pressed into service because of the great demands for energy both in Canada and in the Niagara and Buffalo districts. For convenience, the statistics for the years 1917 and 1916 are included. The increase in output for 1918 approximates 4,000,000,000 kw-hr.

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DATA ON OUTPUT AND LOAD FACTOR OF LARGEST GENERATING SYSTEMS IN AMERICA

(This includes all companies in the United States and Canada having yearly outputs in excess of 100,000,000 kw.-hr.)

System	1918				1917				1916			
	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)	Peak Load (Kw.)	Date of Peak Load	Yearly Output (Kw.-Hr.)	Yearly Load Factor (per Cent)
Niagara Falls Power Company	254,139	Apr. 8	2,054,360,080	92.2	152,340	Aug. 1	1,188,221,770	88.97	143,360	Nov. 24	1,015,525,680	80.64
Ontario Power Company	224,000	Dec. 13	1,606,786,936	81.9	123,500	Nov. 11	990,086,100	91.5	123,900	Oct. 12	942,221,900	86.80
Commonwealth Edison Company	400,010	Dec. 2	1,508,070,000	43.5	392,330	Dec. 28	1,488,080,000	44.6	369,740	Dec. 19	1,341,964,000	43.20
Montana Power Company	157,800	Nov. 21	1,108,125,350	....	147,712	Jan. 11	947,732,014	73.0	149,740	Dec. 19	867,940,326	84.50
Shawinigan Water & Power Company	136,800	Sept. 24	1,058,136,117	....	119,000	Dec. 21	633,573,610	60.4	108,000	Dec. 14	478,540,000	50.00
Montreal Light, Heat & Power Company	166,730	Dec. 6	976,462,529	68.0	152,665	Nov. 12	946,832,817	70.8	.....	.....	.....	.....
New York Edison Company and United Electric Light & Power Company	286,103	Dec. 11	958,878,156	38.2	278,097	Dec. 12	954,913,584	39.2	254,824	Dec. 20	856,385,319	38.30
Pacific Gas & Electric Company	166,705	June 4	922,037,604	63.1	158,272	Nov. 27	854,099,030	61.6	141,008	Dec. 19	768,304,907	62.20
Toronto Power Company	125,000	Dec. 3	897,512,877	81.9	118,000	Dec. 14	800,638,000	84.0	129,000	Dec. 20	660,873,579	58.40
Public Service Electric Company	185,738	Dec. 5	795,481,279	48.9	181,500	Nov. 27	734,665,649	46.2	174,000	Dec. 14	608,018,729	39.82
Detroit Edison Company	172,000	Dec. 13	773,876,700	51.3	152,300	Nov. 27	672,200,600	50.4	130,200	Dec. 19	546,925,300	47.80
Southern California Edison Company	163,125	July 12	779,758,000	54.5	166,755	Oct. 11	685,416,000	54.4	60,930	Dec. 28	299,950,513	56.04
Philadelphia Electric Company	166,294	Dec. 6	693,447,962	47.6	148,931	Nov. 20	600,583,589	46.0	142,260	Dec. 12	444,785,884	35.60
Duquesne Light Company	141,000	Dec. 6	641,874,585	51.9	125,000	Nov. 9	592,575,925	54.0	101,000	Dec. 21	463,537,660	52.30
Buffalo General Electric Company	104,100	Nov. 22	587,761,870	64.4	95,400	Dec. 6	440,596,100	52.7	65,500	Dec. 14	328,412,550	57.00
Mississippi River Power Company	102,950	Mar. 8	557,200,000	61.8	86,400	Oct. 31	476,500,000	63.0	82,400	Nov. 27	393,400,000	54.30
Cleveland Electric Illuminating Company	128,319	Nov. 22	543,663,042	48.33	113,228	Nov. 27	444,735,309	45.0	84,999	Oct. 25	340,670,721	45.80
Utah Power & Light Company	81,313	Dec. 27	533,044,000	74.83	79,011	Dec. 21	502,183,000	72.5	68,894	Dec. 6	412,726,000	67.80
Tennessee Power Company	87,800	Dec. 11	519,959,383	67.6	85,200	June 15	547,945,475	73.41	81,650	Dec. 14	483,354,162	67.00
Pennsylvania Water & Power Company	89,000	Feb. ..	500,641,122	64.2	86,000	.....	516,891,000	68.6	77,000	.....	417,837,600	61.80
Great Western Power Company	75,480	Aug. 12	451,309,000	68.0	74,900	Oct. 6	457,998,635	71.13	74,100	Dec. 14	408,391,067	62.65
Consolidated Gas, Elect. Lt. & Pr. Co., Baltimore	82,760	Nov. 7	433,196,550	64.9	69,980	Dec. 4	343,523,580	62.4	55,620	Dec. 11	249,836,310	59.10
Puget Sound Traction, Light & Power Company	88,230	Dec. 20	427,800,000	55.4	83,800	Dec. 21	396,600,000	54.0	77,030	Nov. 28	353,697,263	51.80
Consumers' Power Company	98,666	Nov. 21	404,412,000	46.8	94,235	.....	380,570,917	46.0	.....	.....	315,964,337	.....
Electric Company of Missouri and Union Electric Light & Power Company	92,000	Nov. 26	395,820,236	49.1	92,300	Dec. 6	376,891,756	46.5	88,544	Dec. 11	333,964,652	43.10
Alabama Power Company	86,850	Dec. 19	392,247,862	51.5	58,250	Nov. 14	289,715,125	56.7	40,500	Dec. 11	184,345,360	51.07
Wisconsin Edison Company and Milwaukee Electric Railway & Light Company	87,855	Nov. 20	327,784,516	43.0	71,106	Nov. 30	275,966,740	44.0	64,170	Dec. 5	218,421,711	39.00
New England Power Company	76,900	Dec. 16	323,127,784	48.0	71,500	Oct. 30	300,600,000	46.0	64,000	Dec. 12	246,000,000	44.00
Minneapolis General Electric Company	66,189	Nov. 1	297,443,050	53.3	54,940	Dec. 6	222,146,210	46.16	43,640	Dec. 14	171,672,890	44.90
Edison Electric Illuminating Company of Boston	95,774	Dec. 6	293,966,604	35.0	83,966	Dec. 19	265,430,474	36.1	80,539	Dec. 12	239,557,144	33.72
Brooklyn Edison Company, Inc	86,000	Dec. 11	282,424,822	37.5	78,000	Dec. 19	255,912,300	37.5	67,200	Dec. 19	233,452,500	38.10
Portland Railway, Light & Power Company	56,900	Dec. 23	258,424,940	52.0	50,620	Dec. 31	218,086,315	49.0	47,335	Nov. 29	194,146,555	46.50
Sierra & San Francisco Power Company	52,634	July 16	246,759,842	53.7	45,270	Jan. 11	196,069,588	49.44	.....	.....	191,620,000	.....
Georgia Railway & Power Company	68,000	Nov. 8	238,489,012	....	78,200	Apr. 24	258,607,882	.....	72,600	Mar. 17	211,872,638	.....
Michigan Northern Power Company	33,519	Dec. 24	233,381,654	79.4	32,990	Dec. 3	221,538,757	76.7	20,066	Dec. 25	131,075,152	74.40
Rochester Railway & Light Company	52,300	Nov. 22	196,171,300	42.8	42,154	Dec. 13	162,490,264	44.0	40,250	Dec. 16	146,069,428	41.00
Washington Water Power Company	33,956	Nov. 26	195,628,500	65.1	36,707	Dec. 20	188,311,100	58.5	30,440	Dec. 14	162,825,400	60.80
Great Northern Power Company	45,780	.....	180,040,171	44.9	40,000	Oct. 24	180,583,920	51.5	38,200	Nov. 21	163,807,560	48.80
Adirondack Electric Power Company	50,250	Nov. 8 & Jan. 23	174,567,275	39.6	42,000	Dec. 7 & 14	158,570,164	43.1	41,575	Dec. 12 & 22	151,128,310	41.40
Potomac Electric Power Company	48,000	Dec. 20	173,180,014	41.0	44,800	.....	140,762,646	36.09	38,600	Dec. 18	122,158,818	36.10
Virginia Railway & Power Company	35,700	Dec. 18	164,810,750	52.8	37,000	Dec. 18	153,128,026	47.39	33,900	Dec. 18	132,275,000	44.54
Southern Sierras Power Company and Nevada-California Power Company	28,200	Aug. 6	161,347,690	65.3	25,900	Aug. 9	148,267,885	65.3	22,400	Apr. 28	131,084,265	66.50
Toledo Railway & Light Company	40,305	Dec. 4	161,103,970	45.7	37,627	Dec.	162,061,232	49.4	36,428	Dec. 22	134,842,360	42.20
Southwestern Power & Light Company	38,100	Sept. 26	148,562,000	44.5	31,500	Nov. 17	126,396,800	46.0	25,600	Oct. 5	95,740,000	43.00
Empire District Electric Company	25,400	Sept. 5	114,446,685	51.4	23,000	Apr. 1	105,487,860	52.4	26,900	Mar. 26	119,280,363	49.70
Southern Power Company *	.....	.....	.....	....	.....	.....	.....	.....	.....	.....	.....	.....

* No data received.

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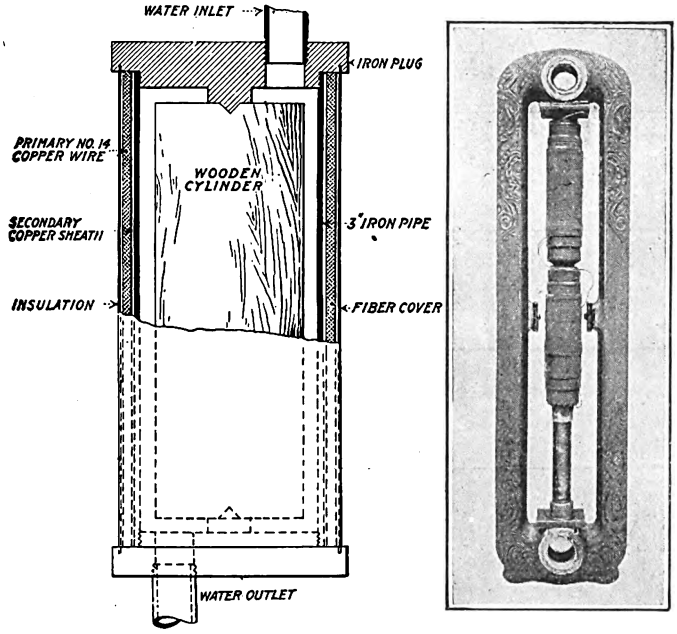
HIGH-POWER-FACTOR INDUCTION HEATERS

Construction and Performance of Three Types Which Are Respectively Suitable for Tank, House and Tap-Water Heating

BY C. EDWARD MAGNUSSON
University of Washington, Seattle

SEVERAL types of induction heaters have been on the market for a number of years, but their use has been limited, mainly on account of two undesirable features—low power factor and the humming sound produced. The handicap of an 80 per cent or even lower power factor, as is the case in many induction heaters, has proved too great for successful competition with resistor type having unity power factor at all loads. Moreover, the alternating flux produced vibrations giving a disagreeable humming sound, which practically excluded this type of heater from residences and other places where noises would be objectionable.

By a new means (U. S. patent No. 1,260,564) there



FIGS. 1 AND 2—CONSTRUCTION OF HEATER ELEMENT AND RADIATOR WITH HEATER APPLIED

may be constructed at low cost induction heaters which are practically noiseless and which operate at 95 per cent or even higher power factors. The construction as well as performance of three types of heaters built according to this new design are described here. One type is for heating water for a tank, another for heating a house in connection with the ordinary hot-water radiator system, and the third is for heating water as it is drawn from the faucet.

In each case the iron pipe through which the heated water flows forms the transformer core. The secondary is made by winding bare copper wire tightly around the pipe and sweating it into a continuous sheath. The primary is insulated from the secondary and consists of insulated copper wire wound around the secondary.

One model of the heater designed for continuous service is rated at 500 watts, 240 volts, 60 cycles, the electrical part being made of a core of 1-in. (25-mm.) iron pipe, a secondary of No. 24 copper wire and a primary of 3320 turns of No. 20 copper wire. A special rate of $3.60 per kilowatt per month (twenty-four hours each day) is made for this service in Seattle.

A heater similar to the one described, but rated at 2 kw., is shown herewith inserted in a three-column water radiator. In this case the primary consists of No. 18 copper wire in two coils of 1480 turns each. A side view of the radiator is shown in Fig. 2. When taking 508 watts the first heater mentioned produces a power factor of 98 per cent on a temperature of 50 deg. C. Data on the heater shown in Fig. 2 are given in the following table:

					—Temperature, Deg. C.—		
				P.F.,		—Radiator—	
Time	Volts	Amp.	Watts	Per Cent	Room	Bottom	Top
10:20	240	9.9	2315	97.5	21.5	22.5	24.0
10:30	240	9.5	2190	96.1	21.5	23.0	34.2
10:40	240	9.25	2140	96.4	21.6	30.0	43.5
11:00	240	9.1	2100	96.3	21.5	40.0	54.5
12:00	240	8.8	2030	96.2	21.8	58.0	72.0
1:00	240	8.7	2010	96.2	22.2	68.0	82.0
2:00	240	8.65	2000	96.4	23.4	70.0	82.8

The third type of heater is for intermittent service, the water being heated as it is drawn from the faucet. As a result it has to heat the water instantaneously and is rated at 2.5 kw., 125 volts and 60 cycles. The electrical part consists of a core of 3-in. (75-mm.) iron pipe, a secondary of No. 28 copper, and a primary of 318 turns of No. 14 copper. The construction of this type of heater is shown in Fig. 1. When operated at rating a power factor of 93.4 per cent was obtained at a temperature of 60 deg. C. The quantity of water heated and the temperature to which it is raised depend directly on the kilowatt output minus the heat lost by radiation and in warming the heater.

Magnet wire was used for the secondary in all the heaters mentioned, not from choice, but because neither armature wire nor aluminum could be obtained. Armature wire should be used, as the temperature inside the primary coil is considerably higher than that of the water. If the flux density of the iron is below saturation, the humming sound due to transformer action is very low. The primary coil may also be impregnated with sodium silicate or some other heat-resisting filler to minimize the vibration. During last winter several heaters similar to the one shown in Fig. 2 gave very satisfactory service in heating drafting rooms in the Puget Sound Navy Yard. Armature wire was used in the primary, and the coil was impregnated with sodium silicate. The sound emitted was barely audible close to the radiator and caused no inconvenience to the draftsman.

THE ignorance of our people with respect to the mere technique of investing is truly amazing. While the Liberty loan campaigns have rendered a service of immeasurable value in blazing the trail, much remains to be done in bringing about a thorough understanding on the part of the wage earner as to what a coupon is, how to buy and how to safeguard his investment. The increase in wages can only be maintained if it is accompanied by thrift on the part of the wage earners, and by their promptly putting back the money into money-earning enterprises. It is for this very reason that it is an economic necessity to teach the little fellow how to save and invest.—*Paul M. Warburg.*

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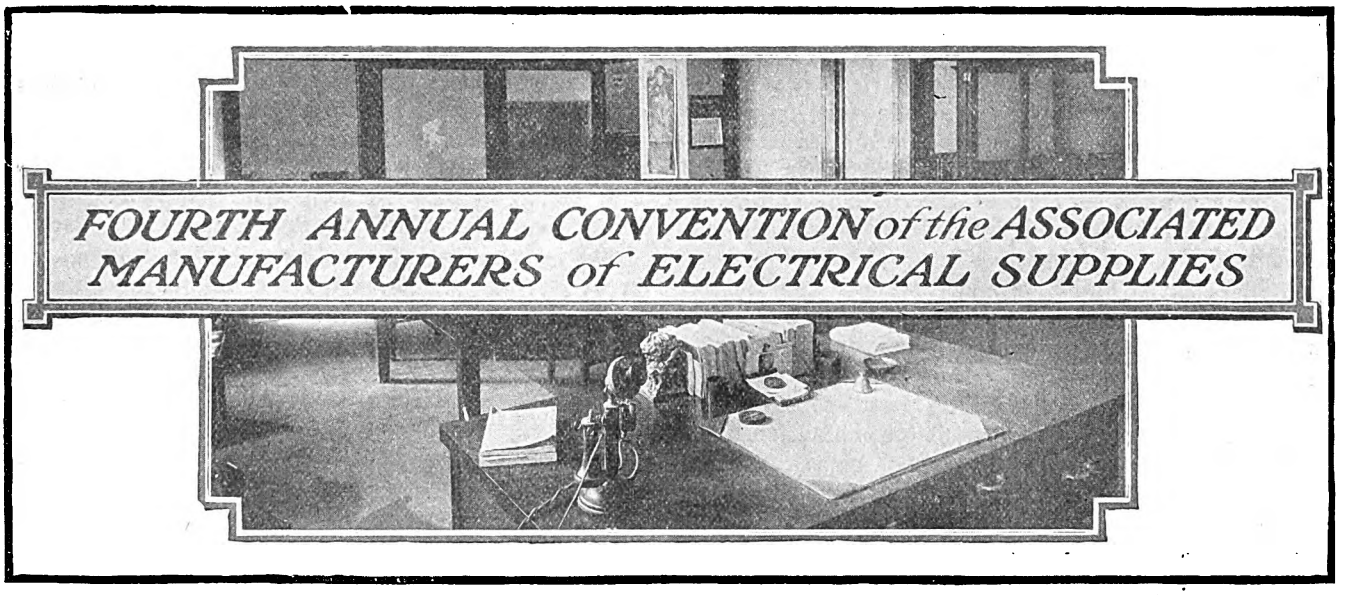

MEMBERS of the Associated Manufacturers of Electrical Supplies, meeting for their fourth annual convention at Delmonico's, New York, on March 20, reviewed their work under strenuous war conditions and heard thoughtful presentations of their new opportunities and problems. Results of the co-operative war service work in the national crisis were emphasized. The addresses also brought out clearly the conspicuous accomplishments in other measures touching the electrical manufacturing industry more directly. There were definite forecasts of further constructive effort in the coming year.

Calling the convention to order at 2:30 p. m., the vice-president, B. E. Salisbury, Pass & Seymour, Inc., explained that he was presiding in the absence of the president, A. W. Berresford, in Europe. Mr. Salisbury read the annual address prepared by Mr. Berresford in review of the work and prospects of the association.

The President's Address

President Berresford expressed in his address his great personal regret at his absence from the annual meeting, which was due to conditions beyond his control.

The history of the past year, Mr. Berresford said, is an embodiment of the setting aside of personal interest, and of ends achieved by conscientious effort directed to the public good and exerted through earnest self-sacrifice. Of the war work of the association, its members and the electrical manufacturing industry he said:

> The need of the nation required the doing of certain work, and we have ample reason to point with pride to the willing service rendered by our membership and to the part it has taken in making possible the successful outcome of the great struggle. Members of the Associated Manufacturers of Electrical Supplies made up the larger part of the supply division of the general war service organization and in addition provided by far the largest number of those engaged actively in the work. Although in many instances the chairmen of the section and of the corresponding group were different individuals, in practically every instance they were members of the association. In the group committee organization they carried more than their share. That this was but natural by reason of the character and activity of our association detracts not at all from the credit due. We have reason to be proud and we are proud.

Mr. Berresford then took up the subject of organization for reconstruction, saying:

> The work of the war service organization as such is practically complete, but there lie before us the problems of providing an organization for reconstruction which shall voice competently and authoritatively the needs of the industry as a whole and which shall represent adequately the interest of its least considerable member. The plans for this are in process under the auspices of the Electrical Manufacturers' Council, and our earnest effort will again be asked in the forwarding of them.
>
> That there is need for such an organization is obvious. There are always before us the matters ordinarily handled by association and which can be dealt with in no other way. It is evident that the completeness of an organization is a direct measure of the effectiveness with which these questions may be handled and of the extent to which the decisions reached will be adopted.
>
> At the moment, however, there are questions of greater possibilities than these and which, by their very nature, render essential a most thoroughly representative organization. The government proposes in one way and another to coöperate with industry. To permit of this coöperation the government must be made acquainted with the needs of industry, and this acquaintance can be had only if industry places its needs clearly and authoritatively before the government.
>
> The men who establish the actual contact must know and be able to prove that they are actually speaking for the industry as a whole, for they will certainly be questioned as to this. To have behind them simply this or that association would render their efforts futile, unless these associations comprise practically the entire industry.
>
> It has seemed best to develop the reconstruction organization through the existing associations, and to do this effectively will require the same quality of conscientious service and self-sacrificing effort in the common interest as you have accorded to the work of the war service. I know that you will give it.

In congratulating the association on the international trade committee President Berresford said that at the time that an investigation of the tariff situation was proposed many looked upon the proposition as of generic rather than specific interest. In its effect on the country in general it must react on the industry, but in individual lines only had it made evident its direct effect.

"To-day, with the world conditions as they are," added Mr. Berresford, "we see that it vitally affects each one of us, and the value of the work already done and the imperative need for doing far more is borne in upon us with increasing weight.

"The object sought is to be able at the proper time to present to the Tariff Commission a consistent and warranted demand for the protection essential to each

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class of product and to do this for the entire industry. Arrangements have been made for the coördination of our work with that of the apparatus manufacturers as represented in the Electric Power Club, so that there shall exist none of the conflicts and differences of opinion which so frequently obscure a proper presentation."

The formation and organization of the Electric Safety Conference were discussed by Mr. Berresford as reported in another column of this issue.

Possibilities of combination under the Webb-Pomerene act were mentioned by Mr. Berresford. "Some attention has been given to possible combination under the Webb-Pomerene bill, and it may be that the International Trade Committee will address you in the near future on this subject," he said. "Certain plans are in process in an effort to place the possibilities before the industry in concrete form, and these may mature at an early date. The problem is complicated by many considerations and is of no small magnitude, but there seem to be probabilities of satisfactory solution and the purpose is to advise you fully as soon as definite statements can be made. Such an organization must, of course, be entirely apart from this association."

In conclusion, Mr. Berresford spoke of the actual need for closer and at the same time more representative association if the grave problems now presenting themselves are to be solved to the full advantage of the industry. They cannot be solved individually—they must be solved coöperatively.

"There must be active, aggressive allegiance and well-informed, intelligent participation," said Mr. Berresford. "The amount of time employed, comparatively speaking, is small, the resulting benefit out of all proportion."

Annual Report of the General Secretary

Charles E. Dustin, the general secretary, then read his annual report. Referring to the fact that the association is about to start on the fifth year of its activities, and recalling its small beginning, Mr. Dustin said that it has gradually grown to a position of influence and standing. The accomplishments of the sections have had a far-reaching influence for good in bringing together manufacturers in the electrical industry who might not meet in any other way, in adopting measures of standardization and conservation, and have been a means for the general betterment of the whole electrical manufacturing industry.

There are now, completely organized and doing splendid constructive work, said Mr. Dustin, twenty-five sections and several others under process of organization. The situation in connection with the Underwriters' Laboratories, the National Fire Protection Association and its work has been very satisfactorily handled by the representative of the association on the electrical committee of the N. F. P. A., Howard R. Sargent. [Later in the meeting Mr. Sargent made a brief report of what has been done for the good of the industry.]

As approved by counsel and authorized by the board of governors, the work of tabulating industrial statistics for the section members has been continued, many additional sections taking advantage of this means of obtaining valuable information of much benefit to all. This work includes the tabulation of statistics pertaining to the products handled by members, compilation of sales covering certain defined periods, tabulation of costs, movement of tonnage, etc. These figures are sent to the office of the general secretary by the individual manufacturers, tabulations are prepared and copies are sent to each member entitled to them, the original figures being returned to the maker and the identity of the company furnishing the figures in no way disclosed.

The interlocking standardization committee has made great progress in its work, Mr. Dustin added. This is given to each section interested. It has been suggested that all sections hold their June meetings this year at the Hotel Griswold, New London, Conn., as was done last year. A letter has been sent to the various sections to elicit their view in the matter. The dates proposed are June 16, 17 and 18.

Charles Blizard, Electric Storage Battery Company, presented the report of the finance committee, of which he is chairman. Expenses of the association were increased as a result of the war and the larger activities arising from investigation of the tariff situation.

Report of International Trade Committee

John J. Gibson, Westinghouse Electric & Manufacturing Company, then presented his report as chairman of the international trade committee. He described the development of its work. In referring to the appointment of William Burgess, Trenton, N. J., as adviser to the committee, Mr. Gibson spoke of the conversation which he and Mr. Burgess had with Chairman Taussig of the Tariff Commission. The commission expressed a desire to coöperate fully with the committee in its work of analyzing the industry. It was stated, however, that the commission preferred to work with the industry as a unit.

This illustrated, said Mr. Gibson, "the necessity for very close coöperation on our part with any other association or group of electrical manufacturers who take up the same line of work and the necessity for all such effort in the electrical industry to be thoroughly coördinated so that a united front might be presented at Washington on this important matter.

"Your committee has therefore recommended to the board of governors that its work be carried on in very close coördination with the work of a tariff committee appointed in the Electric Power Club, and arrangements have been proposed (or have been completed) by which the desires of the Tariff Commission will be met by having the committees of the two organizations mentioned act jointly in this matter.

"While the membership of the two organizations mentioned does not include all of the electrical manufacturers in this country, still the membership lists cover so great a percentage of the electrical manufacturers in number, size and importance that it may be considered as being representative of the industry. Should, however, other manufacturers not members of other organizations desire to act in this matter, arrangements can be made by which committees appointed by such groups may act jointly with the tariff committee of the Electric Power Club and your committee."

The first subject in connection with the tariff which the committee took up, said Mr. Gibson, was a study of the administrative features of the existing tariff bill, the revision of which was then in the hands of the United States Tariff Commission. Representations made by the Tariff Commission by the adviser to the committee as to the wrong and imperfect operation of certain features of the administrative laws were not

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without effect and had great influence with the Tariff Commission in the work of revision.

The next work taken up was that of analyzing electrical products as to their component materials. Mr. Gibson added:

This was undertaken in order to find out the effect of the present law under which a large bulk of electrical apparatus would be classified as to import duty rates according to the component material of chief value. Reports on this subject from a large majority of our membership indicated clearly that such a method of classifying electrical apparatus was illogical since the determining factor, the component material of chief value, was not the element of cost which caused the need for a protective tariff. Furthermore, the use of such determining factor actually resulted in inconsistent and in some cases ridiculous differences of classification in the same lines of product, the import customs rates actually changing in some instances with sizes of the same article.

The results proved clearly that it was necessary to make a more thorough analysis of the costs of electrical products along the lines of the percentage of cost involved in labor, material and overhead.

This study has brought out clearly the great question of whether the electrical industry desires to have separate consideration in any new tariff bill under a separate electrical schedule, or whether it desires to take its chances as to what it may get in the way of protection if it permits its goods to be classified at random under other schedules, the determining factors in these being matters not electrical or not directly connected therewith.

Should it be decided that the electrical industry wants a separate schedule, the next question is one which must be determined by each section of the association as representing its branch of the industry, and that question is what rate of import customs duties is necessary for proper protection. Any claim made by any branch of the industry must be supported by scientifically collected data to prove that the protection is needed.

This work is now under way, and, considering the fact that it is quite probable that a new tariff bill will be introduced in the new session of Congress, the work should be prosecuted very vigorously in order that we may be in a position to answer when called upon by the United States Tariff Commission.

Mr. Gibson then told of the work done on matters dealing with export trade. The committee has given careful attention to the subject of classification of electrical apparatus for use of the Census Bureau, the Bureau of Foreign and Domestic Commerce and the Tariff Commission. A statistician has been employed, and it may be necessary to secure additional assistants.

NEED OF TARIFF REVISION

Following the presentation of this report, William Burgess, tariff adviser to the committee, read a paper discussing some of the questions involved in the study of this subject. He indicated that new conditions affect the tariff issue. Viewed from the standpoint of revenue production it does not mean what it meant in the past, the requirements of the nation are now so much larger than they were. But from the standpoint of protection it is more important than ever before that the interests of the industries be safeguarded. Mr. Burgess expressed the opinion that when Congress is called in session again the question of the tariff will be taken up promptly. He emphasized the importance of a separate classification for electrical manufactures and showed the growth of that industry in Japan.

Joseph McElroy, 3d, export sales manager Pass & Seymour, Inc., gave a world view of the "Opportunities for the Sale of American Electrical Articles in Foreign Countries."

Thomas M. Debevoise, general counsel of the association, pointed out the opportunities for combination for export trade under the Webb-Pomerene act. The association or corporation formed for this purpose must be organized solely for export purposes and engaged solely in export business. If electrical manufacturers act together under the new law, they must form an independent body. If manufacturers unite in this way in separate groups representing distinct lines of manufacture, they could not offer through the resulting organizations complete lines to foreign consumers. But if the groups had a common selling agency the result would be that complete lines could be offered. That is the ideal to be kept in mind, though it may not be reached for some time. Judge Debevoise expressed the opinion that the main thing to do if manufacturers proceed under the Webb-Pomerene act is to start on as simple a basis as possible and slowly progress toward the ultimate goal of a common selling agency.

Howard R. Sargent, General Electric Company, made a report as representative of the association on the electrical committee of the N. F. P. A.

W. T. Pringle, Pringle Electrical Manufacturing Company, national councilor representing the association in the United States Chamber of Commerce, made a report on the work of the year affecting the two organizations.

In calling upon chairmen of sections for any reports they cared to make Vice-president Salisbury expressed much gratification at the manner in which these subsidiary organizations are doing their work.

Joseph Rockhill, General Insulate Company, chairman Molded and Formed Insulation Section, spoke of the activities of that section. It had held its own fairly well and performed its patriotic duty to the nation, he said. Mr. Rockhill discussed the unrest in conditions and the uncertainty in the material situation. He felt that coöperation was never more urgent than now.

BANQUET AND ELECTION OF OFFICERS

As chairman of the nominating committee R. E. Gallaher, New York Insulated Wire & Cable Company, presented for governors for three years from April 1: LeRoy Clarke, Safety Insulated Wire & Cable Company; J. J. Gibson, Westinghouse Electric & Manufacturing Company; J. W. Perry, H. W. Johns-Manville Company; Warren Ripple, George Cutter Company; W. C. Robinson, National Metal Molding Company. The secretary was instructed to cast a ballot for the nominees.

At the banquet held on the evening of the same day, also at Delmonico's, addresses were made by Robert K. Sheppard, Simplex Wire & Cable Company; Gov. Walter E. Edge of New Jersey and Major Paul Debevoise of the 312th Infantry, U. S. A. Mr. Sheppard spoke feelingly of the service flag of the association. It was suspended in the banquet room and showed 32,929 stars with 278 gold stars. The Maunfacturers' Chorus of Bridgeport, Conn., of which George S. Hadley, secretary Harvey Hubbell, Inc., is director, entertained the large number of members and guests present.

The board of governors, meeting at the conclusion of the annual meeting, reëlected as president A. W. Berresford, Cutler-Hammer Manufacturing Company. J. F. Kerlin, Corliss Carbon Company, was elected vice-president. J. W. Perry, H. W. Johns-Manville Company, was reëlected treasurer, and Charles E. Dustin general secretary.

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Power Supply for Atlantic Seaboard

Comprehensive Scope of Plan of Secretary of Interior Lane for Development of Super-Power Stations in Boston-Washington District Described by W. S. Murray Before the A. I. E. E.

W. S. MURRAY, consulting engineer of New York, discussed before the American Institute of Electrical Engineers at Boston on March 14 the plan of Secretary of the Interior Lane for meeting the power needs of the Atlantic seaboard district between Washington and Boston.

Turning to the plan of trunk-line power supply lately fostered by Secretary Lane, Mr. Murray pointed out that in 1914 he had become interested as an engineer in the possibilities of centralized motive-power supply for the six principal railroads operating into the New York City district on the western side of the Hudson River —the Lehigh Valley, Central New Jersey, Delaware, Lackawanna & Western, Pennsylvania, West Shore and Erie roads. Here appeared an excellent opportunity to form a power equipment company to work out a standard equipment for service in this district. Power might be supplied from a station of from 100,000 kw. to 200,000 kw. rating in the Hackensack meadows. In view of the financial embarrassment of the railroads it appeared that the financing might be taken out of the hands of the transportation companies and handled by equipment trust bonds. Power houses, shops and equipment might have been financed in this way.

BILLIONS FOR CONSERVATION

The above plan gradually developed into a regional one, as it was studied. "I offer you this slogan," said Mr. Murray: "We have spent billions of dollars for destruction for preservation. Let us now spend billions of dollars for construction for conservation." Continuing, he said: "It is without a shadow of a doubt in my own mind that as sure as we are sitting here to-day the waste by improper power application on the Atlantic seaboard between Washington and Boston amounts to between $50,000,000 and $100,000,000 a year, and probably much more. Think of the millions of tons of coal that are wasted between those two points in the proportion of freight, passenger and switching tonnage. Think of the millions of tons that are wasted in the factories of that district, of the millions of dollars that are wasted owing to the higher maintenance cost of the steam locomotive as against the electric locomotive. Think of the millions of dollars that are lost by virtue of the steam locomotive being unable to consolidate behind it train tonnage equal to that of the electrical engine. Then integrate these millions and you will only approximate the totals I have given you.

"It should be borne in mind, as Secretary Lane has pointed out in a recent presentation of this matter, that it is not the intent to ignore the needs of other sections, or to suggest that there are no other regions in which similar opportunities for improvement in power supply exist; but our beginning must be made somewhere, and it is here on the North Atlantic seaboard where density is at a maximum that the greatest economic return can be effected, not to speak of the elimination in the future of the serious deficiency in power our industries were facing during the closing days of the war.

"Now to return to our Atlantic seaboard conditions. Why are we allowing all this waste? It is like everything else in this country. We have had so much we have not known what to do with it. The time has come when we owe it to posterity to brace up and change our name from that of a nation of wealth to a nation of economists. We can help the world far more if later we can claim justice to the latter title.

"I have given much thought to Secretary Lane's proposed super-power generation, transmission and distribution plan for application in the regional districts between Boston and Washington. By such an arrangement is offered the opportunity of propelling all trains in this region by electricity and at the same time supplying all industrial concerns with like power. I am most thoroughly in accord with the Secretary's advances in regard to this matter. He has in contemplation a system of trunk-line transmission between Boston and Washington, the route of which will lie sufficiently removed from the coast, as a military precaution, and which would employ the use of steel transmission towers supporting wires bearing three-phase, 25-cycle current at a potential, say, of 150,000 volts—these lines, probably three or four in number, lying parallel to each other and on private right-of-way.

"Such lines should be energized through large-unit tidewater steam-electric stations, hydroelectric stations and steam-electric stations at coal-mining centers. The specific location of the stations would conform with conditions conducive toward highest economy based on transmission efficiency, diversity factor, and breakdown service between plants. It is a practical conception to think of such stations of the steam order furnishing a kilowatt-hour to these lines at a rate between 10 lb. and 15 lb. (4.5 kg. to 6.8 kg.) of steam; the water plants furnishing their quota of course without robbing the earth of a pound of coal. The southward sweep of such a transmission system would probably bisect the line between the anthracite coal mines of Pennsylvania and tidewater, offering opportunity to use the millions of tons of culm coal now wasting and unavailable for power service, also coal at present being mined and now wasted for the reasons named.

VAST ECONOMIES POSSIBLE

"I ask you to exercise your imagination and visualize the economies which would be rendered on such a system. I think I can speak with authority on the railroad end of this matter, as ten years' constant observation on fuel economy as between steam and electric service has shown that the electric passenger engine, ton for ton on drivers, will handle trains of equal weight mile per mile for one-half the coal consumed in steam practice. In the case of freight operation this is even better, being two and one-half to one, while in switching the ratio becomes three to one. These are not guesses but facts, supported by records of millions of ton-miles in the three classes of service mentioned. In our factories electric driving will average a coal saving of two to one. . . . Skeptics may say that such a plan as offered by the Secretary of the Interior is all

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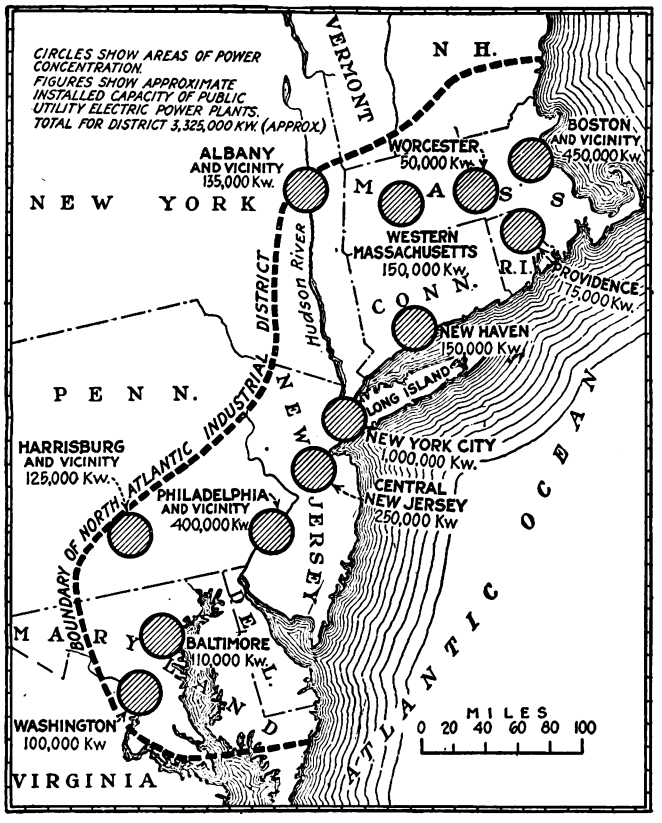
imagination. The part that had to be imagined is there, and rightly there; the part that is not imagined represents practicability, for it offers at once the challenge that if power can be produced at such rates—and we know that it can—there is a growing market for it; and in order to compete in the world market while maintaining the American standard of wage and living we must have Secretary Lane's super-power plan clearly presented before the American Congress and we must back it up."

Mr. Murray said that at first blush the super-power plan would appear to be a "large order." "This is so," he said, "but the world is full of big problems and of as big men to solve them. We are on the verge of very large things. Professor Breckenridge of Yale University states that the production of bituminous coal is now over 500,000,000 tons yearly compared with 100,000,000 only a few years ago. From 750,000,000 to 100,000,000 tons of anthracite coal per year are being mined, and it is estimated that in seventy-five years the supply of the latter will be virtually exhausted. The importance of reducing the fuel consumption per kilowatt-hour can hardly be exaggerated. The amount of wasted coal in this country, especially in the eastern district, is almost criminal. We have learned to think in billions of dollars, and when we view it in the proper perspective, with relation to the resources of the country, the super-power plan takes its place modestly in line with normal development and brings out the real sense of proportion it bears to the necessary expansion of all the arts that the future must bring.



PROPOSED SCHEME OF INTERCONNECTION FOR NORTH ATLANTIC POWER SYSTEMS

"We have been prone to think of our railroads," said Mr. Murray, "as great arteries capable of meeting the exigencies of any industrial expansion. Were I to plot it in the form of two straight lines referred to rectilinear coördinates, I could see industrialism moving upward and away from transportation, with 30 degrees between them; but alas! it is worse than this. The curve of industrialism is more logarithmic than rectilinear, and while transportation may make a doubtful claim of a constant rate of acceleration, industrialism, so ably represented in power to drive it ahead, has an ever-increasing rate of acceleration, and the angle widens between them for every increment of time. . . . Ten years ago if the super-power plan had been suggested it would have died a natural death. The supporting traffic was not here. It is here now and growing every minute. The railroads are a common carrier for general commodities. The super-power transmission will be a common carrier for power. To-day coal is preempting 33 per cent of our railroad carge space. It congests and consequently deters other shipments. As we recall the New England winter of 1917-18, what arguments can rise in our minds against the proposed new common carrier of power, the response of which will be instantaneous to the throw of a switch?"

In closing, Mr. Murray referred to hydroelectric and interconnection work in Connecticut, which is expected to save in the vicinity of 500,000 tons of coal annually, and touched upon the possibilities of supplying hydroelectric energy to Philadelphia from a development which appears feasible in Pike County. About 90,000 kw. is required at Philadelphia. The water-power project investigated involves a reservoir with a storage capacity of 7,500,000,000 cu.ft. (210,000,000 cu.m.), a watershed of 240 sq. miles (62,000 hectares), rainfall of 32 in. (81.3 cm.), and a fall of 350 ft. (105 m.) in the stream in a run of 5500 ft. (1676 m.). A drawdown of 26 ft. (7.9 m.) is permissible. Development could be effected up to 100,000 kw. The total cost of the project, including a 102-mile (164-km.) transmission line, is about the same as of an equivalent steam plant at tidewater, but the operating expense of the water-power plant figures an estimated saving of about $1,000,000 per year. The super-power scheme, Mr. Murray said, could be extended to Portland, Me., on the north and to Richmond, Va., on the south, if desirable. The speaker said he had not found one dissenting voice among his engineering, commercial and railroad friends regarding the investigation that Secretary Lane has proposed into the economies of the super-power system. "This nation," said Mr. Murray, "owes a job to every soldier, be he returning from Europe or from his post in the United States. There are two million sons of America returning from overseas. Can they not fairly ask, 'Have you been thinking of us over here while we have been fighting for you over there?' Millions have been spent in factory and in field to accomplish the construction and purpose of this super-power transmission and distribution. It will, while creating a new national wealth, automatically provide ways and means for the employment of American labor and be a fair answer to the fair question of the returning soldier."

Books Received

PUBLIC UTILITY RATE FIXING. By C. E. Grunsky. San Francisco: Technical Publishing Company. 169 pages. Price, $2.50.

ANNUAIRE POUR L'AN 1919. With Scientific Information. Published by the Bureau of Longitudes. Paris: Gauthier-Villars et Cie. Price, 3 francs.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CHANGE IN TEST VOLTAGE

Action Taken by Transformer Manufacturers Regarding Winding-to-Core Test Voltage

Since transformers having low-voltage ratings in the 2300-volt class are very frequently connected in Y by operating companies to supply 4000-volt secondary distribution, manufacturers belonging to the Electric Power Club have decided to adopt the following test voltages between low-voltage winding and core:

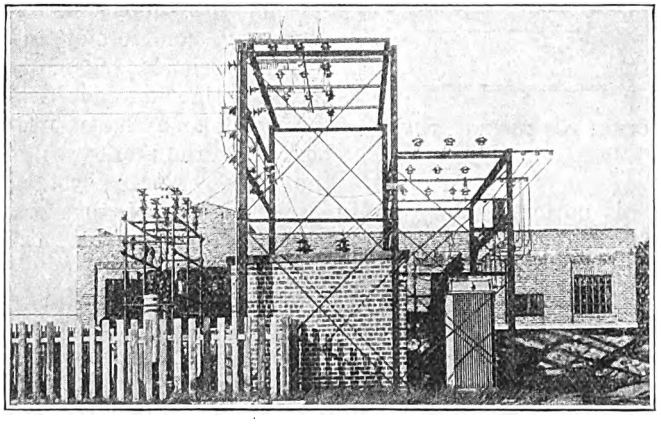
Highest Operating Voltage	Test Voltage
1500 and less	4,000 volts
1501 to 4500	10,000 volts
4501 and greater	Twice the highest operating voltage of the low-voltage winding plus 1000 volts

This change from the practice that has previously existed will make the voltage comparable with the insulation test voltage required between high-voltage and low-voltage windings on transformers of this class.

OUTDOOR MINE SUBSTATION WITH BRICK METER HOUSING

Made with Expanded Metal Poles, Pin-Type Insulators, Unit-Type Equipment and Air-Break Switches

The outdoor substation illustrated is installed at a coal mine controlled by a public utility. Among its important features are the low cost per kilowatt-ampere,



EQUIPMENT PERMITS EASY INSTALLATION

the use of standard unit-type equipment which can be assembled in special arrangements to meet local conditions, and the speed of installation, thus keeping the labor costs at a minimum. The structure made of expanded steel sections occupies a ground area of 20 ft. by 10 ft. 7½ in. (6 m. by 3 m.), giving sufficient space for a house in which high-tension automatic oil-switch and metering equipment may be installed. Attached to the main tower is a steel extension carrying the transformer buses and providing space underneath for four 300-kva., 33,000/2200-volt, single-phase transformers, one of which is a spare.

A high-tension three-pole double-break-per-phase switch is equipped with choke coils which reflect incoming disturbances to the lightning arrester. This switch is of the remote-control, manually operated, interlocking type, enabling all three poles to be simultaneously opened and closed from ground level by means of a common handle which can be locked in either position. Between the electrolytic arrester and the incoming lines is a set of single-pole disconnecting switches equipped with carbon-tetrachloride limit fuses.

The high-tension bus supports are of the unit type, interchangeable in design with insulators on the switching equipment. The low-tension supports are also of the unit type, with adjustable fittings, permitting easy installation.

Outdoor substations of this type meet the modern demand for economy in material, as they permit the use of a minimum amount of steel in the supporting structure. This information was contributed by H. W Young, president of the Delta-Star Electric Company.

CONSIDERATIONS ON THE FUSIBILITY OF COAL ASH

Formation of Clinkers Due to Melting of the Ash Constituents May Be Reduced by Careful Consideration of Melting Point

Fusibility tests as made in the laboratory are not usually directly comparable to the conditions existing when coal is burned in the furnace, but analysis of clinkers from boiler furnaces indicates that clinkers easily form when iron is present in the ash in the ferrous state. Consequently the values obtained in the laboratory are in this respect comparable to the actual fuel-bed conditions and give the lowest temperatures at which the intimately mixed ash will soften, forming clinker. The accompanying table of fusibility of coal ash, compiled by the United States Bureau of Mines, gives the average values for different coal beds in each region. The temperature taken as the softening point is that at which an ash pyramid ¾ in. (19 mm.) high and ¼ in. (6.4 mm.) wide at the side of the base, mounted in a vertical position, will fuse down to a spherical lump. The temperatures at which the tips of the cones first fused and at which the ash became very fluid are also taken and serve mainly as an indication of the viscosity of the melting ash. These values are not tabulated. The low softening temperature of the ash from the coals of the Middle West is probably due to the pyrite, gypsum and calcide that occur so generally as impurities in coal from the interior of this country. In general it might be said that the individual mines are producing coal having a lower sulphur content than the average sulphur value given for the bed in which they occur. Further, the fusibility temperature

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of the ash is higher at many of the individual mines than indicated in the table for the bed:

TABLE I—FUSIBILITY OF COAL ASH FROM THE INTERIOR OF UNITED STATES

Region, State, Bed	Number of Mines Sampled	Total Number of Samples	Average Softening Temperature, Deg. Fahr.	Ash in Dry Coal, Average Per Cent.	Sulphur in Dry Coal, Average Per Cent.
Eastern Region:					
Illinois					
No. 1 bed	1	6	2110	11.74	4.86
No. 2 bed	6	15	2010	9.97	3.58
No. 5 bed	9	27	1990	10.84	3.28
No. 6 bed	36	160	2160	10.27	2.30
No. 7 bed	2	13	2050	10.62	2.69
Indiana					
No. 3 bed	3	11	2090	10.71	4.34
No. 4 bed	7	30	2390	8.17	1.62
No. 5 bed	9	29	2130	10.23	3.54
No. 6 bed	1	5	2040	9.91	.65
Minshall bed	1	1	2120	9.60	2.99
Western Kentucky					
No. 6 bed	1	4	2130	8.81	2.97
No. 9 bed	20	78	2030	10.53	3.67
No. 10 bed	2	2	1990	11.99	4.18
No. 11 bed	7	39	2030	9.57	4.08
No. 12 bed	3	17	2150	10.20	2.30
Western Region:					
Kansas					
Bevier bed	2	6	1980	14.83	4.71
Cherokee bed	3	8	2110	9.42	3.18
Leavenworth bed	1	3	2020	18.26	5.46
Weir-Pittsburgh bed	3	7	2010	11.68	5.31
Missouri					
Bevier bed	16	42	1960	13.47	4.90
Bowen bed	1	3	1940	13.18	4.61
Cainsville bed	1	3	1980	12.71	5.78
Cherokee bed	1	3	2150	7.51	1.97
Jordan bed	4	12	2010	12.74	4.42
Lexington bed	14	39	2000	13.48	4.04
Lower Rich Hill bed	3	8	1940	15.39	5.43
Lower Weir-Pgh. bed	2	6	1940	10.78	4.45
Mulberry bed	2	5	1990	14.58	3.18
Mulky bed	4	9	1940	11.28	5.25
Rich Hill bed	1	3	1970	15.47	6.12
Tebo bed	8	23	2040	11.64	4.66
Waverly bed	1	2	2020	17.43	8.29
Oklahoma					
Dawson bed	3	3	1920	8.95	3.91
Henryetta bed	2	2	1980	8.03	1.59
Lehigh coal bed	3	15	2150	11.46	4.17
Lower Hartshorne bed	9	27	2020	6.03	1.43
McAlester bed	6	28	2180	6.94	1.67
McCurtain bed	1	6	2110	6.92	0.84
Panama bed	2	4	2160	6.81	1.46
Stigler bed	5	5	2050	5.13	1.91
Upper Hartshorne bed	3	7	2170	6.15	1.51
Arkansas					
Denning bed	1	3	2200	7.38	2.45
Hartshorne bed	5	9	2120	11.59	1.40
Paris bed	1	3	2140	10.12	3.28
Shinn Basin bed	1	1	2180	10.36	2.23
Southwestern Region:					
Texas					
Santo Tomas	2	2	2580	19.21	1.98

ALTERNATING-CURRENT MOTORS FAVORED IN STEEL PLANT

Records of Direct-Current and Alternating-Current Motor Failures and Cost of Repairs in Bethlehem Steel Plant

During a five months' test period (ended Dec. 1, 1918) in the machine shop of the Lehigh plant of the Bethlehem Steel Company 137 alternating-current motors showed a perfect service record. During the same period there were twenty-six total failures among 353 direct-current variable-speed motors and thirty-nine total failures among 342 direct-current constant-speed motors. These 832 motors had an aggregate rating of 7195 hp., making the average motor size 7.2 hp. The maximum rating was 25 hp. and the minimum 0.5 hp.

The actual cost of repairs to a group of 200 motors in the same shop was investigated. These motors averaged about 4.3 hp. each, which is about 40 per cent less than the average of 7.2 hp. for the entire shop. There were twenty-seven total failures in this group during the five months, and the failures all occurred in the direct-current motors, of which there were 150. The fifty alternating-current motors showed a perfect record.

A large percentage of the failures originated in the commutators; where the breakdown did not actually occur at this point the commutator had to be at least repaired. In addition to such repairs or renewals about 40 per cent of the armatures had to be rewound. In repairing the twenty-seven armatures that failed about 432 hours were spent, involving a total cost of about $475, of which $260 was for labor and $215 for material. At this rate the annual expense would be $1,140.

The foregoing maintenance cost is based on twenty-seven failures in one group of motors in five months. However, in that same period there were sixty-five total motor failures in that shop and 432 machine-tool motor failures in the entire plant. The constant-speed motor failures could be reduced to a negligible quantity by using only alternating-current motors for that service. Such a change should reduce the complete motor failures and the total motor maintenance expense by 40 per cent or more.

This information is based on a paper read by H. W. Tice before the Philadelphia Section of the Association of Iron and Steel Electrical Engineers.

STANDARD RATINGS OF THREE-PHASE TRANSFORMERS

Revisions Made by Representative Manufacturers at a Recent Meeting Held by the Electric Power Club

By taking care not to order three-phase distribution transformers whose ratings are not listed in the accompanying table, engineers will avoid the extra delay and expense which are always involved in procuring special units. The list represents the standard ratings adopted by the Electric Power Club at a recent meeting and hence will represent the manufacturers' attitude in the matter. For transformers of this class, oil-immersed self-cooled units and frequencies of 25 and 60 cycles are standard.

STANDARD THREE-PHASE DISTRIBUTION-TRANSFORMER RATINGS

Standard Line Voltages	Standard Sizes for Each Voltage Class Inclusive*	For Supplying Service Voltages 600 and Below Transformer High-Voltage Ratings for Operation from Various Standard Line Voltages		Transformer Low-Voltage Ratings for Supplying Service Voltages 600 and Below
		On Full Winding	Approximatcly On Taps 10 per Cent.	
2,300	5 to 200	2,200/3810Y	.....	.... to 220/440
		2,300/4000Y	.....	.... to **230/460**
		2,400/4150Y	.....	.... to 240/480
4,600	5 to 200	4,400Y	.....	.... to 220/440
		4,600Y	.....	.... to **230/460**
		4,800Y	.....	.... to 240/480
6,600	10 to 200	6,600Y	5,940	.... to 220/440
		6,900Y	6,210	.... to **230/460**
		7,200Y	6,480	.... to 240/480
11,000	10 to 200	11,000Y	9,900	.... to 220/440
		11,500Y	10,350	.... to **230/460**
13,200	10 to 200	13,200Y	11,880	.... to 220/440
		13,800Y	12,420	.... to **230/460**
22,000	10 to 200	22,000Y	19,800	.... to 220/440
		23,000Y	20,700	.... to **230/460**
33,000	25 to 200	33,000Y	29,700	.... to 220/440
		34,500Y	31,050	.... to **230/460**

* Standard sizes in kva. continuous ratings at 55 deg. C. rise: 5, 7.5, 10, 15, 25, 37.5, 50, 75, 100, 150, 200.

Heavy type indicates normal voltage ratings on which guarantees will be made. It is understood, however, that where a transformer is suitable for operation at two volage ratings or at three voltage ratings, this flexibility will be definitely indicated on the nameplate, on the connection diagram or on a paster inside the transformer cover.

All sizes of distribution transformers having low-voltage ratings of 230/460 volts are suitable for series or multiple three-phase service only by proper connection inside of the tank.

Standard transformers having voltage ratings listed above will be designed for full rated kva. output at any specified tap voltage without exceeding guaranteed temperature rise.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INTERESTING COST DATA ON 1200 ELECTRIC RANGES

Byllesby Properties Show Annual Income of $55.39 per Range, with Low Installation and Maintenance Costs

Information collected by the publicity department of H. M. Byllesby & Company on the ranges at practically all of the company's properties as of Jan. 1, 1919, showed that there were 1200 ranges connected to the company's lines. The energy consumed by these ranges during 1918 was 1,550,036 kw.-hr., or an average of not quite 108 kw.-hr. per month per customer.

All of the properties have not gone into the range business on the same scale. The number of ranges in service at the various properties investigated varies all the way fron one range to as many as 650 ranges. The lowest rate charged at any property is about 2½ cents per kilowatt-hour, while at one place the rate charged is as high as 8 cents. The total energy income from these 1200 ranges during the year 1918 was $60,270.38, or an average of $55.39 per range.

While the installation costs shown on the table are in no wise complete, they give a fair conception of what may be expected in various American communities. The average outside installation costs, according to the figures given in the table, amount to $68.95. It is quite probable that for some cities this figure would be too low. It is particularly noticeable that the larger cities show higher installation costs, and it is probable that the figure of $128, which is given for Minneapolis, might be taken as a fair average figure for a large city.

As calculated from the data in the table, the cost of inside installations averages $30. It is noticeable that this figure coincides exactly with that given for Minneapolis and agrees approximately with the figure at San Diego.

Apparently not all of the companies have kept accurate records as to the cost of maintenance of electric ranges, but the data secured from those which have kept these costs show an average maintenance cost per range of $2.89. This figure appears to be strikingly low in comparison with the annual income of $55.39.

That the properties from which these figures were taken are not at all saturated with range business is evident from the fact that the commercial departments of the properties themselves have estimated that there are more than twice as many prospective purchasers of electric ranges as there are range customers.

BROOKLYN COMPANY RESUMES HOUSE-WIRING CAMPAIGNS

Rejuvenated Plan Presents Prices for Wiring One Room, One Floor or Entire House on Liberal Installment Plan

Beginning April 1, the Brooklyn Edison Company resumes its house-wiring campaigns on already built houses in Brooklyn. The Brooklyn plan of electrifying old houses has worked out most successfully in the past, securing for the central station many thousands of residences along its existing mains. The rejuvenated plan presents a schedule of prices for the wiring of one

ELECTRIC RANGE SITUATION AT PROPERTIES OF H. M. BYLLESBY & COMPANY, JAN. 1, 1919

Name of Company	Number Ranges in Service	Average No. 1918	Total Kw.-Hr. Consumption, 1918	Total Revenue, 1918	Average Income per Range	Rate (Net), Cents	Installation Cost Outside	Installation Cost Inside	Company Maintenance Cost	Ranges Removed	Number of Prospects
Dallas	20	16	22,883	$845.42	$52.81	4½ 1st 30 3½ 2nd 30 2½ all over	$80.00	$24.00	$20.00	2	30
Enid	1	1	94	12.05	12.05	Reg. power rate	0	0	0	0	0
Eureka	7	7	10,246	352.82	50.40	33 1st 150 Sunday 0.005	12.00	.....	0	1	3
Everett	1	1	.....	24.00	24.00	5	9.00	.....	0	0	0
Faribault	17	15	14,400	590.00	39.33	45.	15.00	12.50	.....	1	.....
Kalispell	159	145	263,831	5,936.20	40.94	2½	50.00	28.00	1,500.00	12	100
Louisville	43	22	90,000	3,000.00	136.36	3	100.00	90.00	.....	0	650
Minneapolis	650	594	715,000	36,000.00	60.60	3	128.00	30.00	1,250.00	12	1,500
Montevideo	14	14	22,022	836.70	59.76	4	45.00	25.00	9.00	0	.....
Hutchinson	10	10	14,025	544.62	54.46	4	47.00	22.00	2.50	1	3
Pipestone	0	2	186	20.21	10.11	4	.....	.....	0	..	6
Norman	19	21	15,732	1,133.16	53.96	8	85.00	18.00	.....	0	0
Oklahoma City	2	2	4,960	248.00	124.00	5	80.00	18.00	.....	0	6
Richmond	10	9	16,683	414.02	46.00	3.3	100.00	75.00	.....	1	300
San Diego	119*	80	187,679†	4,586.13†	57.32	3.33	140.77	25.00	646.56	0	250
St. Paul	7	7	6,335	390.76	55.82	7.3 1st, 5.2 thereafter	100.00	35.00	0	0	Many
Sioux Falls	22	22	12,468	681.00	30.95	5.5	5.00	6.00	7.00	1	40
Stillwater	98	120	153,492	4,655.29	38.79	3	41.29	12.50	0	0	122
Totals	1,200	1,088	1,550,036	$60,270.38	$55.39	.....	$1,033.06	$421.00	$3,435.06	31	3,000

* Besides 128 water heaters. † Including water heaters.

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room, one floor or the entire house and includes fixtures, glassware and tungsten lamps. A liberal partial payment feature is offered, with payments as low as $2 a month, extending over a period of twelve months if desired. A new set of fixtures of the Adam design has been selected which it is expected will make the plan more attractive and salable than ever before. The fixtures of the dining room, living room, library, bedrooms and main hall are operated by a center-switch control which is easy and convenient to operate and saves the expense of wall switches. By the new method, one or all of the lights in each fixture may be operated as desired. A combination bowl and shower dining-room fixture has been substituted for the dome which formed an essential part of the old plan. This affords a better illumination and can be conveniently used with appliances on the dining-room table. On all pull-chain socket fixtures a new arrangement has been adopted whereby sockets will be of 660 watts capacity, which will permit the use of any appliances. The following schedule gives the prices to be charged and which are for single apartments and residences along the commercial mains of the company. They are based upon acceptance within ten days of quotation. Certificates of approval of the Department of Water Supply, Gas and Electricity and of the New York Board of Fire Underwriters will be furnished:

No. 1, Kitchen.—Ceiling outlet with one-light fixture, pull-chain socket, 50-watt tungsten lamp, shade and a baseboard or side-wall flush receptacle, located in kitchen on the first floor, $21.45.

No. 2, Cellar.—Ceiling receptacle with 50-watt tungsten lamp located in cellar near heating apparatus operated by a flush switch at head of cellar stairs, $11.90.

No. 3, Dining Room.—Ceiling outlet with three-light shower fixture, center switch control, shades and 50-watt tungsten lamps, $17.80. (No. 3a—If combination bowl and shower fixture is desired instead, add $2.75.)

No. 4, Parlor.—Ceiling outlet with four-light shower fixture, center-switch control, shades and 50-watt tungsten lamps, $16.90.

No. 5, Library.—Ceiling outlet with 15-in. bowl fixture, two lamp sockets, and 50-watt tungsten lamps operated by a center control switch, $17.

No. 6, Main Hall.—Ceiling outlet in hall with one-light chain fixture, pull-chain control, shade and 50-watt tungsten lamp, $12.60.

(If wall bracket is desired instead, deduct $3.15.)

No. 7, Bedroom.—Ceiling outlet with two-light shower fixture, center-switch control, shades and 50-watt tungsten lamp, $12.50.

No. 8, Piazza.—Ceiling outlet on piazza with ceiling fixture, 50-watt tungsten lamp and ball shade, switch located in hall, $15.

No. 9, Bathroom.—Side-wall outlet, one-light nickel-plated fixture, pull-chain socket, shade and 50-watt tungsten lamp, $8.45.

No. 10, Pantry.—Side-wall outlet, one-light bracket fixture with pull-chain socket, shade and 50-watt tungsten lamp, $8.30.

No. 11, China Closet.—Side-wall outlet, one-light bracket fixture with pull-chain socket, shade and 50-watt tungsten lamp, $8.30.

No. 12, All Other Outlets.—Other lighting outlets, one-light bracket fixture, pull-chain socket, shade and 50-watt tungsten lamp, $8.30.

No. 13.—Two three-way switches for controlling hall light from upper and lower floors, $15.85.

No. 14.—Baseboard, wall and ceiling receptacles, each $7.15.

No. 15.—Floor receptacles, $9.90.

No. 16.—Bell-ringing transformers for alternating current only (this device does away with all trouble and expense of dry and wet batteries), $7.90.

No. 17.—Single-pole flush wall switches, each, $7.15.

No. 18.—For running risers through additional floors in houses of more than one family add $7.15 for each floor above the first floor. (In this schedule the floor above the cellar is considered the first floor.)

Deductions for fixtures if personal selection is desired: No. 1, $2.30; No. 3, $9.20; No. 3a (bowl and shower), $11.95; No. 4, $10.35; No. 5, $10.45; No. 6, $4.90; No. 7, $5.95; No. 8, $1.15; No. 9, $1.90; Nos. 10, 11 and 12, each, $1.75.

The soliciting for this class of business is done entirely by the company's salesmen, but the actual work of installation is performed by the electrical contractor designated by the customer. This method of awarding contracts has worked out most satisfactorily to all concerned, and all the Brooklyn contractors have again signified their desire to coöperate with the company in the same manner as heretofore.

UTILITIES' RELATION TO APPLIANCE SALES

A Discussion of the Essentials for the Successful Merchandising of Socket Devices in Any Community

Central stations should create a desire on the part of the public to own and use electrical appliances in order to improve the load factor and keep up the revenue of their residential business. This was the thought expressed by W. S. Head, manager of the commercial service department of the Duluth (Minn.) Edison Electric Company, in a paper read on March 20 before the Minnesota Electrical Association. To keep the utility's rates from defeating the very purpose for which appliances are sold, it was pointed out that the following features should be embodied in the rate schedule:

1. The minimum charge should be high enough to cover the ready-to-serve charge, but not high enough to make a large percentage of the public non-users because they do not expect to use the service represented by the minimum charge.

2. Rates should stimulate use of service through one meter by decreasing the cost per kilowatt-hour with increased use and improved load factor.

3. Schedules should be designed for small unit profit from a large volume of business.

The proper rates are not everything, however; the public should be educated in the advantages, care and application of electrical household appliances. When this shall have been accomplished and the old ideas of fear and mystery dispelled, consumers will seek to purchase appliances of their own accord.

Consumers buy from both central station and contractor-dealers, and for the benefit of all concerned these two classes of merchants should each use clean, fair, non-discriminatory sales methods. If a customer gets something which fails because it is a cheap, faulty appliance, the tendency is for him to throw it away and condemn all electrical appliances. However, the best equipment needs repairing sometimes, and provision should be made for doing such work promptly and without undue trouble to the user. It is also desirable to reconcile conflicting statements by different retailers on the operating cost and characteristics of the same appliance. Conflicting statements breed suspicion in the mind of the customer. It is held that all these problems can be successfully solved if the best energies of the central stations and the contractor-dealers are combined and subjected to the same general direction.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Lamps and Lighting

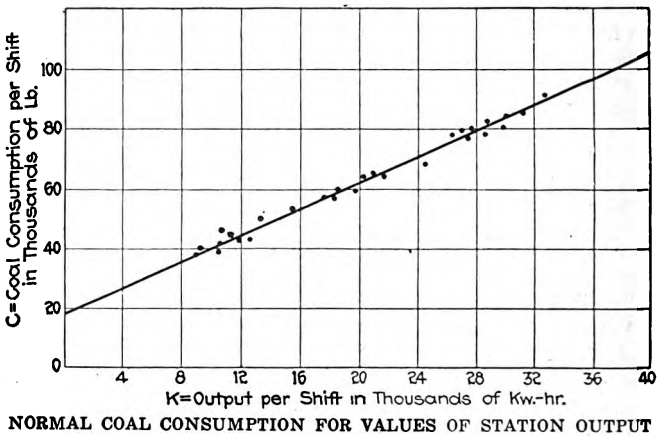
Electric Incandescent Lamp Situation in France.—A. Larnaude gives some interesting facts regarding the electric incandescent lamp situation in France. Carbon lamps are now used only in cases where great strength of filament is required. Vacuum lamps with tungsten filaments are considered to work at 1.1 to 1.3 watts per candle and to give a useful life of 1000 to 1200 hours. Gas-filled lamps are giving 400 to 3000 candles at about 0.6 watt per candlepower. Owing to the high temperature of incandescence attained the finest wires will not resist adequately in an atmosphere of nitrogen, and lamps giving less than 300 cp. to 400 cp. at 110 volts require argon, which M. Claude is now preparing on an industrial scale. The thermal conductivity of argon bears to that of nitrogen the relation 1 : 1.5—a difference which is sufficient to render practicable lamps giving 50 cp. to 100 cp., operating at less than 1 watt per candle and having a normal useful life. Owing to the low dielectric cohesion of argon gas (only 38 as compared with 465) it is, however, necessary to employ a mixture of argon and nitrogen. In a 50-cp. lamp about 400 mm. of wire is used. Here M. Larnaude also points out the great variation in distribution of candlepower met with in modern incandescent lamps and emphasizes the desirability of expressing values in lumens.—*Illuminating Engineer*, August, 1918.

Generation, Transmission and Distribution

Present Development of Transmission Lines in Kansas.—F. ELLIS JOHNSON.—A study of the development of transmission systems in the State of Kansas was undertaken with the idea of aiding in the future electrical development of the state. Extensive tables are presented giving physical data of interest in connection with the Kansas transmission lines. There is also an appendix giving a brief summary of the considerations involved in the design of iron and steel transmission lines.—*Bulletin of the University of Kansas*, No. 12, June 15, 1918.

The "Bayerwerk" Electricity Scheme.—In 1915 O. V. Miller drafted a scheme, since developed and now adopted by the Bavarian government, under which the Bayerwerk is to establish a high-tension network to distribute electrical energy over an area including Munich, Augsburg, Dettingen, Schweinfurt, Nuremberg, Wurzburg, Bamberg, Bayreuth, Amberg, Haidof, Regensburg, Landshut and Kochel. Energy will be collected from the Walchenseewerk, from state water-power stations to be erected from time to time, and from power houses having available surplus energy at economical rates. The Walchensee station is to develop 50,000 kw. and deliver to the network 150,000,000 kw.-hr. per annum at 100,000 volts, three-phase. It is proposed to supply energy only in bulk, to large consumers who will erect their own transformer stations and distribution networks. A list is given in the original paper of firms and municipalities interested in the foundation of the Bayerwerk. The state is to put up 51 per cent of the 10,000,000 marks capital and other shareholders the remaining 49 per cent. The state reserves the right to purchase the entire undertaking after fifty years at a price equal to the first cost minus 1 per cent per annum.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elektrot. Zeits.*, Sept. 12, 1918.)

Coal Consumption of Steam-Power Plants.—ROBERT H. PARSONS.—It is the purpose of the article to suggest practical methods of keeping check on the efficient use of fuel shift by shift, whatever may be the output of the plant. The writer suggests the preparation of charts similar to that shown in the illustration whereby it may be shown what the normal coal consumption should be for any value of station output. This curve is seen to be a straight line, the equation for which is represented by the author as $c = 18{,}000 + 2.2\ k$, k representing the output per shift in thousands of kilo-



NORMAL COAL CONSUMPTION FOR VALUES OF STATION OUTPUT

watt-hours and c being the coal consumption per shift in thousands of pounds. Similar charts may be prepared for checking the important parts of the plant operation, such as water rates, in terms of station output.—London *Electrical Review*, Feb. 21, 1919.

Tests on Steam-Engine Governing.—A. GRAMBERG.—Tests were made on a non-condensing horizontal steam engine with a view to elucidating the phenomena occurring during automatic governing. The engine was equipped on the high-pressure cylinder with Collmann valve gear and controlled by a ball governor. Curves are given showing the sleeve travel as a function of speed for various sleeve pressures; also the governor position for various speeds and adjustments. For the purpose of the tests there was added to the governor shaft a spindle on which weights could be placed at definite intervals above and below the governor shaft. The increase in these forces due to these weights is approximately proportional to the paths traveled by the governor sleeve, the speed of rise being approximately proportional to the distance either above or below the

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weights from the governor shaft. Horizontal displacement of the weights affects the speed of rotation but not the degree of lack of uniformity of governing. The behavior of the curves of equal engine output is interesting. At higher speeds a smaller torque corresponds to the increased output; a higher position of the governor would hence be expected. This occurs at all loads, but not when the set runs idle; in the latter case the internal resistance of the set determines what happens. Varying the vertical setting of the auxiliary weights does not affect the average speed of the engine but varies the degree of lack of uniformity.—*Science Abstracts, Section B,* Jan. 31, 1919. (Abstracted from *Dingler's Polytechnical Journal,* Feb. 23, 1918).

Traction

Hints for the Freight Operator.—A. B. COLE.—The writer points out the fact that the market train service has provided a lucrative business in connection with interurban traffic. It should also be undertaken by steam railways where it is possible to adopt electric locomotives for this service. The writer discusses the possibility of using motor cars, trailers and electric locomotives. He also points out the proper signaling required for safe operation of this freight service.—*Electric Railway Journal,* March 1, 1919.

Operation of Street-Railway System of New Orleans.—H. W. T. HOGG.—The writer discusses the problem of the rehabilitation of the street-railway systems of New Orleans. The subject matter of the report may be divided into five groups, namely, (1) rerouting the car lines, (2) routing the cars, (3) number of cars required, (4) labor problem, and (5) the reorganization problem.—*Proceedings of the Louisiana Engineering Society,* February, 1919.

Swiss Report on Corrosion by Earth Currents of Electric Railways.—This is the second part of the report (for the first part see *Abs.* 667, 1918), and deals chiefly with the form and size of the corrosion phenomena met with in practice and their causes. Corrosion may be due to two causes, either chemical or electrical. The former is first considered. Rust, in the narrow sense, is defined as the red oxide of iron formed by the action of air and water; but in a wider sense it may be taken as including insoluble basic salts of iron formed by the action of acids in the soil. Wrought-iron pipes seem to be destroyed more readily than cast-iron by rust in the narrow sense, though this may be due to the fact that large cast-iron pipes are often laid deeper and hence further from the oxygen of the air. But where it is a question of acids cast iron is more readily destroyed than wrought. Soils containing calcium and magnesium sulphate or cinders are especially dangerous. Corrosion due to earth currents may be caused by mechanical destruction of insulating coverings, which then become a danger rather than a protection, since the current density may be so high as to cause serious damage in conditions otherwise favorable. The case of pipes laid parallel to electric rails is considered, as being more amenable to mathematical treatment. In such a case the potential drop between pipe and rail varies from 0.5 volt to 3 volts for a characteristic operating period. Increases up to 5 volts may occur. The resistance of the earth varies according to its composition and moisture content, but mortar and cement have a much higher conductivity than ordinary soil. A table is quoted giving the current density required to reduce the wall of a pipe to one-half its original thickness in twenty, thirty, forty or fifty years. Happer went thoroughly into the question of protection by means of insulating joints and coverings, investigating the influence of inorganic joints, alloys, oxides, silicates and wrappings of paper, cloth, cement, etc., and found none of them could be relied on with certainty. Screwed or riveted joints in wrought iron show no great increase in resistance, but a socket joint is equivalent to 30 m. of pipe.—*Science Abstracts, Section B,* Dec. 31, 1918. (Abstracted from *Schweiz. Elektrot. Verein,* August, 1918.)

Installations, Systems and Appliances

Electricity in the Ceramic Arts.—J. P. ALEXANDER.—Until recent years electricity had not been introduced into pottery and tile-making factories for the reason that it had been generally supposed that a steam engine, by reason of the excess power it could produce over its normal rating, was the only driver that could start up the machinery after the clay had settled in the mixing tubs overnight. Recent electrical installations have shown the fallacy of this idea and have proved to ceramic engineers that the electric motor can duplicate any of the engine drives. In the article here noted the processes employed in the pottery industry, etc., and the service of electricity in this field are well outlined.—*General Electric Review,* February, 1919.

Electric Heating and Cooking.—FRANK BROADBENT. The writer states that even were electric cooking more expensive than cooking by the use of gas or coal the economy in food itself would be sufficient justification for the use of electricity. As typical of results obtained in one of the London national kitchens, it is stated that the loss in weight of beef cooked by various methods is approximately as follows: By gas, 32 per cent; by coal, 30 per cent; by electricity, 12 per cent. Even better results were obtained in the cooking of mutton. Other advantages of using electricity in cooking are stated.—*Beama Journal,* January, 1919.

Boiler Units with Air Reheaters.—Description of an installation of the Underfeed Stoker Company in an English central station by means of which the heat contained in the hot gases which escape from the fireboxes is advantageously used to heat air blown under the grates by electric motors mounted upon the framework of the grates.—*Revue Générale de l'Electricité,* Feb. 15, 1919.

Phenomena of Water Hammer.—C. CAMICHEL, D. EYDOUX and M. GABIEL.—In two previous articles on this subject M. Gabiel has studied the maxima of water hammer at the distributing point and at the gateway of a conduit and has indicated applicable formulas (*Revue Générale,* Sept. 21 and Oct. 5, 1918). In this article the authors deal with water hammer occurring along the length of the conduit and give formulas for calculating it at every point for conduits of constant diameter and constant or variable thickness where the opening and closing are in a straight section of the pipe.—*Revue Générale de l'Electricité,* Feb. 15, 1919.

Protective Effect of Reactance Coils.—O. BOHM.—The author applies his method of investigation, which previously dealt with the case of transformer windings, to the case of protective choking coils.—*Science Abstracts, Section* B, Jan. 31, 1919. Abstracted from *Elektrot. u. Maschinenbau,* Aug. 25, 1918.)

Practical Phases of Boiler-Room Practices.—EDWARD MARSHALL.—Considerable progress has recently been

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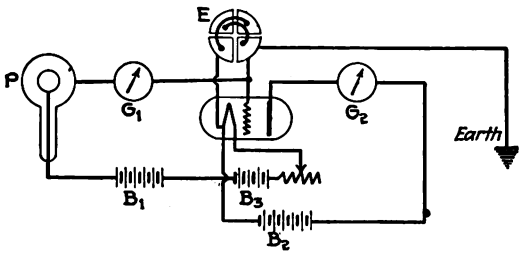
made in the operation of boilers owing to the fact that a great many had to be more or less reconstructed in order to burn a poorer quality of coal than that for which they were designed originally. More attention has been given to operating data than ever before, and few companies now operate their boilers without keeping some record of the percentage of ash to the amount of coal burned or without a record showing just the proper time to clean the boilers both inside and out. Instead of the old method of blowing down boilers two or three times a day some titration method is used to determine when blowing down is necessary. The author cites some typical experiences such as the case of a plant where extremely high chimney temperature was corrected by reconstructing the baffling and where an excess of exhaust steam was used to bring up the temperature of the feed water. He also calls attention to the necessity of keeping in closer personal touch with employees in order to gain better results and also to prevent excessive labor turnover.—*Ohio Electric Light Association Monthly*, February, 1919.

Electrophysics and Magnetism

Amplification of the Photoelectric Current.—CARL ELI PIKE.—A method has been outlined by Jakob Kunz by means of which the photoelectric current may be amplified, thus making the photoelectric cell more useful



CONNECTION OF VACUUM TUBE FOR AMPLIFYING PHOTOELECTRIC CURRENTS

as a photometer, especially in the region of ultra-violet light and also for technical purposes. By means of the audion as indicated in the diagram the author has shown that photoelectric current can be amplified from 1600 to 5000 times. With different audions amplifications of 18,000 have been obtained.—*Physical Review*, February, 1919.

Telegraphy, Telephony and Signals

Couplings in High-Frequency Amplifiers.—J. SCOTT TAGGART.—The circuits described in this article are complete wireless receiving circuits and possess the advantage of not employing either intermediary transformers or oscillatory circuits between the valves.—*Wireless World*, February, 1919.

Graphical Method of Calculating the Attenuation Constant of Loaded Telephone Circuits.—It is stated that the method of the author can be applied to advantage on almost all loaded lines, including open-wire aërial lines, underground and submarine cables. Charts are offered for the calculation of such lines, and numerical examples are worked out.—*Post Office Electric Engineers' Journal*, January, 1919.

Oscillating Valve.—E. V. APPLETON.—The most important relations in a double-anode valve are those between plate voltage, plate current and grid voltage when the filament temperature is constant. It is the aim of this article to show how the conditions required for the production of continuous electric oscillations by any three-electrode valve can be foretold from its static characteristics.—*Wireless World*, January, 1919.

The Fundamental Wave and the Harmonics in a Homogeneous and in a Non-homogeneous Antenna.—L. DUBAR.—Sequel to an article by M. Chireix (*Revue Générale*, Sept. 14, 1918) in which in many simple cases of non-homogeneous antennas formulas of the distribution of currents and voltages and equations giving the proper wave lengths were established. In this article the equations are solved, approximately at least, and conclusions concerning the distribution of harmonics in some simple hypothetical cases are drawn.—*Revue Générale de l'Electricité*, Feb. 22, 1919.

The Development of the Telegraph in France.—J. B. POMEY.—After a brief historic summary relative to the underground telegraphic network which was established in France following the war of 1870, the author shows that to-day the construction and exploitation of a great network of this kind presents no technical difficulty and that, all things considered, such a network is financially more economical than the existing networks with aërial wires. He also contends that it is now in the general interest of the telegraphic service to plan the construction of a great network of cables with multiple conductors of which some sections could be carried aërially on concrete poles as is done in the United States.—*Revue Générale de l'Electricité*, Feb. 22, 1919.

Miscellaneous

Electricity in Agriculture.—A system is described involving the use of elevated rail tracks which are permanently erected parallel to each other on opposite sides of the area to be cultivated to carry traveling electric motors by means of which the hauling necessary for draining and plowing are accomplished.—London *Electrical Review*, Jan. 10, 1919.

Electro-Culture Experiments by the South Wales Power Company.—An outline is given showing the apparatus required and the amount of energy used per acre on considerable tracts of land subjected to the stimulation of the electrical field. It appeared that a considerable increase in production was attained.—London *Electrician*, Jan. 17, 1919.

Magnetos for Oil Engines.—E. BIFFI.—A large number of experiments upon a Bosch magneto are reported in this article. The type experimented on was that for an eight-cylinder oil engine with fixed coils and rotating magnetic armature core. The maximum induction in the core was found to be 9700 c.g.s. lines per square centimeter. A large number of diagrams and curves illustrate the article.—*Science Abstracts, Section B*, Dec. 31, 1918. (Abstracted from *Elettrotecnica*, Aug. 5, Aug. 25, Oct. 5 and Oct. 15, 1918.)

Flow of Water Through 1½-In.-Diameter Pipe and Valves.—FREDERICK W. GREVE, JR.—The following conclusions are based on the work and curves are produced: The relation of loss of head to discharge in all cases can be represented by the general equation $H_l = MQ_n$; that M and n both vary with the restriction of area to flow through the valves, decreasing with increase in values of d/D; that Weisbach's coefficients, which show average values for small gate valves, give values of H_l that are too small, and that a gate valve causes less loss of head than a globe valve and that the losses are nearly equal for $d/D = 0.23$.—*Bulletin* No. 1, Engineering Experiment Station, Purdue University.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

SHIP SCHENECTADY IS LAUNCHED AT HOG ISLAND

Eighteenth Ship Is Given Name of City of New York State in Recognition of Work Done by General Electric Company

In recognition of the work done by the General Electric Company, which is furnishing all of the turbines for the ships built at Hog Island, the eighteenth ship to be launched from those yards was christened "Schenectady" as she slid off the ways on March 15. Miss Miriam Rohrer, daughter of A. L. Rohrer, electrical superintendent of the General Electric Company, was sponsor.

WISCONSIN ASSOCIATION ON SERVICE AND SECURITIES

Papers Delivered at Wednesday Session of Convention View Utility from the Angles of Banker, Commissioner and Operator

Service first was the paramount thought of the first day's session of the Wisconsin Electrical Association, which met in annual convention at the Hotel Pfister, Milwaukee, March 26 and 27. In an address on "Public Utilities and Securities" Chester Corey of the Harris Trust and Savings Bank, Chicago, stated that the successful banker must always be ready to furnish money to the utility on reasonable terms and the chief problem of the utility is to maintain the proper credit. He said that it is generally conceded that an interurban railway which does not earn more than $2,000 a mile is not entitled to credit. Another type of company not entitled to credit is one having faulty capitalization. If fixed charges amount to 85 per cent of earnings, fluctuation of prices may very easily wipe out the 15 per cent margin. Any company to retain good credit should earn one and one-half times its fixed charges. Mr. Corey believed that private ownership under public management conduces to most economical and efficient management.

An address on "Safety and Sanitation" by R. McA. Keown, engineer of the Industrial Commission of Wisconsin, was followed by a paper on "The Value of the Quality of Service" by Commissioner John S. Alen, Railroad Commission of Wisconsin.

President John St. John, assistant general manager Milwaukee Northern Railway, Cedarburg, Wis. recommended in his address that hereafter the convention be divided into two parts, one to deal with problems relating to light and power companies and the other to take up problems of interest to railway companies.

A paper on "Public Utilities Rendering Service to Industries" was read by N. J. Whelan of the Wisconsin-Minnesota Light & Power Company, Eau Claire.

W. L. Goodwin also addressed the association, explaining his merchandising plan and the work he has done to coördinate the interests of the dealer-contractors and the central-station men. In behalf of dealer-contractors he urged coöperation in Wisconsin. A committee was appointed to confer on this subject with a committee from the dealer-contractors' association.

CONVENTION COMMITTEES OF N. E. L. A. ARRANGE PROGRAM

Domestic, Commercial and Industrial Lighting to Be Featured by Exhibits, Lectures and Reports at Atlantic City Gathering

Six committees of the National Electric Light Association held meetings in Chicago March 24, 25 and 26. In these meetings the plans of the committees were crystallized and definite programs were worked out. The committees were the lighting sales bureau, the power sales bureau, the merchandising committee, the executive committee of the Commercial Section, the overhead-lines committee and the safety and accident prevention committee. A feature of the activities of the lighting sales bureau will be a fifteen-thousand-dollar exhibit which will be prepared in conjunction with the lamp committee, partly at the expense of the lamp manufacturers.

Some of the reports which will be submitted by the lighting sales bureau are on the commercial aspects of lamp apparatus, electrical advertising, outdoor lighting, residence lighting, lighting of public buildings and store lighting. There will also be a paper on probable causes of decreases in revenue and methods of remedying these conditions. W. A. Durgin, Chicago, will make an address and give a demonstration on industrial lighting. The power sales bureau plans to discuss live topics of the day, particularly those in which interest was stimulated by the war. Discussions from the floor rather than set papers will prevail in this meeting. The topics to be discussed include electrochemistry, the effect of the war on isolated-plant costs, electric furnaces for the three purposes of melting steel, melting non-ferrous metals and heat-treating metals, electric welding, desirability of correcting power factor in customers' installations, and industrial electric trucks and tractors. The efforts of the merchandising committee will be confined mainly to bringing its 1915 report up to date. Important features of the report will be data on a uniform accounting system, discussions of merchandising profit and advertising by small stations. The principal topic before the overhead-lines committee was inductive interference. The safety and accident prevention committee devoted considerable time to the National Electrical Safety Code.

Among entertainment features are dinners to be given by the lighting sales bureau and the power sales bureau. In order to be able to stage a still more elaborate entertainment program these two bureaus will combine after the dinners in a joint celebration.

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DUTIES OF AN ENGINEER IN GOVERNMENT AFFAIRS

Discussion on Means and Methods of Increasing Productivity of Labor—Need of Organization to Voice Engineering Opinion on Public Questions

The local sections of eighteen engineering societies representing different phases of the engineering profession in Greater New York met on Wednesday evening under the chairmanship of Gano Dunn, past-president of the American Institute of Electrical Engineers, to discuss the relation of the engineer to public activities beyond the limits of his technical horizon. Different angles for discussion were assigned to the five leading speakers. They indicated why engineers should accept civic responsibility and should influence legislation; how the engineer can be used to advantage in governmental administration, also what the engineer can do to influence public opinion and allay popular unrest.

"We have emerged from the war with a political unrest in which the voice of reason is drowned between the clamor of labor and the sentimental appeal of visionary reformers," said Philip N. Moore, past-president of the American Institute of Mechanical Engineers, in his address on the "Civic Responsibility of the Engneer." "Now, as never before, we need the trained mind of the engineer to think clearly with unflinching logic from cause to effect."

Calvert Townley, past vice-president of the American Institute of Electrical Engineers, said in the course of his talk on "The Relation of the Engineer to Legislation" that "an engineering training fits a man to arrive at logical conclusions regardless of outside influences and he is therefore qualified to express opinions on legislative and other subjects outside his field. Engineers must concentrate on certain specific lines and be persistent if much is to be done with legislatures."

That the trained engineer is the logical man for the management of undertakings involving the planning and execution of engineering was the conclusion of Nelson P. Lewis, vice-president of the American Society of Civil Engineers, in his paper entitled "The Relation of the Engineer to Administration."

"Morale is as important to the engineer as to the soldier," said Spencer Miller, vice-president of the American Society of Mechanical Engineers, who spoke on the "Relation of the Engineer to Public Opinion." The "spirit," in its broadest sense, back of the man wins in engineering as in other fields. Engineers are widely respected for their character, and anything which builds character will create better public opinion. A simple code of ethics was advocated to which all engineers could subscribe.

Comfort A. Adams, president of the American Institute of Electrical Engineers, in his paper on the "Relations of the Engineer to Distribution and Production" pointed out that if engineers could so improve methods and machinery that the productivity of labor would be increased until it is possible to pay labor a real living wage and still have a fair return for capital, then they will have the remedy for the present undercurrent of industrial unrest. "We are now paying a high price for having exploited cheap foreign labor," he said, "because the most active discontent to-day is in that group of people. Engineers must face the facts fairly and unless we take an intelligent step forward the great tank of discontent will crush us and all we represent."

Dr. C. A. Doremus, S. N. Cassell, Daniel Turner, F. Skinner, J. G. Johnson, H. A. Pratt, Lieut. Van Gelder, Farley Osgood, C. F. Scott, J. K. Thompson, Louis C. Marburg, and L. G. Graton were among those who contributed to the discussion.

EXHIBIT OF WAR WORK PHYSICAL APPARATUS

To Be Held Under the Auspices of American Physical Society at Bureau of Standards, Washington, from April 25 to 30

In connection with the annual meeting of the American Physical Society, April 25 and 26, it is planned to have an exhibit of physical apparatus illustrating the application of physical principles to the solution of war problems. In view of the fact that the National Academy of Sciences will be in session in Washington on April 28 to 30, inclusive, it is planned to hold the exhibit open through April 30.

The council of the Physical Society has selected the following committee to make arrangements for the Washington meeting, with powers to add to its membership: G. K. Burgess, chairman; E. B. Rosa, G. O. Squier, A. W. Duff, J. A. Ames.

At the meeting of the above committee on March 6 F. A. Wolff of the Bureau of Standards was invited to serve as a member of the committee and to take charge of the exhibit. The following statement has been issued in regard to the matter.

Object and Scope.—The main purpose of the exhibit is to present an opportunity to the physicist to inspect and see in operation new apparatus developed for war purposes, whether by the research worker or the manufacturer.

Exhibitors.—Exhibits will be accepted from military and naval establishments, universities, research institutions, manufacturers and individual investigators, whether members of the society or not. Certain military establishments have already signified their intention of participating in the exhibit. To avoid duplication of exhibits and the exhibition of apparatus which for military reasons it may be deemed unwise to show, it is suggested that prospective exhibitors first take up with the proper army or naval authorities the question of what may be properly exhibited.

Entries.—All exhibitors should furnish without delay a brief description of the apparatus which it is proposed to exhibit, together with a statement regarding space requirements (table, wall or floor). If special facilities are required to show the method of operation, ample notice should be given. In view of the space limitations, the committee feels compelled to reserve the right to accept or decline any entry, though every effort will be made to provide for all important, instructive and interesting exhibits offered.

Expenses.—Since neither the Physical Society nor the Bureau of Standards has funds available for the purpose, exhibitors will be obliged to prepay express or freight charges both ways, as well as any special expenses incident to installation and operation. The bureau will, as far as practicable, undertake to provide for hauling the exhibits and for assistance in unpacking, installing and repacking of same.

Shipping Instructions.—All exhibits should be securely packed and plainly addressed "Physical Society Exhibit, Industrial Building, Bureau of Standards, Washington, D. C." The name and address of the exhibitor should also be given. Neither the Physcial Society nor the Bureau of Standards is authorized to assume any risk of loss or breakage. All shipments must, therefore, be made at owner's risk.

Correspondence.—All correspondence regarding the exhibit should be addressed to F. A. Wolff, Bureau of Standards, Washington, D. C.

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ELECTRICAL SAFETY CONFERENCE FORMED

Organized by Associated Manufacturers of Electrical Supplies, Electric Power Club, Underwriters' Laboratories and Other Bodies

Acting upon a recommendation and suggestion from the Electrical Manufacturers' Council, representing the Electrical Manufacturers' Club, the Electric Power Club and the Associated Manufacturers of Electrical Supplies, there has recently been organized a body known as the Electrical Safety Conference for the consideration of accident and safety questions relating to electrical manufactures and products. The organizations coöperating for the formation of this conference are the Associated Manufacturers of Electrical Supplies, the Electric Power Club, the Underwriters' Laboratories, the National Workmen's Compensation Service Bureau and the Bureau of Standards, each of which is represented on the conference by two members who have been appointed as follows:

For the Associated Manufacturers of Electrical Supplies—A. W. Berresford, Cutler-Hammer Company, Milwaukee, Wis.; S. L. Nicholson, Westinghouse Electric & Manufacturing Company, East Pittsburgh.

For the Electric Power Club—A. H. Moore, General Electric Company, Schenectady, N. Y.; Clarence C. Collens, 2d, Reliance Electric & Engineering Company, 1086 Ivanhoe Road, Cleveland.

For the Underwriters' Laboratories—W. H. Merrill, 207 East Ohio Street, Chicago; Dana Pierce, 25 City Hall Place, New York.

For the Bureau of Standards—Dr. Morton G. Lloyd and Dr. E. B. Rosa, Bureau of Standards, Washington, D. C.

For the National Workmen's Compensation Service Bureau—Albert W. Whitney and L. L. Hall, 45 Park Row, New York.

The officers are: A. W. Berresford, chairman; A. W. Whitney, vice-chairman; Dana Pierce, secretary-treasurer.

The objects of the conference are stated as follows:

To promote by cöoperative effort the orderly, consistent and proper development of practice in electrical manufactures and installations with regard to accident hazards.

To promote the development and adoption of safety standards for the construction and test of electrical appliances and for their application and installation.

To interpret and make uniform the application of electrical safety codes both in regard to general principles and in regard to particular classes of appliances and systems.

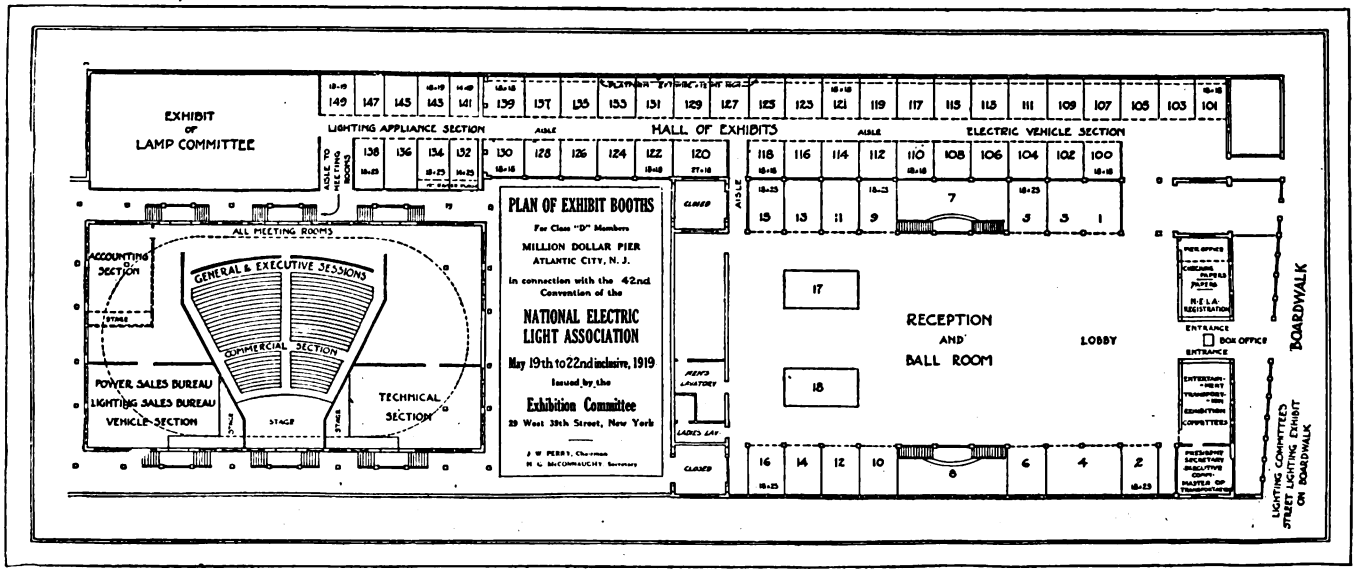
The active work of the conference as between the different coöperating associations will be conducted by means of special committees appointed from time to time, which will report back through the conference to the associations for the purpose of securing agreement and uniformity of action.

The first subject undertaken by this conference will be that of industrial controllers, on which a committee of which H. D. James of the Westinghouse Electric & Manufacturing Company is chairman, has recently been appointed. It is expected that at an early date other lines of investigation and discussion will be undertaken.

In his speech before the convention of the Associated Manufacturers of Electrial Supplies last week President A. W. Berresford of that organization said regarding the new organization:

One development of the year which is of direct interest is the formation of the Electric Safety Conference. Under the operation of workmen's compensation acts in the various states, most of which demand or permit insurance against the risk involved, the companies handling such risks found it necessary to evolve means whereby an equitable determination of the hazard could be made and the expense of providing against it properly distributed. This took the form of an organization known as the Workmen's Compensation Service Bureau, which, in a sense, occupies a relation to the casualty companies similar to that of the National Board of Fire Underwriters to the fire companies. To determine standards of installation, construction and test there was the same need of laboratory facilities. Initially it was proposed to establish casualty laboratories, but ultimately the work was, by agreement, undertaken by the Underwriters' Laboratories, and much duplication of plant and effort was avoided thereby.

Plan for Exhibits at Atlantic City Convention of National Electric Light Association



The exhibition committee of the National Electric Light Association has announced that great interest is being taken in the plan for exhibits to be held in connection with the annual convention at Atlantic City during the week beginning May 19. J. W. Perry is chairman of the committee and H. G. McConnaughy secretary.

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WILL DISCUSS THE STATUS OF INDUSTRIAL LIGHTING CODES

Meeting in New York on April 11 Is to Be Joint Gathering of Illuminating Engineering Society and A. I. E. E. Committee

A joint meeting of the Illuminating Engineering Society and the lighting and illumination committee of the American Institute of Electrical Engineers will be held at the Engineering Societies Building, New York, at 8:15 o'clock on the evening of April 11. As stated previously in the ELECTRICAL WORLD, the meeting is to be devoted to a discussion of the "Present Status of Industrial Lighting Codes in the United States." G. H. Stickney, past-president of the Illuminating Engineering Society and a member of the committee on lighting legislation of that society, will present the paper of the evening. The program for the meeting is purposely limited to one paper so that there may be time for an expression of many different viewpoints.

MINNESOTA ASSOCIATION'S AFTER-WAR CONVENTION

Advisability of Revising Former Principles Considered —Frank L. Cross of St. Paul Elected President for the Ensuing Year

The twelfth annual convention of the Minnesota Electrical Association, which closed its three-day session at St. Paul on March 20, will go down in the records as most beneficial to those in attendance. While in a great majority of cases those members who had attended the previous conventions came to obtain information rather than to give it, the conference just closed showed a real disposition on the part of the members present to give their own experience as a means of obtaining the experience of others. Information about new departures in public utility practice, made necessary by the after-war readjustments which the industry is undergoing, and which are expected to result in better business and more friendly relations with the public, was listened to with keen interest and elicited lively discussions.

One of the most interesting features of the convention was an address by William C. Redfield, Secretary of Commerce of the United States, who happened to be passing through the Twin Cities, visiting Minneapolis especially to address the "better business convention." Secretary Redfield spoke of the wonderful part electricity played in helping to win the war, dwelling particularly on wireless telegraphy, wireless telephony and the guiding of ships by electrical signals.

President B. W. Cowperthwait of Faribault in his presidential address urged the united effort of the association's membership in solving the problems of industrial readjustment. "We must continue the work of the reconstruction period with the same ideals of humanity and justice that guided us when we were mobilizing our resources for war," he said, continuing:

> To-day we are facing a new era in the history of our country. That it is to be an era of great prosperity we cannot doubt. The question for us is how we can administer the affairs of the utilities which are intrusted to us to the best interests of the communities served. I make this statement advisedly because it is now well recognized that we hold a position of public trust which we are entitled to administer only as long as we do so wisely and with due consideration of the rights of the public.
>
> If the war has brought out any one fact in our business it is the importance of public utilities to the economic growth of the country. We found our country able to prepare for the emergency which confronted it only as it was able to manufacture the materials of war, and the constant cry of the manufacturer has been for power and more power. This demand for power was made upon the central station at a time when every manufacturer of electrical equipment in the country was months behind on government work and no private orders could be filled without authority from the federal government.
>
> Again, when the word went out to conserve fuel it was to the central station that the manufacturer turned—wasteful isolated steam plants must be abandoned and central station service substituted. It is for us to see that business so acquired is now retained and that the isolated plant be never allowed to return.
>
> The country as a whole has been awakened to the necessity for conservation of our national resources. If our business is to expand it must be through the elimination of wasteful methods. I have in mind the low generating costs which can be secured by the development of large central stations, both hydroelectric and steam. These results can be brought about by the extension of transmission-line systems which are rapidly connecting the large centers with the rural communities, thus bringing the advantages of electric service to the farmer. This rapid growth of the transmission-line system is enormously extending the field for electric development. At this time I believe it would not be out of place to urge the passage of such laws as will make practicable the development of our undeveloped water powers, which were so sorely needed during the war and have greatly lightened the burden placed upon transportation.

H. L. Cross, vice-president and general manager of the St. Paul Gaslight Company, presented a paper on the reconstruction period and laid particular stress on the necessity of friendly relations with the public, not only for any particular company, but also for the industry as a whole. He advocated the use of intensive and extensive publicity campaigns as a means of keeping the public informed at all times of what the industry has done, is doing and is going to do. Mr. Cross's paper was intensely practical as well as being admirable in topic and treatment.

The discussion indicated great interest in the publicity side of the electrical industry.

D. F. Parrott, of the distribution department of the Minneapolis General Electric Company, read a paper on the recent developments in transmission-line construction for medium voltages. This paper was a concise presentation of the latest practice in line construction.

W. F. Heald, Duluth Edison Electric Company, addressed the conference on the merchandising methods for central stations and laid particular emphasis on the necessity of excluding selfish motives for the benefit of the electrical business as a whole. Closer coöperation between central stations and contractor-dealers, Mr. Heald stated, is vital to the industry and absolutely necessary to a complete understanding of the electrical industry by the public.

H. J. Meyer, Minneapolis, formerly administrative engineer for the Minnesota division of the United States Fuel Administration, outlined the work of the administration's bureau of conservation. Professor Sheperdson of the University of Minnesota presented a paper on some coming electrical developments.

Officers for the ensuing year were elected as follows: President, Frank L. Cross, St. Paul; vice-president, Leonard Peterson, Thief River Falls; second vice-president, R. M. Howard, Winona; secretary and treasurer, Meyer Barnert, St. Paul; director, W. F. Heald, Duluth.

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WATER CONSERVATION PLAN IS DISCUSSED IN MASSACHUSETTS

Recommendations of Special Commission Considered at Legislative Hearing in Boston—Private Development Under Commission Supervision Favored

The recommendations of the special commission on water conservation in Massachusetts were discussed at a legislative hearing in Boston March 18, and representatives of the New England Power Company and Turners Falls Power & Electric Company appeared in favor of the general plan providing for the coöperative development of power privileges recently outlined in the ELECTRICAL WORLD.

Chairman A. R. Weed of the Massachusetts Gas and Electric Light Commission explained the report of the special commission, which has been printed as Senate Document 298, with a draft of an act designed to promote the development of water-power resources in the state and in coöperation with other neighboring states. Mr. Weed pointed out that there is now developed about 300,000 hp. on Massachusetts streams and 500,000 hp. might be made available within the state by a satisfactory conservation program. It is proposed to authorize the forming of a reservoir or improvement company along the lines of the Wisconsin law to create storage, the developments by this organization to be based on a majority in interest and in numbers among the riparian owners along the streams concerned. The annual costs of storage operation and charges would be met by tolls, with provision for triennial readjustment of tolls, and the bill provides that in case the private owners do not develop their privileges the State may ultimately develop them. Mr. Weed said that the special commission did not desire to embark upon a state-ownership or public-operation program at this time, favoring private development under the supervision of the commission on waterways.

E. E. Davis, a civil engineer of Northampton, Mass., contributed data as to the potential and developed resources of the Westfield River, as follows:

	Developed Head, Ft.	Installed Hp.	Mean Annual Output, Hp.-hr.
Present	178	6,450	39,000,000
Potential	2,303	40,000	230,000,000

PRESIDENT HARRIMAN DISCUSSES BILL

Henry I. Harriman, president of the New England Power Company and Boston Chamber of Commerce, said that the great mass of Massachusetts water powers are not worthy of development from the financial viewpoint until storage has been created to equalize to a certain degree the very low flow of the rivers. The company's Somerset reservoir has increased the minimum flow of the Deerfield River at Shelburn Falls from 50 second-feet to about 350 second-feet. Enough water has been stored to fill the little bottom valleys in the dry days of the average year, and this has been possible because the company has controlled the greater part of the power on the stream and could afford to make an investment in the reservoir because it could spread its cost over all the powers on the stream which it owned. Mr. Harriman added:

> This bill enunciates the same principle where a common ownership is impossible. It lays upon all of the parties who are benefited by the storage the obligation to pay a part of the cost. Two or three of the companies interested in power on the Connecticut River have within the last two or three years made extensive studies of the storage possibilities of the upper Connecticut. It appears that at Bellows Fall, Vt., for example, the minimum flow could be increased from 1000 second-feet to 5000 second-feet if all the various power interests on the river would pay their share of the cost.
>
> At present there is developed about 300 feet on the Connecticut. While some progress has been made by private agreement between the various companies, it is not complete, and I believe that state regulation of such a matter is wise and in the public interest. The public gets a direct and immediate benefit because the rates of the public utilities using and selling hydroelectric power are regulated, and a benefit to mills and other private users is also realized. Our coal haul in New England, 600 miles from the mines, is the longest haul to any great manufacturing area in the country. Most of the other large industrial areas are within 100 or 200 miles of the mines. Water-power development should be encouraged.

Mr. Harriman suggested several amendments to the bill, among these being the granting to electric utilities of the right to develop power at the various sites, the specification of a reasonable dividend on the investment required for storage in place of a stated 6 per cent dividend, the sale of energy by the reservoir company at the dam site and the right of the parties to development to fix tolls, subject to filing with and regulation by the commission. The hearing was continued to March 25.

OPPOSE EXTENSION OF POWER OF MASSACHUSETTS COMMISSION

Representatives of Central Stations Present Arguments Against Plan to Enlarge Authority of the Gas and Electric Light Commission

At a legislative hearing in Boston on March 5, E. W. Burdett, counsel for the Massachusetts Gas and Electric Association, and Henry I. Harriman, president of the New England Power Company, opposed various recommendations of the Gas and Electric Light Commission for increased authority over the sale of bonds, for the power to specify depreciation allowances and dividend declarations and to validate street-lighting and inter-company contracts. These recommendations were detailed in the ELECTRICAL WORLD of Jan. 18, 1919, page 122. In general the opposition was to plans that would carry the commission over the border line into the managerial field.

Mr. Burdett said that he represented from sixty to seventy gas and electric companies, about forty of which sell electricity. The association is represented by an executive committee of eleven, which has given careful consideration to the bills in question. The capitalization represented totals about $50,000,000. The association feels that the time has come when, in response to the dictates of self-preservation, it must make a stand against the invasion of the business management of these corporations. All the members agree to the principles of the supervision, control and regulation by public authority, but feel that the line between public supervision and control on the one hand and business management on the other is the dead line across which officialdom cannot go without a challenge. The association believes that these bills overstep that limit.

Chairman A. R. Weed of the Massachusetts Gas and Electric Light Commission discussed public utility regulation briefly at a hearing in Boston March 12 in connection with the board's annual recommendations for legislation.

"I do not believe," said he, "that any public board

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wants to meddle with the public service corporations where it is proper to keep hands off.

"I have heard a good many suggestions to the effect that the board ought to administer the law as it stands, confining itself to the important questions intrusted to it by the Legislature and not go out of its way to make suggestions that are outside and are paternalistic in their character. I do not believe it would be an efficient method of applying the remedy if, when we reached the point where a company should correct its ways, we had either to approach it by methods of publicity, primarily, or by a recommendation which we could not enforce. I think this is a remedy the virtue of which rests largely in the fact of possessing power. . . . I don't think, in fact, that you men realize the authority granted to the board with respect to rates, with respect to impairment of capital, to the supply of individual customers and other important questions. That power is of considerable importance, is more drastic and has less qualification about it and was earlier enacted than any other [regulative] law in the United States. . . . The power has been administered with moderation, and, I believe, on the whole, with reasonable justice. . . . If that confidence cannot be placed in the board, it is high time that some new arrangement was made."

STANDING COMMITTEES OF N. F. P. A. ELECTRICAL COMMITTEE

Personnel of Bodies Which Will Have General Direction of Recommendations for Changes of the National Electrical Code

In accordance with the newly adopted procedure of the electrical committee of the National Fire Protection Association the following standing committees have been appointed to have a general direction and supervision of investigations and recommendations for future changes and revisions of the National Electrical Code:

Cars and Railways. — M. Schreiber, chairman, Public Service Electric Company, Newark, N. J.; R. C. Bird, Ralph Sweetland.

Devices and Materials.—A. R. Small, chairman, Underwriters' Laboratories, 207 East Ohio Street, Chicago; H. R. Sargent, H. O. Lacount.

Fixtures, Heaters, Signs and Lamps. — J. C. Forsyth, chairman, New York Board of Fire Underwriters, 123 William Street, New York; G. E. Bruen, C. H. Lum.

Generating Stations and Substations. — A. M. Schoen, chairman, Southeastern Underwriters' Association, Atlanta; W. H. Blood, K. W. Adkins.

Grounding. — W. H. Blood, chairman, National Electric Light Association, 147 Milk Street, Boston; C. M. Goddard, H. S. Wynkoop.

Industrial Applications.—G. S. Lawler, chairman, Associated Factory Mutual Fire Insurance Companies, 31 Milk Street, Boston; F. Osgood, C. B. Langdon, J. M. Curtin.

Outside Wiring, Building Supply and Services. — M. G. Lloyd, chairman, Bureau of Standards, Washington; C. H. Hill, F. F. Burroughs.

Signal Systems, Wireless and Lightning. — W. S. Boyd, chairman, Western Association of Electrical Inspectors, Insurance Exchange, Chicago; A. M. Paddon, C. W. Mitchell.

Theaters, Moving Pictures, Places of Public Assembly and Garages. — Washington Devereux, chairman, Philadelphia Fire Underwriters' Association, 141 South Fourth Street, Philadelphia; V. H. Tousley, C. M. Tait.

Wiring Standards and Systems.—W. C. Peet, chairman, Peet & Powers, 70 East Forty-fifth Street, New York; Dana Pierce, F. Overbagh, R. P. Strong.

Suggestions for such changes should be sent to Dana Pierce, chairman of the electrical committee, 25 City Hall Place, New York, for reference to one or more these standing committees.

THE LIGHTING INDUSTRY DURING RECONSTRUCTION

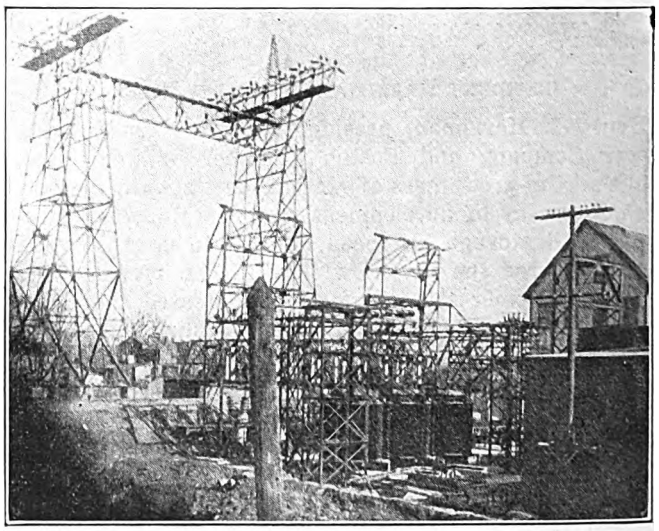
Definite Measurement of Intensities and Fixing of More Exact Requirements for Specific Kinds of Work Will Be Features

Two fundamental things which the men in the lighting industry should preach to the electrical trade and to the public during the coming year were explained by S. E. Doane, chief engineer of the National Lamp Works of the General Electric Company, Cleveland, before the Chicago Section of the Illuminating Engineering Society on March 20.

The first fundamental is that the foot-candle, which is the unit of light intensity, can be definitely and easily measured. The second deals with the lighting requirements for various classes of work. The speaker predicted that the intensities necessary for different jobs in all trades would become a matter of record in which the agreement as to values would be reasonably well accepted. As an instance of the beginning of this work, he cited the work of the Industrial Commission of Ohio in its proposed code of industrial lighting. In its present form this code devotes eight closely tabulated pages to data giving foot-candle intensities that should be employed in various classes of manufacturing.

Discussion of the address centered largely around the point that the Illuminating Engineering Society has not announced intensity standards which it is willing to declare are correct for use in different trades and various applications in the trades. J. N. Pierce, electrical contractor, pointed out that it would make the selling job of the trade very much easier if some national body would take the responsibility of announcing such data.

Outdoor Substation Replaces Steam Plant



At Westfield, Mass., a 500-kva. outdoor transformer installation is being completed by the Turners Falls Power & Electric Company, which supplies energy to the municipal lighting department of the town and to the Springfield Street Railway Company's local lines, formerly furnished by an 1800-kva. steam plant owned by the town and a 1000-kw. steam plant owned by the railway company.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

San Francisco Electrical Development League.—At the March 17 meeting of the league Charles Victor, Pacific Coast manager Yawman & Erbe, spoke on "The Personal Side of Scientific Salesmanship."

Trenton (N. J.) Engineers' Club.—On April 10 H. C. Eddy, senior inspector of traffic, Board of Public Utility Commissioners of New Jersey, will give an address on "The Development of the Electric Railway" at the meeting of the Trenton Engineers' Club, Trenton, N. J.

Public Utility Problems Presented to Board of Trade.—An interesting address on "The Problem of the Public Utility" was given by Ralph Elsman general manager of the Kings County Lighting Company, Brooklyn, N. Y., before the Gravesend Beach (N. Y.) Board of Trade on March 3.

Piezo Electricity Discussed in Syracuse.—At a joint meeting of the Syracuse Chemical Society and the Technology Club, Syracuse, N. Y., held on March 8, an illustrated talk on Piezo electricity, its development, uses, etc., was given by Alexander McL. Nicolson of the Western Electric Company, New York.

Engineers' Club of Philadelphia.—Morris L. Cooke is to speak on "The Participation of Engineers in Public Affairs" and Prof. George B. Pegram, dean of the School of Mines, Engineering and Chemistry, Columbia University, is to speak on "A Broader Type of Training for Engineers" at the Tuesday noon luncheons of the Engineers' Club of Philadelphia to be held on April 15 and 22.

Electrical Men of Buffalo Organize.—"The Electric Club of Buffalo" is the name of an organization recently formed in Buffalo, N. Y., "to encourage the more extensive use of electricity and to promote generally the welfare of the electrical industry." Among other things that the club will try to do will be urging the adoption of durable and efficient electrical devices and apparatus and their safe and proper installation. A feature of the organization is that each corporation, partnership and individual is entitled to only one vote regardless of how many men in a company are members of the organization. The club also intends to have meetings of a civic and educational nature. The first officers of the club are: President, L. A. Wooley; vice-president, L. E. Le Vee; secretary, H. H. Howell; treasurer R. Wahle.

A. I. and S. E. E., Philadelphia Section.—"Power Transmission" will be the subject of a talk by H. B. Vincent, operating engineer, Day & Zimmerman, Philadelphia, before the April 5 meeting of this section of the Association of Iron and State Electrical Engineers, to be held in the Engineers' Club.

Engineers' Society of Milwaukee.—J. R. Watson of Chicago gave a talk on "The Use of Synchronous Motors with Ammonia Compressors" at the March 19 meeting of this society, while Duncan Watson, M. I. E. E., a London alderman and chairman of the Joint Conference on Electrical Undertakings of Greater London, made a short address.

N. E. L. A., Power Sales Bureau.—A dinner will be held by the power sales bureau of the National Electric Light Association at Atlantic City during the week of the association's annual convention. John W. Meyer, Philadelphia Electric Company, chairman of the dinner committee, would like to be advised of the members' present business connections.

Employer and Employee Relations.—A joint meeting of the Chicago sections of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Western Society of Engineers, held on March 24, heard A. H. Young, manager of the industrial relations department, International Harvester Company, speak on the subject of "Industrial Personnel Relations."

I. E. S., Philadelphia Section.—On March 21 a paper entitled "Transmission of Colored Light Through Fog," prepared by C. L. Utterback, University of Washington State, was presented by Prof. Thomas D. Cope, University of Pennsylvania, who also discussed several of its phases. A paper will be presented at the April meeting of the section on "Some Practical Measurements of Daylight in Modern Factory Buildings," by E. G. Perrot and F. C. Vogan, of the architectural firm of Ballinger & Perrot.

American Institute of Electrical Engineers

Schenectady Section.—"Industrial Reëstablishment of War Cripples" was the subject of an address by Prof. F. H. Sexton, Nova Scotia Technical College, Halifax, N. S., given before the meeting held on March 21.

Lynn Section.—E. F. W. Alexanderson, consulting engineer, General Electric Company, lectured on "Transoceanic Radio Communication" at the March 26 meeting. A new radio system of the General Electric Company, known as the "Alexanderson system," was described in the lecture, which was illustrated by lantern slides.

Toronto Section.—Frank R. Ewart presented a paper entitled "Business Relations of the Engineer" at the meeting on Feb. 21. This section has opened a department in its employment office for the use of engineers and technical men returned from the front and desiring new business connections.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Valuation, Insurance and Depreciation.—The Railroad Commission of Wisconsin, in authorizing the Wisconsin Traction, Light, Heat & Power Company, Appleton, to increase electric rates, takes up also a number of other practices affecting operations. It says on several subsidiary points: "The utility contends that the value to be used at this time should at least be based upon the average cost of buildings, machinery, apparatus, material and wages during the past five years. During the present period of abnormally high prices the commission's engineers have adopted a ten-year average in determining unit costs in order to smooth out the price curve in those instances where the investment cost basis could not be used because of lack of adequate and reliable records. In the present case it is not believed that an appraisal at this time would show values materially different from those outlined above. . . . It appears clear that the consumers are now contributing through the rates charged an amount sufficient to enable the utility to carry insurance sufficient to cover every contingency which might arise. The utility, in order to protect not only itself but its customers, should, we believe, modify its present practice relative to carrying its own insurance on parts of its property. . . . The company, instead of reserving each year a percentage of the depreciable plant value based upon a composite life study, ignores such value entirely and sets aside a percentage of the gross revenues. This is a very convenient method used by a small number of utilities. It has the advantage of regulating the amount provided for depreciation in accordance with the gross income, but a reserve so provided may have no proper relation to the deterioration actually taking place in the property, because it is fixed entirely independently of the invested values. We have in this case based our allowances for depreciation upon the depreciable physical property used and useful. In the case of the electric light and power department of the utility this procedure results in a larger annual charge to operating expenses for this item than the utility's practice. In justice both to the consumers and to the utility, we believe that the utility should adjust its depreciation charges in line with the actual depreciable property."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Water Power in Iceland.—United States Commercial Attaché Erwin W. Thompson, Copenhagen, Denmark, sends the following, taken from the Copenhagen *Berlingske Tidende:* "One of Norway's most prominent hydraulic engineers, G. Saetermoen of Christiania, recently made a speech in the Polytechnic Union in Christiania with regard to the building and utilization of water power in Iceland. Iceland is much better adapted than Norway for building water-power plants. The water-level variations are considerably less, the climate is more favorable, there are no ice difficulties, no fishing and no rafting of timber. Upon Norwegian initiative a new company has been formed under the name of "Titan" for building a series of power plants in Iceland. It is first the intention to utilize for electric power the Thorsaflod, which is Iceland's largest river. It has three tributaries running through southern Iceland with a total width of 5000 ft. to 8000 ft., and it has the most favorable development possibilities at proportionately small cost. The six power stations which are planned will together produce 1,114,000 hp., and the power can be delivered to Reykjavik just as cheaply as the Norwegian cities get their waterfall electricity.

Power Development in Sweden.—United States Consul General Albert Halstead writes from Stockholm, Sweden, that for the purpose of promoting greater efficiency in the operation of existing power stations in their district thirty-three of central Sweden's largest power producers have organized the Aktiebolaget Bergslagens (Combined Power Control), with a minimum capital of $402,000 and a maximum of $1,206,000. This company does not contemplate the erection of any new stations. It has found that the full production capacity of all stations at present in operation is not utilized, and it will aim, by a transfer of power from those stations capable of a greater output to those carrying too heavy a load, to make an equitable distribution. The Torpshammar Aktiebolaget is building at Torpshammar (Sundsvall) a new power station to develop 30,000 hp. The water-power commission, which was granted $2,200,000 for its work in 1918, has asked the government for an additional $268,000, to be used in making new purchases. The commission also has asked for $268,000 in 1919 and $670,000 in 1920, to be used in the construction of new power stations and in the improvement of stations already operating. Stations at Tyttbo and Umea are in view and extensive improvements at the Norrforsarna and Sorforsarna stations are among those planned.

Appliance Campaign at Cohoes, N. Y.—The Cohoes (N. Y.) Power & Light Corporation is about to open a display room and start an intensive campaign covering the sales of electric appliances.

National Electric System for Spain.—United States Consul General C. B. Hurst writes from Barcelona that a royal order published Dec. 31, 1918, provided that as soon as possible a permanent Spanish electric commission should be formed under the direction of the Ministry of Public Works. This commission is to report on the following points: (1) The possibility and practicability of the construction by the state, directly or indirectly, of a national system for the distribution of electric energy; (2) the maximum extension possible of such a system; (3) the approximate cost of such a system calculated on a basis of relatively normal prices, or with copper at between £70 and £80 per ton; (4) the possibility of the state supplying the capital to be thus employed or of guaranteeing its interest, taking tolls on the energy transmitted, and how much this toll should be, or any other means of financing the system deemed preferable; (5) the possibility of a uniform tension and the means to secure it; (6) the basis on which a law should be drawn up in connection with the foregoing. The director general of Spanish commerce, industry and labor states that it is of transcendent importance to Spanish industry that it avail itself of the electric energy that the country is capable of producing.

Re-education and Rehabilitation of Injured Employees.—A special committee has reported to the executive committee of the Empire State Gas & Electric Association on the re-education and rehabilitation of employees injured in industry. It is composed of J. C. Robinson, Ralph Elsman and C. E. Morrison, chairman. It expresses the belief that injured employees should be re-educated at least and perhaps rehabilitated at some central establishment organized for that purpose such as the Red Cross Institute for Crippled and Disabled Men, New York. The committee recommends that the public utility industry of New York State undertake this re-educational and rehabilitation work by arranging for a course of study at some central establishment, and that the necessary equipment be provided by the industry. This equipment might include the apparatus necessary for general training in both the gas and electrical industries. The committee also decidedly recommends the re-employment by the public utilities of their own disabled employees, provided they have successfully passed the requirements of the re-education instruction, and provided such employees are fully able to compete with others not handicapped by disability of any kind. The Federal Rehabilitation and Vocational Board, the committee understands, has suggested to some of the public utilities that they arrange to train, or educate industrially, injured sailors and soldiers, and that during the period of re-education the public utilities accept the burden of paying these sailors and soldiers a living wage. It is believed by the committee that the appropriations made by the government for this work were meant to include the maintenance during re-education of injured sailors and soldiers and that it is no function of the public utilities to assume this expense. The committee recommends, however, that the public utilities freely co-operate by permitting disabled soldiers and sailors to enter their plants for re-educational purposes, provided that no wage expense is attached thereto.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Muncipality's Relation to Rates.—Regulations regarding rates for gas which municipalities may impose in granting licenses or permission to use the streets to public service corporations do not form contracts beyond the inherent police power of the Legislature to modify, according to the Court of Appeals of New York (121 N.E. 777). Rate regulation being a matter of police power, the terms and conditions upon which a gas and electric company is allowed to use the streets of a municipality may be modified without impairing the obligation of a contract within the constitutional provision. Under the Public Service Commissions law, the state Public Service Commission has authority to regulate charges made by a gas company supplying the residents of a village.

Flowage Rights.—Where certain flowage rights appurtenant to plaintiff's lands were vested in plaintiff's grantor, but not conveyed with the fee to plaintiff nor with defendant's dam and factory sites, and according to the record remained in grantor, neither plaintiff nor defendant is possessed of the flowage appurtenant to plaintiff's land by grant, the Supreme Court of Michigan held in Murphy versus Big Rapids Water Power Company (170 N. W. 644). In a suit for mandatory injunction to compel defendant to lower a dam to prevent backing up water over plaintiff's springs, which he used for domestic purposes by means of a hydraulic ram, it was held that the relief alternative to lowering the dam should be a money consideration and not perpetual furnishing of energy for running a pump.

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

H. E. Cox, formerly an engineer for the Birmingham Steel Products Company, has been appointed assistant to the chief engineer of the Birmingham (Ala.) Railway, Light & Power Company.

Barzillai G. Worth, vice-president and formerly electrical engineer of Walter Kidde & Company, Inc., has been elected treasurer of the Monmouth Chemical Company and will also be in charge of manufacturing and research.

Arthur V. D. Piper has been elected president and member of the board of directors of the subsidiary companies of the Central New Hampshire Power Company, Concord, N. H. Mr. Piper has been general counsel for the companies for some time.

H. H. Clark, formerly electrical engineer of the United States Bureau of Mines and during the war a major in the Chemical Warfare Service, has returned to civil life as chief engineer of the Witherbee Igniter Company of Springfield, Mass.

F. L. Cross, who has been elected president of the Minnesota State Electrical Association, has been associated with the public utility business in the Northwest for about ten years. From March, 1910, until November, 1917, he was vice-president and general manager of the Madison (Wis.) Gas & Electric Company. Since that time he has been vice-president and general manager of the St. Paul (Minn.) Gas Light Company, which is a combination electric and gas property.

Gen. Guy E. Tripp was recently decorated with the distinguished war service medal of the United States government, which was awarded him for his excellent work in systematizing methods and practice, resulting in the efficient coöperation of industries producing ordnance material for the army. He entered the army with the rank of colonel as chief of the production division of the Ordnance Department and was later promoted to the rank of brigadier general as assistant chief of ordnance. Before going into service General Tripp was president of the board of directors of the Westinghouse Electric & Manufacturing Company, to which position he returned after the signing of the armistice.

Guy C. Pierce will succeed W. E. Coman, whose resignation was announced in the ELECTRICAL WORLD of Feb. 15, as vice-president and general manager of the Northwestern Electric Company at Potland, Ore. Mr. Pierce has been identified with the electrical systems of the Pacific Coast for many years. In 1887 he was in the employ of the local electrical company at Sacramento, Cal., going later to San Francisco, where he had responsible charge of work in some of the pioneer power installations of the state. In 1901 he went to the City of Mexico to take charge of electrical properties for Pittsburgh interests. After remaining there for three years he went to New York and was for two years chief inspector for the Hudson & Manhattan Tunnel Company. From 1906 to 1909 he was identified with the East St. Louis & Suburban Railway Company, controlled by E. W. Clark & Company of Philadelphia. In 1909 and 1910 he was engaged in the development of the Mount Hood Railway & Power Company at Portland, Ore., which was later taken over by the Portland Railway, Light & Power Company. Mr. Pierce goes to Portland from Los Angeles, where he has been associated with R. C. Gillis in water-power development.

L. L. Newman, who was elected vice-president of the Birmingham (Ala.) Railway Light & Power Company, a little less than a year ago, has been named chief engineer of the company. He will devote practically all of his time to maintenance work. Mr. Newman prior to his appointment early in 1916 as assistant general manager of the company was superintendent of way and structures. Previous to his connection with the Birmingham property Mr. Newman was employed in various departments of the Pennsylvania Railroad.

Ira W. McConnell has become associated with Dwight P. Robinson & Company, Inc., constructing and consulting engineers, New York City, in the capacity of vice-president. Mr. McConnell was graduated from Cornell University in 1897 and for the next two years was instructor in the College of Civil Engineering at Cornell and for one year professor of Civil Engineering at the Missouri School of Mines. Mr. McConnell's experience includes six years in the United States Reclamation Service. In 1909 he became chief irrigation engineer for J. G. White & Company and later vice-president and general manager of the Idaho Irrigation Company at Richfield, Idaho. In February, 1912, he was employed by the Stone & Webster Engineering Corporation as consultant in connection with the design, construction and operation of public utilities, water powers, railways, steam-power stations, industrial buildings, etc. In 1916 he made a five months' study of general business conditions in South America, the trip covering the developed portions of Brazil, Uruguay, Paraguay, Argentina, Chile and Peru. In the following year he became chief engineer for Stone & Webster and later works manager and assistant general manager for the American Shipbuilding Corporation at the Hog Island shipyard.

J. K. Swanson, former secretary of the Michigan Power Company and assistant secretary of the Consumers' Power Company, has been appointed successor to B. R. Laraway as manager of the Jackson (Mich.) district of the Consumers' Power Company.

W. I. Bickford, who was elected chairman of the Atlantic division of the Electrical Supply Jobbers' Association at the recent meeting in New York City, has been secretary-treasurer of the Iron City Electric Company, Pittsburgh, Pa., since its organization in 1907. Mr. Bickford was born in Washington, D. C., Nov. 13, 1879. He attended Phillips-Exeter Academy and in 1901 was graduated in electrical engineering from the Massachusetts Institute of Technology. During the following school year he was an assistant instructor in the department of electrical engineering and physics at the institute. He then became electrical engineer in the office of the supervising architct of the Treasury Department at Washington and in 1903 became associated with the Iron City Engineering Company, Pittsburgh. In September, 1904, he became secretary-treasurer of the company. Mr. Bickford is a member of a number of prominent Pittsburgh business and social societies and for the past two years has been a member of the executive committee of the Electrical Supply Jobbers' Association.

Obituary

Charles T. Jaeger, one of the pioneers of the miniature incandescent-lamp industry, died recently at his home in Brooklyn, N. Y., from pneumonia. Mr. Jaeger retired from active business about five years ago. He was a brother of Herman J. Jaeger, of the H. J. Jaeger Company, Weehawken, N. J.

Thomas Bentley Hardin of the law firm of Hardin & Hess died March 12 at Phoenix, Ariz. Mr. Hardin was considered an authority on corporation and public utility law. From 1888 to 1907 he was in practice at Seattle, Wash., being a law partner of James Hamilton Lewis, now a United States Senator from Illinois.

Dr. James J. Clark, a pioneer in the development of telegraph devices and a contemporary of Samuel Morse and Alfred Vail, died in Washington, D. C., on March 21 at the age of ninety years. At the time of his death Dr. Clark was probably the oldest pioneer in the telegraph industry. He entered the industry in the forties. He was a builder of telegraph instruments in Philadelphia in the early days. He also built telegraph lines and at the outbreak of the Civil War connected the War, Navy and other government departments by wire. Prior to that all communication between these departments had been by courier. Dr. Clark invented the first successful cloud-circuit repeater, which with slight changes from the first design is still in use.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

BUILDING EXPECTED TO OPEN UP BEFORE LONG

Cut in Steel Prices Should Hasten Contracts—Except for Conduit, Lower Prices in Electrical Materials Not Anticipated

Cuts in steel prices last week are expected to prepare the way for a resumption of building. Structural steel is lower and pipe is expected to follow almost immediately. Moreover, the cuts have been sufficient to warrant the expectation of lower prices on tools, hardware, heating and plumbing iron and steelware.

Should the expected lower prices of building materials bring any considerable volume of construction, the electrical trade will naturally benefit. However, it must be remembered that orders for electrical material are among the last to be placed. For that reason even if building began on a large scale in April the electrical trade would hardly be expected to feel it before July or later.

There is this satisfaction, however. Manufacturers and jobbers will know sufficiently well ahead what is expected of them and consequently will be in a position to make favorable quotations and deliveries without injury to stocks.

It seems doubtful that electrical building materials will go much lower. Wire, with the exception of a few concerns, has followed the price of copper downward rather consistently. Copper appears to be at about as low a level as it will reach this year. In fact, it would not be surprising to see copper 2 cents to 3 cents higher before the end of the summer. Schedule material, however, shows no signs of coming down.

Rigid conduit, following the announcement of the steel cut, came down five points, and flexible metallic conductor is off this week $10 per 1000 ft.

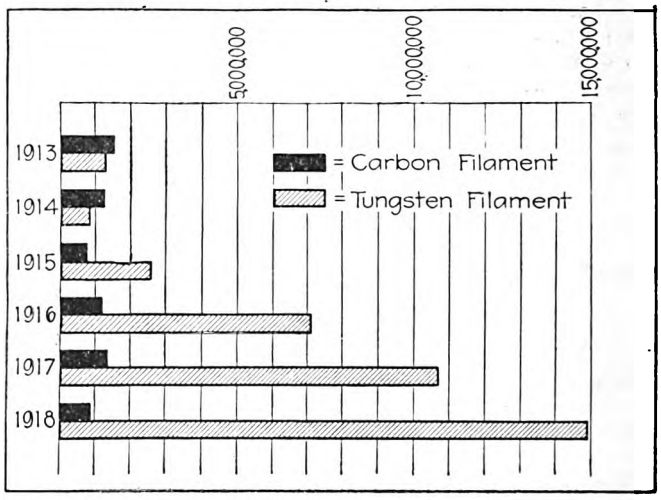
ANALYSIS OF EXPORTS OF INCANDESCENT LAMPS

In Six Years the Number of Lamps Exported Has Increased Over Ten Times—Still Large Unfilled Market

Exports of electrical goods have grown rapidly in the last six years, particularly exports of incandescent lamps. An analysis of the growth of the foreign demand for this commodity has been made by the ELECTRICAL WORLD. As will be noted from the chart, the exports of carbon lamps have been virtually the same year in and year out, while the exports of metal-filament lamps, with the exception of a slump in 1914 when the war began, are rapidly mounting. The figures as shown in the accompanying table give the number of metal-filament lamps exported annually, classified according to world geographic divisions. In each case the year has been taken as the fiscal year ended June 30. For 1913 the total is 1,363,493 lamps; it was 849,261 in 1914, 2,509,849 in 1915, 7,670,868 in 1916, 10,703,531 in 1917, and 14,855,849 in 1918.

It is evident, however, from a study of these figures that the foreign market for lamps is almost exclusively in North and South America. Thus 76 per cent of the lamps exported went to this hemisphere in 1913, 81 per cent in 1914, 64 per cent in 1915, 54 per cent in 1916, 84 per cent in 1917, and 87 per cent in 1918.

It is interesting to note how the war affected the Canadian demand for American lamps. Starting out in 1913 Canada took but 7 per cent of this country's exports of metal-filament lamps, or 95,864 lamps. It took 9 per cent in 1914, or 75,568 lamps; 9 per cent again in 1915, or 220,452 lamps; 7 per cent in 1916, or 537,403 lamps; 18 per cent in 1917, or 1,894,913 lamps, and 22 per cent in



GROWTH IN NUMBER OF INCANDESCENT LAMP EXPORTS DURING PAST SIX FISCAL YEARS

1918, or 3,261,113 lamps, thus becoming the foremost export customer in this market.

In South America Argentina and Brazil are the largest markets. Combined they imported American metal-filament lamps as follows: 1913, 336,977 lamps; 1914, 128,380 lamps; 1915, 510,748 lamps; 1916, 1,338,226 lamps; 1917, 3,758,884 lamps, and 1918, 4,266,086 lamps. These two republics absorbed 67 per cent of all American lamps going into South America in 1913, 53 per cent in 1914, 72 per cent in 1915, 71 per cent in 1916, 92 per cent in 1917, and 68 per cent in 1918.

There is, however, a large foreign demand that is not being met by American lamp manufacturers. As far back as 1912, for instance, Germany exported (exports to United States excluded) lamps to the value of $12,700,000, or, at an average of 30 cents per lamp, 42,000,000 lamps. Germany's largest customers in that year, on the same basis of 30 cents per lamp, were: Italy, 3,200,000 lamps; Spain, 2,400,000 lamps; Argentina, 1,500,000 lamps; Brazil, 1,400,000 lamps; Great Britain, 5,500,000 lamps; Austria-Hungary, 3,600,000 lamps; France, 2,300,000 lamps; Russia, 8,600,000 lamps, and Belgium, 1,800,000 lamps.

NUMBER OF METAL-FILAMENT INCANDESCENT LAMPS EXPORTED DURING LAST SIX FISCAL YEARS— CLASSIFIED GEOGRAPHICALLY

	1913	1914	1915	1916	1917	1918
Europe	36,599	18,126	447,300	1,923,881	285,655	194,675
North America	513,244	442,603	894,441	2,287,692	4,863,947	6,720,023
South America	519,895	243,938	706,477	1,884,339	4,105,591	6,249,516
Asia	10,408	14,198	191,477	517,926	599,335	373,089
Oceania	190,650	96,551	150,218	618,894	663,984	891,462
Africa	92,697	33,845	119,936	438,136	185,019	427,084
Total	1,363,493	849,261	2,509,849	7,670,868	10,703,531	14,855,849

Great Britain in 1912, on the basis of 30 cents per lamp, exported about 1,000,000 lamps. No returns were available from Holland or from Austria-Hungary.

Nevertheless, it is apparent that a large foreign demand

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remains unfilled. England was not able to make large exports during the war, and the Central Empires, except for contiguous territory, made none. Holland did a large business during the war in Europe, particularly with England. Japan did some business and is fast becoming a factor in the incandescent-lamp market. There is, however, considerable American capital invested in Japanese lamp production. Such production, the impression exists, will be devoted almost exclusively to supplying the Far Eastern demand in Russia, Japan, China and perhaps Australia and nearby markets.

English lamp manufacturers are for making a bid not only to supply the domestic market but also to enter foreign markets to a larger degree. Owing to domestic conditions, however, it seems doubtful that English manufacturers will become a large factor in foreign markets at the present time.

The United States used to import large numbers of lamps, but, owing to the ability to diminish production costs, it was possible as early as 1914 to compete with foreign lamps on a price basis. Since that time patent infringement has served to prevent any large quantity of foreign tungsten-filament lamps being imported.

METAL MARKET SITUATION

Steel Prices for the Year Stabilized—Copper Market Has Grown Stronger

With the strongly expressed opinion of many steel producers that at this time there should be either a large reduction in steel prices, one that would command the interest of the long-range buyer, or none at all, there comes the news that an average reduction of about $7 per net ton will fit grooved-steel skelp and wire products and $5 per net ton will fit everything else. The Industrial Board stated that the public should not expect to buy below the reduced prices during the present year.

There has been a decided change for the better in the copper market. The sales for March 22 and 24 totaled 35,000,000 lb., or better than either January or February, and if the major part of the inquiries now in the market are closed before the end of March, the total transactions for March alone would be about 100,000,000 lb., or more than the combined sales from Nov. 11 to Feb. 28. Apparently the turn has been reached, for the market price is advancing and is quoted at 15.25 cents per pound. Last week it was 14.87½ cents.

Aluminum has dropped off a cent and sheet zinc a cent, while copper at London has advanced £1. Scrap lead has dropped about ½ cent and scrap zinc about the same, but the old-metal market has continued in its quiet state.

NEW YORK METAL MARKET PRICES

	March 18	March 25
Copper:	£ s d	£ s d
London, standard spot	77 0 0	78 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	15.25 to 15.50	15.25 to 15.50
Electrolytic	14.87½	15.25
Casting	14.75	14.87½
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	6.90	6.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	10.00
Spelter, spot	6.50	6.52½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	30.00	29.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.25	12.75 to 13.00
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.25
Lead, heavy	4.75 to 4.87½	4.25 to 4.50
Zinc, old scrap	4.50 to 4.75	4.00 to 4.50

THE WEEK
IN TRADE

THE last of the winter months is gone, and the industry faces spring in excellent condition. Building is opening up, in a small way to be sure, but definitely. Lower steel prices and dropping materia' costs predicate the coming of larger building.

Prices of conduit, metallic flexible conductor and wire are lower. It appears evident, however, that the latter has about reached its lower limit, at least for some time.

Collections are holding up well, and with a continuance of good retail business and a promise of work building should be better.

NEW YORK

With the recent action of the industrial board of the Department of Commerce and the representatives of the steel industry, wherein the price of steel for building construction, among other steel products, was reduced, there is manifest hope that consideration will soon be given to other materials of building construction, with the result that there will be lower prices all along the line. The declines so far have been of such a nature that there is expected to result a moderate amount of transient business, covering requirements that could hardly be postponed. These lower prices merely tend to stabilize the market and establish a minimum which is likely to prevail during the 1919 building season.

During the week ended March 15 contracts were placed in the metropolitan district for a total of 167 projects, representing an expenditure of practically $5,500,000, as compared with 112 operations, for $3,000,000, placed the week before.

Labor disturbances are fewer this week than they have been in some time.

Several refrigeration projects have just come through, and it is expected that they will be in operation about the first of July. Central stations have withdrawn some of the restrictions placed on extensions of lines, but as yet there has been little advantage taken of this commercially either for power or lighting purposes. Increase in watt-hour meter sales has not been marked, but a small market has been noticed for power transformers and regulators.

Jobbers have reported March so far as a rather good month. Their collections have been good both from contractors and dealers and are keeping pretty well under sixty days.

USED APPARATUS.—One large dealer states that, although inquiries have fallen off, orders have become better. Most of the equipment is for use on central-station lines rather than on isolated lines. His experience with motors bought by the government for war work is that the government is holding many of these motors for future use. Another large dealer reports the used market very quiet and finds that in some cases the government is using motors in part settlement to the industrial concerns where they were used. This equipment has been written off at a low percentage of its original cost.

TRANSFORMERS.—An increase in demand for power transformers of all sizes has been reported by one large manufacturer. These are for both central stations and industrial plants. Inquiries in another case bring no appreciable increase in demand. Deliveries are becoming much better.

FEEDER REGULATION.—There has been reported an increased demand for this type of apparatus.

SWITCHBOARD EQUIPMENT.—A much improved market has been reported for panelboards and equipment, and especially oil switches. This is in a large part for converting and replenishing industrial plants.

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IRON CONDUIT.—Since the change in steel prices rigid conduit has eased off five points.

NON-METALLIC FLEXIBLE CONDUIT.—Discounts have changed from 60 per cent to 70 per cent, making a reduction in price of 25 per cent.

LAMP CORD.—Some very large orders have recently been placed, presumably for socket devices.

POWER CABLE. — With the exception of Hartford, Conn., which is ordering cable for street lighting, there is little activity in this section for power cable. Cincinnati, however, has just placed a large order for use in street lighting, and Chicago and Niagara Falls have ordered cable for power puproses.

CRANES.—Prices on overhead electric cranes have been reported down 20 to 33⅓ per cent, and in one case 50 per cent.

FLEXIBLE METALLIC CONDUCTOR.—Prices were reported on Monday to be down $10 per 1000 ft.

WIRE.—Rubber-covered wire base is still on 20 cents. One manufacturer went to 18 cents this week, which is the lowest mark wire has yet hit. Another producer, however, stiffened his base from 20 cents to 22 cents. Present indications are that wire has gone about as low as it will do for some time.

CHICAGO

A climax appears to have been reached in the market situation. Up to the present time practically all Chicago jobbing houses have had more persons than usual in the departments devoted to answering inquiries, and these departments have been further behind than ever. The trouble has been that not a sufficiently large percentage of these inquiries developed into business. Indications this week are that the market has turned the corner and that estimating will now give way to buying. Observers who have made this decision arrive at it on the basis of two facts—first, the steel price situation has been definitely settled, and, second, buyers who have been watching the copper market very closely for the last three weeks have closed orders. In regard to the steel price there is a divided opinion among the jobbers as to the effect on the electrical business. Some think it will help the situation wonderfully; that conduit will of course decline somewhat, but that the real effect will be brought about more by the stabilizing influence of the decision than by any change in price. Others would like to have seen the price decrease from 20 to 25 per cent with assurance that it would hold for a longer period than that stated in the present understanding. It is agreed that line hardware will probably go from 10 to 15 per cent lower, but this is not a large item, inasmuch as a 10 or 15 per cent change in the price of hardware does not make a big change in the price of a line. There have been a number of price changes during the week. The building outlook in Chicago continues to be bright, if one may judge from the columns of the newspapers. Ground will be broken in June for a new hotel on Chicago's north side to cost $4,500,000. The American Association of Engineers is endeavoring to promote the building of a ten-million-dollar memorial building in the city. Building permits for the week increased to $1,370,000 against last week's figure of $500,000.

Further information regarding the building program for grain elevators for 1919 gives more specific information as to the amount of electrical material which will be required for this work. Of the large type of elevators seventy-five are scheduled to be built in 1919. A typical design for such an elevator includes forty-seven motors ranging in size from 3 hp. to 100 hp. There are in such an installation 1081 outlets.

COPPER WIRE.—The Chicago City Railways Company this week purchased 97 miles of three-line No. 0 trolley wire from the Central Electric Company of Chicago. The base of both rubber-covered and weatherproof copper wire in Chicago has remained at 20 cents.

HIGH-TENSION PORCELAIN.—The market for high-tension porcelain is steady, and it seems improbable that there will be price decreases in the near future. High-tension insulators are usually made up in quantities at the factories during the winter months to supply the spring demand. This course was followed during the past winter, and the present stocks are those which are made up under high cost conditions. It seems improbable that prices will decrease until these stocks have been entirely cleared out, and they may not even decrease then, as the labor situation in the porcelain centers is reported not to have improved.

STANDARD PORCELAIN.—There has been a decrease in price of about 25 per cent in standard porcelain.

BOXES AND BUSHINGS.—There has been a decrease in price of 15 to 20 per cent affecting boxes and bushings.

CONDUIT.—Non-metallic flexible conduit has decreased 25 per cent in price.

APPLIANCES.—The general appliance market continues to exhibit a strong demand with supply maintained in a desirable manner.

BOSTON

The volume of trade is well maintained, despite the slow development of new business projects. Stocks are beginning to get "spotty," owing to the hand-to-mouth purchases of jobbers. Inquiries are coming in faster, and central-station outputs are holding up exceedingly well. Collections are fairly good this week. Great interest in electrical accessories was displayed at the Boston automobile show this week, and a banner year is anticipated by distributers. Prices weakened about 25 per cent last week in circular loom, and bare copper-wire quotations reflect recent downward tendencies. Domestic appliances are moving rapidly, and an excellent response is noted to house-wiring campaign efforts now under way. Retail business appears quite active. Considerable interest is being shown in small water-power facilities throughout New England. In the electrical industry labor conditions are freer from serious disturbance than for some time. Electrical manufacturers report raw material plentiful. Non-employment exists to an unfortunate extent, but this is in part due to the desire of returning soldiers and sailors to obtain new jobs in place of their former posts.

CIRCULAR LOOM.—Current quotations show a drop of about 25 per cent in the past week. The maximum discount quoted is now about 66 per cent. Prices of ⅜-in. and ½-in. loom fell to $15.50 and $18 per 1000 ft. respectively.

CONDUIT.—Prices still hold without much change, but jobbers with sizable stocks fear that some losses will have to be borne in the near future if the expected reduction through the government steel price standardization materializes. Stocks are irregular, and the demand is small.

MOTORS.—Stocks are accumulating and inquiries are in fair volume. Prices are steady for the most part, though the temptation to shade quotations under close competition is very strong just now. Some revival of business in the textile field gives ground to anticipate a better movement of motors here before long.

ELECTRIC AUTOMOBILES.—The demand is excellent and prices appear to have little effect on the market. A prominent dealer reports inability to obtain sufficiently prompt deliveries from the factory. Not all distributers adopted the recent price advances quoted by sales agencies in other parts of New England. It is said that these advances were not increases established at the factories but were due to increased overhead costs in distribution combined with an inadequate supply of cars.

STORAGE BATTERIES.—A heavy demand for automobile service is reported, with steady prices throughout the past week. A shortage of wooden separator material and rubber-jar stock is conceded in some quarters.

WIRE.—Rubber-covered base price this week is 21 cents; weatherproof, 18¾ cents, and bare, 17½ cents. Inquiries are increasing and deliveries are excellent. It is felt that prices are close to the minimum.

ELECTRIC RANGES.—Inquiries are increasing and some orders are being handled by distributers. Stocks are good.

SCHEDULE MATERIAL.—Local stocks are in good volume. No early price changes are anticipated. Small

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orders are increasing in number, and improved business is being enjoyed here and there by contractors.

SIGNS.—Business is increasing materially. The high cost of labor is keeping prices high, but an increased advertising outlay is calling for a good deal of electric sign work. The shortage of miniature and sign lamps lately reported has been generally overcome.

INDUSTRIAL ELECTRIC TRUCKS.—Government business has been considerably curtailed by the failure of the naval appropriation bill at the last Congressional session. Prices are likely to reflect recent reductions on storage batteries within a few days.

ATLANTA

Government reports show that Atlanta is short approximately 2500 homes, and the present realty activity, together with the increasing number of building permits, points to a return of normal conditions. This condition holds true in other Southern industrial centers. A few cities show a surplus of labor. The railway clerks' strike continues, and incoming and outgoing freight commitments are demoralized.

VACUUM CLEANERS.—Although trade has been very satisfactory during the past three months, dealers and jobbers report increased activity this week, and all types and sizes are moving briskly. Anticipating a period of heavy buying during the early spring months, jobbers have placed substantial orders and shipments are arriving in sufficient volume to handle the present demand.

WASHING MACHINES.—Jobbers' and retailers' sales show a marked improvement this week. On the whole business has been good, but present activity indicates an increase in the volume of transactions. The trade is especially optimistic in regard to future sales, and large orders are being placed. One feature of note is the activity of certain jobbers in going after the rural business created by farm-lighting outfits. There is no doubt that this year will witness a heavy sale of washing machines of all types.

LAMPS.—The volume of sales shows a slight decrease, but not so great when compared with the previous year. In fact, dollar value is in excess. Although cantonments and shipbuilding plants have curtailed their purchases, ordinary commercial channels, and especially the lumber industry, have increased their requirements, and a higher general average is maintained. The manufacturers have become very active since all restrictions have been off, and all territories will be well covered in the next few months by local dealers. The demand for miniature lamps has exceeded all expectations, and manufacturers are exerting every effort to increase production, which is reflected in shorter shipments. While the call remains insistent, distributers are getting in better shape each day to handle the volume of business.

FARM-LIGHTING OUTFITS.—Despite the entry into this market of new companies, the aggregate volume of transactions is growing by leaps and bounds, and apparently every one is obtaining as much business as can be handled. The sale of this equipment opens up a wide market for supplies, fixtures and socket appliances, and a number of dealers are taking the opportunity of laying in stocks of such goods. The market for lighting outfits in the Southeast has hardly been "scratched." Shipments on certain sizes are coming through much better.

CREDITS AND COLLECTIONS.—Manufacturers' collections are good and compare favorably with the corresponding period in February. There is no increase in jobbers' paper, and receipts from this quarter are well up to the required standard. Accounts with a few of the larger utilities are somewhat sluggish. The much-looked-for liquidation on account of cotton holding has not materialized, and surface indications are that all current indebtedness is being satisfactorily taken care of. While sentiment in certain quarters is opposed to the so-called "cotton-holding" program, it must not be overlooked that, at least for the present, the electrical interests of the Southeast are tied up indirectly with the success or failure of this movement. Contractors, dealers and retailers have experienced a profitable year and their accounts through jobbers are in satisfactory shape.

SEATTLE—PORTLAND

Seattle jobbers as a whole report that the volume of business during the week shows a decided increase over the week before, due primarily to resumption of activities in shipyards. It is believed that from now on sales volumes, both wholesale and retail, will show gradual increases. Retailers report an increasing demand for fixtures and household appliances, particularly irons, washing machines and sewing machines. Range sales show an increase over last month. Generally speaking, stocks are in excellent condition. There has been no recent change in prices.

Unusual activity in the construction of small homes to meet housing needs in the Puget Sound district is noted, although there is a tendency to wait for a reduction in costs. An increasing interest in Puget Sound cities' industrial future is found in inquiries relating to sites and the possibilities of financing new industries, particularly tools and machinery. Eastern Washington and Oregon farmers are reported to be having a hard time to secure competent help, and with the actual beginning of spring work at hand the situation is causing considerable concern.

The Portland district reports that the general industrial situation remains practically unchanged as compared with the past week. The volume of sales shows no decrease. There were no large sales reported, although several are pending awaiting the definite settlement of labor troubles. The chaotic conditions which have obtained in the Northwest since the signing of the armistice are gradually disappearing with the end of shipyard strikes, reopening of mills, camps and certain industrial institutions and the prevalent spring weather. Retailers in Portland report business as good, in fact beyond what was really expected. Building activities are not yet very strong, being confined principally to residences and repairs, although a few concrete buildings, either garages or industrial structures, are under erection.

SAN FRANCISCO

Realty business in San Francisco and Bay cities during the week was small. Several sales in widely separated sections indicate, however, that the investment element is watching the market. There is a big demand for homes, and the rents remain high. The architects have a lot of construction work laid out waiting for the people with the capital to instruct them to proceed. However, there have been at least six fair-sized apartment houses started during the past week.

The war-time rates on electricity which were allotted the power companies last June will probably be discontinued by order of the State Railroad Commission unless the different companies are able to show that abnormal conditions still exist. The companies have been called to appear before the commission on April 29. The commission last June authorized a surcharge of 1 cent a kilowatt-hour on all energy sold for lighting purposes and 0.2 cent a kilowatt-hour for power purposes.

FARM-LINE TELEPHONES.—The farmers have done no real construction of telephone lines for the last three years. As a result of a good rainy season and the assurance of good crops and large profits, the farmers are ready to make improvements. The sale of telephones and associated material has been excellent this year and will probably continue so for several months.

FARM-LIGHTING PLANTS.—There is a wonderful demand for these plants. One dealer in Fresno purchased a carload of plants and has prospective purchasers for all of them.

INTERPHONES.—The demand in the last two years has been from industrial plants, a large number of which had come into existence during that period. As the demand from that source will now drop off, sales are now looked for from apartment houses, hotels and large residences, and the electrical dealer is combing that field.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00	$20.00	$18.00
½-in.—	30.00	24.00	21.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–26.50
½-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08¼
⅜	.08¼
½	.08¼
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4 80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 12.1%	9% to 14.1%
2500 to 5000 lb.	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18
Coil to 1000 ft	28.60

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $17.00
1/5 to std. pkg.	12.00 to 14.00

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$22.00
1/5 to std. pkg.	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
0-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41
No. 18, full spools	.39

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net— Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
No.			
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$20.20	18.18	$15.15
10	27.00	24.30	19.44
8	33.12	30.36	26.50
6	52.50	48.13	42.00

CHICAGO

	Price per 1000 Ft. Net— Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
No.			
14	$18.00–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$26.75
25 to 50 lb	26.75
50 to 100 lb	25.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $25.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

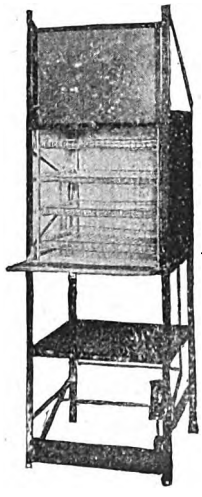
Electric Sign Without Wiring

The customary wiring and bushing arrangement for electric signs has been replaced by slots formed of two pieces of angle iron in the interchangeable-letter bulletin being marketed by W. F. Keckeisen, 1644 First National Bank Building, Chicago. Into these slots are inserted the porcelain blocks, one for each letter to be used. Contact is completed with the letters through pins inserted into contact points in the porcelain blocks. Because of this elimination of wiring and bushings it is said that one-third less material is required for this type of sign than for a standard interchangeable-letter sign of the same size. Less labor is required for making the sign, and the erection may be accomplished by one man.

Electrically Heated Roll Warmer

While designed primarily for keeping rolls warm and fresh, the warmer recently developed by the Duparquet, Huot & Moneuse Company of 108 West Twenty-second Street, New York City, should find extensive use as a food warmer, the makers say, owing to the small amount of energy consumed and the efficient arrangement for supplying moist heat.

Water in a tank connected to the house water supply or filled by hand as required is evaporated by an electric heating element, and the moist heat is



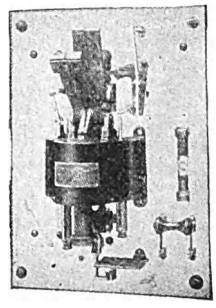
UPPER SECTION OF DOOR SLIDES UP, WHILE LOWER SECTION DROPS DOWN

automatically supplied by a sight feed device which shows the amount of water being supplied at all times. A 500-watt General Electric sheathed-wire unit placed on each side of the roll compartment allows free circulation of the heated air. Energy may be obtained from the usual lighting circuit and is controlled by a switch mounted on the warmer with an indicating pilot light.

An interesting feature of this warmer is the self-closing door, which is made in two sections, the upper part sliding up while the lower portion drops down and forms a shelf upon which the bread tray may be set. The door-opening device consists of an arrangement of levers actuated by a foot bar extending across the front of the warmer and placed flush with the front. An adjustable air cushion is also provided to prevent doors from closing too rapidly. Pulleys, chains and counterweight are eliminated by this arrangement.

Adjustable Automatic Reclosing Circuit Breakers

Three additional types of automatic reclosing circuit breakers manufactured by the Automatic Reclosing Circuit



HAS SOLID COPPER CONTACTS AND CARBON TIPS

Breaker Company of Columbus, Ohio, are provided with overload, dead-load and time-interval adjustments. The dash pots by which the time for the breakers to remain open is regulated are of the bellows type and can be adjusted for any time interval from a half second to five minutes or more Types ARL and DRL breakers are furnished with laminated brush contacts and auxiliary copper contact tips and "graphaloy" arcing tips, while type CRL is supplied with solid copper contacts which make a sliding contact and with "graphaloy" arcing tips on the front contact arm. The ampere ratings of the breakers range from 25 to 2000; overload calibrations have minimums of from 15 amp. to 1200 amp. and maximums of 50 amp. to 3600 amp., while the entire three types are procurable in 110, 250 and 600-volt sizes.

Sockets with Detachable Push-Buttons

Installing push-button sockets in husks, socket covers and other restricted locations often entails considerable time on account of awkward positions. The Bryant Electric Company of Bridgeport, Conn., which makes

BASES AND RECEPTACLES ARE INTERCHANGEABLE

the "Wrinklet" line of interchangeable lamp receptacles and sockets, has improved the push-button socket designated as No. 81 by making both buttons detachable. This is accomplished by molding a threaded stud laterally into each of the buttons, the stud in the black or "off" button being of a larger diameter and a different thread from the stud molded in the red or "on" button. This feature prevents transposition of the two buttons after the socket has been inserted in the fixture.

Ejector Cut-out for Transformer Protection

A special fuse, a handle and a housing are the essential parts of an ejector cut-out now manufactured by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, for protecting transformers. Among the features claimed by the manufacturers of this device are that it is thoroughly safeguarded against corrosion induced either by the atmosphere or by gases, that the operator may inspect and handle it with safety, that an indicator shows whether the cut-out is in operating condition or whether the fuse has blown, that it is easily re-fused, since linemen can conveniently carry extra fuse tubes to be inserted in the housing, and that the space occupied is quite small, as 3½ in. (8 cm.) is the total length of cross-arm required. The cut-out is 16 in. (40 cm.) high, and is mounted at an angle of 30 deg. from the vertical for convenience in handling.

The handle of this device not only provides a means for inserting and re-

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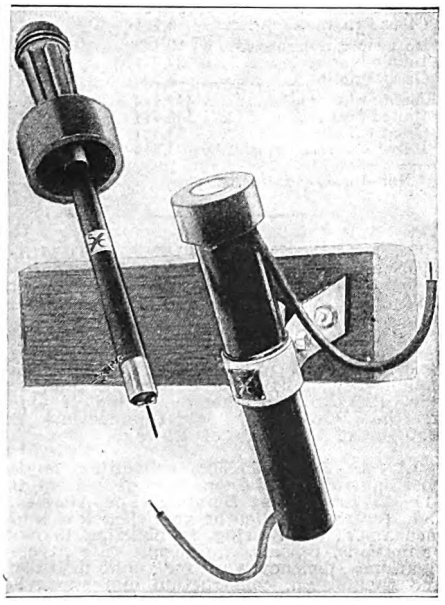
moving the fuse but also acts as a cover to the whole unit, fitting down over the top of the main housing to exclude water, snow and sleet. The leads furnished with the cut-out pass directly through openings in the main housing and fasten securely to the internal contacts, so that there are no terminals or other line parts that can be touched by the operator during normal operation. A supporting clamp, made of hot galvanized steel, is fitted around the cut-out for mounting on the cross-arms.

The fuse proper consists of a "Bakelite" tube, inside of which is a high-tensile-strength, high-resistance, fusible link, held under tension by a coil spring fastened into the base of the fuse tube. This link is shunted by the fuse element proper, and the latter is therefore not subject to any tensile strain. The fuse element is inclosed in a cork, and this is in turn inclosed in the fuse tube. The fuse tube screws di-

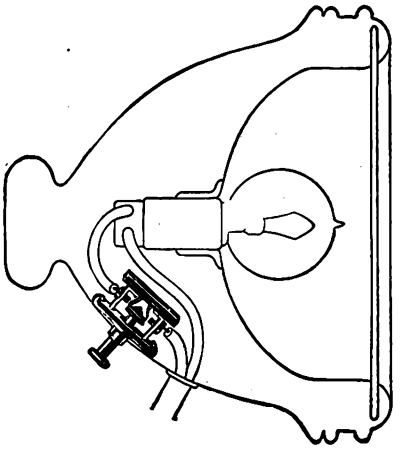


CONDITION OF FUSE VISUALLY INDICATED

rectly into the cut-out handle, making a rigid unit of these parts. The current is conveyed from the base of the fuse to the fusible link through flexible copper cables shunting the coil spring, so that the current traveling through the spring is negligible.

Switch Mounted Inside of Spotlight Shell

One of the recent developments of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is a push-and-pull spotlight switch made for mounting within the shell of the light. According to the maker, a satisfactory automobile lighting switch must have large "wiping" contact surfaces to prevent excessive contact resistance, and the contactor must "float" on the operating shaft in order that vibration and side strain on the button shall not cause the light to flicker. Both of these features have therefore been incorporated in this switch. Its insulating parts are made of fiber, the frame of stamped steel, the contacts of brass, and the contactor of phosphor bronze. These parts are riveted together into

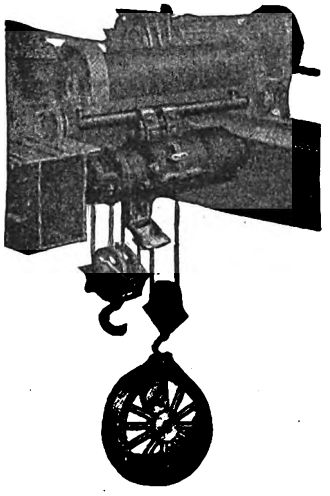


NO VIBRATION OR SIDE STRAIN ON BUTTON TO CAUSE FLICKERING OF LIGHT

one solid unit which, it is stated, does not loosen or change alignment when subjected to vibration or strain. The switch mechanism is not inclosed because it is installed inside of the spotlight shell with only the button protruding. Either rivets or machine screws can be used to fasten the switch to the shell, and no plate is required, since drilling one hole for the button and two for the rivets or screws permits mounting the switch as shown in the accompanying illustration.

Auxiliary Hoist for Traveling Cranes

Cranes for lifting heavy loads are usually slow-moving, and their use results in a loss of time when handling light loads which often constitutes a considerable part of the day's work. Moreover, there is a power loss when large cranes are used for light-load



DOES NOT INTERFERE WITH OPERATION OF MAIN HOIST

manipulation, since the hook and block themselves have an appreciable weight. To overcome these drawbacks N. B. Payne & Company, 25 Church Street, New York City, have recently developed an auxiliary hoist for attachment to any overhead traveling crane, which will handle light loads at a higher speed than that of the main hoist. This auxiliary hoist does not require an extra trolley, does not shorten the travel of the trolley on the bridge, and does not take up any additional room overhead nor interfere with accessibility of the main hoist. It is pointed out by the makers of this auxiliary hoist that by its application a standard single-hoist electric traveling crane may be equipped with two lines for drop-bucket service. Ordinarily these auxiliary hoists are supplied by the makers in from 1-ton to 5-ton sizes, but larger special sizes may also be obtained. Control may be arranged from cage, floor or pulpit according to the crane upon which the hoist is appplied.

NOTES ON RECENT APPLIANCES

Vacuum Cleaners

The Jewel Electric Company, 4714 Broadway, Chicago, is making two new electric vacuum cleaners, known as the "Quaker" and the "Jewel."

Linotype-Metal Feeder and Pot Heater

Electric metal feeders and pot heaters for linotype machines have been developed by the Fort-ified Manufacturing Company of Kansas City, Mo.

Power-Factor Meter

For power survey work and tests on motors the Esterline Company of Indianapolis, Ind., has recently brought out a portable graphic recording power-factor meter.

Wire-Braiding Machine

A machine for braiding a covering over wire, which is said to be operated on a new principle, is being made by the Wardwell Braiding Machine Company, Central Falls, R. I.

Motor-Driven Controller

For use with fire-alarm sirens, signal lights, searchlamps, whistles and other special applications the Reynolds Electric Company, 423 South Talman Avenue, Chicago, has developed a motor-driven controller or flasher.

Bell-Ringing Transformer

The "Liberty" bell-ringing transformer manufactured by the Betts & Betts Corporation, 511 West Forty-second Street, New York City, has been improved so that it does not interfere with the ordinary use of the socket to which it is attached.

Switch and Receptacle Box

Where junction or pull boxes are necessary and yet would be unsightly in finished walls or floors, the exposed switch and receptacle box made by the Trans-Com. Lighting Products Corporation, 508 Broome Street, New York City, may be used.

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Trade Notes

Foreign Trade Opportunities

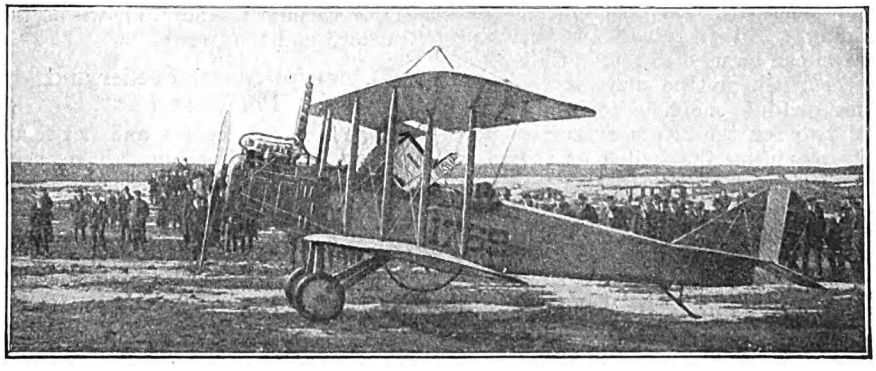
Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The Industrial Federation of Sweden has issued the first annual year book of reference concerning industrial firms, their personnel and the goods produced. The book contains 1200 pages and sells for 25 kroner (about $7).

A member of a firm of electrical supply importers in Australia (No. 28,728) is in this country and desires to be placed in connection with manufacturers of electrical machinery, specialties and supplies. He wishes to form business relations with manufacturers only.

A member of a firm in New Zealand (No. 28,749) is in this country and desires to secure an agency from manufacturers only for the sale of electrical supplies, electrical steel tool blanks, copper wire (plain and coated), woven-wire fencing, steel wire, etc.

ELECTRIC WASHING MACHINE AIRPLANE DELIVERY.—Airplane retail delivery began in Chicago March 11 at noon. Lieut. Ralph C. Diggins, formerly of the Ninety-second Aero Squadron, U. S. A., carried a 265-lb. Federal washer sold by the Commonwealth Edison Company in the cockpit of his Dayton-Wright biplane. The start was made from Grant Park, in the heart of Chicago, where the washer was unloaded from an electric truck into the airplane, and the flight ended 14 miles away at the suburban home of Mr. Dawes, a well-known banker. This is said to be the first time anything of this kind has been done in the United States. The feat is considered especially notable because the airplane was not changed in any way for the occasion.



DELIVERING WASHING MACHINES BY AIRPLANE

HIGHER LAMP PRICES IN GERMANY.—As of Jan. 28, increases in the price of incandescent lamps have been made in Germany by the A. E. G., the Bergmann Company, the Osram Works, the Radium Electricity Company, Siemens & Halske and the Siemens-Schuckert Works. Under this arrangement, at 24 cents to the mark, the price of wire lamps with pear-shaped bulbs ranges from 72 to 90 cents; wire lamps in globe form are quoted at 86 cents to $1.68, and gas-filled lamps are at $1.20 to $2.64, exclusive of the lamp tax in each case. As the makers expect an improvement before long, it is said that the above prices have been calculated so as not to include the whole of the additional cost of production arising from the existing labor condition and other circumstances.

SWEDEN'S POWER-TRANSMISSION LOANS.—The Board of Trade and the Board of Agriculture point out in a joint memorandum to the Swedish government that applications for loans from the newly established power-transmission loans fund amount to about 6,000,000 kroner ($1,680,000). With reference to this the two departments consider that the state ought to assist the applicants to some greater extent than can be possible with the funds at present available, 1,000,000 kroner ($280,000) per year, to cover the loan requirements for the electrification of country districts. They therefore propose that a further sum of at least 1,000,000 kroner for each of the years 1919 and 1920 shall be granted for the purpose.

WAR SERVICE OF B. F. STURTEVANT COMPANY.—Without the addition of a single square foot of new factory building area, the plant of the B. F. Sturtevant Company, Hyde Park, Mass., passed from 10 per cent war work in April, 1917, to 90 per cent war service in November, 1918. The production of steam turbo-fans for destroyers increased 500 per cent from February to September, 1918, and at the latter time the company was practically equipping one destroyer per day with forced-draft outfits, the usual size of turbine being about 150 hp., designed for superheated steam service. For the Emergency Fleet Corporation many 15-hp. engine-driven fan units were completed, and the production rate was increased 350 per cent from February, 1918, to September without employing additional labor. This rapid and extended increase was accomplished largely by concentrating efforts on one type and two sizes of fan engines, 6-in. by 5-in., and 7-in. by 6-in. The company also supplied a large number of fans for forced-draft boiler-plant service and built economizers. One of the most important products of the company during the war has been gasoline-electric generating sets, built in sizes of 5 kw., 10 kw. and 15 kw., for portable service and also for use in fixed locations.

SOUTH AFRICA PREPARING FOR ELECTRIC VEHICLES.—The *British and South African Export Gazette* states that after peace the electrically propelled vehicle for transport, delivery and other purposes is expected to play a more important part in the business life of South African cities wherever electricity is available. Owing to the gasoline shortage and with an eye to future business, Cape Town, Port Elizabeth, East London and Durban are doing everything possible to extend the use of such vehicles. At Cape Town the charge per unit supplied is 2 cents between 11 p.m. and 8 a.m. and 5 cents during the remainder of the day. Energy is also supplied at special rates where the consumer guarantees to use 100,000 or more units per annum. At Port Elizabeth there is every facility afforded for the use of energy. The city electrical engineer of East London says that the municipality views electric vehicles very favorably and adds that a 2-cent charging rate during "off" hours may be looked forward to. Johannesburg already has the 2-cent charging rate. There the general post office has ten electric vehicles, which are used chiefly to collect the mails. There has already been some effort made to install electric vehicles upon a larger scale in the different public-service departments of the South African Union, but the high prices ruling have so far militated against progress being made in this direction.

BRAZILIAN ELECTRICAL IMPORTS.—Imports of electrical materials and machinery into Brazil showed a slight increase during 1917 as compared with 1916, Vice Consul Richard P. Momsen reports. Switzerland supplied a larger share of dynamos than the United States, but in electric motors the American article found preference, the shipments amounting to $100,297 out of a total of $167,800. Electric lamps, which formerly were supplied chiefly by Holland and Germany, are now being supplied by the United States, about 10 per cent of the imports being shipped by Holland. Imports of electrical machinery declined from $3,347,249 in 1913 to $1,594,389 in 1917, the United States being credited with $1,348,925 during 1917. Copper and other electrical wire was almost all imported from the United States. There follow details of electrical imports for 1916 and 1917:

	1916	1917
Dynamos and electrical generators	$83,080	$106,541
United States	43,500	35,817
Sweden	313	.....
Switzerland	26,062	55,337
Electric motors	123,465	167,800
United States	41,753	100,297
Great Britain	28,224	18,198
Switzerland	40,060	28,994
Insulators	74,626	101,835
United States	52,706	71,319
Great Britain	17,060	27,412
Lamps, electric	311,838	454,877
United States	237,199	369,936
Great Britain	14,293	17,494
Netherlands	39,571	54,824
*Machinery, electrical	1,126,311	1,594,389
United States	876,358	1,348,925
Great Britain	118,284	129,006
France	36,830	23,755
Transformers, electrical	152,313	107,279
United States	130,562	90,872
Great Britain	13,749	4,169
Wire, copper, electrical	355,605	360,502
United States	341,578	345,793
Great Britain	8,850	1,753
*Wire, copper	97,104	159,108
United States	84,624	148,590
Great Britain	8,466	9,320
Wire, copper, uninsulated	30,149	19,046
United States	27,241	19,046
Great Britain	2,280	.....
*Electric wire or cable	449,174	829,595
United States	380,534	721,697
Great Britain	34,381	18,642
Italy	25,810	21,115

* Not elsewhere stated.

THE ARGENTINA NAVAL COMMISSION announces that, effective Feb. 25, the offices of the commission will be at 2 West Sixty-seventh Street, New York, where all business will be transacted.

C. C. WALLACE, formerly manager of loading of the munitions section of the Stenotype Company, Indianapolis, Ind., is now director of development and service of the Powdered Coal Engineering & Equipment Company of Chicago.

JAMES E. BARKER, consulting engineer, announces the opening of offices at 611-615 Investment Building, Los Angeles, Cal., for the practice of gas, electrical and mechanical engineering, specializing in examinations, reports, appraisals, rate investigations, efficiency work for public utilities, and the design, construction and supervision of water, gas and electric systems.

J. E. SLIMP, who has for many years been connected with the sales department of the Ohio Brass Company, has resigned to become associated with H. C. Dodge of Boston, who is at the head of several manufacturing companies in New England. Mr Slimp will remain with the Ohio Brass Company until about April 1, and will be present at the A. E. R. A. mid-year meeting and dinner in New York as one of the Ohio Brass representatives.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., has purchased a tract of 20 acres in the northeastern section of Detroit, where plans are reported as being arranged for a plant to cost $750,000. The manufacturing business of the main plant at 1400 Russell Street is to be removed to this new location and the former plant used for other purposes. Completion of the new plant is expected to increase the company's facilities largely, making possible the employment of larger working forces.

THE INTERNATIONAL OXYGEN COMPANY of Newark, N. J., has opened offices in the First National Bank Building, Pittsburgh, Pa., in charge of R. A. Cornwall. Philip Wesley, formerly Pittsburgh representative of the company, has been placed in charge of the Chicago sales office in the Railway Exchange Building, Chicago. The British branch of the International Oxygen Company, known as the Integral Oxygen Company, Ltd., has commenced the manufacture of electrolytic cells and other products for the British market. E. L. W. Byrne is the general manager in charge, with offices at 38 Victoria Street, Westminster, London, S. W.

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THE DELTA-STAR ELECTRIC COMPANY, Chicago, has opened a Pittsburgh office at 305 Union Arcade Building. This office is in charge of E. S. Stickle, formerly connected with the W. A. McCombs Company.

R. L. HUTTO, St. Louis, Mo., has been appointed manager of the Delhi Battery & Supply Company, the St. Louis distributer for Prest-O-lite storage batteries. Mr. Hutto will give special attention to the service department and announces that a service engineer from the Prest-O-lite factory will soon be associated with him.

J. F. MACKIN, located at Columbus, Ohio, has become connected with the Black & Decker Manufacturing Company of Baltimore as representative throughout the entire State of Ohio. Mr. Mackin has been connected with the portable electric drill industry for years, his former connection having been with the Independent Pneumatic Tool Company.

C. D. WILLIAMS, former assistant manager of the Stuart-Howland Company, electrical supply jobber, Boston, has become general sales manager of the Efficiency Electric Company, East Palestine, Ohio, manufacturer of a line of industrial electrical devices. Prior to going with the Stuart-Howland Company Mr. Williams was sales manager for the Simplex Electric Heating Company, and before that he was connected with the Western Electric Company. Mr. Williams has been head of several of the important committees of the Westinghouse Agent Jobbers' Association.

W. D. HAMER, representative of the Electric Service Supplies Company, Philadelphia, has been transferred from his former territory in the Middle West to a Southern territory with headquarters in Atlanta, Ga. He has been connected with this company for fourteen years. Prior to 1905 he was employed in the stores and engineering department of the Lehigh Valley Railroad Company. In 1907, with the coöperation of the Nashville Railway & Light Company, he proposed and developed, what was reported to be the first prepayment car operated in the South. Mr. Hamer is also the inventor of the Keystone triangle arm.

THE CHICAGO PNEUMATIC TOOL COMPANY announces the following changes: Offices and warehouses have been opened at Tulsa, Okla., and El Dorado, Kan. The Boston office has been removed to 182 High Street, with F. S. Eggleston as district manager of sales. At this point a complete stock of repair parts will be carried for pneumatic and electric tools, air compressors, oil engines and rock drills. The Detroit office has been removed from 236 Hancock Avenue to 502 Farwell Building. J. I. Edwards has been appointed manager of the rock-drill sales division, succeeding E. Eklund, who has been appointed special foreign representative. Mr. Eklund will leave soon for Europe on business. Fred H. Waldron, formerly Minneapolis representative, has been appointed manager of the pneumatic tool sales division, succeeding J. G. Osgood, resigned. Mr. Waldron's offices are in the Fisher Building, Chicago. Nelson B. Gatch was recently appointed district manager of sales at Minneapolis, with offices in the Metropolitan Bank Building. J. K. Haigh has recently been appointed assistant district manager of sales in San Francisco, with offices at 175 First Street.

THE ELECTRIC VACUUM CLEANER COMPANY, INC., with principal offices in Cleveland, Ohio, and New York City, has filed articles of incorporation with the Secretary of State at Albany. The new concern is a consolidation of the business and manufacturing facilities of the Frantz-Premier Company of Cleveland and the vacuum-cleaner business of the Edison Electric Appliance Company of Chicago. It will be devoted to the manufacture and sale of electric vacuum cleaners (including stationary and portable types). It is understood that it will equip its output with General Electric motors. The present local service stations maintained by the Frantz-Premier Company will be extended and developed to give complete service to users of products of the new concern. The Frantz-Premier Company is one of the largest manufacturers of electric cleaning apparatus in the country. The directors of the new company are Julius Tuteur, Maynard H. Murch, John Sherwin, A. V. Cannon and E. W. Miner of Cleveland; F. S. Hunting of Fort Wayne, G. A. Hughes of Chicago, C. E. Patterson of New York, and A. K. Baylor of New York. This proposed incorporation was mentioned in the ELECTRICAL WORLD for Feb. 8, on page 290.

Trade Publications

VACUUM CLEANERS.—"Jewel" and "Quaker" vacuum cleaners are dealt with in a new folder of the Jewel Electric Company, 4714 Broadway, Chicago.

SEWING MACHINES.—Portable electric sewing machines are the subject of a recently issued circular from the Davis Sewing Machine Company, Dayton, Ohio.

AUTOMOBILE HEADLIGHT.—A folder about a new automobile headlight manufactured by J. T. Roffy, 340 Lewis Avenue, Brooklyn, N. Y., is being distributed.

REVERSE-PHASE RELAYS.—Type TS reverse-phase relays are the subject of a recently issued folder from the Palmer Electric & Manufacturing Company, Boston.

COOKING APPLIANCES.—A catalog of its electric cooking devices has been recently issued by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City.

LEAD-BURNING TRANSFORMER.—The General Electric Company of Schenectady, N. Y., tells about its lead-burning transformer for arc-welding storage-battery connections in bulletin 3483-2.

TURBINES AND REDUCTION GEAR.—Bulletin No. 3 of the Moore Steam Turbine Corporation, Wellsville, N. Y., contains information regarding single-stage and multi-stage steam turbines and reduction gears.

OIL SWITCHES AND CIRCUIT BREAKERS.—Bulletin No. 433 prepared by the Condit Electrical Manufacturing Company of South Boston, Mass., contains information about type D-16 oil switches and circuit breakers.

MOTORS AND GENERATORS.—Various types of motors, generators, motor-generators, rotary-converters and ventilating fans are taken up in a loose-leaf catalog being distributed by the Fidelity Electric Company, Lancaster, Pa.

FARM-LIGHTING PLANT.—Instructions for installing, operating and maintaining type N of the Lay farm-light generator, which can be run by an automobile, have been issued in booklet form by the L. A. Young Industries of Detroit, Mich.

FLOODLIGHT PROJECTORS AND REFLECTORS.—The Crouse-Hinds Company of Syracuse, N. Y., has issued a sixty-three-page bulletin No. 304, covering Imperial floodlight projectors and reflectors. Besides complete descriptions, illustrations and lighting data, many unusual uses for these lights are shown.

STEEL TANKS AND BOILERS.—The Coatesville (Pa.) Boiler Works have recently published a cloth-bound and "profusely illustrated" book of ninety-six pages about its products. Many installations of its tanks, boilers and other heavy steel plate works are shown. Besides information about the works and their products the book has A. S. M. E. boiler specifications and other general data.

SYNCHRONOUS MOTORS.—In "The New Book of E-M Synchronous Motors" issued by the Electric Machinery Company of Minneapolis, Minn., particularly interesting sections of the forty pages are those containing comparative curves of the efficiency and power factor of synchronous motors and induction motors of corresponding ratings. The diagrams showing I^2R losses reduced by placing condensers at various points on a system are also a noteworthy part of this exceptionally complete analysis of synchronous motors.

ASH-DISPOSAL SYSTEMS.—The American Steam Conveyor Corporation, 110 West Fortieth Street, New York City, and 326 West Madison Street, Chicago, has just issued a 160-page book entitled "Modern Methods of Ash Disposal." This is a presentation of methods of moving ashes, soot and combustion waste from boiler room to disposal station. Advantages and drawbacks of the different systems are very completely discussed in the front portion of the book, while the rest of it is devoted to photographs and information about various "American" fittings and installations of these devices. Interesting data on the coals of the United States and other tables are included in this well-prepared publication.

HIGH-TENSION CONDENSERS.—High-tension condensers, protective devices and other wireless equipment form the subjects of an illustrated folder recently issued by the Dubilier Condenser Company, 217 Center Street, New York City.

LIGHTING UNITS.—A lighting unit for home, store, office, assembly room, etc., made by the Dempsey-Glavin Electric Corporation, 408 West Thirty-fourth Street, New York City, is the subject of a folder prepared by the manufacturer and now being distributed.

BELL-RINGING TRANSFORMER.—The Betts & Betts Corporation of 511 West Forty-second street, New York City, has issued a folder containing information about its improved Liberty bell ringer. Proofs of advertising electrotypes about this transformer are printed on a card distributed to dealers.

INDOOR BUS SUPPORTS.—Addenda bulletin No. 31A has been prepared by the Delta-Star Electric Company, 2433 Fulton Street, Chicago, for filing with bulletin No. 31 and has for its subject unit-type indoor bus-supports. Space in this publication is also given to heavy-duty busbar supports and unit-type bus spacers.

POWDERED-FUEL SYSTEM.—The Quigley transport system for preparing, distributing and burning powdered fuel is the subject of bulletin No. 11 prepared by the Quigley Furnace Specialties Company, 26 Cortlandt Street, New York City. The pulverizing plant and other equipment used in the system are well covered by reading matter and illustrations, the latter including a detailed diagram of the coal-milling plant and the air-transport system. Shut-off valves, switching valves, controllers, burners, dust-tight gates, a fuel-bin gage, "cyclone" collectors and blast gates are described.

New Incorporations

THE WILLIAM J. RAINAUD LAMP COMPANY, 121-23 Lafayette Street, Newark, N. J., has been organized to manufacture lamps. William J. Rainaud, 308 Lafayette Street, Newark, is interested in the company.

THE ELECTRIC WELDING COMPANY OF BALTIMORE, 101 East Fayette Street, Baltimore, Md., has been incorporated by J. Bannister Hall, Hans Froelicher, Jr., and Thomas Swann. The company is capitalized at $150,000.

THE FEDERAL ELECTRIC COMPANY of Milwaukee, Wis., has been incorporated by E. A. Lambert, Frank Ziekursch and L. M. Wesser. The company is capitalized at $10,000 and proposes to manufacture electrical goods, supplies and accessories.

THE NATIONAL MACHINE & ELECTRIC COMPANY of High Point, N. C., has been incorporated by Herman E. Wood, Thomas G. Shelton and J. C. Smith. The company is capitalized at $125,000 and proposes to manufacture electric machinery, etc.

THE AMERICAN RAILWAYS SIGNALS COMPANY of Terre Haute, Ind., has been chartered with a capital stock of $200,000 to manufacture railroad signal devices. The incorporators are Thomas G. and Harry W. Beggs and John H. and John T. Beasley.

THE BUSHNELL MAGNETO CORPORATION of San Francisco, Cal., has been incorporated with a capital stock of $1,000,000 by J. B. Bushnell, W. T. Merriman, S. Hodson, L. W. Buck and W. S. Killingsworth. The company proposes to deal in electrical supplies, etc.

THE OZARK LIGHT & POWER COMPANY of Eureka Springs, Ark., has been incorporated with a capital stock of $100,000 to construct and operate an electric plant and street-car system, as well as manufacture and sell ice, etc. The officers are James Bowen, president; P. G. Walker, vice-president, and H. D. Jenkins, secretary and treasurer.

THE O. K. GIANT BATTERY COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $2,000,000 and proposes to do a general chemical and electrical engineering business. The incorporators are Samuel C. Wood, Arthur M. Brody of Chicago, Ill., and L. B. Phillips of Dover, Del.

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New England States

DANVERS, MASS.—The Electric Light Commissioners have petitioned the town of Danvers for authority to purchase electricity from the Eastern Massachusetts Electric Company of Boston to be delivered at the switchboard to operate the municipal electric lighting system.

EASTHAMPTON, MASS.—The Turners Falls (Mass.) Power & Electric Company has purchased the electric power station at Mount Tom from the Easthampton Gas Company.

IPSWICH, MASS.—The finance committee of the Council has recommended that a committee be appointed to investigate the question of purchasing electricity from the Newburyport (Mass.) Gas & Electric Company to operate the municipal electric system. The extension of the electric lighting system to Linebrook parish is also under consideration.

WESTERLY, R. I.—At a recent meeting of the Board of Trade the members favored an amendment raising to $300,000 the bond issue of $100,000 for the construction or purchase of a municipal electric light plant in Westerly, passed some time ago by the State Legislature.

PLAINVILLE, CONN.—Estimates, it is reported, have been asked by Landers, Frary & Clark of New Britain, for the erection of a factory building, 60 ft. by 162 ft., four stories, and a power house, 42 ft. by 42 ft., in Plainville.

PUTNAM, CONN.—Bids, it is understood, have been received for the construction of an electric power house, 28 ft. by 40 ft., for the Nightingale Morse Mills in Putnam, to cost about $80,000.

Middle Atlantic States

ANDES, N. Y.—The question of replacing the present street-lighting system with electric lamps is under consideration.

BELMONT, N. Y.—The Village Board has been instructed to call a special election to vote on the proposal to appropriate $10,000 for the installation of an electric lighting system, provided that a satisfactory contract can be made with W. P. Clark for the purchase of electricity.

BROOKLYN, N. Y.—Application has been filed with the finance committee of the State Legislature by the Brooklyn State Hospital for appropriations to provide for improvements as follows: For the installation of additional power-plant equipment, $5,000; the installation of a new local telephone system and lighting of the institution grounds, $1,500 and $1,000 respectively; for the installation of a new fire-alarm system, $5,000; the installation of new electrical and mechanical equipment in the laundry, $65,000. Isham G. Harris is superintendent.

CENTRAL ISLIP, N. Y.—Application has been made to the finance committee of the State Legislature by the board of managers of the Central Islip State Hospital for an appropriation of $47,000 for improvements at the institution as follows: $15,000 for the installation of a new fire-alarm signal system, $30,000 for the purchase of new electrical and mechanical equipment, and $2,000 for improvements to the boiler equipment at the north colony.

MACEDON, N. Y.—The Town Board is considering submitting the proposal to issue $6,500 electric improvement bonds to the voters.

NEW YORK, N. Y.—Bids will be received by Thomas J. Drennan, fire commissioner, Municipal Building, New York City, until March 31 for furnishing and installing conduits, cables, wiring protector frame and appurtenances in the Manhattan Central office on Transverse Road No. 2, Central Park. Blank forms and further information may be obtained at the above office. A deposit of $5 will be required for specifications.

POUGHKEEPSIE, N. Y.—Plans are under consideration for extensive improvements at the Hudson River State Hospital, including the installation of new electrical equipment. Walter G. Ryan is medical superintendent.

NEWARK, N. J.—The Federal Adding Machine Company, York and Grove Streets, New Haven, Conn., is contemplating the erection of an experimental plant in Newark, to cost about $250,000.

ATHENS, PA.—Arrangements are being made to install electric lamps in East Athens to replace the oil lamps now in use. The Sayre (Pa.) Electric Company furnishes electrical service in Athens.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

BEATTY, PA.—Plans, it is understood, are being prepared for the construction of a power plant at the St. Vincent's College, to cost with equipment about $100,000. The Joseph A. Langdon & Sons Company, 608 Grant Street, Pittsburgh, is consulting engineer.

FELTON, PA.—An effort is being made to have the Edison Light & Power Company of York extend its electric transmission lines to Felton.

PITTSBURGH, PA. — The Pittsburgh Railways Company is planning to build an addition to its power house at McKee's Rocks, and also the erection of a new station at Castle Shannon.

PITTSBURGH, PA.—Plans are under consideration by the Aluminum Ore Company, a subsidiary of the Aluminum Company of America, Oliver Building, Pittsburgh, for the construction of a plant at Sollers Point, Md., to include machine shop, forge shop and a number of general shop buildings. A power plant will be erected, equipped with steam-driven electric generators of about 4000 kw. The equipment of the boiler plant will include a battery of marine-type boilers, equipped with automatic stokers, blowers and overhead coal bunkers. The cost of the plant is estimated at about $8,000,000.

BENWOOD, W. VA.—Bids, it is understood, will be received by S. G. Smith, Wheeling, receiver for the Benwood & McMechon Water Company, for equipping the plant for electrical operation, including the installation of motors, etc., and laying water pipe. G. H. Davies of Harrisburg, Pa., and S. H. R. Hudson of Pittsburgh, Pa., are engineers.

WASHINGTON, D. C.—Bids will be received by the superintendent of the United States Coast and Geodetic Survey, 205 New Jersey Avenue, S. E., Washington, D. C., until April 9 for an electrically driven milling machine for use in finishing the edges of electro-deposited copper printing plates, the sizes of which range from 18 in. by 24 in. to 38 in. by 48 in.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 25, Eastern and Western navy yards, Schedule 3858—miscellaneous bells and buzzers. Brooklyn, N. Y., Schedule 3889—11,000 ft. interior communication cable. Eastern navy yards, Schedule 3891—miscellaneous steel galvanized conduits and conduit fittings. Until April 22, Brooklyn, N. Y., and Norfolk, Va., Schedule 3880-100 storage batteries. Until April 28, Washington Navy Yard, Schedule 7885½—26 key resistance units, miscellaneous ammeter panels, 95 relays, 100 door switches, and 7175 antenna bus switches. Until April 4, Philadelphia, Pa., Schedule 7886½—two generator equipments. Newport, R. I., Schedule 7890½—20,000 ft. double-conductor cable. Further information may be obtained at the above office.

North Central States

DETROIT, MICH.—The Scripps-Booth Motor Company, it is reported, will erect a plant in Detroit, to cost about $1,500,000.

DETROIT, MICH.—Contracts, it is understood, will soon be awarded by the Central Forge Company, Euclid Avenue, for the construction of a steel heat-treating plant on Euclid Avenue near the Grand Trunk Railroad. Smith, Hinchman & Grylls, 710 Washington Arcade, are architects.

THREE RIVERS, MICH.—The Eddy Paper Company of White Pigeon is considering the construction of a plant in Three Rivers, to cost about $1,750,000.

AKRON, OHIO.—The Goodyear Tire & Rubber Company, it is reported, contemplates the erection of a new factory building, to cost about $500,000.

CLEVELAND, OHIO.—The Home Specialty Company is planning to erect a new plant on East 152d Street. The company manufactures electric washing machines.

CLEVELAND, OHIO. — Contract has been awarded by the Cleveland Automobile Company to the Crowell-Lundoff-Little Company for the construction of an automobile plant. A power plant is included in the plans. J. V. Whitbeck, chief engineer of the Chandler Motor Car Company, which is controlled by the same interests, is president. Ernest Woller is chief engineer.

DAYTON, OHIO.—Preliminary plans have been prepared for the construction of a factory for the Dayton Fan & Motor Company, South Ludlow and Bayard Street, to cost about $175,000.

TOLEDO, OHIO.—The Standard Oil Company of Ohio, Gas Building, has purchased a site northeast of the city on which it proposes to erect a large refinery, involving an initial expenditure of between $4,000,000 and $5,000,000.

WAUSEON, OHIO.—The City Trustees have been authorized to purchase wire, motors and other electrical equipment, pipe, pumps, etc., without advertising.

WHITESBURG, KY.—The Florence Mining Company, which has acquired the property of the Cumberland-Hazard Coal Company, it is reported, is contemplating improvements to the property, including the installation of electric equipment and opening new mines. L. H. Stone of Cincinnati, Ohio, is manager.

DECATUR, IND.—The Farmers' Light & Power Company, recently organized with a capital stock of $5,000, proposes to furnish electricity for lamps and motors in Union and Root Townships from the Dent schoolhouse. John D. Nidlinger is president.

GARY, IND.—Work will soon begin on the construction of a large plant for the O. K. Battery Company in Gary.

INDIANAPOLIS, IND.—Plans are being prepared for the erection of a new factory building for the Motor Device Company. The capital stock of the company has been increased from $300,000 to $500,000. U. Z. Wiley of Indianapolis is interested in the company.

CENTRALIA, ILL.—The ice factory of the Centralia Ice Company, it is reported, has been purchased by the Duquoin Utilities Company. The new owner will install battery equipment and will operate the plant by electricity. William Farrell is manager.

SPRINGFIELD, ILL.—The contract for lighting the court house and county jail for the next year has been awarded to the municipal electric light plant.

APPLETON, WIS.—The construction of a plant for the manufacture of direct-connected generating units, farm-lighting systems and other electric equipment and appliances, to cost about $50,000, is reported to be under consideration by the Langstadt & Meyer Company. A. H. Meyer is secretary.

FOND DU LAC, WIS. — The Eastern Wisconsin Electric Company is contemplating extensions to its transmission lines.

JIM FALLS, WIS.—Plans have been prepared by the Wisconsin-Minnesota Light & Power Company of Eau Claire for the construction of a hydroelectric power plant at Jim Falls. E. A. Pierce of Eau Claire is vice-president and general manager.

STURGEON BAY, WIS.—Plans are reported to be under consideration by the High Falls Company to erect an electric transmission line from Green Bay to Sturgeon Bay. For further information address W. J. Wadsworth.

SUPERIOR, WIS.—Bids will be received by L. A. Nichols, secretary of board of education, Blaine School Building, Superior, until April 14 for construction of grade school building, including vacuum cleaning system, heating and ventilation, electric conduits and wiring, electric clocks and bell work.

BENSON, MINN.—Improvements to the municipal electric light plant, to cost about $30,000, are under consideration by the City Council. W. E. Skinner, Plymouth Building, Minneapolis, is engineer. Theodore K. Lee is superintendent.

CROOKSTON, MINN.—Steps have been taken by farmers residing between Crookston and East Grand Forks for the erection of an electric transmission line between the two cities.

OKLEE, MINN.—Improvements to the water and electric plant, to cost about $15,000, are reported to be under consideration.

ST. PAUL, MINN.—The Villaume Box & Lumber Company is reported to be in the market for twenty to thirty electric motors.

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ST. PAUL, MINN.—Work has been resumed on the construction of the twelve-million-dollar union depot in St. Paul which was discontinued more than a year ago owing to the war. The Northern States Power Company is negotiating for a contract to furnish all electrical and steam service for the new building. The amount of electricity required is estimated at about 529 kw. The company is also negotiating with the Miller Hospital Association, which is erecting a new hospital, to cost $500,000, to furnish electrical service for the building, which will require about 260 kw.

BLOOMFIELD, IOWA.—A committee has been appointed by the City Council to make investigations relative to improvements to the municipal electric light plant. It is proposed to change the system from 110 volts, direct current, to 2300 volts, 60 cycles, three-phase, and to reconstruct the lines. New equipment consisting of a 225-kw. generator directly connected to a Corliss engine and a 100-kw. generating unit will probably be installed.

WEBSTER CITY, IOWA.—During a recent windstorm three smokestacks at the municipal electric light plant were blown down.

BUTLER, MO.—The City Council is considering improvements to the municipal electric light plant. The question of purchasing electricity from another town is also under consideration.

JAMESTOWN, N. D.—The proposal to issue bonds to establish a municipal electric light plant will be submitted to the voters at an election to be held April 7.

MITCHELL, S. D.—Bids will be received at the office of R. E. Davis, city auditor, Mitchell, until April 10 for improvements to the waterworks system, including material and equipment, separate bids to be submitted as follows: (1) Pumping station, well houses, machinery, foundations, etc.; (2) pumping station equipment, including one 2,000,000-gal. triple-expansion pump, one 37½-kva. generator and Unaflow engine, one 125-hp. boiler and auxiliaries; (3) alternate for No. 2, pumping station equipment, including two 60-kva. generators and Unaflow engines, one condenser, two 750,000-gal. and two 375,000-gal. motor-driven centrifugal pumps and auxiliaries; (3A) alternate for Nos. 2 and 3, pumping station equipment, including two 750,000-gal. and four 1,500,000-gal motor-driven centrifugal pumps and auxiliaries; (4) four motor-driven deep-well pumps of the working-barrel type, complete with starters; (5) alternate for No. 4, complete air-lift system for four wells, including pumps, piping and compressor; (6) three 12-in. wells, 159 ft. deep, including casing; (7) one 48-in. by 90-ft. brick or concrete stack; (8) one 200,000-gal. tank on 125-ft. tower. Bidders may combine two or more sections. Bids will also be received at the same time for cast-iron pipe, etc. Plans and specifications may be obtained from the city auditor upon deposit of $5, of which $3 will be refunded upon return of plans. Burns & McDonnell, Interstate Building, Kansas City, Mo., are consulting engineers.

CLARKSON, NEB.—Bids will be received by the village of Clarkson until April 2 for furnishing the necessary labor and material for rebuilding the electric light plant and pumping station, including power house, chimney, 80 ft. high, 3 in. inside diameter at top (bids will be received on concrete, brick and radial construction); one 115-hp., 277 r.p.m., Unaflow steam engine, one 90-kva., three-phase, 60-cycle, 2400-volt generator, complete with exciter; one three-panel switchboard; one 72-in. by 16-ft. fire-tube boiler, complete with breeching; one double-acting boiler-feed pump; one 150-hp. feed-water heater, and one two-stroke deep-well pump complete with 10-hp. motor and two 5-kva. transformers. Bids will be received on the entire work or separate sections. Plans and specifications may be obtained at the office of the Henningson Engineering Company, Omaha, upon deposit of $10. Plans are also on file in the office of the village clerk, Clarkson.

OMAHA, NEB.—Plans are being prepared by H. C. Christiansen & Company, architects, Chicago, Ill., for the construction of a large cold-storage plant for the Skinner Packing Company at Twelfth and Douglass Streets, Omaha, to cost about $500,000.

STERLING, NEB.—Bonds to the amount of $16,000 have been voted for the installation of a municipal electric lighting system in Sterling.

INDEPENDENCE, KAN.—Arrangements are being made to replace the arc lamps now in use with tungsten lamps. Plans are also under consideration for the installation of a new ornamental lighting system.

OSWEGO, KAN.—The City Council has engaged A. C. Moore of Joplin, Mo., engineer, to prepare plans for the proposed municipal electric light plant.

ROSEDALE, KAN.—The State Legislature has appropriated $150,000 for a power plant for the Rosedale Hospital.

Southern States

RALEIGH, N. C.—The Carolina Power & Light Company is contemplating extending its system from Goldsboro to Mount Olive.

ALMA, GA.—An election will be called to vote on the proposal to issue $15,000 in bonds for the installation of a municipal electric light plant.

PENSACOLA, FLA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 7, under Specification 3785, for electrical equipment at Pensacola. The cost is estimated at about $30,000. A deposit of $10 will be required for plans.

NASHVILLE, TENN.—At an election to be held April 3 the proposal to issue $60,000 in bonds for the installation of a boiler in the electric light plant will be submitted to the voters.

MOBILE, ALA.—The Mobile Electric Company, controlled by H. M. Byllesby & Company, 208 South La Salle Street, Chicago, Ill., has decided to construct a new power plant at some point on the Mobile River or Three Mile Creek, the site to be selected, at a cost of about $1,000,000. The new plant will be erected in addition to the present power house at Royal and St. Anthony Streets, which was partly wrecked by an explosion on Feb. 21. T. K. Jackson of Mobile is manager.

LEXINGTON, MISS.—The city of Lexington would like to receive estimates on the cost of furnishing and erecting a complete electric light plant for the municipality. Both stream and oil engines will be considered. W. L. Jordan is city clerk.

SENATOBIA, MISS.—The City Council has authorized an issue of $15,000 in bonds for the installation of a new electric light and water plant. The new plant will furnish electricity for Coldwater, 6 miles distant, and for the County Agricultural High School. The present municipal plant has been in service for about fifteen years.

FORT SMITH, ARK.—The Majestic Coal Company of Fort Smith, recently organized, is in the market for mining machinery and power-plant equipment. W. J. Pendergrass is interested.

TEXARKANA, ARK.—The Southwestern Gas & Electric Company is planning to rebuild its carhouse and shops, recently damaged by fire. The loss is estimated at about $150,000.

DUNCAN, OKLA.—Bids will be received by the city of Duncan until April 1 for furnishing material and equipment and installing same for waterworks and electric light plant, including two 160-hp. engines, complete with all accessories, directly connected to 100-kva., three-phase, 60-cycle, 2300-volt generators, with exciter and rheostats. Alternate bids will be received for furnishing and installing oil and natural-gas engines directly connected to 100-kva. generators; one five-panel switchboard and power wiring; one 350-gal. per minute, 100-lb. head, two-stage, centrifugal pump, directly connected to 40-hp. 2300-volt, three-phase, 60-cycle motor; two 40-hp., 2300-volt, three-phase, 60-cycle motors, belt drive; one 60-hp., 2300-volt, three-phase, 60-cycle motor, to be directly connected to present pump, and one pump house complete. Bids will be received on any or all of the above equipment, but preference will be given bids covering all the above items. The Benham Engineering Company, Colcord Building, Oklahoma City, is consulting engineer.

AUSTIN, TEX.—The City Council has appropriated $10,000 for placing cables in conduits, the work to be done by the Water and Light Department.

DALLAS, TEX.—Wiley Blair, chairman of the committee of the Dallas Chamber of Commerce, which is promoting the construction of an interurban electric railway between Dallas and Wichita Falls, a distance of 125 miles, has announced that funds for the survey of the proposed railway have been raised. A similar project is being promoted by the Dallas Northwestern Traction Company.

SUGAR LAND, TEX.—The Sugar Industries, operating the Imperial Sugar Company, Sugar Land Manufacturing Company, Sealy Mattress Company, Imperial Mercantile Company and Sugar Land Feed Company, contemplates the construction of an electric power house to supply electricity to all of its departments. The plans provide for the installation of two generating units of 500 kw. each. G. D. Ulrich is vice-president and general manager.

Pacific and Mountain States

KALMATH FALLS, ORE.—The California-Oregon Power Company is considering the construction of a dam across the Link River in connection with the use of the large power plant at Copco, Cal.

GLENDALE, CAL.—The Board of City Trustees has authorized plans to be prepared for the construction of a municipal electric light plant. It is proposed to utilize water power to be developed in connection with extensions to the municipal waterworks system. The cost of the entire project is estimated at about $175,000. H. B. Lynch, Central Building, Los Angeles, is engineer.

HOLTVILLE, CAL.—The Holton Power Company is planning to erect a 15,000-volt transmission line from El Centro to Calexico to supply electricity to the entire Imperial Valley. This line replaces a small line erected thirteen years ago. The plans include the construction of a new substation at Brawley, the installation of new equipment at the Holtville station and a new line between El Centro and Brawley.

LOS ANGELES, CAL.—The Bonnie-Reed Film Manufacturing Company of Niles contemplates the construction of a motion-picture plant, including studios, offices, laboratories, warehouse, grand stands, power plant, etc., on Sunset Boulevard and Bronson Avenue, to cost about $1,000,000. Train & Williams, Exchange Building, are architects.

OGDEN, UTAH.—Plans are being prepared by M. C. Couchot, engineer, 110 Sutter Building, San Francisco, Cal., for the construction of an elevator and flour mill for the Sperry Flour Company in Ogden, to cost about $300,000.

SNOWFLAKE, ARIZ.—The Snowflake & Taylor Irrigation Company is contemplating the installation of an electric light plant to supply electricity for lamps and motors in the towns of Snowflake, Taylor and Shumway in Navajo County.

LAMAR, COL.—The Public Utilities Commission has authorized the city of Lamar to call an election April 1 to vote on the proposal to issue $45,000 in bonds for the construction of an electric light and power plant. Electrical service is now supplied by the Intermountain Railway, Light & Power Company.

LOVELAND, COL.—Bids will be received by the city clerk of Loveland, City Hall, Loveland, Col., until April 1 for approximately 109 ornamental single lamp posts and 10,000 ft. of three-conductor, 600-volt underground wire. Plans and specifications may be seen or obtained at the above office.

Canada

EDMONTON, ALTA.—The construction of a new telephone plant, to cost about $900,000, is under consideration by the Public Utilities Commission.

WINNIPEG, MAN.—The provincial government has appropriated $350,000 to assist in the erection of an electric transmission line from Winnipeg to Portage la Prairie. The total cost is estimated at $700,000.

COBOURG, ONT.—The Hydro-Electric Power Commission of Ontario is planning to erect a planing mill at Cobourg, to cost about $60,000.

ROCKLAND, ONT.—Bids, it is understood, will soon be asked by W. C. Edwards & Company, Ltd., Sussex Street, Ottawa, for the construction of a pulp and paper mill in Rockland, to cost about $3,600,000.

THREE RIVERS, QUE.—The International Paper Company, 30 Broad Street, New York, N. Y., is considering the construction of a paper-manufacturing plant in Three Rivers, to cost about $3,000,000.

CRAIK, SASK.—The installation of a municipal electric light plant in Craik is under consideration by the city officials.

MOOSE JAW, SASK—Extensive improvements will be made to the municipal electric light plant, which with proposed line extensions will involve an expenditure of about $223,000. The installation of a 3000-kw. turbo-generator is included in the plans.

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(Issued Feb. 18, 1919)

1,294,679. METHOD OF JOINING METAL PLATES; Maurice Lachman, New York, N. Y. App. filed June 19, 1918. Rivet passed through hole in one plate and welded to other one.

1,294,680. METHOD OF UNITING PLATES; Maurice Lachman, New York, N. Y. App. filed June 19, 1918. Weld localized in portion of meeting surfaces.

1,294,691. SELECTING DEVICE FOR ELECTRIC BELLS AND THE LIKE; William E. Muntz, London, Eng. App. filed Sept. 5, 1914. Gives distinctive call according to location of caller.

1,294,694. ELECTRODE FOR VACUUM DISCHARGE DEVICES; Henry J. Nolte, Schenectady, N. Y. App. filed Aug. 7, 1918. Anode always maintained in desired relation to cathode and grid.

1,294,695. WATER HEATER; Clark M. Osterheld, Stoughton, Wis. App. filed Sept. 25, 1915. Heats flowing water in pipe or duct leading to faucet or aperture.

1,294,722. TELEPHONE SYSTEM; Roy H. Smith, Philadelphia, Pa. App. filed April 22, 1918. No interference between controlling apparatus of signals installed at different operators' positions.

1,294,744. SEAL FOR CONDUITS; William W. Wotherspoon, New York, N. Y. App. filed April 23, 1912. Liquid paraffin introduced and allowed to harden.

1,294,756. TUNNEL KILN; George H. Benjamin, New York, N. Y. App. filed May 21, 1917. Combines features of "direct fire" and "muffle" type.

1,294,784. MAGNETIC BRAKE; Earl J. Ferry, King City, Cal. App. filed March 11, 1918. For motor vehicles.

1,294,790. FIXTURE SUPPORT; Frederick A. Godfrey, Chicago, Ill. App. filed Dec. 19, 1917. Expedites fastening stud to outlet box and reduces number of bolts.

1,294,794. PULL SOCKET; Mark J. Gretsch, New York, N. Y. App. filed May 12, 1917. Chain operates cam, which in turn controls contacts.

1,294,830. ELECTRIC ARC FURNACE; Ivar Rennerfelt, Djursholm, Sweden. App. filed Aug. 24, 1916. May be used directly on lighting circuits without special starting devices.

1,294,837. ELECTRIC FURNACE; Frederick von Schlegell, Evanston, Ill. App. filed Nov. 25, 1918. Reduces loss of metal due to volatilization.

1,294,841. TELEPHONE SYSTEM; Frank M. Slough, Rochester, N. Y. App. filed March 20, 1917. Number of telephone line upon which service is being given may be indicated to observer.

1,294,862. ELECTRIC SWITCH; Ernest O. Bennett, Bluefield, W. Va. App. filed July 13, 1917. Spring-actuated contact or pair of contacts primarily receives blade of knife switch.

1,294,878. LEVEL; Michael H. Constantine, Franklinville, N. Y. App. filed June 8, 1918. Electrically illuminated.

1,294,880. FUSE; George Denman and Edward F. Lewis, Terre Haute, Ind. App. filed March 27, 1918. When primary fuse burns out current is automatically transferred to secondary auxiliary fuse.

1,294,894. RECTIFYING COMMUTATOR; Harry A. Froom, Worcester, Mass. App. filed Nov. 12, 1915. Converts direct current into alternating current for spark coil of ignition system.

1,294,899. LOCKING MASTER SWITCH FOR ELECTRIC SYSTEM; Ardashes M. Gulamerian, Summit, N. J. App. filed Aug. 8, 1916. For motor-driven vehicle.

1,294,923. TIRE ALARM; Jeremiah C. Long, Everett, Mass. App. filed Feb. 21, 1916. Alarm sounded when pneumatic tire becomes deflated.

1,294,974. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed Oct. 6, 1916. Air controlling valve device automatically operates to control brakes if electrical control fails.

1,294,975. DEVICE FOR ELECTROPNEUMATIC BRAKES; Walter V. Turner, Wilkinsburg, Pa. App. filed Oct. 21, 1916. Prevents release of brakes in changing ends on double end brake.

1,294,983. STATION FOR WIRELESS TELEGRAPHY AND TELEPHONY; George von Arco and Alexander Meissner, Berlin, Germany. App. filed Dec. 27, 1912. High-frequency current generated by machine.

1,295,007. CIRCUIT BREAKER; William Corley, Washington, D. C. App. filed April 26, 1918. For use in submerged naval mining operations to break circuit under abnormal conditions automatically.

Record of Electrical Patents

Notes on United States Patents

1,295,009. METHOD OF UNITING METAL BODIES; Lawrence P. Crecelius, Cleveland, Ohio. App. filed April 30, 1915. Reduces current and time required.

1,295,020. ELECTRIC BRAKE SYSTEM; Nathan Fallek, Denver, Col. App. filed June 30, 1915. For vehicles.

1,295,040. MULTIPLE SWITCH; Charles H. Kenney, Milwaukee, Wis. App. filed Feb. 26, 1914. May operate independently or automatically.

1,295,045. ELECTROTHERMIC FURNACE FOR THERAPEUTIC PURPOSES; Tiodolf Lidberg, Chicago, Ill. App. filed March 4, 1918. Small quantities of liquid may be heated or evaporated, or instruments cleansed and sterilized.

1,295,048. METHOD OF AND APPARATUS FOR BENDING TUBES; Harry P. MacDonald, Montclair, N. J. App. filed Dec. 23, 1916. Article may be heat-treated while in bending apparatus.

1,295,080. EXTRACTION OF ZINC; Henry L. Sulman and Hugh F. K. Picard, London, England. App. filed Jan. 20, 1917. Neutralization of last portions of acid with which ore is treated quickly completed by addition of zinc hydrate.

(Issued Feb. 25, 1919)

1,295,095. TROLLEY REPLACER; Harry G. Albietz, St. Louis, Mo. App. filed June 21, 1918. Traveling spool on pole contacts with wire and guides trolley wheel to wire.

1,295,096. TELEPHONE SYSTEM; Albert Andersen, Chicago, Ill. App. filed Oct. 24, 1913. Call signal omitted in substation circuit, subscriber being signaled through receiver.

1,295,100. ELECTROLYTIC REFINING OF METALS; Blasius Bart, Newark, N. J. App. filed Dec. 12, 1917. Entire supply of metal used in eletcroplating is evenly consumed.

1,295,113. INDICATOR; Donald E. Burger, Mount Vernon, N. Y. App. filed Nov. 21, 1917. Used as street or station indicator for car and display advertising.

1,295,121. INDICATOR; Jacob Cartun, Philadelphia, Pa. App. filed June 30, 1916. Motor-car signaling device.

1,295,122. ELECTRIC BATTERY; Rufus N. Chamberlain, Chicago, Ill. App. filed Feb. 16, 1917. Rechargeable dry cell inexpensively made.

1,295,144. STARTER FOR INTERNAL-COMBUSTION ENGINE; Frank E. Fisher, Detroit, Mich. App. filed Feb. 18, 1918. Front cover plate of engine cylinder supports electric starting and generator unit.

1,295,168. KNOCK-OUT FOR ELECTRICAL BOXES; Duncan C. Hooker, Farmington, Conn. App. filed June 27, 1918. Caused to rotate on uncut portions of metal as pivots, easily twisting off.

1,295,175. AUTOMATIC TELEPHONE SWITCHING APPARATUS; Alexander E. Keith, Hinsdale, Ill. App. filed Sept. 25, 1914. Rotary or non-numerical switch.

1,295,181. TELEPHONE-EXCHANGE SYSTEM; Fritz Lubberger, Chicago, Ill. App. filed Dec. 10, 1919. Subscriber may call another of same group without extending call through main station.

1,295,185. ROTARY CONNECTOR; Trygve E. Meyer, Lombard, Ill. App. filed Feb. 18, 1914. Proper operation by subscriber insured.

1,295,191. WIRING CONNECTION FOR AUTOMOBILE LIGHTS; Frank E. Mullin, Pennant, Saskatchewan, Canada. App. filed June 2, 1917. Spaced loops in doubled wire fit on binding posts and extended eye at one end attaches to conductor.

1,295,227. RAIN ALARM; Arnold T. Soderquist, Dalbo, Minn. App. filed July 7, 1917. Depressing balance rings bell.

1,295,229. TELEPHONE-EXCHANGE SYSTEM; Arthur B. Sperry, Chicago, Ill. App. filed July 28, 1908. Permits connection of private branch exchange with automatic central system.

1,295,245. METHOD OF AND APPARATUS FOR RADIO SIGNALING; Roy A. Weagant, Roselle, and Harry Shoemaker, Jersey City, N. J. App. filed Jan. 6, 1916. Excludes interference from electromagnetic waves of different frequency.

1,295,278. GENERATOR; Bruce W. David, Cleveland, Ohio. App. filed March 20, 1915. Automatically takes care of plurality of welding arcs, independently of interposition of loading resistance in circuit.

1,295,285. ELECTRIC GAS LIGHTER; Roy F. Dowdy, Roanoke, Va. App. filed March 23, 1918. Attaches to screw-base receptacle.

1,295,309. ELECTRIC FURNACE AND METHOD OF OPERATING THE SAME; Jervis R. Harbeck, New York, N. Y. App. filed April 24, 1917. Static-fluid cooling system.

1,295,365. STORAGE-BATTERY PLATE AND METHOD OF BUILDING; John M. Peterson and Alvin O. Retrum, Dawson, Minn. App. filed Dec. 11, 1917. Thin leaves radiating from base receive active material.

1,295,389. RECTIFIER FOR AUTOMOBILE GENERATORS; Lee R. Titcomb, Danville, Ill. App. filed Dec. 24, 1917. For Ford magnetos.

1,295,405. TELEPHONE-EXCHANGE SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed March 3, 1917. Apparatus charges call only if connection is successfully established.

1,295,410. THEFT SIGNAL FOR VEHICLES; Bruno Zabel, Edgewood Borough, Pa. App. filed Dec. 7, 1917. Bells ring when brake is released.

1,295,416. AIR-CONDITIONING APPARATUS; Arthur F. Berry, London, Eng. App. filed Aug. 10, 1916. Air passed over electric heater and mixed with cooler air.

1,295,435. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed July 26, 1917. Calling party's connection to private branch exchange line maintained while called party obtains connections without aid of operator and converses with third party.

1,295,445. CONTROLLER FOR MOTOR-DRIVEN VALVES AND OTHER DEVICES; Peter P. Dean, New York, N. Y. App. filed Sept. 14, 1916. Substantial jamming action at limits of movement of driven part provided for.

1,295,454. TRANSMISSION CIRCUIT; Henry C. Egerton, Passaic, N. J. App. filed Aug. 30, 1916. Amplifier does not cause excessively loud side tone in loud-speaking receiver when local transmitting apparatus is used.

1,295,457. ELECTRIC WELDING TOOL; George A. Engstrom, Topeka, Kan. App. filed Feb. 18, 1918. Handle cooled by ventilation and rotated without breaking circuit.

1,295,459. ELECTRIC BATTERY; Raymond W. Erwin, Fremont, Ohio. App. filed April 15, 1915. Granular oxide prevented from sifting through perforated container of cell electrodes during handling.

1,295,464. GRADED INSULATION; Giuseppe Faccioli, Pittsfield, Mass. App. filed Jan. 2, 1917. Terminal insulator has material omitted at some points and concentrated at others without impaired insulating qualities.

1,295,475. DRY CELL; Harry F. French and Raymond C. Benner, Fremont, Ohio. App. filed Aug. 23, 1916. Layer of paper or cloth omitted between zinc and mix.

1,295,481. VACUUM TUBE; Alfred Greiner and Francis J. Farrelly, Hartford, Conn App. filed Nov. 28, 1914. Valve tube prevents change of polarity of current and guards X-ray tube in circuit.

1,295,487. SYSTEM OF AUTOMATIC CONTROL FOR MOTORS; William S. H. Hamilton Schenectady, N. Y. App. filed March 18 1918. For motor-operated cooling means for electrical apparatus.

1,295,497. PORTABLE ELECTRIC LAMP; Harry Henderson and Arthur E. Case, Marion, Ind. App. filed Sept. 30, 1916. Body formed of a single sheet of metal.

1,295,498. SYSTEM OF ELECTRICAL DISTRIBUTION; Edward M. Hewlett, Schenectady, N. Y. App. filed March 9, 1917. Controlling means for circuits of plurality of electric conductors.

1,295,499. SYSTEM OF ELECTRICAL DISTRIBUTION; Peter Cooper Hewitt, Ringwood Manor, N. J. App. filed Dec. 13, 1913. Periodic variations produced by mutual interaction of conducting gas or vapor and magnetic lines of force.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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The Engineer's Place in the Scheme of Things

NOTEWORTHY among the events of the recent meeting of the American Institute of Electrical Engineers at Boston was the address of the president emeritus of Harvard University. The burden of eighty-four years has not dulled Dr. Eliot's keen intellect nor lessened his interest in contemporary affairs, and his own early scientific training lent to his words an additional weight of authority. In dwelling upon the engineer's need for both broad intellectual training and warm human sympathies the veteran educator occupied unattackable ground. Of all the professions, he said, engineering does most to increase the comfort of the people and facilitate the pursuit of happiness. One has only to contrast the mode of life in highly civilized countries to-day with that of the early nineteenth century, when modern engineering got its real start, to realize the truth of this assertion. To engineers, be they solitary inventors or the constructors, appliers and extenders who flock in the inventor's trail, not only the rich but the poor as well owe the far greater ease with which, as compared with their predecessors, they procure their daily warmth and light, hot and cold water, facilities for cleanliness, fire for cooking and means of refrigeration. To them men owe the greater rapidity and pleasure and the smaller cost of travel by land and water. To them are due pleasures and excitements our ancestors never dreamed of—the phonograph, the motion pictures, the pleasure car, the motorboat, the airplane. How much have the express trains, the swift ocean steamers, the telegraph and the telephone done to lessen the pain of separation from friends by providing means of swift communication and of prompt reunion when the need arises! And what a stimulus the human mind has gained from the daily spectacle of structures of many kinds, in stone and iron and concrete, on, above and under the earth's surface, huge often in size but with the grace that skillful adaptation of means to ends imparts, which are at once man's victory over nature and the monument to that victory!

Engineering, Dr. Eliot observed, used to be considered a materialistic profession, but he knew of none involving a greater use of the imagination. Here is a truth of which sight is sometimes lost. Lawyers are tied to statutes, physicians to the pharmacopœia, clergymen too often to their creeds, but no pent-up Utica contracts the vision of the engineer; the whole boundless universe is his. To the imagination of Watt and Stephenson, of Morse and Bell, of Langley and Wright, of Edison and Marconi the world is immensely the debtor. To the engineering imagination of yesterday it will soon owe the ability to talk across the ocean and to traverse it on wings. To-day other marvelous projects are taking shape in the engineering brain, and to-morrow will announce them to a freshly astonished but no longer incredulous world.

Dr. Eliot's criticism of some of the methods of instruction in our elementary and secondary schools, his insistence on university training, for the ordinary engineer as well as for the genius (who perhaps needs it less), and his views on the part that engineers should take in enlightening corporations and inspiring workmen toward harmony and common effort in turning imagination into achievement will appeal to a far wider audience than even the one he addressed. He himself, famed mainly as educator and publicist, discloses none the less an engineering mind of the finest type, practical, constructive, lucid, intent, seeking refuge, in the closing days of a long life, neither in the cynicism of disillusioned age nor in the rhapsodies of cloistered visions, but helpful, unselfish, philanthropic to the end—uniting in rare and fine proportion the material, from which no man can escape, with the spiritual, which no man should deny.

Up go the rates on telegraph messages, and the manner of their promulgation shows what novices other public utility managers are. The commissions and utility companies have always held out for performance and service first, but such sentiments find no lodgment in the office of the Postmaster-General. He dispatches service as Richard III did Henry VI, "Down, down to hell and say I sent thee thither!"

Isolated Plants and Economy

WE WONDER how far the general public has come to realize the very grave economic changes in power production which have occurred within the last few years. Undoubtedly it feels them, and engineers have come to grasp them fully. Yet, in spite of all this, there are hundreds, yes thousands, of isolated plants still operated at what must really be serious loss to their owners. With cheap labor and cheap coal the difference between the cost of power purchased and power generated may be comparatively small. As coal and labor go up the operating costs of a plant with a poor load factor rise at an appalling rate, and even when the load factor is fairly good the difference in economy between a big plant and a small one is formidable.

As things stand to-day the absolute cost of fuel has on the whole more than doubled and the cost of labor has risen in about the same degree. Moreover, the former shows no hopeful indications of dropping and the latter very plain symptoms of rising. A standard eight-hour day comes pretty nearly being an accomplished fact in general industry, and longer working

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periods can usually be maintained only at a considerable wage increase. Whether this element in the cost of power is to be maintained permanently at the present high level may be open to question, but wages are not likely to come down without a reduction in the cost of living, and the latter waits on the former in an economic deadlock. The coal costs are likewise unlikely rapidly to be reduced.

The result of these changes on the isolated plant is nearly or quite to double the actual cost of energy per kilowatt-hour. In some instances it is increased even more, and the added cost of replacement and repairs at present is still another serious item for consideration. Meanwhile, although most central stations have been forced to adopt a coal clause, there is very little doubt that such increases of price as they have been obliged to make are far less than the added charges that overwhelm the producer of power on a small scale. It is therefore time for a very thorough overhauling of the whole question of costs by those who are operating independent plants and striking anew the balance sheet between power purchased and power produced.

The great increase in central-station loads from the realization of this situation is, of course, already obvious; but we doubt very much whether any considerable percentage of the isolated plants which would actually profit by changing to central-station service have even yet come over. The same forces that are building up great networks supplied from a few big stations, replacing plants locally active, make the economic condition of the small power producer conspicuously bad, so that he now would profit by shutting down, even if it were necessary to undertake a considerable transmission from an economic source in order to get his power. The day of most of the basement plants is pretty well passed, and if their owners would deliberately sit down and find out the costs that are piling up ahead of them, they would not long hesitate in making the change, once economically possible or plausible, now imperative.

Philosopher, economist and statesman that he was, Benjamin Franklin saw the advantages of daylight saving over a century and a quarter ago. Betraying his natural bent, he also figured out how much money might be saved, but alas! there is nothing to indicate that Franklin rose with the cock. The narrative published elsewhere would suggest quite the contrary.

Illumination Required for Industrial Operations

IN CONNECTION with the ever-present subject of industrial lighting we are glad to present the data promulgated by the New York Industrial Commission with respect to the minimum intensities of illumination required for a large number of specific cases. They follow rather closely the recommendations of the Illuminating Engineering Society, and while now presented in a tentative way, the values here given will be made mandatory July 1 unless the experience gained before that time renders changes desirable. The list has been prepared with special reference to conditions as they exist in the various operations of numerous industries. From place to place in a given establishment they will necessarily vary according to the particular operations being conducted. The list, however, is sufficiently general in scope and specific in detail to give the factory inspectors a very clear view of the conditions as they ought to exist.

In running over the table we are impressed with the fact that certainly in nearly every instance these values are real minima which should not be reduced, and, such being their nature, it is evident that a factor of safety must be allowed for the deterioration of the lamps and fixtures during usage. This allowance is specified as 25 per cent for the initial illumination in order to maintain the required values. In many instances we think that the minimum is too low, as, for example, in the finer operations of jewelry manufacture, in engraving and in exact inspection in various industries. We have not yet discovered any case in which the recommended intensity seems unnecessarily high for the requirements of really efficient work. This table should convey to inspectors valuable information to be applied in the course of their regular duties.

Not a few central stations during the war curtailed in their commercial departments so that now new departments must be built. This time a true foundation for permanency should be laid and departments so organized that they can be expanded or contracted to fit conditions without destroying their structure.

The Maintenance of Power Equipment

THE big industrial plant presents for the power engineer a series of intricate and troublesome problems. His original plant must be laid out with reference to the particular work to which it is to be applied, the general economics of the situation as it exists and the possibilities of passing beyond the initial stage to future growth and perhaps to the utilization of a general power supply. These are things which need something of the prophetic instinct, but besides these in the immediate present lies the problem of maximum continuous usefulness, which requires that all the elements of the plant from prime movers to motors shall be ready at all times to do their appointed work.

We were glad therefore to give last week a discussion of the maintenance of power equipment which we believe will be profitable to many of our readers. The study centers about the operations of one big typical plant in steel-mill practice, involving a capacity of 18,000 kw., serving the general purpose of a system scattered over 1200 acres. When one realizes that the electrical department numbers about 275 employees, the importance of thorough organization is self-evident. To this end a very complete system of keeping track of all the apparatus and its performance has been inaugurated under skilled foremen who have charge of certain particular phases of the work. Inasmuch as continuous operation is peculiarly necessary in this class of industrial work, every effort in planning the equipment and keeping it at top efficiency is systematically directed toward this end. The result of this complete study of the situation has been steadily to improve the operating conditions, to better the equipment in making extensions, and to keep the whole plant working toward higher industrial efficiency. The details given in our paper are well worth thorough study by those who are charged with the grave responsibility of keeping up large power systems, and not a few of the methods described will be found of very general application.

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Accurate Timing in Electrical Tests

IN CONDUCTING short-time tests of electrical apparatus it sometimes happens that the precision of the apparatus under test exceeds that of the ordinary stop watch with which the test is made. In such a case, unless the observer is on his guard, the error he may assign to the apparatus may be mainly attributable to the unsuspected error of his timekeeper. This possibility is clearly presented in the article this week by Prof. F. A. Kartak. Two methods of obviating the difficulty are described, one involving an improved form of stop watch, the other a cycle counter converted into the equivalent of an accurate timekeeper through the intervention of a carefully adjusted tuning fork.

It is certain that electrically driven forks are coming into more generally recognized use. A tuning fork, properly constructed, is a wonderfully reliable timekeeper, and, unlike an ordinary pendulum, its frequency is nearly independent of its amplitude of vibration unless the amplitude is unusually large. The precision in time obtainable with tuning-fork control is easily of the third order, or one part in a thousand, and without much difficulty can be raised to the fourth order, or one part in ten thousand. In the stroboscopic fork, which is another well-known laboratory adjunct, the precision with which a steady speed of rotation can be measured is also of the third or fourth order.

The average cost of energy at the various army cantonments was 2.5 cents per kilowatt-hour. Most of the cantonments were located some little distance from nearby cities, necessitating rather long service extensions, but we presume some calumniator will arise and insist that there was profiteering in this charge.

The Muscle Shoals Nitrate Plants

ALMOST instructive and impressive view of the preparations made by the government for the fixation of nitrogen on a large scale is given in our columns this week by Messrs. E. R. Welles and C. T. Mitchell. Although the cessation of hostilities has put a temporary end to the need of nitrates for military purposes, their importance in agriculture is so great that, if the plants here described can be operated as economically as their projectors have thought, they may be of very large importance in time of peace.

The installation of both plants was a rush job of the severest character, in which the ordinary routine of design and construction had to be abandoned in favor of doing everything in the least possible time. It is greatly to the credit of the engineers that this was accomplished without being driven by necessity from sound lines of design. The power stations must be of high economy if they are to be useful in times of peace. The plants had to be erected and put in operation within a year, and to facilitate operations it was decided temporarily to take part of the power from the transmission system of the Alabama Power Company, which is capable of supplying about a third of the total output. The remainder is to come from the steam stations.

A notable fact in respect to them is that while on Jan. 1 of last year nothing but preliminary sketches had been made and none of the apparatus for the power plant purchased, eleven months later the cyanamide process had been started up with transmitted power, the first unit of the great turbine was practically ready for use and the two others under erection or ready for shipment, while the boiler plant was so far completed as to be ready when the turbine required steam. Whatever may be the ultimate fate of the plant under commercial stress in time of peace, its preparation for action in so short a time ranks as one of the big engineering feats of the war.

The power to fix rates is a fundamental regulatory function, overshadowing many managerial prerogatives in its influence on corporate welfare. Good management invites minimum interference from state commissions, but where prices and capitalization are subject to their jurisdiction it is fatuous to suppose that company administration is independent.

Maintaining the Efficiency of Hydroelectric Plants

THE changes of the last decade or so in the hydraulic efficiency of waterwheels have been of a somewhat startling character, although not very widely realized. The fact is that efficiencies, owing to more skillful design and installation, have risen something like 10 per cent when the plants are operated under reasonably favorable conditions. Besides this the general situation with respect to hydroelectric power has itself changed somewhat radically. While the earlier plants were oftentimes hunting for load, the later ones are wondering how load can be supplied without recourse to steam auxiliaries. In short, the time has come when to meet the growing demands of industry hydroelectric installations must be operated at high efficiency and must save water to the utmost, both by storage and by more skillful utilization. F. H. Rogers, hydraulic engineer for an extremely well-known builder of turbines, in the current issue brings very strikingly to notice the refinements which modern practice demands in a hydraulic plant. The matter which he specially considers is the maintenance of high efficiency.

The point of the matter is this, that while it is perfectly practicable to produce turbines of around 90 per cent useful efficiency, thus wringing out of the stream some 10 per cent more energy than used to be believed possible, it requires some reasonable degree of watchfulness to maintain continuous operation at the full rated efficiency. Of course, variations of efficiency due to load will always occur; but for any definite load increases in losses must be looked upon as a symptom of avoidable impairment of efficiency. Through water friction losses and leakage losses it is extremely easy to lose several per cent in the available power of the plant, which in these days may mean several per cent less salable energy or the corresponding amount of power produced from steam auxiliaries at high prices of fuel. The remedy for difficulties of this kind, as Mr. Rogers points out—and it is really a very simple one—involves keeping a close watch over the performance of the prime movers, knowing what the plant can do in first-class working trim.

In other words, the hydraulic plant should have the same kind of attention which is customarily given to the performance of a steam plant for the purpose of detecting and remedying any losses of efficiency. For this work indicating and recording gages are necessary, and therefore those which are installed for the initial test should be made permanent accessories of the plant.

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Accurate Timing in Electrical Tests

Errors Resulting from Use of Ordinary Stop Watches—Tuning-Fork Timing Device Which Has Been Found Very Satisfactory in Practice Is Described and Illustrated

BY F. A. KARTAK
Director Standards Laboratory, University of Wisconsin

For general timing work, such as the timing of revolutions of meter elements, the timing of the rotors of electrical machines in deceleration tests, the determination of the rates of rise of currents in circuits of extremely long-time constants and the like, a device similar to the stop watch in its method of application but possessing greater accuracy, ruggedness and reliability is highly desirable. It is also essential that the device, or at least its indicating element, be portable. The construction and performance of such a device are considered in this article.

FOR accurate work in commercial electrical measurements[1] it is essential that short time intervals be accurately measured because longer time intervals, which reduce the objectionable errors, do not permit the speed necessary for commercial testing work. The accurate measurement of short time intervals, however, has presented a more difficult problem than measurement of long[2] intervals, since it has been found difficult to eliminate the starting and stopping errors in measuring devices (such as stop watches), even though the time-keeping rate has been maintained with high precision. It is the purpose of the following discussion to emphasize the unreliability of the ordinary stop watch for this type of work and to describe two methods which have been developed for use at the standards laboratory of the University of Wisconsin to replace the stop watch in the measurement of time intervals.

Depending upon the nature of the testing work to be done, it may be necessary or more advantageous to employ a timing device which falls into one or the other of two classes: (1) Variable-interval timing devices; (2) fixed-interval timing devices. Devices of the first type measure time intervals (of any reasonable length) in seconds or hours and fractional parts. To this class belong stop watches and other similar pieces of apparatus. Devices of the second type measure or set off definite integral values of time in seconds or hours. As will be pointed out later, this type of device is most useful in the testing of portable standard watt-hour meters, but the variable-interval timing devices will be considered in this article.

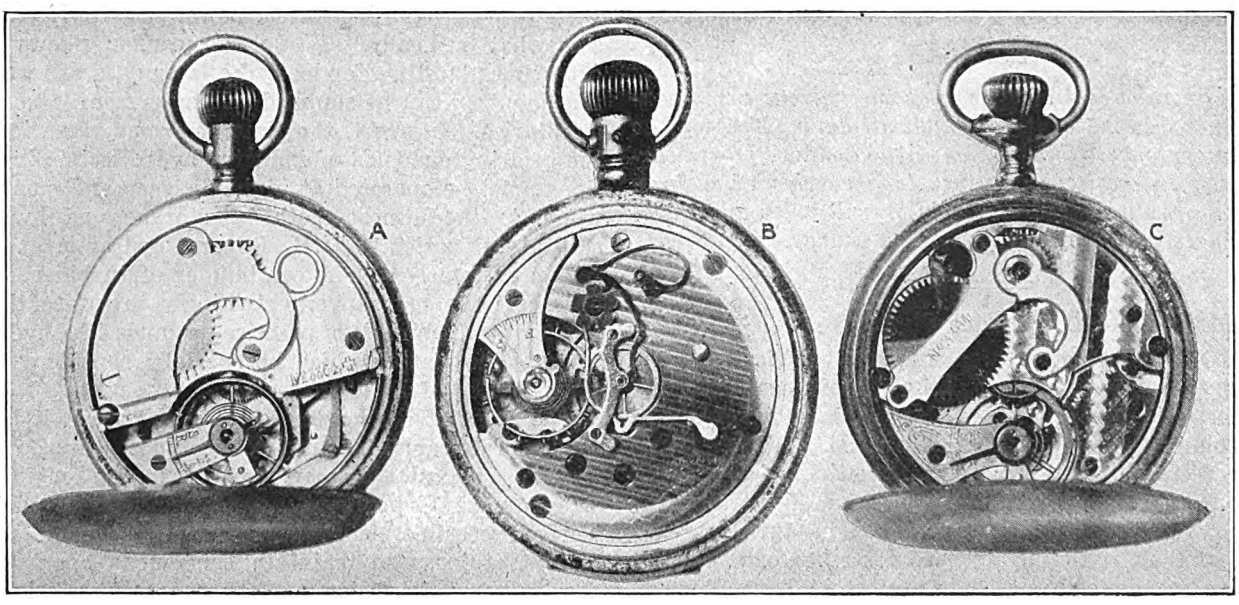

FIG. 1—THREE TYPES OF STOP WATCHES
A and *C* are stop-mechanism types, while *B* is a chronometer with a stop attachment. (See text for explanation of differences.)

The accuracy of the average stop watch in meter-testing work has in general been greatly overestimated. While a well-made watch may usually be regulated to hold a time-keeping rate which is accurate to at least one minute per week or approximately one-hundredth of 1 per cent, errors are introduced during the starting and stopping operations, which may amount to as much as one-half of 1 per cent or 1 per cent, or more, when an interval of not greater than thirty seconds[3] is used

[1] Since the unit of power (the watt) and the unit of time (the hour) both enter into the unit of energy (the watt-hour), it is important in the testing or calibrating of watt-hour meters that the errors in the measurement in both of these quantities be reduced to the smallest value possible. By using a high-grade indicating wattmeter of the precision dynamometer type which has been carefully calibrated by means of a potentiometer, the uncertainty in the power measurement may be reduced to approximately one-tenth of 1 per cent. The use of stop watches, however, for the measurement of the time element of the energy quantity, which has in most cases heretofore been the practice, has introduced, under normal conditions of use, a much greater uncertainty into the measurement of energy.

[2] Inexpensive pendulum clocks may be had which with practically no attention will keep time to within forty seconds per week, and the requirements of the railroad companies covering the accuracy of the watches of their employees demand that the change in rate shall not be greater than twenty seconds per week. These changes in rate amount to approximately seven-thousandths of 1 per cent and three-thousandths of 1 per cent respectively since there are 604,800 seconds in one week.

[3] The minimum time interval permitted by the Railroad Commission of Wisconsin in connection with the testing of electrical meters.

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in testing. In addition to this, it has been observed that many stop watches, while checking out accurately at the end of a complete revolution of the second hand, do not indicate correctly at the fractional parts of the revolution, losing in some cases as much as one-half second during the first thirty seconds and regaining this amount during the remainder of the minute, or vice versa

According to the manner of construction, stop watches may be classed under one of two general headings:

Chronometers with Stop Attachments.—Those in which a chronometer or watch movement operates continuously and in which the depression of the key engages or disengages the stop attachment with the chronometer movement.

Stop-Mechanism Watches.—Those in which the entire mechanism is started and stopped by the depression of the key.

Watches of the chronometer type (see *B*, Fig. 1) are perhaps more often used in important meter-testing work since the time-keeping rate of the movement is more easily checked. In order not to interfere with the time-keeping rate, the stop mechanism is engaged during only approximately the last 10 deg. of the balance-wheel stroke, which covers about 250 deg. Thus an error in amount equal to the time of stroke, or the period of the balance wheel, may be introduced at starting and again at stopping, since the indicating hand does not move or "pick up" until during the last 10 deg. of the 250-deg. stroke. Since nearly all chronometer-watch balance wheels have a period of 0.2 second, the error introduced into a thirty-second interval may be as much as 1.3 per cent even though the time-keeping rate be correct.

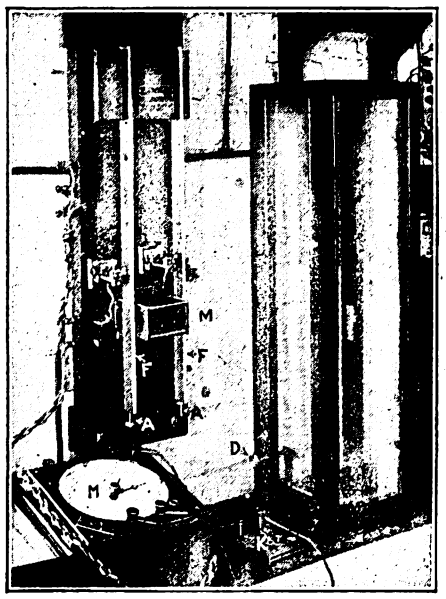

FIG. 2—TUNING-FORK TIMING DEVICE

The device consists essentially of a heavy iron base casting, in the head block of which are mounted the two steel fork legs *f*, actuated by magnet *m*. These legs are rigidly clamped by means of cap screws, the fork legs being adjustable in the clamping slots because of slotted holes in the fork blades. Pressure of *d* starts the forks vibrating. Final adjustment for rate of vibration is obtained by means of counter weights *a* at the ends of the fork legs. *M* is a timing device. The fork was designed to give twenty full cycles or forty strokes per second. The free portions of the fork legs are rectangular in section and are approximately 18 in. (45 cm.) long, the length being calculated from Raleigh's formula: $f = 84{,}600\ t/(l)^2$, where f is the frequency of vibration in cycles or periods per second, t is the thickness of rectangular fork leg in the plane of vibration in centimeters, l is the free length of fork leg in centimeters. The section of the fork leg or rod used was $\frac{1}{16}$ in. by 1 in. (4.8 mm. by 2.54 cm.).

Watches of the stop-mechanism type, which generally include those of least expensive construction, are also usually constructed with a balance wheel beating 0.2 second. In these watches (one of which is shown at *A* in Fig. 1) the possible errors introduced are the same as those discussed above, since the stop hand is actuated only during a small portion of the balance-wheel oscillation.

To reduce these errors a watch of the stop-mechanism type, such as is shown at *C* in Fig. 1, has recently been placed on the market. The balance wheel in this watch

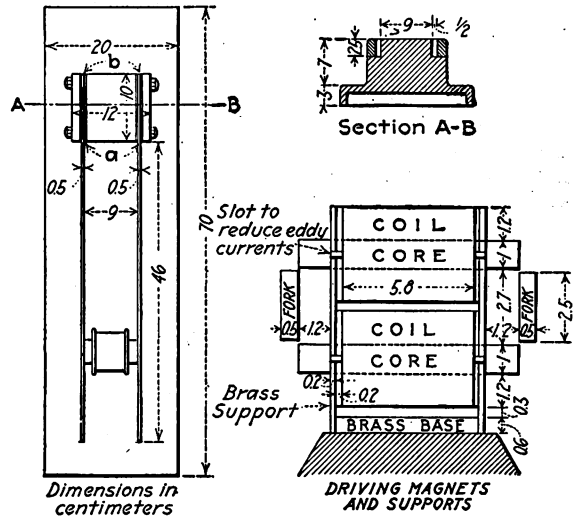

FIG. 3—CONSTRUCTION DETAILS OF TIMING DEVICE

has been made much lighter and the hair spring has been made stiffer and has but two or three convolutions instead of ten or twelve, with the result that the balance wheel makes fifty beats or oscillations per second instead of five. One complete revolution of the hand over the dial takes place in six seconds instead of in sixty seconds. This cuts down the starting and stopping uncertainties from 0.4 second to 0.04 second. Based upon a thirty-second test interval, the uncertainty in the measurement, assuming an accurate time-keeping rate, is thus 0.13 per cent.

While this 0.02-second type of watch has not been used at the standards laboratory of the University of Wisconsin for a time sufficiently long to warrant any comments on its ruggedness for field-testing work, past experience at the laboratory has shown that with stop watches of the ordinary kind (both stop-mechanism and chronometer types) great difficulty is found in maintaining them in a satisfactory condition. The mechanism is too delicate to stand the service of field-testing work in a satisfactory manner for any great length of time unless used and handled with great care. Even with the best of care, such watches should be regularly checked at frequent intervals to make certain that no change in operating characteristics has taken place.

TUNING-FORK TIMING DEVICE

Because of the uncertainty and the unreliability involved in the use of stop watches for the accurate measurement of short time intervals (from thirty to sixty seconds) it has been desirable to investigate the possibilities of developing more satisfactory methods of timing to be used in connection with the testing of portable standard watt-hour meters. A number of such methods,[4] having particular application to special prob-

[4] Thompson, ELECTRICAL WORLD, Vol. 61, p. 296, Feb. 1, 1913; Knopp, ELECTRICAL WORLD, Vol. 62, p. 242, Aug. 2, 1913; "Electrical Meterman's Handbook," 1915 edition, p. 273.

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lems in meter testing have already been proposed and used, but none of these has completely met the requirements of the testing work of the standards laboratory of the University[5] of Wisconsin.

Through the courtesy of the United States Bureau of Standards,[6] permission was obtained to duplicate a

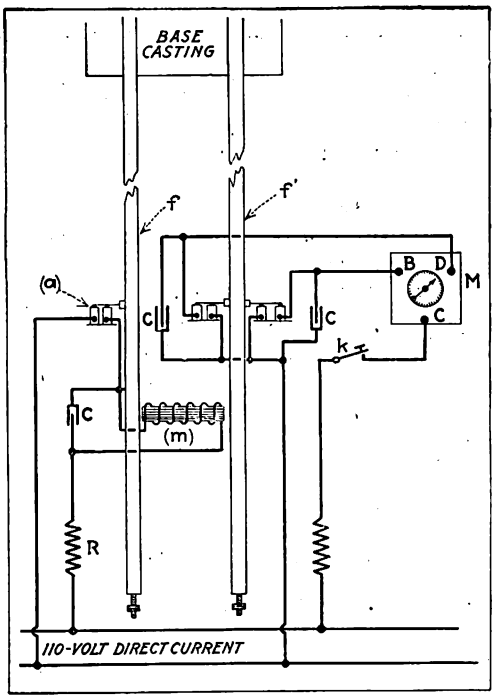

FIG. 4—ELECTRICAL CONNECTIONS OF TIMING DEVICE
The left fork leg, *f*, which is known as the driving or actuating leg, makes electrical connection at nearly the extreme of its left stroke by means of the mercury contact shown at *a*. An enlarged view of this contact is shown in Fig. 5. When the circuit is closed at *a*, the current, which is limited in value by the resistance *r* to about 0.03 amp., flows through the magnet *m*, thus causing both fork legs (which form part of the magnetic circuit) to be drawn together until the contact at *a* is broken. (This action is similar to that of the contact of a vibrating-type ignition coil). If the adjustments of the fork legs and of the contact at *a* are properly made, the fork legs will vibrate at their free or natural periods. The right fork leg *f'*, which is known as the operating leg, makes contact at each end of its stroke, thus causing current to flow from the positive or plus busbar to one or the other contact at either end of the stroke, through the counting device at *M*, and back through the key *k* to the negative busbar or line.

tuning-fork timing device which was originally designed and put into operation at the Bureau of Standards laboratories. To the writer's knowledge a description of this device has not been published by the bureau, but since a number of modifications of the original design have been made by the writer to increase its accuracy and reliability, it is thought desirable to make public at this time a description both of the fork and of the modifications which have been made.

As a timing device which is unchangeable in its operating characteristics, the tuning fork has not had the prominence which it deserves. It is probably not generally known that a fork of this kind when properly constructed can be made to vibrate accurately at its natural period or number of strokes per second regardless of variations in the driving force, and that within reasonable limits the rate of vibration is independent of the amplitude of vibrations of the fork legs. Forks of this kind are only slightly affected by temperature changes, the change in rate of vibration with change in room temperature being only 0.009 to 0.013 per cent per degree Centigrade.

Fork Construction.—The tuning-fork timing device as constructed and used at the standards laboratory is shown in Fig. 2. Difficulty was at first experienced because of the high stresses due to the operation of the fork causing the cast-iron head to fail at point *a* (Fig. 3), thus altering the clamping and the effective free length of the fork and causing a change in the period of vibration of the fork leg. This was remedied by milling out the clamping slot and placing hardened steel faces in the clamping jaws at *b*. In order to eliminate any change in rate due to "fatiguing" of the steel of the fork blades themselves, an "anti-fatigue" alloy steel known as "electro - chrome - silico - manganese spring steel" and having the following average analysis (in percentage) was used: Carbon, 0.43; silicon, 0.65; manganese, 0.85; chromium, 0.90; phosphorus, 0.018, and sulphur, 0.015. The desirability of using an "anti-fatigue" steel is indicated by the fact that after about eight months of steady use the change in rate of the fork cannot be detected by the method of test used, which permits an accuracy of the order of 0.03 per cent.

Operation.—The fork, after being started manually by depressing the plunger shown at *d* (Fig. 2), is caused to operate electrically from a 110-volt direct-current supply circuit and continues to vibrate so long as voltage remains on the circuit. (Read explanation under Fig. 4.) A counting device (Figs. 6 and 7 and

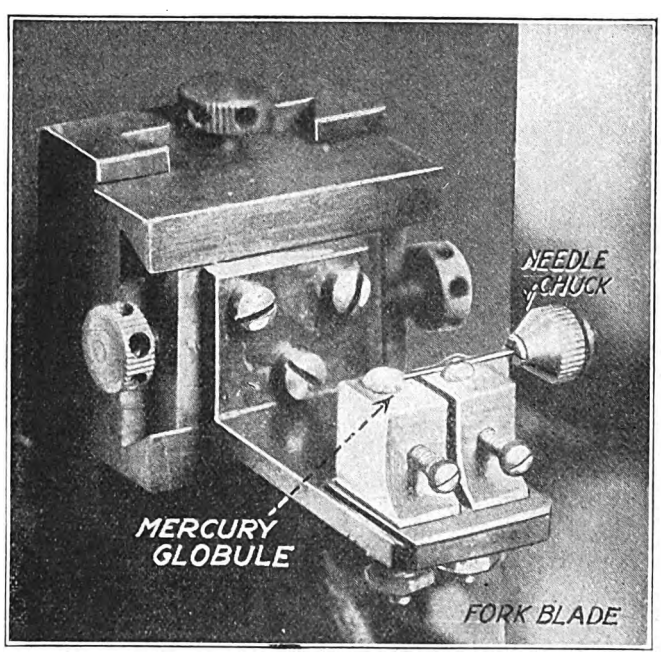

FIG. 5—NEARBY VIEW OF CONTACT-MAKING DEVICE
The contacts consist of steel needles riding in or through one mercury globule and pricking or contacting with another, both mercury globules being mounted on insulated steel blocks into which machine screws are threaded to permit the adjustment of the height and size of the globules. The needle is fastened to the fork leg by means of an insulated needle chuck, the needles thus being easily replaceable. The bracket supporting the mercury globules is adjustable both horizontally and vertically in guides mounted on the base panel.

M, Figs. 3 and 4), whose construction is explained later, registers the current impulse sent through it at the end of each stroke of the fork leg *f'*, thus registering time in steps of 0.025 second each. By utilizing the key *k* as one would the depression key of a stop watch, a time interval may be measured in steps of 0.025 second.

[5]This laboratory, which is maintained jointly by the University of Wisconsin and the Railroad Commission of Wisconsin, undertakes electrical testing and investigational work of different kinds for public utilities, industries and individuals and is regularly testing and calibrating portable standard watt-hour meters for many of the public utilities of the state. This work, together with special investigations in meter testing which are being conducted from time to time, has long indicated the need for the types of timing devices mentioned in this article.

[6]It is desired to give full credit to the Bureau of Standards for the original suggestion and to thank Dr. P. G. Agnew of the bureau in particular for his kindness in furnishing a copy of the original drawings and specifications.

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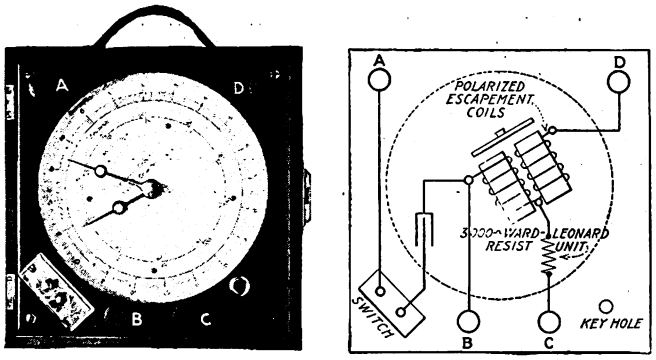
Contacts.—The mercury type of contact (Fig. 5) which was employed in this timing device was devised by the writer to eliminate the use of spring or metallic contacts, which (no matter how lightly made) react mechanically on the fork proper, causing a change or



FIGS. 6 AND 7—COUNTING DEVICE AND INTERNAL CONNECTIONS
With the connections to the binding posts *B*, *C* and *D* made as shown in Fig. 4, a current at one stroke of the fork passing through the meter binding posts from *B* to *C* causes the armature of the polarized magnet to be turned in one direction, and, at the end of the reverse stroke of the fork, a current passing through the meter binding posts, *D* to *C*, causes the armature to be turned in the reverse direction.

variation in the natural period of the fork. This mercury contact is noiseless as well, whereas it was necessary to operate the fork originally equipped with mechanical contacts in a sound-proof case.

Meter or Counter.—The meter or counting device used at the standard laboratory is a Holtzer-Cabot cycle counter, equipped with special connections for this type of service and provided with a special dial which reads directly in seconds. (See Figs. 6 and 7.) This instrument consists essentially of a high-grade clock mechanism in which the usual balance wheel and hair spring have been replaced by the moving element of a polarized telephone ringer in such a manner that this moving element actuates the escapement of the clock shown on the left-hand side of Fig. 8. The action of the polarized relay taking place at the rate of forty movements per second releases the escapement of the clock at the

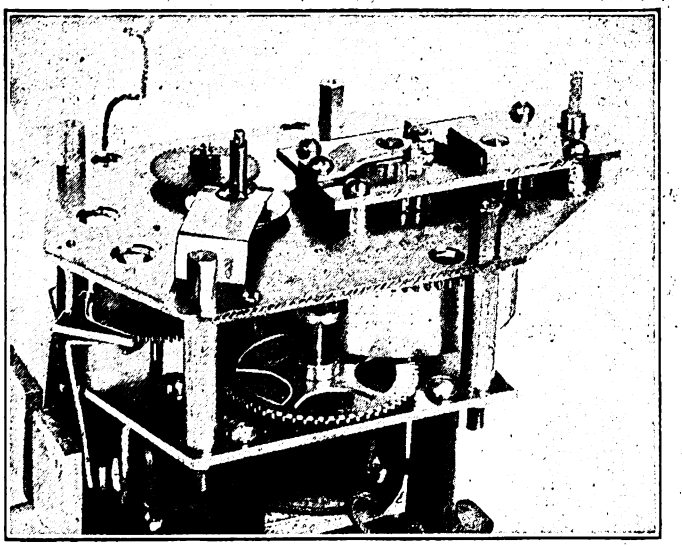


FIG. 8—CLOCK ESCAPEMENT ACTUATED BY POLARIZED RELAY AT LEFT

rate of forty beats per second and, with the clock hands properly geared to the movement, causes a corresponding indication over the dial to take place.

Temperature Coefficient.—The temperature coefficient of the fork as determined over a range of room temperature of 14.5 deg. C. to 42.5 deg. C. was found to be 0.011 per cent per degree. The temperature coefficient curve which shows the fork to be compensated for correct operation at 22 deg. C. is shown in Fig. 9.

Adaptability.—The fork described is permanently mounted on the brick wall of the standards laboratory. Its utility has been increased by providing a three-conductor cable connecting the fork and the counting device of sufficient length to permit the counting device to be used at any point in the room. By connecting this three-conductor cable to the switchboard circuits the counting device may be used in any part of the laboratory building.

For important meter-testing work at different substations or other meter installations a fork of this kind placed in the meter shop or laboratory of a central station might be connected to a counting device at any substation by means of a pair of wires with a ground return for the third conductor. A pair of wires either overhead or in a telephone cable would answer all requirements when using a ground return (if the necessary permission were obtained for the use of the wires from the telephone company), since the operating current of the counter is of the order of 0.02 amp.

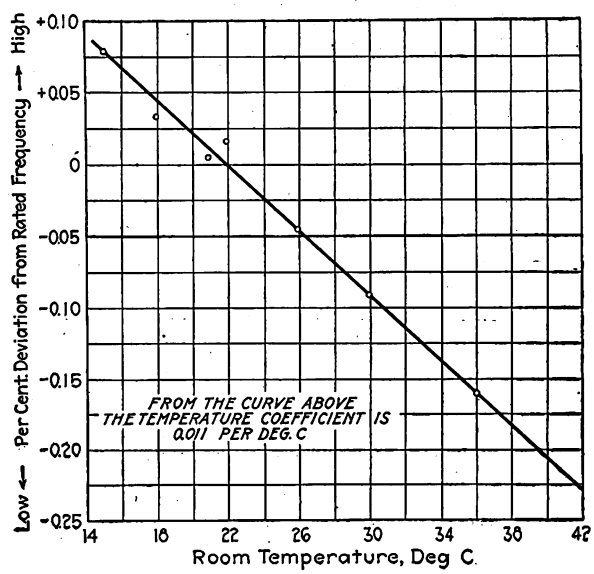


FIG. 9—TEMPERATURE COEFFICIENT CURVE FOR TUNING FORK TIMING DEVICE

While it is quite possible that a fork could be constructed which would accurately beat 0.01 second instead of 0.025 second, this increase in frequency would not be warranted in ordinary meter-testing work, since the personal errors in closing and opening the key at the beginning and end of the time interval are greater than the error due to frequency of the fork. The possible error in the measurement of time intervals due to the frequency of the fork would be 0.025 second at the closing of the key and again 0.025 second at the opening, or a total of 0.05 second. Tests at the standards laboratory have indicated that the usual error to be expected due to personal uncertainty in closing and opening the key amounts to about 0.2 second. With this uncertainty there would be but little gain in accuracy by increasing the beat of the fork from 0.025 second to 0.01 second, especially with the uncertainty introduced through the temperature coefficient when the room temperature cannot be closely maintained.

A discussion regarding fixed-interval timing devices will be printed in a later issue.

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MINIMUM INTENSITIES FOR DETAILED OPERATIONS

Adopted by New York Industrial Commission to Take Effect July 1, 1919—For Guidance of Factory Owners and Managers

DATA on minimum and recommended intensities of illumination for general purposes have been published by the Illuminating Engineering Society and incorporated with little change in several industrial codes, but until now very little information has been available on requirements for particular operations. While not enough study has been given to specific cases to justify any hard and fast specifications for illumination intensities, the following data will give factory electrical engineers an idea of what the New York Industrial Commission considers fair values at the present time.

The data are tentative but will be made mandatory July 1 unless the experiences which have been reported or will be reported before that date justify changes. While the figures are based on tests in well-lighted installations, the commission suggests that factory engineers make tests to determine whether other values should be substituted.

There are some operations for which it is not advisable to specify any intensities. For instance, in certain parts of the process of glass manufacture it

MINIMUM INTENSITIES FOR DETAILED INDUSTRIAL OPERATION AND PROCESSES

	Minimum Foot-Candles at the Work
BAKERIES:	
Mixing and baking operations	1.00
BOILER ROOMS:	
Boiler rooms (general)	0.25
Pumps, condensers and apparatus	1.00
BREWING:	
Brewhouse (general), cleaning, malt mills, beer kettles, mash-tubs, rice cookers, beer-cooling coils, ferment room, stock room, filter room	0.50
Beer-keg washing, cooperage, racking or keg filling, automatic bottle-filling machine	1.00
CANDY MANUFACTURING:	
Mixing, cooking, hand dipping, machine dipping, cutting, cream beating, cooling, wrapping, packing, weighing	1.00
Machine operations	2.00
CHEMICAL MANUFACTURING:	
Furnaces, roasters, stills, precipitation, crushing, grinding, crystallizing, mixing tanks, evaporating, filtering	0.50
Extractors, compounding	1.00
CIGARS AND CIGARETTES:	
Stripping, cigarette packing (hand and machine)	1.00
Hand rolling, banders (hand), banding machines (cigarettes)	2.00
Automatic cigarette machines, paper-punch machines, cork-tipping machines, cylinder dressing machines (for tobacco)	1.00
DAIRY PRODUCTS:	
Cooler rooms, washing machines, pasteurizing apparatus, cream separators, ice cream freezers, churns, clarifiers	0.50
Bottle filling, bottle cappers, butter worker, butter printing, ice crushers	1.00
Packing and shipping	1.00
ELECTRIC CABLE MANUFACTURING:	
Flexible conduit and armor-cable machines	1.00
ENGINE ROOMS:	
At machines and engines	1.00
Switchboards and transformers	2.00
FERTILIZER MANUFACTURING:	
Cookers, pressers, fertilizer dryers, fertilizer mills	0.50
FOUNDRIES:	
Rough molding, tumbling barrels, charging floors, cleaning at cupola	0.50
Fine molding, grinding, machine molding	1.00
Coremaking	2.00
GLASS INDUSTRIES:	
Furnaces, annealing ovens, glass blowing	0.50
Mixing room	0.50
Grinding	1.00
Polishing	2.00
Etching	3.00
Cutting	5.00
GRINDING, BUFFING AND POLISHING:	
Rough work	1.00
Medium work	2.00
Fine work	3.00
ICE MAKING:	
Ammonia valves, tank floor, compressed-air hoist, compressors, dipping tanks, at run to storage, ammonia pump	0.50
JEWELRY:	
Gold and silver polishing, buffing, burnishing, punch-presses, clock assembling and repairing	5.00
Engraving, stone setting, modeling, saw piercing, jeweling, designing	5.00
LAUNDRIES:	
Washing machines, hydro extractors, starching	0.50
Sorting, marking and folding	1.00
Hand ironing	1.00
LEATHER GLOVES:	
Cutting	3.00
Sewing and stitching (machine or hand), examining, finishing	5.00
MACHINE SHOPS:	
Rough bench work, machine work, assembling	1.00
Medium bench work, machine work, assembling	2.00
Fine bench work, machine work, assembling	3.00
MEAT PACKING:	
Slaughtering, casing machine, casing department, beef coolers, packing, extractors, sausage-casing machines, dressing, post-mortem inspection, offal work, scalding vats, automatic dehairing machine, cleaning and cutting, grinding, casing, cooking	2.00
MILLING AND GRAIN PRODUCTS:	
Dust-collecting apparatus, grain elevators, general operations in workrooms	0.50
Separator, scouring, grinding, bolting, bagging, packing, all automatic machines	1.00
PAINT MANUFACTURING:	
Color-drying rooms	0.50
Compounding room, mixers (pony, liquid, cyclone), grinding mills, striking vats, boiling tubs, drying pans, putty chaser, can filling, can labeling, can soldering	1.00
PAPER-BOX MANUFACTURING:	
Power paper-cutting machines, slitting machines, scoring machines, automatic machines, stripping, top labeling machines, bench work (hand)	1.00
Corner staying machines, corner cutters	2.00
PAPER AND PULP MILLS:	
Wood grinders, acid plant, barkers, digesters	0.50
Paper machines, calender rolls, winders, beaters, wet press, screening	1.00
PEARL-BUTTON MANUFACTURING:	
Grading machines, wet and dry polishing	0.50
Grinding machines, cutting blanks and shells, carding buttons, hand turning, automatic machines	1.00
Sorting of waste, sorting for thickness	2.00
Grading for color and defects	2.00
PRINTING INDUSTRY:	
Metal pots	0.50
Stereotype casting	0.50
Job printing presses, cylinder presses, paper-ruling machines	1.00
Lithographing, electrotyping, trimming saws	2.00
Linotype and monotype machines, hand type-setting, proofreading	3.00
Engraving	5.00
RUBBER MANUFACTURING:	
Vulcanizing	0.50
Compounding scales, tubing machines, rubber-spreading machines, starching machines, cloth-printing machines, acid-curing room, churn room	1.00
Grinding mills, calenders, washing machines	1.00
Pressing forms	2.00
SHOE MANUFACTURING:	
Buffing, cutting, channeling soles, lasting, welting, trimming uppers, miscellaneous bench and machine work, stitching (hand and machine), turning	2.00
Inspection, trecing, cleaning, finishing	5.00
SOAP MANUFACTURING:	
Kettle house, dryer, mixers, soft-soap vats, blotter, framing	0.50
Soap press, soap mills	1.00
STEEL MILLS:	
Charging floors, loading yards	0.25
Rolling mills, sheet and bar mills, reheating furnaces	0.50
Wire drawing and straightening mills	1.00
TANNERIES:	
Dehairing, dehairing forms, pressing, tacking boards	0.50
Tanning paddle vats, putting-on machines, steam dryers, coloring and dyeing, measuring machines, blooding	0.50
Glazing machines, ironing machines, staking (knee, arm, machine), finishing tables, abrasive wheels, shaving machines, buffing, sorting of raw hides (for color after shaving), beamslers (or fine dehairing)	1.00
WOODWORKING:	
Carriage saws in long mills, mortiser machines, wood boring and bench work	1.00
Circular saw, band saw, swing saw, jointer, wood shaper, tenoning machine, planer, veneer cutter, resaws, wood-turning machines, sandpaper machines	3.00

	Minimum Foot-Candles at the Work: Light	Dark
TEXTILES (COTTON):		
Receiving and opening bales, openers, pickers, lappers, cards, slashers	0.25	0.50
Drawing frames, fly frames (slubbers and speeders), spinning frames (ring), twisters, spoolers, warping, doublers, nappers	0.50	1.00
Weaving, knitting, inspecting	1.00	2.00
TEXTILES (WOOL):		
Receiving and opening bales, pickers (burr, mixing, and rag), cards (breaker)	0.25	0.50
Garnetting machines, spoolers, cards (finishing), spinning (mule or jack), winders, washing extractors, boarding	0.50	1.00
Knitting frames, cutting, sewing machines (ribbing, finishing, seaming), examining	1.00	2.00
CLOTHING:		
Sewing, finishing and inspecting	3.00	5.00
Pressing and sponging	1.00	1.00
Cutting	2.00	2.00
Shrinking	0.50	0.50

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is more desirable to observe conditions or operations in the light produced by the molten glass. In other operations it is more satisfactory to observe conditions by the silhouette effect, as in working with dark threads and lamp filaments. In all such cases in which work is of necessity carried on in comparative darkness special precautions should be taken to safeguard the workmen.

In order that the illumination should not fall below the specified minimum during the interval between inspections or cleanings, installations should be designed so as to produce initial illumination values at least 25 per cent higher than given in the table.

Power Needs of United States Nitrate Plants

Problems Involved in Building Two Plants Established by the Government at Sheffield, Ala., Near Muscle Shoals—Sites for Three Other Plants Selected at Indian Head, Md., and Toledo and Cincinnati—Economy of Operation Aimed At

BY EDWARD R. WELLES AND C. T. MITCHELL
Mechanical Division the J. G. White Engineering Corporation

BECAUSE of the dependence of this country upon Chile for its supply of nitrates and by-products, it was generally agreed before the war that we should have a source of supply within this country in case of a possible naval blockade. Consequently, appropriations were made by the government for the erection of huge nitrogen-fixation plants, the output to be used for the manufacture of explosives in times of war and for agricultural purposes during times of peace. Upon our entrance into the war the work on these plans was very much accelerated. A number of scientists and commercial investigators had been at work independently, the American Cyanamid Company having already erected a plant for the commercial fixation of nitrogen by the cyanamide process. At the same time the General Chemical Company was working on the subject, but along other lines, and it had developed a process which appeared to offer a number of advantages. The Nitrate Commission appointed by the government to investigate the relative merits of all known processes recommended the latter as the one on which to begin operations. This recommendation was adopted, and since the General Chemical Company had already prepared plans and purchased some equipment for a plant of its own, it was able to hasten matters by turning all these plans and equipment over to the government for the erection of nitrate plant No. 1.

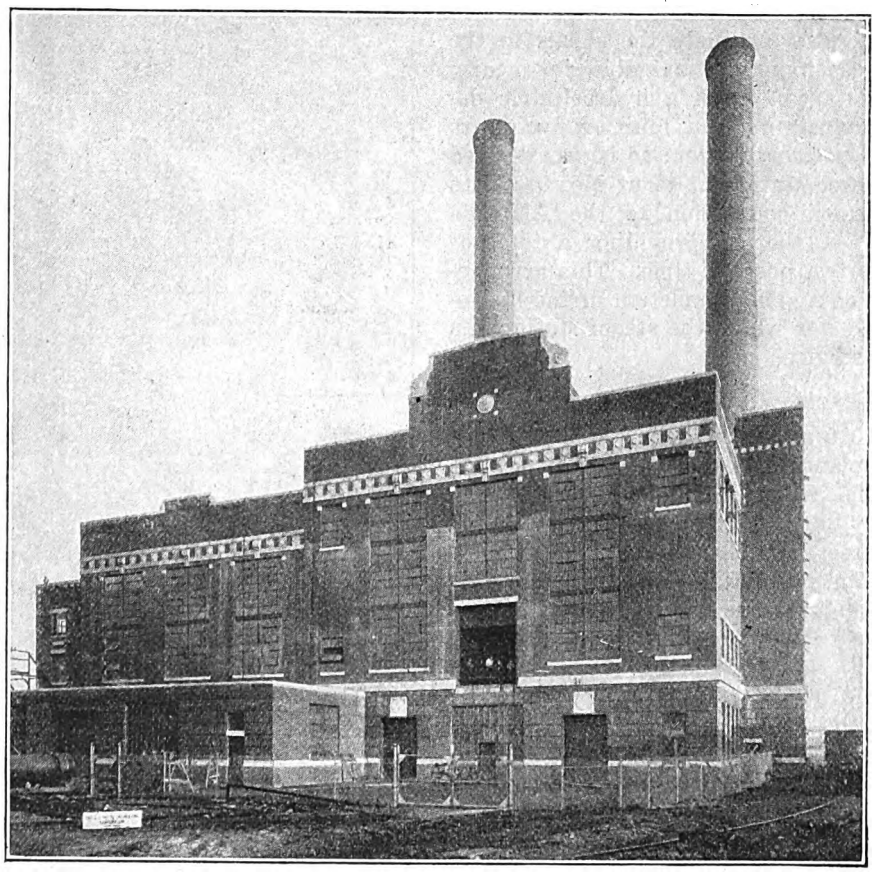

FIG. 1—POWER HOUSE SERVING NITRATE PLANT NO. 1

The Ordnance Department of the United States Army divided the work somewhat as follows: The general design of the ammonia process was placed in the hands of the General Chemical Company; the ammonia oxidation equipment was designed by the Ordnance Department; the design and erection of the chemical system for the absorption of the nitric oxide and the acid concentration was delegated to the Chemical Construction Company, and to the J. G. White Engineering Corporation was given the task of designing and erecting the various buildings and the power station. A site was selected, and the work began in the fall of 1917. When this work was well under way a second nitrate plant (No. 2) was decided upon, and for this plant the cyanamide process was adopted. The Air Nitrates Corporation, a subsidiary of the American Cyanamid Company, was organized to construct and operate the plant. Westinghouse, Church, Kerr & Company were selected as engineers to erect the necessary buildings for the process, and the J. G. White Engineering Corporation was selected to design and erect the power house for the plant.

When the armistice was signed plans had been made for three additional plants—the navy nitrate plant at Indian Head, Md., which was to be similar to nitrate plant No. 1, and nitrate plants Nos. 3 and 4 for the army, at Toledo, Ohio, and Cincinnati, Ohio, whose combined capacity was to equal that of nitrate plant No. 2.

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The requirements which had to be considered in selecting a site for a nitrate plant included the following: (1) It should be inland so as to be easily defended from foreign attack; (2) it should be near a supply of coal and coke in order to avoid excessive freight charges, and (3) it should be as near as practicable to the center of the argicultural demand for nitrates. The city of Sheffield, in the northern part of Alabama, seemed to combine these advantages and was therefore chosen for the site of nitrate plant No. 1. Plant No. 2, which uses the cyanamide system, depends upon the use of the electric furnace, hence the power requirements are relatively large. For this reason a site first was selected at Sheffield because of the possibility of eventually using power from the Tennessee River at Muscle Shoals. The determining feature in the selection of the sites for No. 3 and No. 4 was the existing supply of electric power at these two localities.

For a number of years the development of the hydroelectric possibilities of the Tennessee River at this point has been discussed. This development, if carried on, is expected to give a constant supply of 90,000 kw. and a maximum of about 180,000 kw.; with a dam farther down the river a maximum of possibly 500,000 kw. will be available. It will also eliminate the shoals in the river and make it continuously navigable for nearly twice the present distance. Such a hydroelectric development, however, would require four or five years for construction, and possibly longer; so it was decided to install a steam-power station at plant No. 2 and to construct a high-tension connection to the Alabama Power Company's lines, thereby providing a total of 80,000 kw. in the shortest possible time. This arrangement is to be used pending the completion of the hydroelectric development, after which the steam station can be used for standby service.

Some Problems Involved

Approximately 20,000 men were required in the construction of nitrate plants Nos. 1 and 2, but since the three cities of Sheffield, Florence and Tuscumbia, which form one community, had a combined population of fewer than 10,000 persons (before the war) and had no near neighbors of large population, it was necessary to get the labor from outside the territory—from practically all the states of the Union. In many cases it was necessary to house the families and provide such utilities as gas, water, electricity, etc., as well as all other necessities of a small city.

Despite these huge difficulties, ammonium nitrate was being manufactured in less than one year after beginning the design of nitrate plant No. 1. This was done in spite of the fact that a certain amount of development work had to be done after the erection of the apparatus.

On Jan. 1, 1918, nothing but preliminary sketches, principally free-hand, had been made in the design of nitrate plant No. 2, and none of the equipment for the power plant had been purchased. Nevertheless, on Nov. 25, 1918, eleven months later, ammonium nitrate was being manufactured, using power from the Alabama Power Company's lines, and the first element of the 60,000-kw. turbine of the power house was about ready for operation. The second element was in the process of erection, and the third element was ready for shipment. The boilers and stokers were so far erected as to be ready whenever the turbine required steam.

The quantity of freight handled for this development was enormous and required the construction of special railway yards to provide for storage during unloading. One item alone may give some idea of the magnitude. The 60,000-kw. turbine installed in power house No. 2 required more than forty railway cars to bring it from the manufactory, and this train did not carry the condensers and some of the condenser accessories Similar comparisons might be made of almost every other feature of this project in both power-house and process buildings.

How Process Used Affected Power Plant

The nitrogen-fixation systems adopted for these two plants differ considerably. The cyanamide system, employed at No. 2, utilizes the electric furnace in the manufacture of calcium carbide, which with the addition of nitrogen gas obtained by a partial liquefaction of air becomes calcium cyanamide; from this substance ammonium nitrate is derived. For this work there are

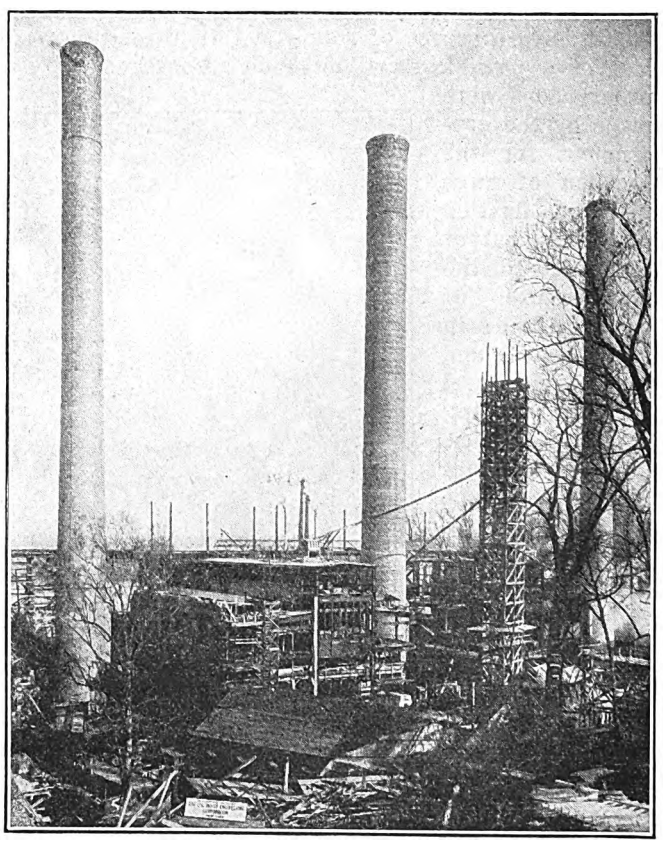

FIG. 2—NITRATE POWER PLANT NO. 2, UNDER CONSTRUCTION, WHICH WILL HAVE AVERAGE LOAD GREATER THAN BROOKLYN'S PEAK LOAD

installed twelve electric furnaces, each requiring 6000 kw. Ten will always be in operation, giving a load of 60,000 kw. This equipment, together with the motor load, will bring the load to about 70,000 kw. or 80,000 kw. with a load factor of about 90 per cent. The large and very constant load required the erection of a station similar to a central station, designed for as high an economy as war conditions would permit.

The process at nitrate plant No. 1 is essentially a contact process, depending on the direct chemical union of the gases necessary to form ammonia in the presence of a catalytic agent. It does not lie within the province of this article to discuss the process; it is sufficient to state that the power load consists principally of motors, operating pumps, compressors, etc., but a proportionately

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large quantity of both high and low-pressure steam is required. Hence, while plant No. 2 has 60,000 kw. turbine capacity (70,000 kw. maximum) and 18,000 boiler-hp., or 3.3 kw. per boiler--horsepower, plant No. 1 has 4000 boiler-hp and 5000 kw. turbine capacity, or 1.2 kw. per boiler-horsepower.

The engineers in charge of work on these stations were faced with the problem of accomplishing the design and erection within a space of time unheard of before, and also at a time when deliveries of material were extremely slow. The fact that the jobs were given a high priority rating very much aided the obtaining of material, but every manufacturer was crowded with government work of the utmost importance and of great urgency; hence the difficulties of obtaining equipment were very great. The ordinary routine in the design and construction of such plants, therefore, had to be abandoned. It was necessary to purchase all of the principal apparatus before the general design of the complete station could be decided upon and to suit the station design to the equipment available. The clearing of the site had to be carried on while the buildings were being designed; the design of the buildings had to be based upon preliminary layouts of apparatus, and there was no time left for radical changes.

The life of these stations after the conclusion of the war is dependent upon their economy. It was, therefore, important that the design should be such as to permit high economy of operation if the project was to be an ultimate success. It was consequently decided to adhere as closely as possible to a design which would result in as high a degree of economy as was practical, but that none except standard forms of apparatus would be purchased and that no feature would be tried unless there was absolute assurance of its satisfactory operation. Additional interest is given to these stations because they were designed and built in record time but without a sacrifice of the principles of economical design.

The generating equipment of plant No. 1 consists of three turbines and a steam-driven exciter, the latter used for starting up. Two of these turbines are rated at 1875 kva., the third at 1250 kva. The latter unit had been purchased by the General Chemical Company for its own smaller plant before being taken over by the government. The turbines are interesting in that they are of the bleeder type, delivering a certain amount of steam to the process from the 10-lb. (700-gm.) pressure stage, the rest to the condenser. The amount of steam bled from the turbine is controlled by a large diaphragm valve operated by the pressure in the process pipe line. The amount bled may be as high as 95 per cent of the total steam delivered to the generator, or it may be nothing at all, according to the demand for exhaust steam. In case the demand should cease, the turbine becomes a straight condensing turbine. The turbine thus acts as a pressure regulator for the process steam; this is the most important function of the bleeding operation. As a matter of fact, the demand for steam in the process is fairly constant, there being no violent fluctuations to cause wear and tear on the regulating mechanism. Since all the auxiliaries in the power plant are steam-driven and exhaust steam is available from four air compressors as well (two of which are in constant operation), there is a considerable excess of exhaust steam over that required to heat the boiler-feed water. This excess is delivered to the process along with the steam extracted from the turbines. A small amount of steam from the process line is admitted to the feed-water heater by means of a thermostatic valve, in order to maintain a constant temperature in the boiler-feed water. From 10 per cent to 30 per cent of the low-pressure process steam comes from the turbines, according to the demand. Since a considerable proportion of the total steam is non-recoverable, there were no special advantages to be gained by the use of surface condensers, and therefore low-head jet condensers, installed directly underneath the turbine, were used. As direct current chiefly is used in the plant, power is developed at 190 volts, 60 cycles, six-phase, and most of it is converted in three rotaries installed opposite the turbines on the turbine-room floor.

Though nitrate plant No. 1 is modern and up to date throughout, the above outline probably covers all the general features, outside of the electrical equipment (which will be taken up in a subsequent article), and will give a general conception of the wide differences between this station and station No. 2, a detailed description of which is to appear later.

WAR-TIME FINANCING IN COLUMBUS, OHIO

Generating Unit Bought with Some Aid from War Finance Corporation, but Delay in Boilers Hampered Full Operation

How the Columbus (Ohio) Railway, Power & Light Company financed the cost of a 10,000-kw. turbine with some aid from the War Finance Corporation is explained in the annual report for 1918. The purchase of the unit and the delay in operation of the turbines under full load because additional boilers have not yet been installed are described as follows by Norman McD. Crawford, the vice-president:

The last annual report refers to the completion of the new Walnut power station with a 15,000-kw. unit. The company had previously taken an option on a second unit of 10,000 kw., and on account of the rapidly increasing power load due to war demands plans were prepared to install this second unit provided its cost could be financed. On account of the impossibility of selling bonds or other securities in the usual way to provide for the floating indebtedness and other requirements of the company, application was made to the War Finance Corporation for a loan of sufficient size to cover all the requirements including the increased power capacity for war purposes. The final result of these negotiations was the issue of a two-year note issue for $2,500,000, $750,000 of which was taken by the War Finance Corporation and the balance placed among the creditors of the company. The War Finance Corporation required as a condition of this subscription that the new 10,000-kw. power unit should be installed in the Walnut station to provide for the demands for power for war purposes. This installation was therefore decided upon and has been progressing. Operation of the 10,000-kw. turbine was started in November, and complete installation of boilers, etc., can be finished within the next six months.

During the early part of the year the boiler installation for the 15,000-kw. turbine which was installed at the Walnut power station during 1917 was completed, and this turbine has been operated up to capacity since that time. During December the second generating unit, a 10,000-kw. turbine, was placed in service at this station. The boilers for this unit, however, have not yet been installed, though the foundations for these boilers and the building to contain them are now under way, and it is anticipated that this boiler installation will be completed during the first six months of 1919.

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Economical Operation of Water Turbines

Determination of the Value of the Principal Losses That May Occur, and Methods of Locating Their Origin—Keeping of Records and Their Utilization—Inquiry Into the Effect of Losses on Output

BY F. H. ROGERS
Hydraulic Engineer, I. P. Morris Department, William Cramp & Sons Ship & Engine Building Company

ECONOMICAL operation of water turbines has to receive careful study from the engineers and operators of hydroelectric stations in order to meet the load demands with the least possible expenditure of water. In such a study consideration must be given to the flow conditions in the river, storage and draw-down, the daily load demand curves, the sudden load changes and the characteristic curves of the turbines. This problem differs in different plants since it depends on

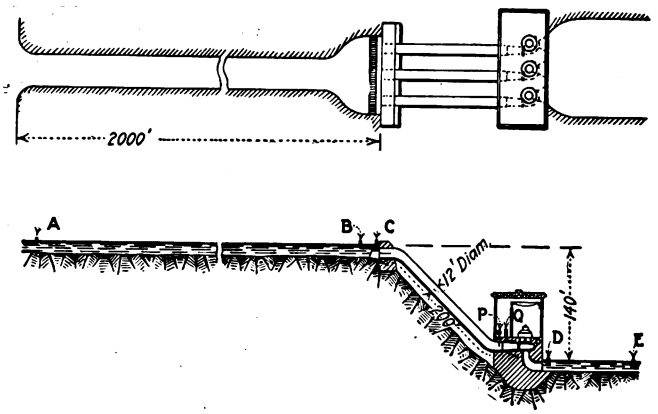

FIG. 1—POSITIONS FOR WATER GAGES IN A SPECIFIC HYDROELECTRIC PLANT

local conditions. It is not the intention of the author to deal with this phase of the matter.

However, in a great many power stations little attention is given to maintaining the efficiencies obtainable when the plant was first built, and no systematic methods are used for checking up the efficiencies or hydraulic losses from time to time. In some plants it is customary to shut down the turbines at stated intervals and inspect the interior parts, but such a practice is not economical and in many instances may be unnecessary. It is possible by the installation of a few simple gages and by careful records of their readings to determine whether the efficiencies are being maintained. If a decrease is noted, it is often possible to determine where the loss is occurring so that a rapid inspection may be made. It is this phase of the subject which will be discussed.

In general such losses may be divided into two groups, (1) friction losses and (2) leakage losses. The former are usually caused by obstructions in the water passages and the latter by actual leakage at drain valves or other parts of the system, or by wear at the runner seals.

APPARATUS AND DATA NEEDED

To determine the value of these losses and to locate their cause it is necessary to have available characteristic curves of the turbines and gradient curves for the water passages and to install elevation gages along the canal, in the forebay and tailrace, pressure gages along the penstock, and a quantity gage near the turbine. To explain the method of using these gages a plant will be considered containing three 15,000-hp. turbines operating under a head of 140 ft. (42.7 m.), the general layout being as shown in Fig. 1. In such a plant elevation gages should be installed at *A*, *B*, *C*, *D* and *E*, a pressure gage at *P* and a quantity gage at *Q*.

The characteristic curves required are as follows: The gate opening for various generator outputs and heads (Fig. 2) and the gate opening for various quantities of water and heads (Fig. 3). These curves are plotted for the gross head at the power station as given by the difference between the readings of gages *B* and *D* and should cover the range in heads likely to occur.

The gradient curves required are those which show the drop in elevations, for various quantities of water flowing, along the canal, through intake racks, and down the penstock as shown in Figs. 4 and 5. It should be noted that the drop in head shown is made up of friction losses plus velocity head, as the various gages referred to do not, of course, measure the velocity head.

All of the above curves should be plotted from readings obtained by actual tests made at the site after the plant is first installed. If for any reason such tests are not made, the curves shown in Figs. 2 and 3 may be plotted from data furnished by the turbine and generator manufacturers. The gradient curves shown in Figs. 4 and 5 may then be plotted from the actual readings taken on the various gages mentioned. The latter method of obtaining the curves is, of course, not so accurate as the first method, but it will give relative results, by means of which the operation of the turbines may be compared from time to time.

The quantity gage referred to measures approx-

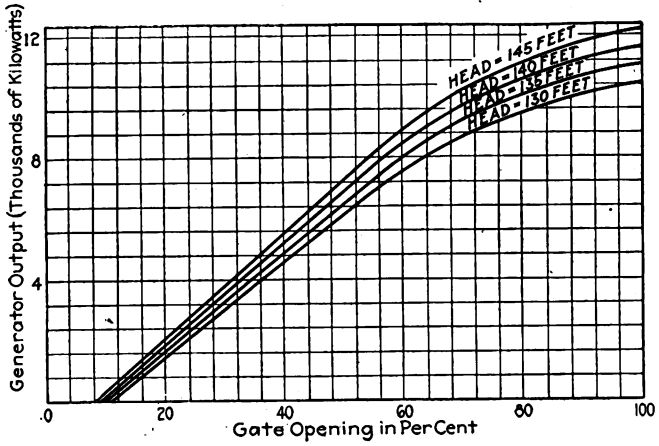

FIG. 2—GATE OPENING FOR VARIOUS GENERATOR OUTPUTS AT DIFFERENT HEADS

imately the difference in velocity heads at two sections of the penstock and hence works on the principle of the Venturi meter. Fig. 6 shows on a large scale a design of quantity gage and the method of connecting it to the turbine penstock. It may be noted that one arm of the gage is attached to the large end of the taper section of penstock, 12 ft. (3.7 m.) in diameter, and the other arm of the gage to the small end of the taper section, 9 ft. 6

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in. (2.9 m.) in diameter. For the particular turbine under consideration the quantity flowing at the gate opening for maximum efficiency would be about 960 cu.ft. (27 cu.m.) per second, and hence the difference in velocity heads at the two sections where the gage is attached is equal to about 21 in. (53 cm.), which will be

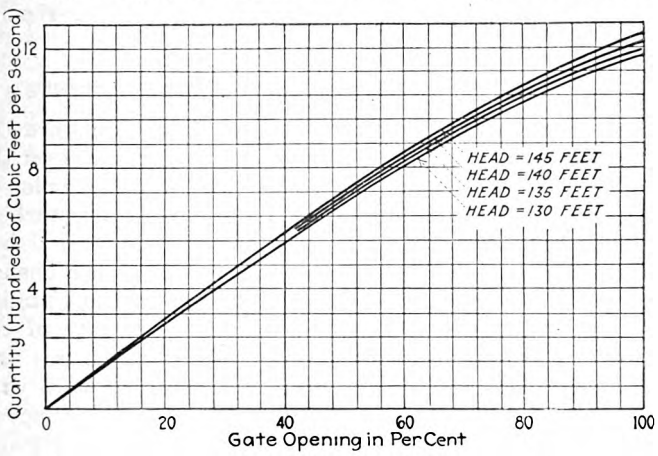

FIG. 3—GATE OPENING FOR VARIOUS QUANTITIES OF WATER AND DIFFERENT HEADS

approximately the difference in reading between the two columns on the quantity gage. By the admission of compressed air to the top of the gage it is possible to bring the water levels in the two tubes within the range of the scale on the gage, so that the difference may readily be observed. This quantity gage should be calibrated at the time the tests are made on the turbine by plotting its readings against the actual quantities flowing as measured by Piot tubes, weir or other approved method, so that at any time thereafter the actual quantity flowing through the turbine can be readily determined.

In the case of the particular turbine under discussion the velocity difference at the two sections is of sufficient magnitude to obtain a large difference in readings on the gage board and hence avoid errors. In the case of a low-head plant where the velocities in the water passages are small it is advisable to use the quantity gage in connection with a differential fluid so as to multiply the readings. Thus in the case of a plant operating under a head of 30 ft. (9.1 m.) the velocity

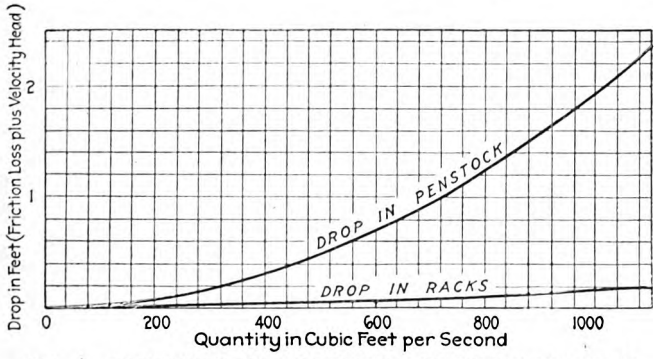

FIG. 4—HYDRAULIC DROP IN RACKS AND PENSTOCKS WITH DIFFERENT QUANTITIES OF WATER FLOWING

near the entrance to the casing would be about 6 ft. (1.8 m.) per second. In such a plant the penstock or intake passage would probably be short so that it would be possible to attach one arm of the quantity gage to a point near the intake of the casing and the other arm to the forebay, in order to obtain as great a difference in velocity head as possible. For conditions such as assumed above the reading on the quantity gage would be about 6.7 in. (17 cm.), which is rather small for the required accuracy. In such an installation a method which can be used to advantage is to invert the quantity gage as shown in Fig. 7 and to fill the lower part with a liquid having a greater specific gravity than water. Carbon tetrachloride, such as is used in Pyrene fire extinguishers, will give satisfactory results. This fluid should be colored by one of the coal-tar dyes which is soluble in the carbon tetrachloride but insoluble in water, in order to give a distinguishing color so that the water surfaces in the gage may be easily read. As the specific gravity of carbon tetrachloride is about 1.5, the velocity head reading on the gage board is multiplied by two, so that for a velocity, as assumed above, of 6 ft. (1.8 m.) per second, the gage reading would now be 13.4 in. (34 cm.).

CHECKING PERFORMANCE

Returning to the actual methods of checking the efficiency and operation of the turbines, readings should be taken at stated intervals of gate opening, generator output, quantity and all gages and compared to the normal conditions, as shown on the curves in Figs. 2, 3 and 4, for the particular gross head as obtained from the readings of gages *B* and *D*. Two general cases may be considered:

Case I.—If the readings indicate a reduction in gen-

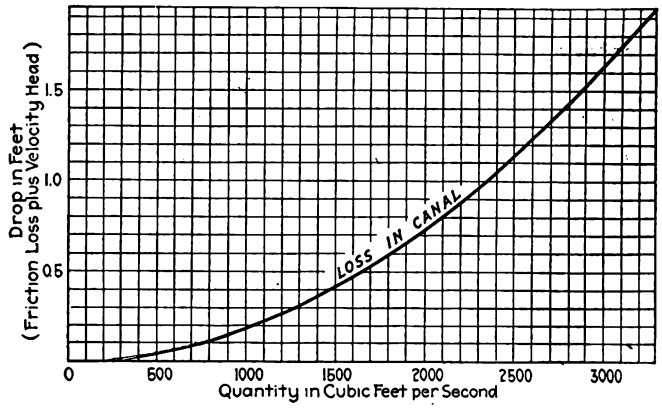

FIG. 5—HYDRAULIC DROP IN CANAL WITH DIFFERENT RATES OF FLOW

erator output and a reduction in quantity used by the turbine, the trouble may be due to one of several causes, namely: (1) Obstruction at the racks; (2) obstruction in the penstock; (3) obstruction in the turbine; (4) obstruction in the draft tube; (5) leakage from the penstock at some point above the quantity gage.

By comparing the actual drop in head as obtained from the gages, through the racks and in the penstock to the normal values as shown by curves (Fig. 4), it can at once be decided whether to eliminate these parts of the system from the investigation. If an excessive drop is noted, it should not at once be assumed that obstructions are present, as the drop may be due to leakage, so that the actual quantity flowing through the racks and in the penstock is greater than the quantity passing through the turbine as read on the quantity gage. A careful examination of all drain valves and other connections to the penstock will usually settle this point. If no leakage is discovered and the gages indicate an excessive drop through the racks, the openings are undoubtedly clogged and the racks should be raked or if necessary removed and cleaned. If the drop in head occurs in the penstock, the unit must be shut down for examination. If the gages indicate no ex-

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cessive losses in these parts, the condition of the tailrace should next be examined for indications of obstructions. Accurate readings in the tailrace are usually difficult to obtain owing to turbulent flow. It is unusual for obstructions to lodge in the draft tube owing to the large size of the water passages, but it is possible for the tailrace partly to fill up with débris and thus cause a loss in head. The appearance in the tailrace of a drop in elevation at any particular section would indicate an obstruction.

So far in the investigation it may have been unnecessary to shut down the turbine. If, however, no additional losses are found through the racks, in the penstock or tailrace, it is evident that the trouble is in the turbine itself and the unit should be shut down for inspection. Although an obstruction may be found in the casing or guide vanes, it will most probably be located near the discharge of the runner vanes as these openings are the smallest of the water passages.

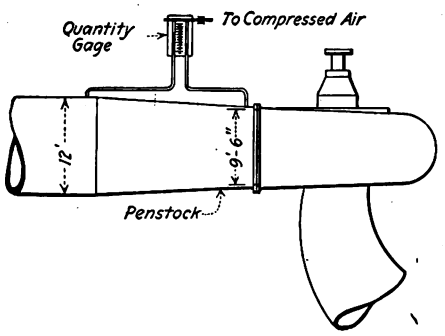

FIG. 6—METHOD OF CONNECTING QUANTITY GAGE TO PENSTOCK

Case II.—If the readings of the various gages and instruments indicate a reduction in generator output and an increase in quantity used by the turbine, the trouble may be due to one of the following causes: (1) Leakage from the penstock at some point below the quantity gage; (2) leakage from the turbine casing or its connections; (3) excess leakage from wear at the runner seals; (4) a broken runner vane.

The first two possibilities can usually be investigated by an examination of all drain valves, relief valves or other connections to the penstock or casing below the quantity gage. If no leakage is found at these points, the unit should be shut down and the interior parts inspected. The most probable cause of the trouble is wear at the runner seals, causing excessive leakage. This should be remedied by renewing the seal rings. Such wear is of greater importance the higher the head on the unit, for, because of the characteristics of the design of high-head turbines, the runner diameter and hence the area at the seals is proportionately greater than in the case of low-head units, so that the same amount of wear results in a greater excess leakage in the former type. Thus, in the case of the unit considered above, operating under a head of 140 ft. (42.7 m.), if the clearance at the seals is increased by wear from $\frac{1}{32}$ in. (0.79 mm.) to $\frac{1}{16}$ in. (1.6 mm.), the excess leakage will amount to approximately 7 cu. ft. (0.2 cu.m.) per second, or nearly three-fourths of 1 per cent of the total flow through the runner. For a wheel operating under a head of say 30 ft. (9.1 m.) a similar amount of wear at the runner seals only results in an excess leakage of two-tenths of 1 per cent of the total flow.

It should be noted that so far in the investigations the gross head from the forebay to the tailrace has been used, so that possible losses in the canal have not been considered. Readings should also be taken of the drop in the canal from gages *A* and *B* and compared to the normal drop, as shown in Fig. 5, for the total quantity passing through all the turbines. Losses may occur from obstructions or deterioration of the canal lining, and if such losses become excessive, an examination should be made and the necessary dredging or repairs carried out.

Loss Limits and Accuracy of Measurements

In conclusion, it might be interesting to state the magnitude of the losses which can be measured on the gages and the value of these losses from a viewpoint of power, efficiency and quantity for the particular turbine considered in this article. A change in the normal flow of 1 per cent can readily be measured as such a change would result in a difference in reading on the quantity gage of 0.37 in. (9.4 mm.). Even in the case of the turbine operating under the head of 30 ft. (9.1 m.) previously mentioned, if the differential fluid is used with the quantity gage, it is also very easy to read a change in quantity amounting to 1 per cent, as in this particular instance the reading on the quantity gage would change 0.26 in. (6.6 mm.).

Considering the value of the losses in the operation of the plant, it may be stated that an increase in water flow of 1 per cent, due to the leakage, results in a loss in efficiency of at least the same amount and a slight loss in power due to the additional friction loss from the larger flow. On the other hand, a decrease in quantity of 1 per cent due to an obstruction in the runner results in a loss in power of at least 1 per cent and an efficiency loss due to the disturbed flow conditions through the runner. If the decrease in quantity is caused by an obstruction in the penstock, the power and efficiency losses become of even greater magnitude, for in such a case the reduction in flow is the result of a loss in head which affects both the power and efficiency.

The quantity of water flowing varies as the square root of the ratio of the effective heads, and as the power output is proportional to the product of quantity and head, this output varies as the three-halves power of the ratio of the effective heads. The efficiency is the ratio of the power output to the power input, and as the input is also proportional to the quantity, this input varies as the square root of the ratio of the heads, so that the efficiency varies directly as the ratio of the heads.

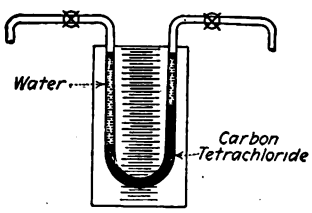

FIG. 7—MODIFICATION OF ORDINARY QUANTITY GAGE

The above relations are shown more clearly by the following formulas in which:

$HP_1Q_1E_1H_1$ = The initial horsepower output, quantity, efficiency and head.

$HP_2Q_2E_2H_2$ = The final values due to a loss in head of $H_1 - H_2$.

$$\frac{Q_2}{Q_1} = \left(\frac{H_2}{H_1}\right)^{\frac{1}{2}} \quad (1)$$

$$\frac{HP_2}{HP_1} = \frac{Q_2 \times H_2}{Q_1 \times H_1} = \left(\frac{H_2}{H_1}\right)^{\frac{1}{2}} \frac{H_2}{H_1} = \left(\frac{H_2}{H_1}\right)^{\frac{3}{2}} \quad (2)$$

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$$\frac{E_2}{E_1} = \frac{HP_2}{Q_2H_1} \Big/ \frac{HP_1}{Q_1H_1} = \left(\frac{HP_2}{HP_1}\right) \Big/ \left(\frac{Q_2H_1}{Q_1H_1}\right) =$$

$$\left(\frac{H_2}{H_1}\right)^{\frac{3}{2}} \Big/ \left(\frac{H_2}{H_1}\right)^{\frac{1}{2}} = \frac{H_2}{H_1} \qquad (3)$$

To understand the application of the above formulas assume a reduction in the effective head of 2 per cent; hence:

$$Q_2 = (0.98)^{\frac{1}{2}}Q_1 = 0.99Q_1$$
$$HP_2 = (0.98)^{\frac{3}{2}} \quad HP_1 = 0.97HP_1$$
$$E_2 = 0.98E_1$$

Thus the quantity is reduced 1 per cent, the horsepower 3 per cent and the efficiency 2 per cent.

What Output Loss Would Mean Financially

Expressed in dollars and cents, such a loss in output would mean a decrease of value of the same percentage for the entire development, including the canal, dam, power house, water rights, transmission lines, and in fact everything which is covered by the total capital investment.

University Training for Engineers

A Broader Outlook, a Fair Knowledge of Economics and Government and Human Sympathies Are Necessary if the Engineer Is to Be Equipped Properly for His Work

BECAUSE of the wide general interest shown in the speech of President Emeritus Charles W. Eliot of Harvard University at the meeting of the American Institute of Electrical Engineers in Boston, March 14, that portion of it dealing with the training of the engineer is published below. As stated in the ELECTRICAL WORLD of March 22, Dr. Eliot's address was most inspiring, and inasmuch as he sees an enormous field of opportunity and usefulness ahead of the engineer his comments are worthy of note and wider study:

"I must go on to speak of the demand for first-class engineers. It is a very small demand at the best, but to fill that small demand is one of the most important tasks of American teachers and universities, because democracy does not lead only to raising the level, improving the capacity of the average man, but should lead to the development and profitable employment of men of superior ability in all sorts of human service. James Russell Lowell pointed out many years ago that unless democracy developed and set to work the highest types of human intelligence and character it would be a failure.

"I believe that to be a statement of absolute truth, gentlemen, not sufficiently understood and appreciated by the mass of educated Americans. The test of our form of government is going to be its capacity to develop scholars, research men, students and practical geniuses of the highest type. How is that to be accomplished?

"Does not the selection for the super-engineer or the super-statesman or the super-lawyer work well in this country—indeed, work quite as well as in any country —with this added advantage, that democratic society being plastic, not crystallized in layers as is society in some other countries, some of which are very impermeable, it results that throughout society, from bottom to top, there is a plasticity, a condition of yielding, with the natural impulse for talent to rise to all layers of society? That I believe to be one of the chief advantages of democratic society. It gives a man who has natural genius and superior talent a chance to go to the top. We had a wonderful case of that in Abraham Lincoln. It was because of democratic society and the opportunities which it offered that Abraham Lincoln attained his immortal vein.

"So I believe that these supermen whom we all want to bring forth in our democratic society will be brought forth, at any rate in many instances, and put in their proper places, and it is the first duty of our advanced institutions of education to provide for them every possible chance.

"What is the motive that, after all, must inspire these young men who are to become what we call here tonight the supermen? It is the scientific motive, gentlemen, the love of the occupation itself, and the satisfaction with their station in life which gives them the chance to devote themselves absolutely to the pursuit or the work that they love. Is not that the way in which all geniuses of the world have found their place? Is it not the way, in the future, that this country will be supplied with the men who are, after all, the leaders of all our progress in all our fields of endeavor and opportunity, exploitive of natural resources and exploitive of the human imagination?

"Now, gentlemen, the way to get for the service of the country these supermen is, I think, first utterly to change from the bottom to top the methods of instruction now used in the elementary and secondary schools and the colleges of the country. We never can get through our free schools the boys we want and the girls we want until the methods of instruction in the elementary and secondary schools are changed.

"But we may look forward, I hope, to the universities being resorted to by boys who mean to be engineers of the first class. Why the universities? Because the engineer of the first class needs to have, to be sure, very highly specialized training, but he also needs to have a first-rate world training. He must not be ignorant of the modern languages; he must not be ignorant of economics and government and history. He needs familiarity with the great facts of all these subjects. He must be able to understand the new problems in government and economics as they arise. His profession requires that he be a man of good general training as well as a man of the highest special training. The good general training he must get in universities; and, again, the engineer of the first class needs contact with all kinds of people, being a leader. He needs in this country, particularly, to be able to deal with men. He must be able to deal with all classes of men, not only with supermen. In the case of all the professions, when you get up to the higher grades of public service, the leader, and particularly the engineer, must be a man who can deal with men with human qualities, as distinguished from the selfish, narrow-minded quality

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which characterizes a great many of our lawyers, doctors, professional business men, manufacturers. We are getting away from these narrow conditions in all the professions, and it is of supreme importance that the great engineers should possess these sympathies and be able to make use of them in their contact with other human beings, to know their motives, their hopes and their desires. This is especially true of great engineers, because any great feat of engineering cannot be accomplished without the coöperation of multitudes of men of all sorts and conditions, and a great engineer must have the faculty of inspiring, at any rate, the leaders and managers of these multitudes.

"At this moment we are threatened with a great depredation of our population, a very great depredation indeed. I was listening to labor leaders at our State House this morning who advocated doctrines which, put into practice, would demoralize every man that came under their influence. For instance, there was advanced the doctrine of limited output.

"Now, we are threatened with a large development of men and women who will act on that doctrine. It is a very great threat. I myself attach no importance to the apprehension that vile socialists of any sort will get a chance in our country, but I think there is an indication about the broad adoption of labor doctrines which shows that these doctrines in their tendency are thoroughly demoralizing to the people who accept them. Any man who is employed in the designing or erection of great engineering work is liable to come in contact with these demoralizing forces. Through whom must he resist these forces? Through the managing force of the great corporation which employs him, or the great partnership which employs him, and these great leaders of engineering forces need to understand all these human relations and to know how to tell the corporation employers or the partnership employers how to overcome these conditions. The engineer cannot get his great designs executed unless he has that capacity and these comprehensive powers.

"Now, we need not expect that the number of first-class engineers to be employed by this country is going to be a very great number, but we must take courage from the fact that the number is increasing, and increasing very definitely, not only because more great teachers of engineering are employed in our higher technical schools and universities, but also chiefly because great corporations are employing great engineers to a much greater extent and at much larger salaries than were visible even twenty years ago, and as I go back fifty years, as I can do, just to the prime of my own powers of observation, I see an immense change for the better in the condition of engineers in American industries.

"Then we have to look forward to the altogether probable expansion of man's power over nature during the next twenty, forty or sixty years. That looks certain. Take, for example, the expansion of man's power over air which has taken place within the last fifteen years —yet that development is only on its threshold. It is one of the drawbacks, insignificant with regard to the great results, of the sudden closure of the great war that airplane work as a military art was only at the beginning of its development. We hardly got a chance to use our extensive preparation, but many of our soldiers have perceived that future wars are going to be carried on and won or lost in the air, not the land or water.

"That is just one field of probable expansion of man's power over nature as a means of overcoming these natural resistances.

"Another sphere of this activity is in the recent development of locomotive forces—in the direction of new kinds of traction, new uses of the explosive engine. I first saw an explosive engine in use in 1864, in the streets of Paris—used, I mean, as a commercial vehicle —and see how the application of that explosive force was expanded in the next twenty years, and has been up to this date, and yet we are only at the beginning of that expansion, not at the middle or near the close, but we are only at the beginning.

"I remember when John F. Butler was Governor of Massachusetts. He and I attended a great celebration at Phillips Academy at Exeter, and we both spoke. He spoke first, and he announced that the great man of the future was going to be the engineer, not the politician, or the statesman, or the minister, or the doctor, or the lawyer, but the engineer; and the reason was that it was the engineer who had his hand on the throttle, that he was to control the material development of the country and put industries to work. I took exception to the statement in the remarks I made subsequently, because I thought there were a good many places in which the engineer did not have his hand on the throttle, at least so definitely and effectively as some of the other professions, but looking to the future we all see perfectly and clearly that the profession of engineering in its higher ranges is going to be perhaps the most serviceable of all of the professions in the direction of increasing the comfort of the population as a body—it is going to develop not only the material prosperity of the people, but the happiness of the people, their success in the pursuit of happiness, which is, after all, the great result to be achieved by civilization.

"Therefore we look forward with a great deal of assurance to the future great serviceableness of the profession which you gentlemen represent, and we welcome the great benefits to man which the service of this profession will render. It used to be considered a materialistic profession, but I do not know that there is any profession which involves a broader or more constant use of the human imagination, and also the broader use of what we may call truthfulness of mind, reverence for truth, obedience to truth and reliance on truth, for the civilization and advancement of the human race."

TO MY mind there are many good and sound reasons why the government should not attempt the nationalization of any industry, but I shall only mention two reasons. To begin with, I question the possibility of government success in the actual operation of any industry as many-sided and as sensitive as the oil industry. Nothing that the government has done either before the war or during the war has indicated that Uncle Sam is a good business manager or even a fair success as an industrial executive. Over and above that fact, however, as an argument against government ownership is the fundamental character of the American people. If we have any national trait worth enlarging and worth preserving, it is initiative and individuality.—*D. M. Folsom, Pacific Coast Petroleum Administrator.*

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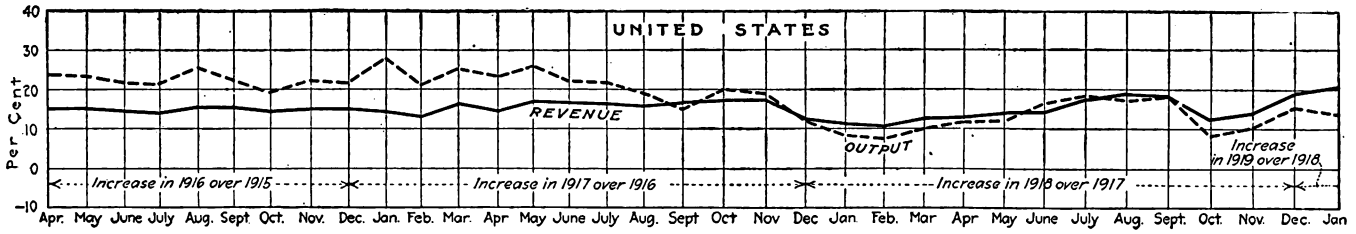
Central Station January Operations



IT IS ENCOURAGING THAT STRIKING INCREASES ARE STILL MAINTAINED

JANUARY reports of central stations to the ELECTRICAL WORLD show a large rate of increase in output over the corresponding month of last year. The rate of increase in revenue was still greater. According to the preliminary statistics from 50 per cent of the industry, the gain in kilowatt-hour output in the first month of 1919 over January, 1918, was 13 per cent; the gain in gross revenue was 20.9 per cent. It is encouraging for the industry that such striking returns should be maintained by the companies in the early uncertainties of the peace period. For 52 per cent of the industry December showed increases of 12.9 per cent in output and 18.4 per cent in revenue. Thus January not only attains the December record but, on the face of the first returns, betters it. However, the January, 1919, figures are compared with increases in January, 1918, over January, 1917, which were less than the normal rates. In January of last year the coal conditions combined with extraordinarily severe weather and industrial readjustments in connection with the war to cause the rates of growth to slacken. This year January had few or no coal shortage difficulties, weather was favorable, and the hesitation in some industries was offset by the new activities which peace means to other industries. The figures bear out the general confidence which was felt in most communities that the aggregate demand for energy would not be lessened substantially whether it came from the industries of peace or those of war. At the same time sharp fluctuations in individual localities may ensue before the restoration of normal conditions.

An interesting feature of the present report is the fact that the percentage of increase in revenue is appreciably larger than that in kilowatt-hour output. This tendency has been noted in recent months, but the margin of difference is more extended.

Based on the statistics from 50 per cent of the industry, the ELECTRICAL WORLD estimates the record for January for the entire industry as follows: Revenue, $53,900,000; output, 2,496,004,000 kw.-hr.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Per-centage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Feb.	60	$24,690,000	$22,307,000	10.6	1,254,217,000	1,168,288,000	7.1
Mar.	60	25,396,000	22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct.	56	26,254,000	23,228,000	13.0	1,517,866,000	1,392,359,000	9.0
Nov.	57	27,894,000	24,215,000	15.1	1,427,470,000	1,287,536,000	10.8
Dec.	52	27,774,000	23,456,000	18.4	1,351,731,000	1,196,990,000	12.9
		1919	1918		1919	1918	
Jan.	50	26,950,000	22,275,000	20.9	1,248,002,000	1,104,174,000	13.0

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	Percentage of Industry Represented	New England States			Percentage of Industry Represented	Atlantic States			Percentage of Industry Represented	Central States			Percentage of Industry Represented	Pacific and MountainStates		
			1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase		1918	1917	Per Cent Increase
REVENUE	Feb.	62	$2,995,000	$2,272,000	8.0	57	$9,473,000	$8,658,000	8.6	53	$7,779,000	$6,746,000	15.3	84	$4,443,000	$4,131,000	9.5
	March	62	2,985,000	2,724,000	9.2	59	9,904,000	8,922,000	11.0	53	7,947,000	6,735,000	18.0	84	4,560,000	4,321,000	5.5
	April	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824,000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug.	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sept.	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct.	63	3,360,000	3,036,000	10.6	51	8,822,000	7,924,000	11.3	50	9,218,000	7,848,000	17.4	81	4,854,000	4,420,000	9.8
	Nov.	64	3,695,000	3,238,000	14.1	54	10,092,000	8,883,000	13.6	50	9,073,000	7,542,000	20.3	81	5,034,000	4,552,000	10.6
	Dec.	64	4,097,000	3,449,000	18.7	47	9,551,000	8,153,000	17.1	46	9,656,000	7,937,000	21.5	75	4,470,000	3,917,000	14.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	4,253,000	3,443,000	23.5	44	9,395,000	7,850,000	19.6	43	8,902,000	7,235,000	23.0	73	4,400,000	3,747,000	17.1
			1918	1917			1918	1917			1918	1917			1918	1917	
KW.-HR. OUTPUT	Feb.	62	110,454,000	102,562,000	7.7	57	438,721,000	403,122,000	8.3	53	358,276,000	342,257,000	4.5	84	346,766,000	320,025,000	8.4
	March	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug.	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept.	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct.	63	139,784,000	128,970,000	8.3	51	481,222,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov.	64	138,559,000	123,033,000	12.6	54	450,210,000	406,725,000	10.6	50	435,135,000	389,541,000	11.7	81	403,566,000	368,237,000	9.6
	Dec.	64	145,543,000	129,838,000	12.1	47	377,931,000	331,810,000	13.8	46	448,928,000	408,167,000	9.9	75	379,329,000	327,175,000	15.9
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan.	63	143,254,000	124,632,000	14.9	44	352,387,000	300,093,000	17.4	43	409,627,000	355,745,000	15.1	73	342,734,000	323,704,000	5.9

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Export Opportunities in Foreign Countries

Conditions Bearing on the Development of Markets for United States Electrical Manufactured Products in All Parts of the World at the Present Time and in the Next Few Years

In connection with the report of the international trade committee presented before the annual convention of the Associated Manufacturers of Electrical Supplies at New York on March 20, addresses were made bearing on export trade conditions. Extracts from the addresses of Joseph McElroy, 3d, and William Burgess are printed herewith.

IN DISCUSSING "Opportunities for the Sale of American Electrical Articles in Foreign Countries," Joseph McElroy, 3d, export sales manager for Pass & Seymour, Inc., reviewed generally the conditions in the entire world.

Mr. McElroy took up first the West Indies, including Cuba, Porto Rico, Haiti and Santo Domingo as well as Bermuda and what is usually known as the West Indies group. The possibility of sale of electrical articles in this section is somewhat limited, with the exception of Cuba and Porto Rico, in which a large volume of American electrical articles has been sold and can be sold. Haiti and Santo Domingo are still in their commercial infancy, and the possibilities of sale in these countries during the next ten years are much greater than during the past ten.

In Jamaica and Bermuda the sale of electrical articles is quite limited owing to the fact that the population is small and purchasing power is also of comparatively little value. Nevertheless, it is the opinion of Mr. McElroy that the opportunities in the coming years will increase rather than decrease in this field.

The South American Field

Coming to South America, with Venezuela, British, French and Dutch Guiana, Brazil, Argentina, Uruguay, Paraguay, Chile, Peru, Bolivia and Colombia, the speaker said that there is a market for American electrical articles in all of these countries, particularly in Brazil. Brazil is a very large purchaser of American manufactured products.

In Argentina the main market is the city of Buenos Aires, but once outside this city, going south, the country is still practically undeveloped.

Uruguay is a good market. Paraguay is a small country and the market is also small. Chile, Bolivia, Peru, Colombia, Venezuela are all growing markets, Mr. McElroy said.

Going north to the various Central American countries near the Isthmus of Panama and to Mexico, the speaker declared it probable that Mexico will be a very large buyer of American electrical articles during the coming years as soon as the political disturbances have subsided and a stable government has been established. Many of the large plantations have water power, and it is logical that America should supply their needs. So far as Central American countries are concerned, the sale of American products is somewhat limited and probably will be for a long time to come.

Going on to speak of Europe, Mr. McElroy first mentioned the British Isles. It is possible to sell many articles of American manufacture in the British Isles, though it is true that Great Britain is one of the principal competitors of this country in this line. The same thing holds good for Norway, Sweden and Denmark. They are large consumers of electrical articles, particularly Sweden, where there are plenty of waterfalls. Electricity is very cheap in Norway and Sweden. In Denmark electricity cannot be supplied in sufficient volume for the demand, and the rate at present is quite high. Norway is supplying energy through a cable to Denmark, but is not able to furnish all that is desired.

Opportunities in France, Belgium and Other European Countries

France will also be a consumer of American electrical products, though France is also to some extent a competitor. Belgium will be a consumer of many electrical articles, and it very much prefers to buy from American merchants rather than from the merchants of any other nationality. Portugal and Spain, Italy and Switzerland are also customers for our goods. Italy and Spain are to a certain extent manufacturers of electrical articles.

It is scarcely necessary, said Mr. McElroy, to say anything regarding the German Empire or of Austria-Hungary and Turkey. Passing down into Mesopotamia, Arabia and the entire Levant, including Greece, Serbia, etc., it is quite probable that many articles manufactured in the United States will be sold in this section during the coming five or ten years. This entire section is now taking on a new lease of life.

It is possible to sell American products in Egypt, Tripoli, Tunis and Morocco, though in some instances it is necessary to make special articles suitable for these markets.

African and Asian Markets

The speaker thinks that it is very probable that within the next ten or fifteen years a large market will develop in various parts of Africa. At present the main market is in the south in Cape Colony and to a slight extent up the east coast. Naturally articles of British manufacture obtain the preference, but if American manufacturers use as much skill, ingenuity and resourcefulness in this market as they have used in other sections of the world, particularly in their own country, there is no reason why they should not capture a fair proportion of the trade.

India is a very large consumer of cheap electrical devices. At present Japan probably dominates this market, but this does not mean that American articles will not sell or do not sell there. That most of the articles sold at present are Japanese is due solely to their low price without regard to quality. This remark applies also to Siam, the Malay Peninsula, Sumatra and Borneo, but not so much to the Dutch East Indies. The Dutch East Indies have a population of more than 40,000,000 people and prior to the war were accustomed to buy their merchandise through Holland, leaving the mother house in Holland to place the order with manu-

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facturers in America or Britain or wherever it pleased. During the war a new condition sprang up, and many of the merchants acquired the habit of dealing with American manufacturers. This condition still exists and Mr. McElroy doubted very much whether the old triangle arrangement would ever be resumed. This market uses a better grade of merchandise than India. The credit of most of the merchants is excellent and they are large consumers of certain articles.

China, Japan, Siberia and Australia

China should be a very prolific field for American manufactured electrical articles of many kinds. Japan to a certain extent has obtained control of this territory owing to the fact that it is situated near by and has supplied very cheap goods made up especially for this market. The Chinese will do business with American manufacturers if met halfway and given what they need or desire. It is practically impossible to sell any articles of American make in Japan. At present it is impossible to do business in central Russia because of the unsettled and unstable government, but it is possible to do a certain amount in Siberia. Siberia has a population of 11,000,000 people, and these people today are practically destitute of all manufactured wares with the exception of a certain amount of foodstuffs and clothing. They have plenty of raw material, such as hides, skins, bristle, timber, minerals, etc., which eventually they will exchange for manufactured articles, and they are strongly inclined to do business with America.

Continuing, the speaker said that Australia and New Zealand present a very favorable opportunity for the sale of American articles. Strong British competition will be met, but there is no reason why many American articles should not be sold in this territory.

So far as the Philippine Islands are concerned, there is a preference for articles of American manufacture, as there is also in the Hawaiian Islands. American articles of various types are sold in Iceland, and there is a possibility of selling many articles in Canada and Newfoundland, said Mr. McElroy.

Mr. Burgess Talks of Conditions in Canada

William Burgess, tariff adviser to the international trade committee, spoke of the great growth of the electrical industry in Japan. He said that the electrical industry as such is not classed separately in Japan; the only branch so classified is the porcelain. There are now three large factories devoting themselves to this branch of manufacture.

The United States is Japan's largest customer. In 1917 the total exports were $801,502,524. Of this amount the United States took $251,780,352. In 1918 Japan's exports to this country increased more than $50,000,000. These goods were produced at an average labor cost of 26 cents a day. Owing to the rice riots last year labor generally received an advance of 50 per cent, making the average wage about 39 cents per day.

The growing demand for electrical goods of all kinds is indicated by the rapid growth of the light and power plants, said Mr. Burgess. In 1907 Japan had 112 such companies, supplying 950,453 lamps (calculated on 10 cp.) and 33,265 kw. for power. In 1916 there were 520 companies, supplying 10,790,776 lamps and 200,400 kw.-hr. power. Motors reported in 1907 were rated at a total of 8278 hp. and in 1916 at a total of 245,470 hp.

SUCCESSFUL CO-OPERATIVE CONTROL OF WATER POWER

New Hampshire Water Conservation Commission Told Agreement Saved Nearly 400,000 Tons of Coal Yearly in Maine and New Hampshire

An interesting outline of the successful control of stream flow by a coöperative organization of water-power users in Maine was recently presented to the New Hampshire Water Conservation Commission by Walter H. Sawyer, consulting engineer, Lewiston, Me. Mr. Sawyer referred particularly to the work of the Androscoggin Reservoir Company, which was organized in 1909 to build the Azisoohos Dam on the Magalloway River, thereby creating a reservoir of about 9,500,000,000 cu.ft. (266,000,000 cu.m.) capacity. The dam and reservoir are both in Maine. A charter was obtained from the State giving the right to take a part of a public lot at one end of the dam site and to flow portions of other public lots above. Other rights of construction and flowage were purchased from private owners.

The four largest users of power on the Androscoggin River—the Union Water Power Company, Berlin Mills Company now the Brown Company), International Paper Company and the Rumford Falls Power Company—entered into an agreement whereby each of the companies purchased stock in the Androscoggin Reservoir Company equal to 25 per cent of the expense of organization and of construction of the new dam. The Union Water Power Company controls, through ownership of dam sites and dams, the stored water in six lakes forming a part of the storage system. The other three companies entered into an agreement with the Union Water Power Company whereby each of the four companies would pay its proportional share of the expenses of operation, maintenance and repairs on the storage systems controlled by the Union and Androscoggin companies.

In return for this agreement for the payment of proportional expenses on its systems, the Union company agreed to discharge from its reservoir system yearly two-thirds of the water necessary to maintain the flow of the Androscoggin River at Berlin, N. H., at not less than 1550 cu.ft. (42 cu.m.) per second, provided the amount of stored water in both systems allowed this. The Androscoggin company agreed to discharge from its reservoir one-third of the necessary amount of water yearly.

Mr. Sawyer states that the plan worked out at the time of the formation of the Androscoggin company has been very successful, and that it has been possible to maintain a flow at Berlin in excess of the minimum specified the greater part of the time. There are several opportunities for increased storage at the headwaters of the Androscoggin, and there is no doubt that these, with the possibilities for power, will be utilized in the not distant future.

Without the storage system, some of the water now saved would have been utilized, but of course the results are far more satisfactory with the storage. The saving of surplus in times of flood makes the water power far more even and valuable at low water.

The total storage above the Azisoohos dam amounts to 96,000,000,000 cu.ft. (283,000,000 cu.m.). The total cost of the dam, dike, flowage, etc., was about $1,000,000, or about $105 per 1,000,000 cu.ft. (28,000 cu.m.) of storage capacity.

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BENJAMIN FRANKLIN AS A DAYLIGHT-SAVING ADVOCATE

America's Pioneer Electrician Discovered the Advantages of Earlier Rising in 1784—He Deplored Needless Waste of Wax and Tallow

DAYLIGHT saving is not a twentieth-century discovery. No less a man than Benjamin Franklin hit upon the idea 135 years ago during his stay in Paris. In March of 1784 he sent anonymously to the *Journal of Paris*, under the heading "An Economical Project," a *jeu d'esprit* worthy of Addison or Steele. This little serio-comic essay begins:

MESSIEURS: You often entertain us with accounts of new discoveries. Permit me to communicate to the public through your paper one that has lately been made by myself and which I conceive may be of great utility.

I was the other evening in a grand company where the new lamp of Messrs. Quinquet and Lange was introduced and much admired for its splendor; but a general inquiry was made whether the oil it consumed was not in exact proportion to the light it afforded, in which case there would be no saving in the use of it. No one present could satisfy us on that point, which all agreed ought to be known, it being a very desirable thing to lessen, if possible, the expense of lighting our apartments, when every other article of family expense was so much augmented. I was pleased to see this general concern for economy, for I love economy exceedingly.

I went home, and to bed, three or four hours after midnight, with my head full of the subject. An accidental sudden noise waked me about 6 in the morning, when I was surprised to find my room filled with light, and I imagined at first that a number of those lamps had been brought into it; but, rubbing my eyes, I perceived the light came in at the windows. I got up and looked out to see what might be the occasion of it, when I saw the sun just rising above the horizon, from whence he poured his rays plentifully into my chamber, my domestic having negligently omitted the preceding evening to close the shutters.

I looked at my watch, which goes very well, and found that it was but 6 o'clock; and, still thinking it something extraordinary that the sun should rise so early, I looked into the almanac, where I found it to be the hour given for his rising on that day. I looked forward, too, and found he was to rise still earlier every day till toward the end of June, and that at no time in the year he retarded his rising so long as till 8 o'clock.

Your readers who, with me, have never seen any signs of sunshine before noon, and seldom regard the astronomical part of the almanac, will be as much astonished as I was when they hear of his rising so early, and especially when I assure them that he gives light as soon as he rises. I am convinced of this. I am certain of my fact. One cannot be more certain of any fact. I saw it with my own eyes. And, having repeated this observation the three following mornings, I found always precisely the same result.

Yet it so happens that when I speak of this discovery to others I can easily perceive by their countenances, though they forbear expressing it in words, that they do not quite believe me. One, indeed, who is a learned natural philosopher has assured me that I must certainly be mistaken as to the circumstance of the light coming into my room; for it being well known that there could be no light abroad at that hour, it follows that none could enter from without, and that of consequence my windows, being accidentally left open, instead of letting in the light, had only served to let out the darkness; and he used many ingenious arguments to show me how I might by that means have been deceived. I owned that he puzzled me a little, but he did not satisfy me; and the subsequent observations I made, as above mentioned, confirmed me in my first opinion.

The event has given rise in my mind to several serious and important reflections. I considered that if I had not been awakened so early in the morning I should have slept six hours longer by the light of the sun, and in exchange have lived six hours the following night by candlelight; and, the latter being a much more expensive light than the former, my love of economy induced me to muster up what little arithmetic I am master of and to make some calculations which I shall give you, after observing that utility is, in my opinion, the test of value in matters of invention and that a discovery which can be applied to no use, or is not good for something, is good for nothing.

Taking as the basis of his calculations the supposition that there were in Paris a hundred thousand families which consumed in the night half a pound of candles per hour, Franklin then went into an elaborate calculation to show that, between March 20 and Sept. 20, 64,050,000 lb. of wax and tallow would be saved annually, equivalent in money value to 96,075,000 livres, or about $18,000,000. He then resumed:

If it should be said that people are apt to be obstinately attached to old customs, and that it will be difficult to induce them to rise before noon, consequently my discovery can be of little use, I answer, "Nil desperandum." I believe all who have common sense, as soon as they have learned from this paper that it is daylight when the sun rises, will contrive to rise with him.

To compel the rest to do so Franklin proposed: (1) a tax of a louis on every window that had shutters; (2) that no family should be allowed more than a pound of candles a week; (3) that no coaches should be allowed to pass after sunset, except those of physicians, surgeons and midwives; (4) that every morning as soon as the sun rose all the bells in every church should be set ringing, and if this was not sufficient, that cannons should be fired in every street "to wake the sluggards effectually and make them open their eyes to their true interest." He continued:

All the difficulty will be in the first two or three days, after which the reformation will be as natural and as easy as the present irregularity, for it is only the first step which costs. Oblige a man to rise at 4 in the morning, and it is more than probable that he will go willingly to bed at 8 in the evening, and, having had eight hours' sleep, he will rise more willingly at 4 in the morning following.

Much could be saved in the other half of the year also, the philosopher averred, and the immense stock of wax and tallow unconsumed during the summer would make candles much cheaper. In conclusion this pioneer would-be saver of daylight wrote:

For the great benefit of this discovery, thus freely communicated and bestowed by me on the public, I demand neither place, pension, exclusive privilege, nor any other regard whatever. I expect only to have the honor of it. And yet I know there are little, envious minds who will, as usual, deny me this and say that my invention was known to the ancients, and perhaps they may bring passages out of the old books in proof of it. I will not dispute with these people that the ancients knew not the sun would rise at certain hours; they possibly had, as we have, almanacs that predicted it; but it does not follow thence that they knew he gave light as soon as he rose. That is what I claim as my discovery. If the ancients knew it, it might have been long since forgotten; for it certainly was unknown to the moderns, at least to the Parisians, which to prove I need use but one plain simple argument. They are as well instructed, judicious and prudent a people as exist anywhere in the world, all professing, like myself, to be lovers of economy, and, from the many heavy taxes required from them by the necessities of the State, have surely an abundant reason to be economical. I say it is impossible that so sensible a people, under such circumstances, should have lived so long by the smoky, unwholesome and enormously expensive light of candles if they had really know that they might have had as much pure light of the sun for nothing.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

FIRST COST OF STEAM PLANTS USING SMALL-SIZED UNITS

Average Results for Selected Plants in Massachusetts Prove to Be Fairly Consistent, Although Data for Individual Stations Vary

The unit cost of a steam-electric plant, especially if it includes only the equipment and superstructures, will not show very great variations in ordinary locations. On the other hand, the cost of foundations, land, etc., may vary considerably owing to local conditions; but these do not, as a rule, greatly affect the total cost of the steam-electric station. Under normal conditions the cost of steam plants for units of 1000 kw. and over is between $80 and $90 per kilowatt. With very large units a lesser cost per kilowatt is usually possible. This total cost is made up normally of about $40 for steam plant, $30 for electric plant and $15 for power house, etc. The total annual fixed charges for a steam-electric plant are about 12 per cent of its first cost, interest usually being taken at 5 to 6 per cent, taxes and insurance at 1½ to 2 per cent, and depreciation at 4 to 5 per cent, based on construction cost.

TABLE I—FIRST COST OF SELECTED STEAM-ELECTRIC PLANTS IN MASSACHUSETTS (1914-17)

Year	Cost per Kw. Steam Plant	Electric Plant	Total
1914	$40.70	$28.40	$69.10
1915	42.50	28.00	70.50
1916	36.00	24.60	60.60
1917	40.00	30.00	70.00
Average.....	$39.80	$27.80	$67.60

* With cost of power and boiler houses included at $15 per kilowatt, the average cost of these plants would be $83 per kilowatt.

In the following table are given data of operating costs and amount of fuel used for the several central-station plants in Massachusetts for the years 1914-17, inclusive, previously referred to. With this pre-war cost of coal ($4) the total operating cost per kilowatt was about 0.88 cent, of which about 62 per cent represented fuel cost, 22 per cent wages and the remainder miscellaneous costs. No data are available as to the average load factor at these plants, but it is probably in the vicinity of 40 to 50 per cent.

TABLE II—OPERATING COSTS, ETC., AT SELECTED STEAM-ELECTRIC PLANTS IN MASSACHUSETTS (1914-17)

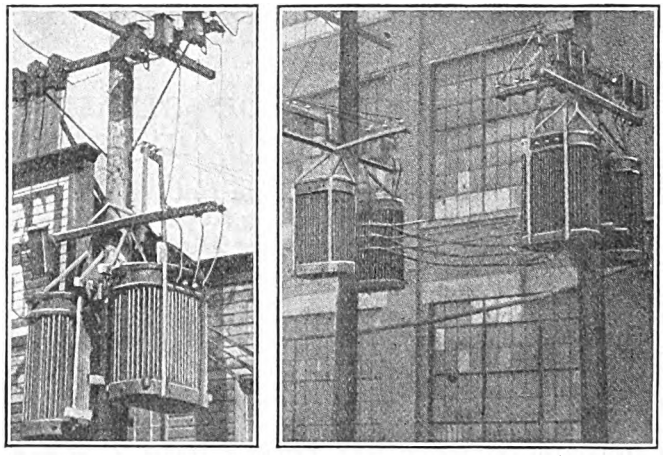
Cost of Coal per Ton of 2000 Lb.	Lb. of Coal per Kw. Made	Cost per Kw., Cents Coal	Wages	Miscellaneous	Total
$4.00 (as reported)	2.75	0.55	0.19	0.14	0.88
5.00	....	0.69	....	....	1.02
6.00	....	0.83	....	....	1.16
10.00	....	1.37	....	....	1.70

This information was given by H. K. Barrows in a water-power report presented to the Maine Public Service Commission and applies only to New England conditions for the years 1914 to 1917 inclusive.

TWO 150-KVA. TRANSFORMERS MOUNTED ON A SINGLE POLE

Utility Installed 300 Kva. in Distribution Transformer Capacity on One Pole to Save Expense—Method of Supporting Units

The installation of two 150-kva., three-phase, 60-cycle distribution transformers on one pole has enabled the Union Electric Light & Power Company, St. Louis, Mo., to save space and the expense of many substations, transformer vaults and additional poles on customers' premises. These double-transformer installations, ranging up to 300 kva. on a pole, have been found adaptable to almost any location. They are not unsightly, and they have been found to have the long life and low cost with the high factor of safety which are so essential in installations of this character. The Union company was a pioneer in hanging single transformers of this size on poles and was also probably the first utility to hang two of these units on the same pole. Transformers rated at 150 kva. weigh about 3500 lb. (1580 kg.) each, so a heavy pole is required to support them. For single installations of two such units a chestnut pole is usually selected at least 40 ft. (12.2 m.) long, with diameters of approximately 22 in. (56 cm.) at the base and 8 in. (20 cm.) at the top. All poles used for this purpose are set in concrete from the bottom of the pole to the surface of the street. Each transformer is hung from a set of three oak arms. The top and bottom arms are each 4 in. by 4 in. by 42 in. (10.1 cm. by 10.1 cm. by 106.6 cm.). The other arm is shorter, measuring 4 in.



FIGS. 1 AND 2—TWO 150-KVA. TRANSFORMERS ON ONE POLE; FOUR 150-KVA. TRANSFORMERS ON TWO POLES

In Fig. 1 note position of the oak arms, especially the short one directly under the upper long arm. In Fig. 2, where the four transformers serve one customer, note the V-braces which help support transformers.

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by 4 in. by 12 in. (10.1 cm. by 10.1 cm. by 30.4 cm.). This short arm is bolted directly under the top supporting arm upon which the transformer hangers rest. The bottom arm serves as a second support to the top arm and in addition holds the bottom of the transformer the proper distance from the pole. Each arm is securely fastened through the pole with machine bolts of §-in. (1.59-cm.) diameter. The top arm is so placed on the pole that the bottom of the transformer will always clear the ground line by 15 ft. (4.5 m.). As a safety measure, to give additional support to the transformer, a special V-shaped brace is hooked under the bottom flange of the transformer on the side farthest removed from the pole and fastened to the pole above. The brace is made of 0.5-in. by 3-in. (1.27-cm. by 7.6-cm.) wrought iron, and the necessary tension is obtained by the aid of a toggle which is bolted through the body of the pole above the transformer.

Each transformer is hoisted into position separately with the aid of a pair of 8-in. (20.3-cm.) three-sheave blocks, one of which is secured to the pole at a point approximately 10 ft. (3 m.) above the top of arm. The exact position of the block must be determined in each case by the height the transformer has to be raised. A 1.25-in. (3.2-cm.) sling is looped under the hoisting lugs of the transformer, and one end of the rope from the block is fastened to this sling. The other end of the rope is then secured to the rear of one of the line trucks, and by a series of short hitches the transformer is raised to the proper position and connected up in the usual way. The second transformer is mounted on the opposite side of the pole at a difference in elevation great enough to allow the bolts of each transformer to have sufficient clearance where they pass through the body of the pole. Customers are being furnished up to 600-kva. capacity from the 4000-volt lines of this company by installing in the street 150-kva. transformers on each of two poles, as shown in one of the illustrations.

ELECTRICITY SUPERSEDES STEAM FOR MAKING CELLULOID COMBS

With an Initial Installation of Five Hot Tables, One Company Increased Production 20 per Cent—Estimate $100 Saving per Month

There have been numerous applications of the electrically heated hot table, but one of the most important and most successful in every respect is its application to the working of celluloid in a comb factory. For such an application certain temperatures are required and varying degrees of heat are necessary for the various steps in the process.

The Ideal Comb Company plant in Lowell, Mass., with an initial installation for five electrically heated hot tables, increased its production about 20 per cent. This was due to the uniformity of the electric heat, which permitted a more economical working of the tables. This company estimated that operating the tables constantly at a moderate rate, except for a short period in the morning and another at noon when they were operated on high heat, it cost about 17 cents a day per table with a power rate of 10 cents for the first 20 kw.-hr. and 2 cents thereafter. On low heat it would cost 9 cents per day per table at this rate. By changing from steam to electric heat it has been estimated that there will result a net saving over the cost of the electric energy of $100 per month on wages of firemen and on coal.

Owing to the uniform heating of the electrically heated hot tables, the comb company found it possible to use 0.125-in. (0.32-mm.) celluloid stock on the electric hot table, while 0.140-in. (6.36-mm.) stock was the smallest that was possible with the steam table. This item is of considerable importance in a factory of any great production.

The tables, which are 1 in. by 16 in. by 24 in. (2.5 cm. by 40 cm. by 60 cm.), are normally rated at 1800 watts and 110 volts and are equipped with a three-heat snap-switch control. Each has six 300-watt steel-clad heaters installed under the steel-top plate, and the heaters are so connected as to take 1800 watts on high, 900 watts on medium and 450 watts on low heat.

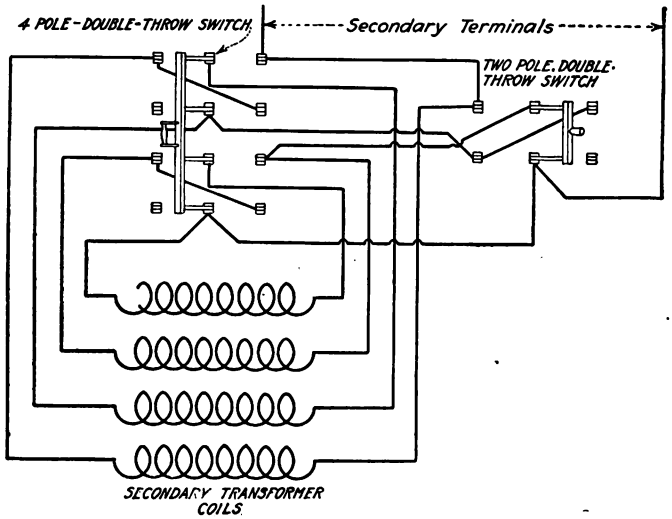
The foregoing information was contributed by John M. Strait, industrial heating section of the Westinghouse Electric & Manufacturing Company.

OBTAINING FULL RATING AT VARIOUS VOLTAGES

"Foolproof" Switching Arrangement That Permits Utilization of Full Rating and Makes Diagram of Position of Switches Unnecessary

BY CLARK POOL

Sometimes it is desirable to make a rapid change in the connections of a transformer so as to secure different voltages without greatly lowering the rating of the transformer. A "foolproof" arrangement of switches



POSITION OF SWITCH HANDLES INDICATES LOW, INTERMEDIATE OR HIGH VOLTAGE

which makes this possible is shown in the accompanying diagram. It is adapted for use with a transformer having four equal secondary coils which may be connected for three different voltages. This arrangement makes it possible to utilize the full rating of the transformer at any one of the three voltages. The entire switching equipment consists of one double-pole double-throw switch and one four-pole double-throw switch.

When the handles of the switches are pointing toward each other, all of the coils are in multiple, giving the lowest voltage; when the switches are pointing away from each other the coils are in series, thus affording the highest voltage. An intermediate voltage can be obtained in two ways by having the switch handles point in the same direction.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

DISPOSAL OF OBSOLETE AND SHOPWORN GOODS

Philadelphia Company Sells at Auction Restricted to Employees Articles That Could Not Be Sold to Regular Customers

Once or twice a year, according to the amount of goods on hand, the Philadelphia Electric Company holds an auction sale for the benefit of its employees. It is conducted in connection with the N. E. L. A. company section meeting. The articles which are sold by auction are either shopworn goods or else discarded or more or less obsolete types of electrical goods. Consequently they could not be sold to regular customers. Many of the parts cannot be supplied readily, and the goods are not so modern as other articles of the same kind that are on sale.

The articles vary from washing machines and carpet sweepers to toasters, broilers, hair curlers, lamps and lamp shades, flatirons, etc. The employees are told the exact condition of the articles and that they are discarded or obsolete types. All are in excellent repair, and where parts are missing, like cords, this fact also is stated.

No effort is made to get big prices or to obtain any profit; yet, in spite of this, some articles are sold at prices near the retail cost. Everything is done on a cash basis. Usually a hundred or more articles are placed on sale, and in most cases the bidding is spirited.

Frequently where a would-be buyer is unable to get some article and is a persistent bidder on others without result another article is awarded to him or her on the first bid. Every effort is made to dispose of the goods to as many buyers as possible. The sale is restricted to the employees of the company.

NEWSPAPER CREATION OF FAVORABLE PUBLIC OPINION

Example of Extent to Which Unsolicited Local Publication Will Go to Make Utility's Place in the Community Strong

Unsolicited editorials in the local newspapers making favorable comment on the local utility are even now sufficiently rare to be of interest. The following paragraphs from the Newburgh (N. Y.) *Daily News* of March 14 last are of this nature and serve to show to what extent a newspaper—the molder of public opinion—will go to create favorable public relations for the utility:

LOCAL EXAMPLE OF THE BEST KIND OF "PUBLIC" OWNERSHIP

The Central Hudson Gas & Electric Company, representing a consolidation of heat, light and power concerns of Newburgh, Poughkeepsie and nearby towns, is one of a long list of corporations which have adopted for their motto "The public be pleased." The Central Hudson company is one of the big assets of Newburgh and Poughkeepsie because it is prepared for every development in the large territory it serves. It is ready to meet any industrial, commercial or household need. It maintains a service which could not be improved upon and which is rarely if ever interrupted even temporarily in the event of accident or storm, owing to its emergency equipment and reserve.

The Central Hudson company serves business men and the people so well that its business is steadily increasing, necessitating betterments and extensions which are to be financed through an issue of $750,000 7 per cent convertible debenture bonds. The assets of this company are so large, its equipment in such splendid condition, its business so great and its prospects so promising that an offer by it of $750,000 bonds, bearing 7 per cent interest, to financial institutions and brokerage houses would be accepted on the instant. The company prefers, however, to distribute the bonds among home people—among its customers, the small as well as the large. To quote the company: "We believe in this city—that is why we have invested over a million dollars here to supply gas and electric service. We believe in the future of Newburgh (and Poughkeepsie)—that is why we are constantly adding to our investment here. But we want a greater community, more industries, more homes, more people, more prosperity. We believe we can and do help community development by being ready to serve, not alone the retail but the wholesale demand of present and prospective users for reliable gas and electric service at reasonable rates."

The company in its advertisements in the *News* has always taken the public into its confidence. It wants the public's interest and support. It believes, and rightly, that by making the public largely the owner of the company it will gain in business and good will. Already its consumers own a majority of its shares of stock.

COLLECTION, BILLING AND METER-READING ECONOMY

System of Machine Bookkeeping and Distributed Discount Period Found to Work Out Very Satisfactorily for Small Property

BY R. J. HOLE
General Manager North Carolina Public Service Company, Greensboro, N. C.

In the old days—that is, prior to July, 1918—meter reading was not any employee's specific work, and all of our reading was done by five or six of the men from the gas and electric departments during the last eight days of each month. During this period of the month all but the most pressing work in the operating departments was neglected, and as a result it would take almost to the next meter-reading period for these departments to get "caught up" again. Furthermore, as the men were inclined to be careless in their reading, we had a good many over and under readings and an unusually large number of "skips" each month. Besides, it seemed to be the ambition of the majority of the readers to keep the daily average of readings down around 100 per man.

This method of reading meters, together with the conditions under which the meters were read, placed a

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very heavy burden on the office force at the end of each month. The two bookkeepers, who kept the customers' records in Boston ledgers, were snowed under with work in extending meter readings, making out bills, posting ledgers and ledger cards, and posting credits; and, notwithstanding hours of overtime each day, they were compelled to call on several other clerks for assistance. As all of the bills were usually ready for mailing not later than the first of the following month, the bookkeepers were forced to begin work at once taking off a trial balance, after which other statistical information, such as kilowatt-hour and cubic feet consumption of gas, was compiled. This work occupied from six to eight days and of course did not leave any time to the bookkeepers for recording cash postings, which on account of the discount period were very heavy during the first ten days of each month. Nor did they have time to make a daily record of new consumers and disconnections. All of the regular routine work was neglected during meter-reading and trial-balance periods.

The Elliot-Fisher bookkeeping and billing machine, together with daily meter readings, was the combination decided upon as a solution of our troubles, and after six months' operation we feel well satisfied with the combination.

A man to be a competent meter reader must be accurate and steady, and we therefore picked from our force a man thought to have these qualifications. This man reads all of our gas and electric meters, with the exception of the gas pre-pay meters, between the fifth and last of each month. The readings he turns in are practically 100 per cent correct, and "skips" are virtually things of the past. The meter reader, if he notices anything peculiar about the reading, whether it is extremely high or extremely low, notes same on his meter-reading book, after his reading, and it is a sign to the billing clerk that he has investigated the matter in so far as he can and that his reading is correct.

The meter-reading slips for each day are placed the next morning on a clerk's desk to be extended; after this operation, which does not take over a couple of hours daily, the slips are turned over to the bookkeeping and billing-machine operator, who at one operation makes out the customer's bill, posts the customer's ledger card and fills in the abstract sheet. As the machine will not clear itself if any figures have been recorded incorrectly, the chances for mistakes are virtually eliminated. The operator checks the bill clerk, who in turn checks the meter reader. If there is anything peculiar about the bill, such as high consumption in gas or electricity, or the opposite, this peculiarity is bound to be noticed by one of these three employees and the matter investigated before making out the bill.

Cash receipts for each day are posted the next day, the total on the abstract sheet proving up with the cashier's total for the day posted.

The machine gives us not only a daily balance on the customer's ledger, but we know at the end of each day what our total sales for the previous day amount to, also the total sales for the month to date. This total is further subdivided to show the revenue accruing from the kilowatt-hours sold for the commercial lighting, power and flat rates, also the revenue from the gas sales. In addition to all this, the register gathers the total kilowatt-hours sold according to classes of service; also the total cubic feet of gas sold. As a result of all this, each day's work is completed as we go along.

There is no congestion at any one period of the month. All our work is now evenly distributed over all working days of each month. This also means a discount period expiring each day, because each bill is stamped the day it is sent out and the discount period extends from this date for ten days. The cashier is busy all the time but never rushed to the point where it is necessary to get assistance. Our collector is aided to the extent that he can give more personal attention to the few delinquents discovered each day than he formerly could when a list of the delinquents had to be taken off at the end of each month, the list sometimes running up into hundreds. This fact alone reduces our bad debts and adds thousands of dollars to the sum total of collections each month.

We first installed one bookkeeping and billing machine, thinking that we could do the billing during the day and the cash posting at night. We soon found, however, this was unsatisfactory, whereupon we ordered another machine and did the cash posting the following day, and at the same time bought all the necessary stationery, etc., for handling our sundry ledger, so that this installation has practically taken our entire system from hand operation to machine operation. We find that with these machines the accuracy of our accounting department is greatly improved.

AN ACTIVE DEMAND FOR RANGES IN NORTHWEST

Contractors Reduce Number of Outlets to Cut High Wiring Costs, Thereby Hampering Appliance Market

Some interesting sidelights on the central-station commercial situation were given to a representative of the ELECTRICAL WORLD recently by A. C. McMicken, commercial manager of the Portland (Ore.) Railway, Light & Power Company. His experience indicates a very rapid increase during the past year or two in the demand for socket devices. Last year, for example, the Portland company made no sales effort whatsoever on electric ranges owing to power shortage, war-load urgency, lack of funds for extending business, etc. Nevertheless, 110 ranges were sold in the company's salesroom, which is merely a display space in the room where bills are paid. Besides, 350 applications for electric range service were refused because the installation would require a transformer or something more than the extremely short extension which the company was willing to make.

There is considerable business in sight in Portland when conditions are such that the company can see its way clear to go after it.

It was pointed out by Mr. McMicken that the sale of household appliances is being very seriously retarded by the lack of convenient outlets. Women give up the idea of purchasing a vacuum cleaner, for example, because of the inconvenience of climbing upon a chair to connect and disconnect each room.

The high costs of war times, Mr. McMicken stated, have served to decrease the average number of outlets, and the contractor, who does not suffer from the same difficulty in the matter as does the power company, is quite willing to meet more nearly the customer's idea of a reasonable cost on the wiring job by cutting down the number of outlets.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Reconnecting Induction Motors.—A. M. DUDLEY.—During the last two years a series of thirteen articles have appeared in *Power* on the subject of reconnecting induction motors. The purpose of the present article is to sum up the principles brought out in the series and to give an outline of the practical points that must be considered in deciding whether or not a given motor may be reconnected for different conditions without new coils or core iron.—*Power*, March 18, 1919.

Adapting and Standardizing Motor Drives. — E. ADLER.—Standardization of motor drives is in the interests of manufacturers and consumers, provided that the needs of individual loads can be met. Two types of motor may be distinguished, namely special motors built to utilize the full requirements of the driven machines and normal motors built to suit as wide a field as possible. A small number of "special" motors may be made from modified "normal" components; if, however, many of the former are required, it pays to build special lines of machines. The following recommendations are made: Small motors should be capable of plug connection; from this point of view 110 or 220 volts direct current or single-phase alternating current is most convenient. Three-phase yields favorable characteristics, but the necessity for three leads, the possibility of reversed rotation and the impossibility of connecting to lighting circuits are disadvantages. If one small "universal" motor cannot be provided for both direct-current and alternating-current operation, small machines for both kinds of current should at least have equal power, r. p. m. and main dimensions. Voltages might be standardized with great advantage. In networks with abnormal frequency the voltage should be chosen so that 50-cycle, normal-voltage motors can be utilized.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elekt. Zeits.*, Sept. 26, 1918.)

Electric Machinery Built of Low-Conductivity Metals.—J. ROTHBAUER.—A comparison is made of the dimensions, output and losses of a generator and a motor, it being supposed that the windings are (1) of copper, (2) of aluminum, or (3) of zinc.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Electrot. u. Maschinenbau*, Sept. 29, Oct. 6 and Oct. 13, 1918.)

Generation, Transmission and Distribution

Study of Conditions on Line Traversed by Sinusoidal Current.—E. BRYLINSKI.—In this paper, presented before the Société Française des Electriciens, approximate formulas designed to give quickly the value of the unknown quantities in alternating-current transmission at the moment of the establishment of a project are given. For example, by them one would be able to determine the voltage E_2 at the end of a line knowing the voltage V_1 at the generator and the apparent power P_a at load; or, again, one could ascertain the maximum of energy that could be transmitted with a given generator voltage V_1. The author shows that the numerical results that are arrived at with complete formulas differ little from those attained by his approximate ones.—*Revue Générale de l'Electricité*, March 1, 1919.

Utilizing Waste Heat.—A discussion of the utilization of waste heat rejected in the exhaust of steam and other engines.—London *Times Engineering Supplement*, February, 1919.

Large Turbo Units.—It is suggested that units of 25,000 kw. or possibly 50,000 kw. will be used in the proposed national power scheme in Great Britain. Up to the present time it is said that there are no 25,000-kw. units in Great Britain, although one had been built of that size for use in America. It is pointed out that such units are economical in steam consumption, first cost per kilowatt, floor space and attendance. Problems of cylinder arrangement and lighting are outlined by the writer.—London *Times Engineering Supplement*, February, 1919.

Water-Power Questions in Sweden.—At a meeting of the Swedish Water Power Association in April, 1918, Sven Lübeck reported that, despite the enormously increased cost of labor and machinery and the financial risks connected therewith, private enterprise in the sphere has increased rather than diminished during the past year. He stated that the high prices of materials have caused a certain change, where circumstances permitted, from iron to reinforced concrete and from concrete to masonry. It was said that the whole utilization of water power in Sweden now amounts to 1,000,000 hp.—*Swedish Export*, November, 1918.

Traction

Car-Lighting Regulator Testing Equipment.—B. H. EHRINGER.—In the past methods of testing and inspecting car-lighting outfits have required that the tester spend a considerable amount of time riding on the cars making his tests and repairs en route. Other companies have driven the car-lighting sets by means of special motors while the cars were standing in the yards. These various methods, however, have been too expensive in that the services of several men were required. Recently a testing outfit has been developed for the New York Central at its passenger car yard in Chicago. In this method the regulating panel is disconnected in the car and taken into the testing room, where it is inspected and tested according to certain requirements laid down by the electrical engineer. This method has been found economical and satisfactory.—*Railway Electrical Engineer*, February, 1919.

High-Power Electric Locomotives for Narrow-Gage Goods Trains.—Some interesting particulars of the high-powered electric locomotive employed on the railways at Bernina, Switzerland, have been furnished by

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Messrs. Brown, Boveri & Company. The conditions on these railways are extremely exacting, necessitating 800 hp. per locomotive. The railway works with a 1-m. gage, the curves are pronounced, and the gradient in parts exceptionally steep. Mechanical and electrical details of the locomotive are featured.—London *Electrician*, Feb. 21, 1919.

Railroad Electrification Facts and Factors.—A. J. MANSON.—In this article there appears a comparison between steam and electric locomotives, as analyzed by electrical engineers, showing the superiority of the electric locomotive over the steam locomotive for general railway service. Charts are presented indicating the relative tractive efforts and horsepower developed by steam and electric locomotives for various speeds. A table showing the results of such comparisons for equal weights follows:

Characteristics	Steam 4-8-2	Electric 4-6-2 2-6-4
Weight—Engine and 14-ton tender	268.5 tons	266 tons
Weight—Engine only	352,000 lb.	532,000 lb.
Weight—Engine on drivers	243,000 lb.	330,000 lb.
Number of pairs of drivers	4	6
Weight per pair	60,500 lb.	55,000 lb.
Wheel diameter, inches	69	68
Total wheel base engine and tender	75 ft. 8.5 in.	79 ft. 10 in.
Maximum tractive effort	58,000	110,000
Maximum horsepower	2,825	5,860
Continuous horsepower	2,825	3,200

—*Railway Electrical Engineer*, February, 1919.

Fuel-Oil Saving in Railway Electrification.—The United States Fuel Administration during its régime in California recommended the electrification of certain of the mountain sections of the railways of that state, with the object of saving fuel oil. Although this was proposed as a war measure, the data are now at hand for peace-time purposes and serve as an indication of the possibilities of electrification from a financial as well as a technical standpoint.—*Journal of Electricity*, March 1, 1919.

Installations, Systems and Appliances

Electricity in French Agriculture.—A. DELAMAIRE.—A description of the methods used in applying electricity to farm labor in the region of Meaux, France, where such cultivation has been developed by the local electrical corporation in coöperation with a government commission and national agricultural and electrical societies. Two metallic transforming substations mounted on wagons step down 15,000-volt, three-phase energy taken from the company's transmission lines to 750 volts and, by means of a flexible cable, drive two windlasses and two balancing harrows. To reach fields at a distance from the network material for extension lines 3 km. in length is provided. These lines are carried upon ordinary poles set only 0.6 m. in the soil and have steel conductors of 7 sq.mm. section. The poles are set 100 m. apart.—*Revue Générale de l'Electricité*, Feb. 22, 1919.

Harrington Forced-Blast Traveling Grate. — There has been a widespread demand on the part of power-plant designers for an automatic stoker that can be forced to a point of capacity far in excess of the limits of natural draft. Certain conditions, however, must be complied with before such application can be considered as commercially successful. These are as follows: (1) The stoker must allow the fuel to remain quiet during the combustion period to avoid clinkers. (2) To avoid the accumulation of refuse in the furnace ash must be discharged as it is formed. (3) There must be no air spaces that are not periodically cleaned in the course of the automatic operation. (4) It is desirable that the stoker be divided into compartments in such a manner that the air pressure and volume in each compartment are suited to the requirements of fuel passing. (5) The stoker must be readily convertible to the natural-draft type during the low-load periods. (6) Parts subjected to the heat and fusing action of direct-fuel contact must be readily replaceable.—*Power*, March 11, 1919.

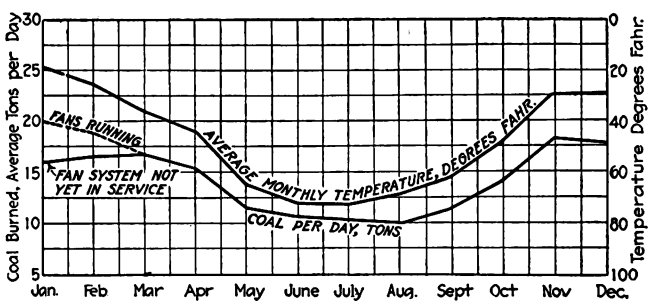
Mechanical Equipment of Industrial Buildings.—CHARLES L. HUBBARD.—This is the second installment of a series of articles on the subject of the equipment of industrial buildings. In this installment are considered the methods of electrical distribution, the selection of the electric motors and the types of variable-speed motors available.—*Power*, March 11, 1919.

Autogenous Welding.—In a paper given before the Institution of Mechanical Engineers Thomas T. Heaton dealt with electric welding processes chiefly as applied to mild steel. Particular attention is given to the methods of testing welds.—London *Times Engineering Supplement*, February, 1919.

Lifting Magnets.—A discussion of the construction, design and use of lifting magnets in industrial operations. It is pointed out that the great advantage of the lifting magnet over other cranes lies in the speed of performing the work inasmuch as no tying or fastening is necessary. The writer states that the energy consumption of such a crane is a small matter as compared to the saving inherent in its rapid action.—London *Times Engineering Supplement*, February, 1919.

Electrical Equipment of New Flour Mill.—A flour mill which is very completely equipped with electrical conveying, elevator and rolling machinery and is situated in the midst of the wheat country at Pasco, Wash., is described.—*Electrical Review*, Feb. 22, 1919.

Central-Station Heating.—JOHN C. WHITE.—Some of the possible economies that may be effected through the wider use of central heating stations are discussed in this paper. There also appear cost data and results obtained with such plants for comparison with other types. It is held to be important to select the proper location for such a heating plant and recommended that more permanent construction should be used and that all consumers be put on meter rates. The economical use of the steam machinery in correlation to the load conditions is also discussed.—*Technical Paper No. 191, Bureau of Mines.*



CURVES SHOWING RELATION BETWEEN FUEL BURNED AND TEMPERATURES, WISCONSIN CAPITOL PLANT

Central Fire-Alarm Station of San Francisco.—In order to prevent the recurrence of a serious fire such as

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that of 1906 every precaution is taken to make the fire-alarm system of San Francisco effective. Special provision is made to insure reliability of the power supply by careful design and interchangeability of circuits.—*Electrical Review*, Feb. 22, 1919.

Electric Arc Welding.—F. A. ANDERSON.—It is said that the development of arc welding has possibilities which have already greatly modified shipbuilding and promise further developments. The present article is the beginning of a series on the general subject of arc welding.—*Journal of Electricity*, March 1, 1919.

Electrophysics and Magnetism

Simple Method of Determining Complete Hysteresis Loops.—M. SCHLEICHER.—A simple method is described for the point-by-point determination of complete hysteresis loops by a ring method, using direct current. The method is compared with others as regards convenience and accuracy. It was devised originally for application to materials not available in thin bars as required for Koepsel's method. Among the advantages claimed are that a minimum number of instruments have to be read, the independent determination and repetition of each point, and the simplicity and good utilization of galvanometer sensitivity. A loop with thirty plotted points can be taken in twenty minutes.—*Science Abstracts, Section B*, Jan. 31. (Abstracted from *Elekt. Zeits.*, Oct. 3, 1918.)

An Electrolytic Method of Determining the Electric Field Round an Insulator.—W. ESTORFF.—The method of exploring the electric field of an insulator was made by the author, who immersed the electrode in an electrolyte in a manner similar to that employed by Fortescue and Farnsworth. Instead of using direct current, however, he applied alternating potentials to avoid any polarization effects and determined the equipotential surfaces from which may be derived the critical field densities. The equipotential surfaces surrounding a string of insulators as determined by the author's method are shown.—London *Electrician*, Feb. 14, 1919.

Electrochemistry and Batteries

Resistance of an Electrolytic Cell.—EDGAR NEWBERY.—The author states that the resistance of an electrolytic cell is made up of two parts, the resistance of the electrolyte and the resistance of transfer from electrode to electrolyte. Comparatively little attention has been given to transfer resistance. The author finds that it is a variable quantity even when the current density is constant, being greatly affected by the previous treatment of the electrodes, the temperature and the presence of colloids. The paper contains a study of this transfer resistance, more especially at the higher current densities.—London *Electrician*, Feb. 14, 1919.

Units, Measurements and Instruments

Using a Gas Jet in Obtaining Graphic Records.—L. LUMIÈRE.—To obviate the imperfections in graphic records caused by the rubbing of the stylus upon the paper the author uses a tube of very small diameter made of aluminum, or a straw covered with varnish or collodion, and terminating in a point bent to meet the paper. Then by employing vapor from a gas jet to react chemically upon specially prepared paper he claims to have arrived at a method of inscription so accurate that it could be used to record messages sent by submarine cable.—*Revue Générale de l'Electricité*, March 1, 1919. (Abstracted from *Comptes Rendus*, Dec. 30, 1918.

Miscellaneous

Study of Municipal Electric Lighting.—The article consists of a study of a report by E. E. Lincoln entitled "The Results of Municipal Electric Lighting in Massachusetts." From his preliminary surveys Mr. Lincoln draws the conclusion that the public plants, situated for the most part in the smaller municipalities, constitute more than 30 per cent of the total number of central stations in Massachusetts, represent about 3 per cent of the total assets and put out about 7 per cent of the energy (4.3 per cent of the assets and 5.4 per cent of the output if the hydroelectric companies are included). But he also says that practically no underground construction has been installed by the public plants, whereas even in 1911 50 per cent of the value of the distributing system of the private plants was accounted for by the underground lines and conduits, and at the same time 40 per cent of the total investment of the companies was in their distributing systems. Finally, the plant accounts as carried by the municipalities have been constantly written off each year for depreciation, at the rate of 3 per cent until 1907, and at the rate of 3 per cent in most cases since that date. Their plant accounts when compared with those of private plants will appear unduly large.—*Stone & Webster Journal*, February, 1919.

Extinguishing and Preventing Oil and Gas Fires.—C. P. BOWIE.—The bulletin aims to point out what has been done by operators in the past and to describe various fire-prevention methods and fire-fighting apparatus which are being used or adopted by many of the larger oil companies. These methods and apparatus, it is believed, if universally employed by operators, will largely decrease the present enormous annual losses. The subject is taken up from the point of view of the large oil-tank owners, but it is possible that some of the methods suggested for fire prevention might be applied to oil tanks of smaller capacities, such as those used by the central-station companies.—*Bulletin No. 170, Bureau of Mines.*

Inflammability of Aluminum Dust.—ALAN LEIGHTON.—Aluminum dust burns quietly when in a pile, but if this pile be disturbed in such a manner as to raise a cloud of dust into the air the burning takes place with explosive violence. If a dust cloud already formed that has a density within the explosive limits be ignited, a violent explosion results. In this article the physical and chemical properties of aluminum dust have been studied with regard to inflammability and the extinction of fires.—*Technical Paper No. 152, Bureau of Mines.*

The Magneto Industry.—It is said that before the war British motor engineers were dependent on Germany for the complete magneto machines, and they also had to look to that country and the United States for the supplies of practically all the raw materials used in the construction of these machines. The home industries, however, set about the task of making the insulating material, enameled wire and magnet steel, so that these as now produced in England are said to be even better in quality than those which had been imported from Germany. The plant of the Thomson-Bennett Works, Birmingham, is described in detail as a typical factory engaged in magneto manufacture.—London *Engineer*, Jan. 10, 1919.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

CONVENTION ARRANGEMENTS OF N. E. L. A. NEAR COMPLETION

Officers Now at Work Perfecting the Program, and the General Plans for Various Meetings Have Been Decided Upon

The National Electric Light Association has sent out to all of its members a circular letter containing general information on its forty-second convention, to be held at Atlantic City, N. J., May 19-22. As previously stated, the headquarters of the association will be on the Million-Dollar Pier, adjacent to all the hotels likely to be patronized by the members during the convention, and all the various departments—registration, hotel, transportation, executive, papers, membership sections, etc.—will have offices there also. All of the general sessions of the convention, most of the section sessions and practically all of the official entertainments will be held on the pier. An unusually fine and large exhibit of modern electrical apparatus and supplies, supplemented by a special exhibit under the auspices of the lamp committee, has been arranged for, as announced in these columns last week.

In view of the excellent train service that exists between New York and Atlantic City, no special trains will be arranged for from New York City or from the New England Section. A special train will be run, however, from Chicago over the Pennsylvania lines. This will leave Chicago on the morning of May 18 and run as a second section to the Manhattan limited. Reservations for this train should be made through Fred R. Jenkins, 72 West Adams Street, Chicago.

As now planned, the mornings of Tuesday, Wednesday and Thursday, May 20, 21 and 22, will be devoted to general sessions, while the afternoons of Tuesday and Wednesday will be allotted to sessions of the four national special sections. The exhibition will be open for inspection on the morning of May 19, and the general reception of the president will take place on the evening of that day. The first business session of the convention will begin at 10 o'clock on Tuesday, May 20.

CONNECTICUT WILL NOT HAMPER POWER EXPORTATION

Bill to Restrict the Sale of the State's Hydroelectric Energy Reported on Unfavorably by Committee.

A movement to limit the exportation of hydroelectric energy from Connecticut appears destined to failure. Last week the legislative committee on the judiciary gave a hearing upon a bill providing that any company desiring to sell more than 500 hp. of electrical energy generated by water power within the state to customers outside Connecticut must obtain permission from the Public Utilities Commission before making such sale, and that such permission should be granted only in case it was shown by the company at a public hearing that the interests of users of electrical energy within the state would benefit thereby.

The bill provided for a yearly jurisdiction of the matter by the commission and forbade making a contract for energy delivery in excess of one year under the above conditions. No general support of the measure was in evidence, although it is much less drastic than the Maine law prohibiting the exportation of hydroelectric energy. Interconnection between Connecticut, Massachusetts and Rhode Island transmission and central-station systems is becoming a well-established practice, and the engineering and economic advantages of energy interchange appear to be widely recognized in Connecticut. The committee reported adversely on the measure soon after the hearing, and Senator Hemenway of the committee informed a representative of the ELECTRICAL WORLD that the bill will not be likely to pass at this session.

NEW YORK'S JEWELED PORTAL FOR THE VICTORIOUS ARMY

Superb Piece of Decorative Lighting, Emblematic of Light, Life and Purity, Erected for Homecoming Regiments

What is considered by many to be the most superb piece of decorative lighting in the history of the art, surpassing any individual effort made at the Panama-Pacific International Exposition, has been erected at the corner of Fifth Avenue and Sixtieth Street, New York City, in honor of the homecoming regiments. This jeweled portal was created in the illuminating engineering laboratory of the General Electric Company at Schenectady under the direction of Walter D'Arcy Ryan. The architecture and decorative features were executed by J. W. Gossley, chief of the art department, and the installation of the jewels, location of searchlamps and operation were handled by the Tucker Electrical Construction Company under the direction of Clarence L. Law, illuminating engineer of the New York Edison Company and secretary of the illumination committee appointed by the Mayor's committee on celebration to the homecoming troops.

Day and night views of the arch are shown on the opposite page. The arch is really a gigantic curtain of jewels draped between two obelisk forms. The obelisks rise to a total height of 80 ft. (24 m.) and are surmounted by great jeweled forms in the shape of sunbursts 12 ft. (3.6 m.) wide and 20 ft. (6 m.) high. Approximately 30,000 jewels from the famous Tower of Jewels of the Panama-Pacific International Exposition are used in the gigantic curtain, and when in use beams of light from arc projectors are thrown on the arch, causing the thousands of jewels to flash the brilliant and pure colors of the spectrum. The arch was designed especially for the purpose of jeweled decoration by W. D'A. Ryan, and the effect is most gorgeous.

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DAYLIGHT SAVING SPURNED IN DOMINION OF CANADA

Objections Made by the Farmers Cause the House of Commons to Reject Measure by a Large Majority

Canada has spurned daylight saving. The objections of the farmers to advancing the clocks one hour were sustained so firmly that the House of Commons, by a vote of 105 to 50, decided to kill the daylight-saving act for 1919. The fight was not led by any party, and representatives of the urban communities were generally arrayed against those of the rural districts.

It appeared from the speeches of the spokesmen of the farmers that the daylight-saving act made it necessary for argiculturists seeking to place their milk on trains or to get their products to market to rise in the darkness as in winter, and an hour earlier than usual. Furthermore, it seemed that although the farmer himself might be prepared to ignore the daylight-saving act and work from daylight to dark, the hired man preferred to act in accordance with the law. Thus, it was argued, the farmer lost the labor of his employee for an hour at the time of day best suited for the performance of certain farm tasks.

Other general objections that were raised were:

1. Farmers would be forced to begin milking operations between 3 and 4 o'clock in the morning, and the women on the farm would have to cook two breakfasts.
2. Owing to the dew of early morning it would be impossible for the farmers to hoe certain crops, such as beans and sugarbeets.
3. The passage of the measure would increase bitter feeling between rural and urban communities.

One angle of the situation discussed briefly was the matter of varying time near the border and the problems that would be caused in train schedules. Some members urged the border sections to adopt the same time as the United States, while others expressed the opinion that matters would be adjusted easily.

At a hearing given April 1 by the Dominion Railway Commission representatives of the Canadian railways and Railway War Board presented reasons for the adoption by Canadian roads of the daylight-saving system now in effect in the United States, despite the fact that the Dominion government has not authorized it.

The witnesses concurred in declaring that the daylight-saving plan would have to be continued on Canadian roads if connections with the United States were to be maintained, as the running of trains on different schedules would constitute a "dangerous experiment" and pile up difficulties in international traffic.

TO PROMOTE UTILIZATION OF ELECTRIC FURNACE PRODUCTS

Organization Formed for the Purpose of Disseminating Data on Electric Furnace Products of All Kinds

Steps were taken to promote the use of various electric furnace products at a meeting called by Acheson Smith, vice-president and general manager of the Acheson Graphite Company, held at Niagara Falls on March 21 and 22.

The meeting passed resolutions inviting all manufacturers of electric furnaces, electrical apparatus and electric furnace supplies and accessories, public utility corporations, designers and inventors of electric furnace equipment and the users of electric furnaces to become members and to join in a campaign to disseminate to engineers and to the public data as to the quality of electric furnace products of all kinds.

The organization formed is to be called the Electric Furnace Association. A permanent organization was created as follows:

President—Acheson Smith, Acheson Graphite Company, Niagara Falls, N. Y.

First vice-president—C. H. Booth, Booth-Hall Company, Chicago.

Second vice-president—W. E. Moore, Pittsburgh Electric Furnace Company, Pittsburgh, Pa.

Secretary—C. G. Schluederberg, Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

Treasurer—F. J. Ryan, American Metallurgical Corporation, Philadelphia.

Directors—The officers and C. A. Winder, General Electric Company, Schenectady, and F. J. Tone, Carborundum Company, Niagara Falls.

The president was authorized to get in touch with all who should be interested in joining the organization and was requested to arrange an early meeting when completed publicity plans could be presented. In the meantime different committees were instructed to perfect reports as a basis for constructive work.

NEEDLESS APPREHENSION OF WATER-POWER CONTROL

Chairman Weed of Massachusetts Commission Defends Program and Says No User Is Under the Heel of Any Power Monopoly

Chairman A. R. Weed of the Massachusetts Gas and Electric Light Commission told the legislative committee on waterways and terminals at a hearing this week that the opposition to the proposed conservation program as set forth in the recent special report of the recess commission on water resources appears to be based upon needless apprehension of monopolistic control. At the last hearing representatives of the Holyoke Water Power Company and other concerns expressed the fear that if the coöperative conservation program should be sanctioned by the Legislature, the New England Power Company and Turners Falls Power & Electric Company might acquire a monopolistic hold upon the privileges on the middle Connecticut River and its tributaries. In the ELECTRICAL WORLD of March 29, page 651, an account was given of the attitude of President H. I. Harriman of the New England Power Company with respect to the proposed legislation, with a résumé of Chairman Weed's outline of the proposed conservation plan.

At the final hearing on Tuesday Mr. Weed replied to the objections urged at last week's hearing. He pointed out that the plan suggested resembles those of the Wisconsin Valley and Chippewa improvement and control projects, which are working out most successfully. State development is not advocated in the Massachusetts plan, but since the state has the right to assess the cost of storage improvements upon the owners of riparian rights, there is no question that a corporation of the state's creation has this right also. The public is vitally interested in the preservation and use of this great natural resource. Regarding claims of monopoly, Mr. Weed said that the Holyoke Water Power Company had thrived for seven years on the tribute it has exacted from the industrial life of the

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Trying to Do the Impossible

The latent power in our streams must and will be used, and any means to thwart it are useless

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community. He pointed out that power cannot be sold in large blocks except on a competitive basis.

"No user of 100 hp. or over," said Mr. Weed, "is under the heel of any power monopoly in any part of this state. Any man who sells power to such a user must base his rates upon the purchaser's cost of producing energy. If that is monopoly, then I don't know what monopoly is! We are a long way from the point where any manufacturer or any community is under the heel of any monopoly in the purchase of power, and I speak from some knowledge of such affairs." Mr. Weed said that he appreciated that the numerous and varied interests on the Millers River are naturally anxious to learn how the cost of storage would be apportioned among them. These interests are more complex, probably, than on any other stream in the state. In the proposed plan the commission would pass upon the creation of any storage on the coöperative basis. By the provision that no such plan could go through without the consent of a majority both in interest (proportioned to head developed) and in number the interests of the small power user would be protected.

W. Rodman Peabody, for the Turners Falls Power & Electric Company, vigorously denied that there was any community of interest or interlocking control between the Turners Falls and New England Power companies, with the single exception of the coöperative storage program on the upper Connecticut River, in which the two concerns share through the Connecticut River Conservation Company. He proposed an amendment to the act which would give the commission increased authority with respect to fixing benefits and tolls for storage secured. Mr. Peabody said that the success of the Connecticut River Conservation Company had led the Cabot interests, with others, to take up storage work on some of the tributaries of the Connecticut River. The only object of the Cabot interests in this work is to increase the summer flow of the Connecticut River at Turners Falls, thus raising the output of hydroelectric energy at the Montague City and other water-power installations.

Charles T. Main, consulting engineer, Boston, and a member of the special water resources commission, said that the cost of storage has hitherto been an abstacle to its development in many cases. Rather than forego the benefits of storage, Mr. Main thought that the state might properly assist in financing abnormal costs, if the flowage to be secured seems to justify this policy. The speaker quoted from the preliminary report of the Water Power Commission of the Conjoint Board of Scientific Societies, published in July, 1918—Sir Dugald Clerk, chairman, and A. H. Gibson, secretary—to show the interest in hydroelectric possibilities now manifested abroad in connection with reconstruction efforts. State assistance in financing such powers was recommended in this report, which suggested that the state might guarantee a suitable minimum rate of interest sufficient to attract private capital, sharing with the latter in the returns above the minimum rate.

Nathan Avery, for the Holyoke Water Power Company, stated that if a provision were inserted in the proposed act to the effect that no tolls shall be assessed on any water rights user in excess of the benefits which he will derive from the conservation program, he would withdraw his opposition. John N. Cole, chairman of the Massachusetts Waterways Board, also spoke, urging water-power conservation through storage development and likening the holders of riparian rights who "sit tight" without developing them to the slothful steward who buried his talent in the earth. He pointed out that New England vitally needs water-power development along still broader lines in order to compete with other sections of the country in manufacturing.

MASSACHUSETTS COMMISSION IS OVERRULED ON TELEPHONE RATES

Full Bench of Massachusetts Supreme Court Rules that the Postmaster-General Can Fix Telephone Toll Rate

The Supreme Court of Massachusetts handed down a decision by the full bench March 22 against the Public Service Commission's petition for an injunction against the New England Telephone & Telegraph Company regarding the toll-rate schedule recently established by order of Postmaster-General Burleson. The Attorney-General of Massachusetts, on behalf of the commission, claimed that the resolution of Congress of July 16, 1918, reserved to the states the right to regulate intrastate rates to the same extent as existed prior to federal control of the telephone and telegraph companies. The court holds that as the United States is in possession, as it is not a party to the suit, cannot be interfered with behind its back, and cannot be made a party, the suit must fail.

MEETING OF THE PACIFIC COAST SECTION, N. E. L. A.

Joint Convention at Coronado Will Include Jobbers, Contractors and Dealers Also, and Program Provides for All Interests

The custom established on the Pacific Coast several years ago of having one big joint convention each year will be continued this year, the date having been set for April 30 to May 2, at the Hotel del Coronado, which is on the outskirts of San Diego. This will be the annual meeting of the Pacific Coast Section of the National Electric Light Association, the quarterly meeting of the California Association of Electrical Contractors and Dealers, the quarterly meeting of the Pacific Coast Electrical Supply Jobbers' Association, and a special meeting of the Westinghouse Agent-Jobbers' Association, in connection with which a special train is to be run from Chicago. The latter additional association meeting is expected to add sixty or seventy jobbers from all parts of the country.

All papers are to be printed in advance, the actual meeting being limited to discussion only. The commercial committee has announced a preliminary list of papers as follows: "The Proper Training of the Sales Personnel," by Lee H. Newbert, I. W. Alexander and J. F. Pollard; "The Contractor-Dealers of To-morrow," by John C. Rendler; "The Jobbers' Relation to the Industry," by W. S. Berry; "Means for Establishing Closer Relations Between the Architects and the Electrical Industry," by J. O. Case; "Interesting the Consumer," by T. W. Simpson; "Progress of Electric Cooking and Heating," by B. M. Maddox; "Wiring for Heavy Wattage Appliances," by an author to be announced later.

The engineering committee announces the following list of papers, which is only partly completed: "Protective Relays on Main Transmission Lines," by George

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E. Armstrong; "Some Minor Aspects of Interconnected Systems," by L. M. Klauber; "The San Joaquin-Edison Interconnection," by G. R. Kenny; "Development of Small Automatic Power Plants," by E. A. Quinn.

H. H. Jones, manager of the San Diego Consolidated Gas & Electric Company, will act as chairman of the general convention committee, and William Clayton, United Light, Fuel & Power Company, San Diego, will serve as vice-chairman.

AMERICAN WELDING SOCIETY PERMANENTLY ORGANIZED

Prof. Comfort A. Adams Is Elected First President and Prof. Elihu Thomson Is the First Honorary Member

At a meeting on March 28, at which those interested in all kinds of welding were represented, the American Welding Society was officially organized and a constitution and bylaws were formally adopted. The first president of the society is Prof. C. A. Adams, president of the American Institute of Electrical Engineers, and the vice-presidents are J. M. Moorehead, consulting engineer, and G. L. Brunner, Brunner Manufacturing Company.

Directors chosen for a period of one year are: W. M. Beard, Linde Air Products Company; M. H. Roberts, Air Reduction Sales Company; M. M. Smith, Commercial Acetylene Company; L. D. Lovekin, American International Shipbuilding Corporation; Alexander Churchward, Wilson Welders Metals Company; W. H. Patterson, Westinghouse Electric & Manufacturing Company; W. J. Jones, Chester Shipbuilding Corporation, and C. A. McCune, Page Steel & Wire Company. Those elected for two years are: R. R. Browning, Oxweld Actylene Company; Prof. A. S. Kinsey, Stevens Institute of Technology; Victor Mauck, John Wood Manufacturing Company; E. L. Hirt, Bethlehem Shipbuilding Corporation; J. F. Lincoln, Lincoln Electric Company; H. M. Hobart, General Electric Company; D. C. Alexander, Quasi Arc Weldtrode Company, and H. R. Swartley, Jr., Davis-Bournonville Company. For three years there were chosen: L. H. Davis, Linde Air Products Corporation; E. L. Mills, Air Reduction Sales Company; D. B. Rushmore, General Electric Company; James Burke, Burke Electric Company; D. H. Wilson, Jr., Wilson Welders & Metal Company; Hermann Lemp, General Electric Company; C. J. Nyquist, Torchweld Equipment Company, and Alexander Jenkins, Alexander Milburn Company. These directors represent equally those interested in gas and electric welding.

By unanimous vote Prof. Elihu Thomson was elected first honorary member of the society, for his inventions in electric welding. Professor Thomson was characterized by the president as the father of electrical engineering in this country.

An important feature of the bylaws of the society was the plan of organization of an American Bureau of Welding for the purpose of coöperative research and standardization in welding, which will consist of the board of directors and representatives from important societies and associations and also from departments of the government.

The board of directors elected H. C. Forbes, former secretary of the welding committee, Emergency Fleet Corporation, permanent secretary, and W. E. Symons, Galena Signal Oil Company, treasurer.

ORGANIZATION NEEDED TO REPRESENT ALL ENGINEERS

Local and National Engineering Societies to Consider How Best to Develop Concerted Action of Members on Public Questions

How can engineers find out what are the views of the profession as a whole on public questions, and if this is accomplished what can be done to give the judgment of the profession commensurate political weight? The solution of these problems formed the nucleus of the discussion on the papers read last week at the representative meeting of New York engineers.

It was generally agreed that engineers should make themselves a potent factor in public affairs. The consensus of opinion was that this would require an organization embracing all branches of engineering, through which the profession could act as a body locally and nationally. Many thought that some existing engineering organization could be modified or expanded to meet their requirements, and the American Association of Engineers was suggested by Daniel Turner as being suitable for the purpose. Jesse M. Smith pointed out that the United Engineering Society now represents the national societies of electrical, mining, mechanical and civil engineers, that it has permanent quarters and its charter permits it to embrace and represent all the engineering societies of the country. Local divisions of the United Engineering Society could be formed if desired, and Mr. Smith thought it would be ill advised to form another association when an organization of the prestige and experience of the United Engineering Society is available.

In order to crystallize the ideas of all into a form productive of action, C. F. Scott presented the following resolution, referring particularly to New York engineers, which was adopted by the meeting:

Whereas all engineers, as citizens, should invite the fullest coöperation; and

Whereas complete coördination of the engineering profession as a whole is essential for the best interests of the community; and

Whereas it is the sense of this meeting that some program be formulated whereby closer coöperation between engineers may be obtained, therefore

Be it resolved, that the secretary of this meeting be and is hereby directed to so notify the secretaries of the several societies or local sections of the societies here represented to-night, with the request that the several secretaries transmit this resolution to their respective local membership together with an invitation to said local membership to appoint a delegate to attend a joint conference, with a view to organizing so as to obtain closer coöperation between engineers, particularly between the engineers resident in the metropolitan district, whereby they may become more potent in fulfilling their responsibilities as citizens.

The question then came up of asking every engineering society in this country to take some action, and with this end in view Louis C. Marburg proposed the following resolution, which was also adopted:

Resolved, that all engineering societies in this country not yet having committees on development be asked to appoint such committees, with instructions to undertake a survey of the aims and purposes of their respective associations and to coöperate with corresponding committees of other engineering and similar societies, and

It is further resolved that a copy of these resolutions be sent to every engineering society in this country.

A third resolution was placed before the meeting by Nelson P. Lewis and adopted. It was to the effect that the various engineering societies be invited to

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appoint representatives who would come together and develop a simple code of ethics which might become the standard for all societies and to which all engineers could subscribe.

In the discussion on the reasons for the apathy displayed by engineers toward activities outside their field, a number of speakers laid much of the blame on the engineering courses of the universities. Prof. Comfort A. Adams said in this regard that much more depended on the instructor than on the subject taught. He said that finer ideals of good American citizenship can be injected into a course on dynamo design than are often given in classes on sociology and allied subjects.

S. N. Castle of the General Electric Company, New York, who acted as secretary of the meeting, assumed the responsibility of notifying the different societies in accordance with the resolutions passed by the meeting.

WISCONSIN ASSOCIATION DISCUSSES LIVE TOPICS

Testing Transformers, Relations with Commissions, Service Extensions and High-Tension Equipment Are Debated

The two important public policy questions discussed at the meeting of the Wisconsin Electrical Association at Milwaukee on March 27 were the relations of the utilities and the Public Utilities Commission and policies on service extensions. J. B. Sanborne of Milwaukee reported on the activities of the State Legislature as applied to public utilities. He said that a bill to make the Railroad Commission elective rather than appointive has been twice defeated. A bill introduced to abolish the commission and the public utility laws should be watched carefully, he said, for if this carries it would leave absolutely nothing to replace the commission form of regulation. A bill has passed the Wisconsin House and Senate to make the fiscal year of all utilities coincident with the calendar year and to accomplish this to permit a report covering a period of six months for those utilities whose fiscal year now ends in June.

The discussion of service extensions was introduced by a paper by A. J. Goedjen, statistician of the Wisconsin Public Service Company, Milwaukee, entitled "A Review of Policies of Service Extensions as Laid Down by State Commissions." This reviewed the activities of many commissions and concluded with the statement that the author believed the Indiana commission's rules on this point were perhaps the best in this country.

"The Proper Loading of Distributing Transformers" was the topic of a paper by Frank A. Robbins, electrical engineer of the Superior (Wis.) Water, Light & Power Company. He recommended the use of self-registering thermometers to measure the maximum safe temperature of transformers. He also suggested that this work should be done in the summer rather than in the fall, which is the usual period for testing transformers.

Alfred Alsaker, chief engineer of the Delta-Star Electric Company, Chicago, delivered an address on "High-Tension Outdoor Substations and Switching Equipment." His talk was illustrated by many lantern slides showing typical installations.

Interesting business activities at the convention included the appointment of a committee to meet with the contractor-dealers and to assist that group in the industry in organizing an effective association. The convention also decided that in the future there shall be a railway division of the Wisconsin Electrical Association.

The officers elected for the ensuing year are: President, Raymond H. Smith, vice-president and general manager of the Eastern Wisconsin Electric Company, Sheboygan; first vice-president, W. C. Lounsbury, general superintendent of the Superior Water, Light & Power Company; second vice-president, A. K. Ellis, superintendent of the Wisconsin Traction, Light, Heat & Power Company, Appleton; third vice-president, L. R. Boisen, vice-president of the Ashland Light, Power & Street Railway Company; secretary and treasurer, J. P. Pulliam, vice-president and general manager of the Wisconsin Railway, Light & Power Company, Winona, Minn.

NEW ENGLAND POWER COMPANY SYSTEM STEADILY EXPANDING

Arrangements Made for Increasing the Generating Capacity of the System by Adding Equipment and by Elaborate Interconnections

The largest gross earnings in the company's history are reported by the New England Power Company system for 1918. During the year the system revenue was $3,557,281, compared with $2,645,973 in 1917, and net earnings were $1,322,880 against $1,144,195 in 1917. The total energy output was 323,000,000 kw.-hr., compared with the previous year's record of 300,000,000 kw.-hr.

The company is now adding at its Uxbridge station a 10,000-kw. steam-turbine unit which it is hoped to have in operation early this month. This will raise the capacity of the Uxbridge station to 15,000 kw. The company has also rewound three 60-cycle generators at its No. 5 station on the Deerfield River, adding transformer and switching capacity to bring the 60-cycle capacity of this plant up from 10,500 kw. to 15,000 kw. The waterwheels were originally designed to handle this increased service, and the station will now be of increased value at times of large stream flow. During the year a synchronous condenser has been installed at the Greendale substation, in Worcester, and the lines of the system have been extended about 18 miles from Ayer to Nashua, N. H. Energy is now being supplied to the Nashua Manufacturing Company, which has contracted for about 6000 kw., instead of enlarging the local steam plant of this concern. It is expected that energy will be interchanged over this line in the future between the New England company and the Manchester Traction, Light & Power Company, thus interconnecting the hydroelectric plants on the Deerfield and Connecticut Rivers with the stations on the upper Merrimac River.

A high-tension connection is being made with the Edison Electric Illuminating Company of Boston, which will enable from 10,000 kw. to 15,000 kw. to be interchanged. Another line has been built from the Millbury operating headquarters of the power company to a new steam-turbine plant of the Shore Line Electric Railway near New London, Conn. This extension will permit an exchange of 10,000 kw. An arrangement has also been made with the Narragansett Electric Lighting Company of Providence, R. I., by which the boiler capacity of that company has been increased, adding 10,000 kw. to the amount of energy which it can deliver to the New England company.

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Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 719 of this number.

Rochester Engineering Society.—H. A. Winne, General Electric Company, addressed the March 28 meeting on "Electric Furnaces."

Electric Club of Chicago.—M. Luckiesh, of the National Lamp Works research laboratory, was the speaker at the March 20 meeting and Capt. Florence Spofford, Red Cross Motor Corps, at the March 27 meeting.

A. I. and S. E. E., Cleveland District Section.—W. W. Walsh of the Standard Underground Cable Company, Pittsburgh, Pa., spoke on "Electrolysis" at the March 17 meeting of this section, Association of Iron and Steel Electrical Engineers.

Utah Society of Engineers.—At the monthly meeting held on March 19 papers were presented by E. H. Beckstrand on "Recent Improvements in Steam Prime Movers" and by L. M. Pharis, hydraulic engineer, Utah Power & Light Company, on "Waterwheel Development."

Engineers' Club of Philadelphia.—Arthur J. Baldwin, vice-president of the McGraw-Hill Company, who lately returned from France, is to present an illustrated paper entitled "The Devasted Area and Its Reconstruction" at a special meeting of the Engineers' Club of Philadelphia on April 23.

I. E. S., New York Section.—The tendency of different illuminants to cause loss of visual efficiency or the power to sustain a clear vision of the reading page was clearly set forth in a paper presented by C. E. Ferée and G. Rand before this section on March 20. The paper was entitled "Some Experiments on the Eye with Different Illuminants." Loss of efficiency expressed in percentage change of ratio of total time clear to total time blurring during three-hour tests showed a variation from 5.43 to 54.86 per cent. The lower figure was obtained where the illuminant was unsaturated yellow, whereas the greatest loss of efficiency was obtained from an illuminant in which the dominant color was bluish green with greater saturation. A comparison of the tendency of the different illuminants used to cause loss of visual efficiency and to produce ocular discomfort showed that the smaller the per cent loss of efficiency the greater was the time threshold of discomfort in seconds. This clearly showed the advantage of the yellow illuminant on the reading page to reduce discomfort to the eye. "Transmission of Colored Light Through Fog," by C. L. Utterback, also presented at this meeting, showed that a searchlamp will have a maximum transmission through fogs if the light is composed of wave lengths of from 5300 m. to 5900 m. only.

Springfield (Ill.) Engineers' Club.—J. L. Stair, chief engineer National X-Ray Reflector Company, Chicago, gave an illustrated talk on the art of lighting at the monthly meeting of the club held Friday, March 14. Special emphasis was placed on the illumination of interiors without the use of ceiling fixtures.

N.E.L.A., Philadelphia Electric Company Section.—H. B. Harmer addressed the commercial branch meeting of this section of the National Electric Light Association held on March 25, his subject being "Safety First and Always," while Joseph A. Steinmetz gave a talk before the main section meeting of April 1 on "A Close View of Peace."

New York Electrical League.—Arthur E. Reinke, European engineer for the Western Electric Company, was the principal speaker at the luncheon of the league held on March 27. His subject was "Bolshevism." M. H. Roughton, Australian commissioner on investigation of exports and imports, spoke on existing business relations between Australia and America.

Joint Electrical Meeting at San Francisco.—The California Electrical Cooperative Campaign on March 13 held a dinner-meeting in San Francisco at which there were represented the Pacific Coast Section, N. E. L. A.; the California Association of Electrical Contractors and Dealers and the Pacific Section, Electrical Supply Jobbers' Association, as well as electrical manufacturers. Glen Arbogast, Newbery Electric Company, Los Angeles, reviewed the progress of the coöperative campaign; C. W. Banta, Wells-Fargo Nevada Bank, San Francisco, spoke on "Some Banking Aspects of the Coöperative Movement," pointing out how credit was improved by proper methods of accounting and business analysis, and J. A. Sparlin, manager commercial research department of the Curtis Publishing Company, spoke on "The United States Itself as the Best Market for the Electrical Trade," dwelling on the buying power of the farm.

American Institute of Electrical Engineers

Fort Wayne Section.—Major Darnell lectured on "The X-Ray and Its Application to War Uses" at the March 7 meeting.

San Francisco Section.—W. F. Dietrich spoke on "Mountain Railroad Electrification in California" at the March 28 meeting of this section.

Pittsfield Section.—An illustrated lecture was given by E. F. W. Alexanderson, consulting engineer, General Electric Company, on "Transoceanic Radio Communication" at the March 27 meeting.

Lynn Section.—The eighth annual banquet of the section is to be held in the Boston City Club on April 12, the address of the evening being delivered by Marshall P. Thompson of Boston.

Milwaukee Section.—The Feb. 19 meeting was held jointly with the Engineers' Club, William Bruce, secretary of the Association of Commerce, speaking on "The Activity of the Engineer in Civic Affairs."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Investigation of Surcharges.—The Great Western Power Company and the Pacific Gas & Electric Company have been ordered to appear before the Railroad Commission of the State of California and show cause why the surcharge on light and power allowed by the commission in June of last year should not be reduced or removed. Unless the utilities are able to show that there is a continuance of the abnormal conditions which led to the creation of the surcharge by the commission solely as a means of enabling the light and power companies to function efficiently during war times, the commission will order a readjustment of charges in the direction of the rates that formerly prevailed.

Rate Increase in Illinois.—The Wright Brothers Electric Light & Power Company has been granted by the Illinois Public Utilities Commission a temporary order making effective for a period of six months from March 1 increased rates for electric service. This is an increase of practically 3 cents in the lighting schedule for the first step and 2 cents for the first step of the power service. The top step of the lighting rate is 15 cents, and the top step of the power rate is 8 cents. A temporary order was also issued authorizing an increase in rates for the Dahlgren Electric Light Company for a period of ten months. The rates fixed by the commission are in excess of the franchise ordinance. However, this ordinance provides that nothing in it shall prevent the utilities commission from increasing rates above the maximum provided, which is 15 cents for the first step in residence lighting. The first step authorized by the commission is 17 cents. An interesting part of this decision is that the customers and Dahlgren will be required to purchase meters from the electric utility at the actual price of such meters, provided that the Dahlgren company shall repurchase these meters, in the event of discontinuance of service, at the full price less 7 per cent per year depreciation.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Fund for Research Work.—The National Research Council has been intrusted by the Rockefeller Foundation with the expenditure within a period of five years of an appropriation of $500,000 for promoting research in physics and chemistry, primarily in educational institutions in the United States.

Higher Telegraph Rates.—An increase of 20 per cent of all domestic telegraph rates became effective April 1 under an order issued by Postmaster-General Burleson. The increase was ordered, Mr. Burleson explained, to meet the increased cost of operation occasioned by wage increases now in effect and made during the last year.

Electric Vehicle Stations.—Electric vehicle routes from New York to Philadelphia, Atlantic City, Easton, Pa., Ellenville, N. Y., Pittsfield, Mass., and New Haven are described in the 1919 "Automobile Handbook," just issued by the New York Electric Vehicle Association. A list of charging stations in and near New York with particulars as to capacity and rates is included.

Report of Cities Service Company.—The annual report of the Cities Service Company for 1918 shows earnings growing from public utility operations during the year of $4,229,563, and from oil operations of $18,050,504, making a total of $22,280,067. This compares with $4,742,652 and $14,509,984 respectively in 1917. The reduction of public utility earnings is accounted for by the high costs of money during war times to finance growth and refund maturing bonds.

Central Station Exhibit in Chamber of Commerce Rooms.—A comprehensive exhibit of local manufactured products is maintained by the Hartford (Conn.) Chamber of Commerce, and among the various displays the Hartford Electric Light Company has provided twenty-five 8-in. by 10-in. photographs of its representative installations. These are mounted on revolving panels and include fifteen views of typical power installations, five views of different types of commercial lighting layouts, and five views of electric heating equipments used in industrial plants and showing japanning and varnishing ovens used in the manufacture of world-famous products. One panel in the company's exhibit is devoted to statistical data showing in graphic form the growth of the company's connected power load over a series of years, the purchasing power of a dollar in electrical energy for lighting service, and comparisons of the average price of energy in various cities against the Hartford rate.

Drought Adds to Cost of Power.—Lack of rainfall and snowfall in the mountains on the Pacific Coast last year cost the hydroelectric companies of California more than $3,000,000, according to the report of the State Railroad Commission. Owing to this condition the hydroelectric companies were compelled to use 2,000,000 barrels more of oil for the production of electricity than would ordinarily be necessary. This oil was formerly sold at from 65 to 80 cents a barrel and jumped to a minimum of $1.50 a barrel.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Right to Place Poles in Streets a License, Not a Franchise.—An answer in an action to compel an electric company to remove its poles, etc., from streets, that city was estopped from prohibiting defendant to occupy the streets, did not raise a question of freehold, the answer not stating how long the city would be estopped, the Supreme Court of Illinois held in City of Sullivan versus Central Illinois Public Service Company (122 N. E. 58). Where a municipal corporation grants a utility the right to use streets without a time limit as to duration of right, such grant is not perpetual and is necessarily limited to the life of the corporation granting it or the corporation obtaining such right. The power conferred by a city on a company to locate poles, etc., in its streets is a license and not a franchise, and hence actions involving right to use of streets by such a company does not involve a franchise so as to give right of direct appeal.

Election Under Workmen's Compensation Act.—In suit based on the first clause of the workmen's compensation act, Section 29, to recover amount paid for lineman's death, due to his coming in contact with defendant's high-tension wires, a declaration which in substance alleged that defendant was engaged in "electrical work" was not defective because it failed to allege that defendant had not elected to be governed by the act, in view of Section 2, according to the Supreme Court of Illinois in Vose vs. Central Illinois Public Service Company (122 N. E. 134). In suit by employers under the workmen's compensation act to recover amount paid for an employee's death, due to contact with defendant's high-tension wires, where defendant was engaged in an occupation making it subject to the act, unless it elected to the contrary, and the proof showed that neither plaintiffs nor their employee had made any election, judgment will not be reversed because plaintiffs did not prove that they and their employee had elected to be bound by the act.

Public Service Commission Fees.—Despite the fees and salaries act and the cost act, under the public utilities act, Section 7, the Public Utilities Commission is not entitled to fees for making a transcript of proceedings before it for use on appeal from its order to the circuit court and is not excused from performing duty enjoined upon it until such fees are paid, the Supreme Court of Illinois held in Kennedy versus State Public Utilities Commission (122 N. E. 111).

Workmen's Compensation.—Where defendant did not plead that either deceased or his employer was subject to the workmen's compensation law, the court did not err in refusing to allow defendant to introduce testimony in support of defense that plaintiff, deceased's wife, had filed her claim for compensation with the Industrial Commission, according to the Supreme Court of Colorado in Arkansas Valley Railway, Light & Power Company versus Ballinger (178 P. 566). Writing the Industrial Commission a letter stating the fact of the accident and that plaintiff would apply for compensation did not constitute an election under the workmen's compensation law. Defendant light company, which directed decedent's employer to remove electric transformers at defendant's distributing point, was under the duty to exercise the highest degree of care and use the utmost degree of caution and foresight to avoid decedent's coming in contact with live wire which was defectively insulated.

Burden of Proof in Negligence Over Sagging Wires.—When plaintiff has proved that he sustained injuries through the dangerous situation of a telephone wire hanging across a public highway, the burden passes to the defendant to show that the dangerous situation of the wire was not due to the act of the defendant and had not existed for such length of time as to charge the defendant with notice of its defective condition, the Supreme Court of Oklahoma held (178 P. 666). In the trial of an action for personal injuries alleged to have been received by a person while driving on the public highway in a covered wagon, where the telephone wires across said highway became sagged and caught the covering of the plaintiff's wagon, throwing him to the ground and injuring him, it is an error for the court to refuse to instruct the jury that "persons traveling upon a public highway have a right to assume that persons using said highway, by maintaining and stringing telephone wires across the highway, have performed their duties, and that the highway is in a reasonably safe condition for public travel," the Supreme Court decides.

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William Lennon has been appointed successor to H. P. Blodgett as superintendent at Gardiner for the Central Maine Power Company.

A. L. Strickland, for the past year district manager for the Pacific Power & Light Company at Seaside, Ore., has been transferred to Pasco, Wash.

Prof. M. I. Pupin of Columbia University is on his way to France to the Peace Conference. Prof. Pupin was Royal Consul General for Serbia to the United States until recently.

Charles J. Marsh, vice-president of the Standard Underground Cable Company and one of the foremost authorities in the United States on the copper market, has been elected president of the New York Metal Exchange.

Prof. Comfort A. Adams, who was elected president of the American Welding Society at its first meeting on March 28, also, it is announced, has been chosen dean of the faculty of the Harvard School of Engineering at Cambridge, Mass. Professor Adams is at the present time president of the American Institute of Electrical Engineers.

W. M. Wood, heretofore assistant to the general manager of the Pacific Power & Light Company, Portland, Ore., has been appointed assistant general manager with headquarters at Portland. Prior to going to Portland in the fall of 1917 Mr. Wood was district manager for the company at Lewiston, Idaho, and before that was in charge of the company's Sunnyside office.

L. C. Stang has succeeded Frank Glosser as superintendent of the light and power department of the Columbus, Delaware & Marion (Ohio) Electric Company. Mr. Stang has been an electrical engineer in the chemical warfare division of the army. Prior to going into the service he was an electrical engineer with Sargent & Lundy, consulting engineers, Chicago.

Sir Oliver Lodge, who has been principal of the Birmingham (England) University since its establishment nineteen years ago, will retire from the position at the end of the present session to devote himself to his studies of the physical and psychical relations of the ether of space. Sir Oliver has been well known throughout the world for his researches in electrical science, particularly with relation to radio work.

Col. Peter Junkersfeld, who had recently returned to his civilian work as assistant to the vice-president of the Commonwealth Edison Company, Chicago, as stated in the ELECTRICAL WORLD on March 15, resigned on March 31 to become engineering manager for Stone & Webster. Colonel Junkersfeld was in charge of the construction of all cantonments while in the army and also in charge of the construction of some of the large gas-plant undertakings of the government, in charge of two or three of the large new docks and of other new work aggregating in excess of $600,000,000.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Raymond H. Smith, vice-president and general manager of the Eastern Wisconsin Electric Company, with headquarters at Sheboygan, Wis., has been elected president of the Wisconsin Electrical Association and the Wisconsin Gas Association. Mr. Smith entered the utility field with the Waterbury (Conn.) Traction Company in 1897 and held various positions in the electric and railway department until 1900, at which time be became assistant superintendent of railways. In 1900 he was transferred to the headquarters of the Connecticut Railway & Lighting Company at Bridgeport as purchasing agent and secretary to the general manager. In 1903 he was made superintendent of the company at Bridgeport and held this position until 1907, at which time he became general manager of the Albany (N. Y.) and Hudson Railroad Company. This company two years later passed through a receivership. Mr. Smith was made receiver and later became general manager of the reorganized company. In 1912 he became general manager of the Jackson (Miss.) Light & Traction Company, which position he held until 1916. In November of that year he was made vice-president and general manager of the Sheboygan (Wis.) Electric Company. When in March, 1918, this company was consolidated with the Wisconsin Electric Railway Company of Oshkosh and the Eastern Wisconsin Railway & Light Company of Fond du Lac, Mr. Smith was made vice-president and general manager of the consolidated company, named above.

RAYMOND H. SMITH

Obituary

F. M. Grant, president of the F. M. Grant Electric Company, electrical contractors and engineers, died recently at his home in Cleveland, Ohio, at the age of fifty years, after a short illness. He formerly was associated with the Erner Electric Company of Columbus and entered business in Cleveland five years ago with W. C. Harrington.

Emil C. Braun, electrical engineer, who came to the United States in charge of the German electrical exhibit at the Chicago World's Fair in 1893, died suddenly in Chicago on March 22 at the age of fifty-one years. Mr. Braun had been connected with H. M. Byllesby & Company since the organization of the company in 1902. He was a graduate electrical engineer of the University of Berlin.

Capt. Stuart Thomson, consulting engineer for the General Electric Company and son of Dr. Elihu Thomson, died from pneumonia on March 23. Captain Thomson was a graduate of Harvard University and of the Massachusetts Institute of Technology. He had but recently returned to Schenectady from Washington, where he had been for a year and a half in charge of engineering and production of aircraft armament, Ordnance Department.

Major James Alfred Roosevelt, member of the consulting engineer firm of Roosevelt & Thompson, New York City, and cousin of the late Theodore Roosevelt, died last week on the naval transport Great Northern while the steamship was 400 miles east of Sandy Hook. Major Roosevelt was well known for his ability to manage utilities, particularly electric railway companies. In 1911 he directed the operation of the British Columbia Company, which operates electric light and railway systems in British Columbia. He went overseas with the Seventy-seventh Division and was cited at Vesle River for displaying exceptional bravery and courage under heavy fire.

M. L. McKinley, one of the pioneers in the installation and construction of electrical distribution systems on the Pacific Coast, died on Feb. 19. He entered the employ of the old Thomson-Houston Company in 1889 and after some experience in the construction of the St. Louis street railway system and street-lighting system and later at the Chicago World's Fair he went to the Pacific Coast in 1894. There he formed a partnership with Messrs. Dunn and Peterson to engage in electrical contracting. They installed the first underground system in San Francisco for the Pacific Power Company in addition to a number of other important lines. Mr. McKinley was general manager for the Tuolumne County Electric Light & Power Company for ten years until its purchase by the Sierra & San Francisco Power Company. Since that time he had been continuously asociated with Capt. H. F. Jackson, president and general manager of that property, in its management and operation.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FUNDAMENTAL SNAP-SHELL SOCKET PATENTS UPHELD

Judge Hough Sustains the Decision of Court Holding that Cutler-Hammer Sockets Infringe Meter Patents

Weber patents for snap-shell sockets have again been upheld as fundamental. Judge Hough on Jan. 22 filed in the United States Circuit Court of Appeals for the Second District his decision in Weber Electric Company versus Cutler-Hammer Manufacturing Company, affirming the decision of Judge Hand sustaining the Weber snap-shell patents against Cutler-Hammer sockets.

After reviewing previous decisions upholding their patents, the court pointed out "that by Jan. 1, 1898, Weber had embodied the invention described and claimed in his earlier patents, which invention is a positive lock for the engagement of the sleeve and cap of lamp sockets, as distinguished from any and every variety of friction device."

The court held that the patent was valid over the Kenney patent, which made use of a frictional lock.

The case therefore came down to a question of the varying degree of strength necessary to engage the sleeve and cap of the sockets. "If they engage by a straight thrust," the court held, "infringement is too clear for discussion; if they fit only under force, it is but a question of degree. Whether thumb pressure suffices or hand power is increased by the use of Klem's lever, it is hand power just the same. The vital point is that Weber's way is to engage by a straight thrust and release by pressure on the sleeve at a point under an engaging projection. Defendant always effects both processes in substantially the same way, because under the range of equivalents always hitherto accorded these patents it makes no difference that sometimes defendant's cap has to be locked on and disengaged with more power than resides in most thumbs."

JANUARY RECORD MONTH FOR ELECTRICAL EXPORTS

Large Shipments of Insulated Wire, Tungsten Lamps and Meters Help Bring Total for Month Up to $6,772,524

Electrical exports opened the current year with another new monthly record. Figures for January show that electrical merchandise to the value of $6,722,524 was exported, or more than $500,000 in excess of the previous record month, which was last November.

Particular interest attaches to the very large shipments last January of insulated wire and cable, metal-filament lamps, and meters and measuring devices. The wire exports for the month were more than $800,000. About a third went to South America, Brazil alone taking $109,722. British South Africa took $101,234, or slightly less than the amount of wire shipped into the whole of Europe. It is also interesting to note that Mexico absorbed $44,493 of the wire, and Cuba $69,053.

Metal-filament lamp exports for January amounted to $578,175, the value of 2,657,117 lamps. In this case Bolivia was the largest customer, taking 674,421 lamps, valued at $134,551. Mexico and British South Africa were also large customers.

In the meter market, which amounted to $324,404, Australia led at $105,924. Japan purchased meters to the value of $48,153.

The exports of fans, heating and cooking apparatus, interior wiring supplies and motors also showed very satisfactory totals for the month of January.

For the seven months ended January last the exports amounted to $38,829,292. At this rate the total for the fiscal year ended June 30 next should be not far short of $70,000,000.

The figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce:

Articles	January 1918	January 1919	Seven Months Ended January 1918	Seven Months Ended January 1919
Batteries	$295,520	$345,811	$2,072,340	$1,949,230
Carbons	93,543	189,351	833,260	1,004,860
Dynamos or generators	252,429	249,853	1,286,941	1,959,545
Fans	68,541	176,526	340,731	477,705
Heating and cooking apparatus	59,652	98,515	316,185	507,399
Insulated wire and cable	548,931	804,481	3,768,016	3,897,729
Interior wiring supplies, including fixtures	104,710	194,565	877,386	863,547
Arc lamps	671	206	7,315	7,681
Carbon filament lamps	9,567	20,041	104,486	73,071
Metal filament lamps	200,420	578,175	1,654,007	2,218,438
Magnetos, spark plugs, etc	380,098	279,174	2,137,946	1,619,402
Meters and measuring instruments	124,192	324,404	779,780	1,275,722
Motors	555,842	680,882	3,771,313	5,522,886
Rheostats and controllers	13,007	48,436	106,619	218,746
Switches and accessories	271,196	177,159	1,296,199	1,168,439
Telegraph apparatus, including wireless	9,208	56,541	174,102	305,944
Telephone	249,992	214,172	1,373,230	1,457,964
Transformers	174,001	309,028	1,179,228	2,498,960
All other	1,245,091	1,975,204	9,247,723	11,802,024
Total	$4,656,611	$6,722,524	$31,326,807	$38,829,292

COPPER WIRE MAY HAVE REACHED LOW PRICE LEVEL

Judging from the Way Wire Has Followed Copper Down, It Would Not Be Surprising to See Higher Prices Soon

There seem good reasons to believe that copper wire and cable have reached their low level in price, at least for the time being. Wire producers have closely followed the downward price of copper with lower wire prices. While copper was dropping from 26 to 14½ cents (the lowest price reached), rubber-covered wire, for instance, dropped from a 34-cent base to a 20-cent base. Some of this reduction in wire base came prior to the first of January when the government copper price of 26 cents was no longer in effect.

Since March 3, when the low price of 14½ cents was reached, copper has been slowly advancing until at this writing it is 15½ cents. Larger and better sales have been made since the price began to advance, and in spite of the fact that there is more than a year's production of copper in stock and unsold, it would not be surprising to see copper go over 16 cents or even a bit higher. Of course, the producers are feeling out the market and will not increase the price beyond a point at which buying begins to fall off.

Since copper went to its low level, four weeks ago, wire producers have not raised their prices. What looked to be a tendency toward a turn last week proved to be a false alarm.

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Nevertheless, if wire continues to follow copper as closely as it did during January and February, higher base prices can be expected shortly.

To those who are planning to lay in stocks of wire or to build transmission lines or distribution systems it seems reasonable to believe that current prices are the lowest they will be this year.

METAL MARKET SITUATION

Copper Sales Show an Increase—Central European Powers Are Short of Copper Supplies

A decided improvement was noticed in the copper market this past week. The price of electrolytic metal increased ¼ cent to 15½ cents per pound, and it is the opinion of many that the bottom copper price has been reached and the upward market has commenced. Sales of refined metal for the week have been estimated at approximately 50,000,000 lb. and for the month of March at 75,000,000 lb., or 20 per cent greater than February sales and five times the January business.

Trading in electrolytic copper in 25-ton blocks and larger was resumed on the New York Metal Exchange on March 31, after a lapse of nearly four years.

The foreign demand for copper has not been satisfied, despite the stocks held by the European governments. Most of the recent inquiries have come from England. where the need is for wire bars and other forms not readily available abroad. Foreign stocks are for the most part ingot bars. Exports for the month have been approximately 9000 tons.

C. F. Kelley, president of the Anaconda Copper Mining Company and chairman of the Copper Export Association, whose committee has just returned from Europe, states, according to a report, that "stocks of copper, while apparently large, are concentrated in the hands of the respective Allied governments. The copper-consuming industries in those Allied countries are without stocks of metals. Government stocks are being used and will be very much reduced in the near future by distribution among the consumers who are now doing a fair business. Germany and what was Austria have completely exhausted their stocks and undoubtedly will be in the market for large quantities of copper as soon as trade restrictions are removed."

There has been a slight increase in the price of spelter, but the market is very quiet. A meeting is to be held in regard to the disposition of government stocks of spelter.

The scrap-metal market is still practically inactive but is encouraged by the advance in copper prices. Scrap copper and zinc have increased fractions of a cent.

NEW YORK METAL MARKET PRICES

	March 25	April 5
Copper:	£ s d	£ s d
London, standard spot	78 0 0	78 0 0
	Cents per Pound	Cents per Pound
Prime Lake	15.25 to 15.50	15.75
Electrolytic	16.25	15.50
Casting	14.87½	15.25
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	6.62½	6.50 to 6.62½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.52½	6.55 to 6.60
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	29.00	29.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	12.75 to 13.00	13.00 to 13.25
Brass, heavy	7.25 to 7.50	7.25 to 7.50
Brass, light	6.00 to 6.25	6.00 to 6.50
Lead, heavy	4.25 to 4.50	4.25 to 4.50
Zinc, old scrap	4.00 to 4.50	4.25 to 4.75

THE WEEK
IN TRADE

BUSINESS appears to be on the threshold of better times. Building is increasing, prices are lower in many fundamental commodities, and the market appears to be more stable than it has been for some time.

Iron and steel commodities are lower, following the reductions in the basic materials. Prices of other goods made largely of iron and copper either have dropped or are about to drop. On other lines there appears to be no tendency toward a break at this time.

Labor appears to be quieter this week than it has been. Farming sections are beginning to call for labor, thus relieving the condition of non-employment to a considerable extent.

The number of inquiries being received is attracting attention everywhere. The trade, however, should not be too quick to take this as an indication of large business about to begin all at once. It is probably true that buyers are doing more shopping to-day than formerly and also are paying more attention to daily conditions.

NEW YORK

Jobbers state that March business did not show any improvement over the volume of business done in February. There is a certain amount of trade constantly going through, and at times there have been little spurts which have given rise to the hope that business was not merely transitory. But the month as a whole averaged only fair. There is still little material being bought for stock.

Lower metal prices are being transmitted to a number of products. It is too early, however, to notice any appreciable change in buying. There are other factors affecting the volume of buying which have not yet been overcome.

Collections have been reported by jobbers as very good. Some are averaging forty-five days from industrials, while others can't expect to do better than sixty days. Contractors, however, many jobbers find, are taking the limit of any time permitted.

Manufacturers are finding that they are required to devote an unprecedented amount of time to inquiries for prices and deliveries and in many cases can hardly keep up with this work.

OUTLET BOXES.—There has been a 10 per cent decrease in the price of outlet boxes and covers.

MOTORS.—There has been a very good market recently for variable-speed motors for printing-press work.

STEAM SETS.—The market for steam-driven generating sets in the neighborhood of 100-kw. capacity has become quite noticeable. These are particularly for marine work.

LIGHTING FIXTURES.—The good demand for lighting fixtures in the remodeling and reconstructing of industrial and commercial buildings and of homes continues. Deliveries can be made in three weeks.

TRANSFORMERS.—There has been a recent reduction of 10 per cent in distribution-type transformers, in sizes up to 200 kva., 35,000 volts.

FLATIRONS.—One prominent make of 6-lb. flatirons is off 50 cents.

DRY BATTERIES.—A prominent manufacturer states that there is no tendency toward a drop in price. The only item of manufacture which has decreased is that of zinc. and this plays too small a part in the cost of the battery to effect a change in price.

FLEXIBLE METALLIC CONDUCTOR.—Recircuiting and remodeling work is keeping this material moving very consistently.

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SMALL MOTORS.—Although no jump in sales has been noted, the market in sizes up to 50 hp. is keeping a constantly upward trend. One prominent manufacturer is placing two motors in stock for each one sold. Manufacturers have not yet had to contend with government motors thrown back on the second-hand market because many second-hand dealers have not bought them up on account of their already large stocks. Many of these motors have never been uncrated.

SCHEDULE MATERIAL.—There is no likelihood of any reduction in price for some time to come. The demand is very light. When ships now in use in the transport service can be released for repairs, there will without doubt be a very large demand for this material.

POLE-LINE HARDWARE.—Reductions of 5 per cent have been reported.

WIRE.—Rubber-covered base still holds on 20 cents, although the average is slightly below that last week, as one manufacturer has changed from 22 cents to 20 cents. There are seven producers quoting on 20 cents, and one each on the bases of 18, 19, 22 and 23 cents.

CHICAGO

The building situation will probably not take definite shape until the price of brick, which is now being investigated is definitely settled. However, the buildings projected still continue to run into high figures, a number of architects reporting in the brick investigation that about $93,000,000 worth of building was being held up in Chicago by this investigation. The building news this week includes a million-dollar theater, a million-dollar office building, one factory to cost $300,000 and one to cost $250,000, a hospital addition at $300,000, while apartment buildings proposed run about $2,000,000 for the week.

INCLOSED SWITCHES.—John E. Gamber, fire marshal for Illinois, has issued a general order which requires that all knife switches other than those used on switchboards and panelboxes are to be of the approved safety inclosed type, so arranged that they can be operated by a suitable handle on the outside of the box when the door of the box is closed. The order also specifies that the switch must be designed in such a way that it can be locked in the "off" position. Means must also be provided to lock or seal the cover of the case. Each switch shall have a suitable grounding device to permit the grounding of the outer cases when required.

COPPER WIRE.—While the market prior to last week was badly demoralized and while jobbers during that period sold wire at prices considerably below that justified by the market, it seems to be definitely understood now that this period of demoralization has passed. The demand has picked up, and it appears that a very healthy demand will be established in the future. Rubber-covered wire and weatherproof wire are both quoted on a 20-cent base by Chicago jobbers at the present time. The situation at the mills among the wire people is that shipments are being made regularly, but the cord people are pretty badly behind.

CONDUIT.—Jobbers are quoting on Card 12, which is down five points.

WASHING MACHINES.—Manufacturers are very optimistic over the outlook, the possibility being that records for this quarter will show an increase of from 30 per cent to 40 per cent in the business, based on units of production. No reduction in price is anticipated during 1919.

ELECTRIC SIGNS.—The electric sign market is experiencing an actual boom. Thousand-lamp signs are sold daily in the regular routine of business.

BAKE OVENS.—Electric bake ovens and the heavier type of electric heating equipment are having much heavier sales.

ELECTRIC APPLIANCES.—The export business of the electric appliance manufacturers is proving to be a considerable factor in keeping the factories busy to practically the limit of output at the present time.

LINE MATERIALS.—The market for line materials with the opening of the spring construction appears to be getting well under way.

BOSTON

A better feeling dominates the trade this week. Inquiries are coming in well for both large and small work under consideration. Stocks are being maintained by stop-gap orders for the most part. Collections are a little slow and seem likely to remain so until after the Victory loan is floated. The central stations are proceeding cautiously regarding expansion, but are gradually relaxing considerably from their restrictive policies of the past year or two. In some parts of New England business is rapidly picking up, notably in the Connecticut Valley. Prices show little change.

House-wiring material is beginning to move faster, despite the absence of a real spurt in building operations. Architects are busy on plans and estimates, and in some localities the electrical contractors are finding more work to do than for many months. Great activity is noted in the manufacture of electrically driven refrigerating equipment. This appears to be the outcome of the mild winter, and a large turnover is expected in this branch of electrical manufacturing this year. Deliveries are still improving.

ELECTRICALLY OPERATED REFRIGERATING EQUIPMENT.—A representative New England concern reports being swamped with domestic orders. Labor and material are both plentiful and prices are holding steadily.

SCHEDULE MATERIAL.—Orders placed with the factories show some improvement, though the volume of business is still below normal. Push-button switches for 110-volt service are in large demand at present. Jobbers are well stocked.

FANS.—Deliveries for this year's trade have been completed in the case of one of the larger jobbing houses. It is expected that the demand will not be seriously affected by price considerations.

STORAGE BATTERIES.—Trade is brisk, with firm prices and steady improvement in deliveries. One popular type of industrial truck battery is now being shipped on a thirty-day basis, compared with sixty to ninety days' quotations a few months ago. Local stocks of ignition batteries are in excellent shape and the market is exceedingly active. Isolated plants are buying batteries to some extent at present for oil-switch operation.

FIXTURES.—Stocks are still rather large, but purchases for the improvement of old houses are a feature of the market. Prices show little change. The demand is quickening a little, compared with a few weeks ago.

MOTORS.—The motor market is a little quieter this week, but prices do not reflect any extended change in conditions. Purchases are being made on a moderate scale, and close observers do not appear to be discouraged with the future outlook. A representative dealer expects business to pick up materially in the early summer and reports that he is now selling motors at a rate closely comparable to pre-war figures. In general the trade is coöperating to prevent excessive depression of prices through the casting of second-hand equipment upon the market at prices far below the intrinsic value of the apparatus. The high cost of labor seems to preclude reductions at present on new motors.

STARTING AND LIGHTING SETS.—A large amount of this equipment is being sold. The fear of the public that new automobiles would be hard to get this year resulted in a record business in the winter just past in fitting old cars with electric starters. Stocks are in good shape.

DRY BATTERIES AND FLASHLIGHTS.—Trade is fairly good. The former shortage in dry cells has been largely overcome, and the price advances of the war period do not seem to have affected business adversely.

APPLIANCES.—Domestic labor-saving equipment is moving well in many parts of New England. Deliveries are very good at present, but jobbers will do well to keep ahead of the demand for washers and cleaners.

INDUSTRIAL HEATERS.—The demand is rapidly increasing for fast heaters of the portable stove type, rated at about 1200 watts, together with electric heating pads and food warmers for factory first-aid and other service. A recent law providing for heating facilities of the above general character is stimulating this class of business.

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ATLANTA

Southeastern electrical interests have enjoyed a big business through government account during the past two years, and the announcement of the War Department this week will be of further interest. The General Staff recommends that the following camps be purchased and made permanent: Sevier and Jackson, South Carolina; Bragg, North Carolina; Jesup, Benning, Gordon, Taylor and Souther, Georgia; Johnston, Dorr and Carlstrom, Florida; Sherman and McClellan, Alabama; Park Field, Tennessee. For the past few months the total purchases from these sources have fallen off to a considerable extent owing to unsettled conditions, but it is felt that when the various camps are again put on a more permanent basis a satisfactory volume of orders will be received.

The reductions in the price of some steel and iron products and spotty reduction in other materials presages an increased volume of buying, but a feeling of uncertainty still exists as the consumer expects other cuts. Smaller buildings and homes in the Southeast are scarce and a small boom has started in this type of construction. The lumber industry is quite active.

Electrical retail sales continue active, and the volume of business is above that of the previous year. A few jobbers report a slowing down of orders on account of decreasing prices, the prevailing tendency being to place fill-in orders.

The strike of the Brotherhood of Railway clerks has ended and distribution has reached normal. The Ware County Light & Power Company, Waycross, Ga., has been granted an increase in lighting rates from 12 to 13 cents.

CHARGING SETS.—Equipments of all types are moving fast and transactions show a substantial increase over last month. One manufacturer is ten weeks behind on orders This line has opened up remarkably during the past year, and all jobbers are particularly active in pushing sales.

TRANSFORMERS.—Local stocks are in excellent shape and reports from other distributing points indicate that stocks are rapidly reaching normal. This section was notified of a reduction on March 24 of 10 per cent in 2300-volt ditributing type. The demand for the heavy power sizes is still off, and no change in prices has been recorded since February.

LIGHTNING ARRESTERS. — A comparison of this month's sales with the same period of last year shows a decrease in the value of orders and the general volume of transactions. An analysis of the situation further shows that while the government bought heavily this time last year, present purchases from this quarter are at a low level, and that to-day's trade is maintained by an increasing call from industrials and central stations. Manufacturers are a little disappointed, however, as bigger business was expected from the central stations to cover normal seasonal requirements.

METERS.—The call from central stations is good and a steady influx of orders has maintained this branch of the industry while others have shown a decrease. Stocks are ample for current needs and nearly normal.

BELL-RINGING TRANSFORMERS.—Jobbers and dealers are placing substantial orders, anticipating an increased demand coincident with and following proposed national publicity for this item.

SEATTLE—PORTLAND

Prominent Seattle jobbers and dealers report that considerable new business has developed as the result of the reopening of shipyards and that business is looking up. However, increased sales to shipyards of past weeks have not justified expectations. Shipyards are not buying nearly as heavily as before the strike. Inquiries for motors and electrically operated logging and lumbering equipment still continue to pour in, but orders are developing very slowly. Central-station and rural utility company buying has not developed as was expected at the time of the signing of the armistice. It is now believed locally that central stations will postpone buying for extensions at least several months more and that buying for maintenance purposes only will be the rule.

During the past week a 5 per cent drop in conduit was noted. This is the first decrease of any importance for several weeks. Both jobbers and retailers report that appliances are moving a shade faster, this being particularly true of washing and sewing machines, flatirons and vacuum cleaners. Ranges are moving about the same, although an increase in number of sales is being freely predicted by large retail concerns. Several jobbers' stocks are in excellent condition, and shipments are coming through well.

Alaska business from present indications will be comparatively light this year. Seattle jobbers state that the amount of business transacted will depend largely upon what the government intends to do with its Alaska projects. Buying from mining companies, fisheries and privately owned utilities is expected to be exceedingly light and merely for maintenance. No projects of any magnitude have been announced.

It is believed in Seattle that the prospects of another strike for higher wages are very remote. All shipyards are running full blast with larger crews than before the strike. While the decision of the Shipping Board to bring the wooden ship building program to an end does not affect present conditions in Gray's Harbor or Seattle and Tacoma yards, which will continue work on uncompleted contracts, the future status of the industry is more or less uncertain. Eastern Washington, especially in the Wall, Yakima and Wenatchee districts, is loudly calling for farm help. The situation is acute. It is reported that nearly every county in Oregon is also calling for farm laborers.

The Portland district reports that business during the past week shows no particular increase over several weeks past. Manufacturing interests report an unusual number of exceptionally good prospects for business in the immediate future. Several jobbers report inquiries regarding connection equipment for proposed industrial enterprises. Renewed activity is noted in business building, particularly garages and warehouses. Residence building continues brisk. The Port of Astoria has plans under way for the expenditure of $1,300,000 in permanent buildings, including a third municipal pier. The city purchasing agent of Seattle is calling for bids until April 11 for furnishing 400,000 incandescent lamps for the ensuing year.

SAN FRANCISCO

Outwardly there has been little change in the financial or business situation during the past week. Locally there is every feeling of confidence. California looks for bumper crops with a greatly increased acreage. The bountiful rains of the past season have gladdened the hearts of the farmers, and the certainty that prices will be maintained assures them prosperity for 1919.

There is little new building reported. A number of residences have been started, however, by real estate companies for speculation.

Collections from dealers and contractors are surprisingly good. In the opinion of shrewd credit men this is because the electrical trade is no longer inclined to take work recklessly without regard to credit risk, and this general determination has compelled previous slow-paying customers to fall into line.

HEATING DEVICES.—Surplus stocks of small heating devices carried over from the holiday season have cut dealers' purchases to a negligible demand, but a gradual sale of stock on hand, coupled with the usual spring business, will restore its tone. Many dealers are again soliciting this small heating-device business on a partial payment scheme which is working out nicely.

HOUSEHOLD APPLIANCES.—Although purchases of smaller electrical household helps are curtailed, it is a testimonial to the far-sighted economy of the buying public that sales of such devices as washing machines and vacuum cleaners have doubled. This is primarily caused by the continued shortage of household help and the high prices for it when obtainable. Liberal credit terms are given by the electrical jobbers as an encouragement.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT. NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
1	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
1	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00	$20.00	$18.00
½-in.—	30.00	24.00	21.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–26.50
½-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 12.1%	9% to 14.1%
2500 to 5000 lb.	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.18
Coil to 1000 ft	25.94

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%-38%	20%-33%
$10.00 to $50.00 list	36%-47%	31%-43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%-32%	10%-27%
$10.00 to $50.00 list	30%-40%	20%-35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $17.00
1/5 to std. pkg.	12.00 to 14.00

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00-$24.15
1/5 to std. pkg.	17.85- 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$16.00	$22.00
1/5 to std. pkg.	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.38
No. 18, full spools	.36

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15-$14.50	$10.50-$12.65	$10.50-$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33 12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00-$20.00	$13.00-$15.00	$11.50-$13 00
12	17.50- 21.63	17.55- 21.63	17.55- 18.54
10	24.05- 28.91	24.05- 28.91	21.16- 24.78
8	33.35- 39.34	33.35- 33.72	29.35- 33 72
6	52.95- 61.74	46.60- 52.92	46.60- 52 92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$25.25
25 to 50 lb	25.25
50 to 100 lb	24.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34 75
50 to 100 lb	23.75 to 37.35

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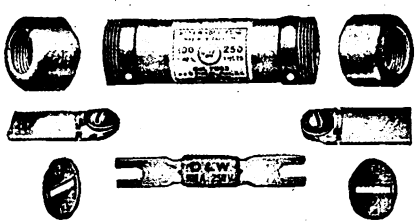
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Knife-Blade Renewable Fuse with Jacketed Link

An important feature of the knife-blade renewable fuses recently developed by the D & W Fuse Company of Providence, R. I., is the "expulsion" or jacketed fuse link, which consists of a flat strip of metal having a slot in the central portion and closely



JACKET SUPPRESSES ARC

wrapped with a covering of specially treated asbestos. The jacket is said to be unaffected by high temperatures and remains intact even when the fuse blows from a short circuit. When the link fuses, the metal within the jacket is converted into a vapor, thereby developing internal pressure within the jacket. This causes a blast of hot gases in each direction from the center of the fuse, tending to extinguish the arc. When the metal has burned back to the terminals the jacket drops out, thus breaking up mechanically any strata of vaporized gas which might tend to maintain an arc between terminals.

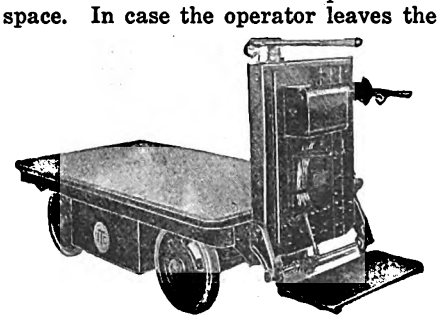
With this jacketed link a longer life is obtained for the casting, says the manufacturer. Another advantage of the link is the increased radiation surface effected through using the jacket, which makes possible a considerable reduction in the total mass of metal required for a given current. By this means a considerable lowering of the pressures developed when the fuse blows on a dead short circuit is effected.

The inner caps on the ends of the heavy fiber tubing are slotted to receive the fuse link and to engage the blades, which are locked by giving them a quarter turn. Asbestos-lined metal washers slip over the blades to align them properly and to regulate the escape of gases. The outer caps screw over the inner ones holding the washers in place. The large quantity of metal used in these fuses helps to cool the gases, which pass along, engaging the screw threads of the ends of the shell and the outer metal caps.

These renewable fuses, according to the maker, will meet the short-circuit tests imposed by the Underwriters' Laboratories, Inc., in which one fuse at a time is subjected to full rated voltage at 10,000 amp.

Industrial Truck with Underslung Battery

The type U-2 industrial truck with a load capacity of 2 tons being placed on the market by the Industrial Truck Company of Holyoke, Mass., has an underslung battery, transmission by lubricated inclosed universal joints and a single-reduction worm drive. The dimensions of the carrying platform are 90 in. by 46 in. (2.2 m. by 1.1 m.) with a height of 25 in. (0.6 m.) and the over-all length of 110 in. (3 m.). The driving platform folds up against the truck and allows it to be placed in an elevator somewhat shorter than its ordinary length, and the controller handle also can be raised up to save space. In case the operator leaves the



TRUCK STOPS QUICKLY WHEN PLATFORM IS RAISED

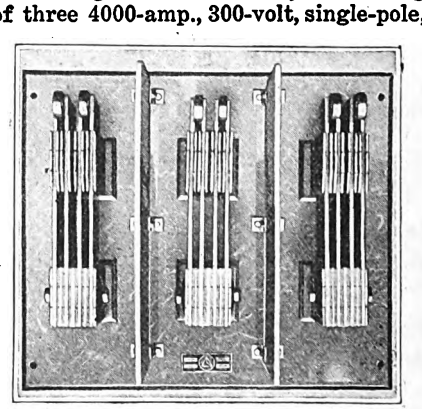
driving platform the brake is automatically applied and the controller is thrown to neutral, stopping the truck within a few inches. There are three forward and three reverse speeds to the truck with a range of 1 mile to 8 miles (1.6 km. to 12.8 km.) per hour. A battery of twenty-four Edison or twelve fifteen-plate lead cells is required. Ball bearings are provided in the wheels, and a warning horn is operated from a button on the steering lever.

Small Direct-Current Ammeters

Direct-current ammeters which may be used in automobiles, on farm-lighting plants, for garage battery-charging sets or for testing purposes are being marketed by the Ballman-Whitten Manufacturing Company, 4440 Olive Street, St. Louis, Mo., in both flush and surface types and with cases of either bright nickel or black-rubberoid finish. The scales of these meters range from 0 amp. to 30 amp. for both charge and discharge. The movements are of the permanent-magnet iron-vane type having no moving coils or fine hairsprings. All the parts are said to be of relatively large dimensions, and the working clearances are also large in order to reduce the possibility of sticking of the moving parts. The calibration of these meters throughout the whole range of the scale is close and the hysterisis effect is negligible, so that the pointer will always return to zero. Each meter has an adjusting vane, and the calibration is carefully adjusted with standards to each individual scale, according to the maker. The scales of these ammeters are of the customary etched metal style and have black letters and a black indicator with a light background in the nickel case and white letters and white indicators in the black-rubberoid finish case. These cases are of drawn brass, while the glass is held in place with a special baked cement which makes it waterproof and is further reinforced with a spring-wire locking ring.

Grouped Disconnecting Switches

Where space is limited in the installation of high-tension switches some method must be used in order to form a compact and simple arrangement. To solve this problem the Delta-Star Electric Company, 2433 Fulton Street, Chicago, has developed a unit-type disconnecting switch assembly consisting of three 4000-amp., 300-volt, single-pole,



BARRIERS PREVENT SHORT-CIRCUIT OF PHASES PLACED CLOSE TOGETHER

single-throw switches mounted on a unit base with barriers between. The switches themselves are of the group type, permitting separate blade operation of each single-pole element. This insures easy opening of switches of high rating.

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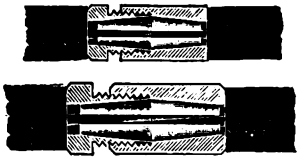
Solderless Connectors for Small Wires

For splicing small wires a simple and efficient solderless connector is announced by Dossert & Company, 242 West Forty-first Street, New York City. It is designated as the type D



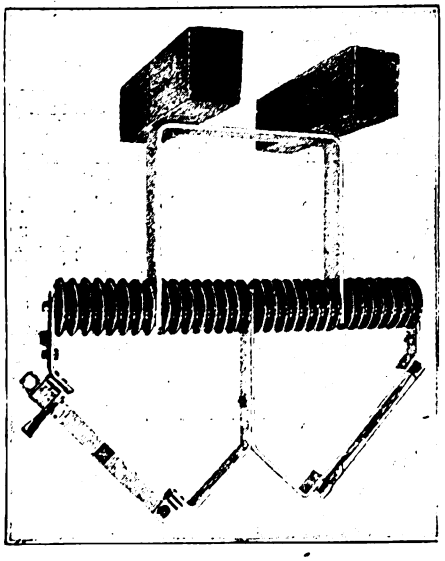
MAKES GOOD CONNECTION BY COMPRESSIVE ACTION

two-way connector and consists of male and female threaded parts acting upon a slotted tapered sleeve or bushing, making the splice by compression. These connectors are supplied in two sizes, No. 8 being for use on No. 8 and No. 9 B. & S. gage wires, and No. 14, which can be used to connect Nos. 10, 12 or 14 gage wires as desired. Their actual size is shown in the illustration.

Outdoor-Indoor Disconnecting Equipment

In developing the disconnecting equipment now being marketed by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, it was the designer's aim to use a minimum amount of material without sacrificing electrical or mechanical strength and at the same time to obtain an easily assembled unit. One special feature of the equipment is the use of corrugated insulators which when mounted vertically give minimum leakage under rain conditions.

The equipment designed for mounting on cross-arms is provided with one

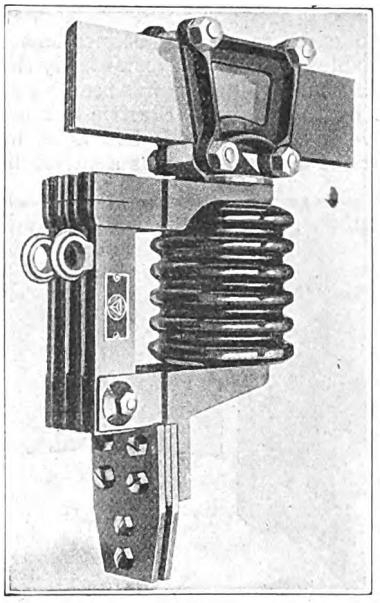


CORRUGATED INSULATORS GIVE MINIMUM LEAKAGE WHEN MOUNTED VERTICALLY

bolt. Pin stops, however, are provided to prevent side movement. Some styles of the equipment can be made to operate either above or below the cross arms by reversing the switch jaws and fuse mountings. For indoor use this allows mounting on the floor or on the ceiling. The switches are provided with die-formed guides notched to lock the blade in closed position. The hinge clip has stops which prevent the blade from moving more than 90 deg. from the closed position. These switches are furnished in the 200-amp. and 300-amp. sizes.

Disconnecting Switch for Direct Clamping on Buses

High-capacity disconnecting switches for clamping directly on buses and with contacts for tapping directly to oil-switch terminals have been developed by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. According to the maker, this method of mounting saves labor, material and space as



UNIT TYPE FOR 1200 AMP., 6600 VOLTS

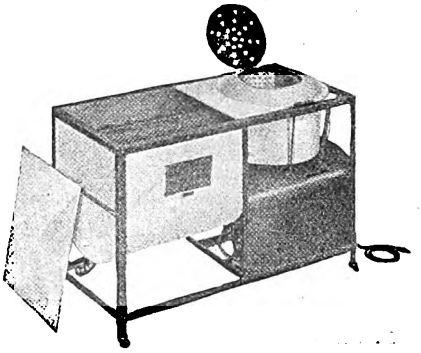
compared to the relatively heavy expense entailed when the ordinary type of switch is used. The blades are of the multiple-group type, and since they are separately operated very easy opening and closing is insured.

Adjustable Industrial Lighting Fixture

For factories, shops and other places where concentrated light is desired the Miller Saw-Trimmer Company, Point Building, Pittsburgh, Pa., is marketing the "Anyangl" lighting fixture, which consists of an upright support and a cross-arm carrying the key socket and locking lamp guard. The cross-arm may be raised or lowered on the upright rod and adjusted to any length. Because of the joint connecting the two pieces the arm can be swung to any angle, describing a complete arc in either the vertical or horizontal plane. A twist on the joint's thumb screw locks the arm and the bulb in the desired position. Three feet (90 cm.) of cord and an attachment plug are sold with the fixture, which is equipped with either a safety lamp guard or a plain reflector.

Combination Clothes Washer and Dryer

Two separate machines — a washing cylinder and a centrifugal extractor — mounted on one frame compose the Marlow electrically operated washer



CLOTHES WASHED BY REVOLVING CYLINDER AND DRIED BY CENTRIFUGAL FORCE

and dryer recently developed by the Marlow Manufacturing Company, 2152 Superior Avenue, Cleveland, Ohio. This machine, which has a twelve-sheet capacity and is suitable for large families, small hotels, hospitals and institutions, is built on commercial laundry principles. The frame is made of steel throughout, while the two tanks are of vitreous porcelain. In one of the tanks the washing cylinder of perforated brass revolves at a speed of 35 r.p.m., and in the other tank the extractor operates at 1500 r.p.m., which removes the water from the clothes in from three to five minutes and leaves them just damp enough for ironing. A ball-bearing motor is used, and the friction-drive mechanism is said to prevent shock to the driving parts and to prolong the life of the motor. This machine can be used for washing and drying separately or both at the same time. The machine is mounted on castors and little vibration is present.

Heavy-Duty Insulating Supports

Great mechanical strength, provision for proper ventilation of buses and an arrangement of conductors which will permit using a minimum amount of copper are desirable for insulating supports used on the low-voltage, three-phase alternating-current systems in vogue with large industrial companies. To meet this requirement the Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago, has developed and placed on the market a line of heavy-duty supports, one of which is illustrated herewith. This unit, which is arranged for carrying four ¾-in. by 5-in. (6-mm. by 127-mm.) bars and for mounting upon two parallel 1¼-in. (31-mm.) pipes, is designed to withstand maximum short-circuit strains

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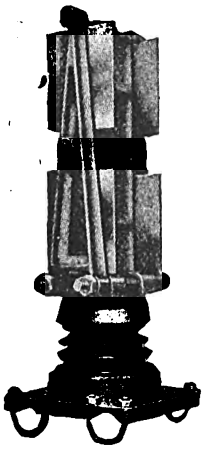
and at the same time to provide a proper factor of safety. Skin effect is reduced to a minimum by an arrangement which places the busbars in the form of a rectangle. All of the bars operate at approximately the same temperature and at the same current

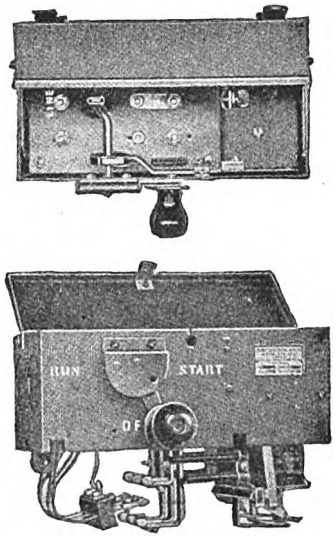


SKIN EFFECT REDUCED BY ARRANGING BUSBARS IN RECTANGULAR FORM

density. This, the maker says, is an advantage over placing vertical bars side by side in the ordinary manner, since it prevents the outer bars from becoming warmer than the inner ones. Insulating spacers are supplied for inserting between the different phases.

Oil Motor Starters with Overload Coils

To start and control single-phase and polyphase induction motors and to insure electrical protection, safety to operators and continuity of service, the Condit Electrical Manufacturing Company of South Boston, Mass., is making type N-1 oil motor starters with overload release coils, for use with



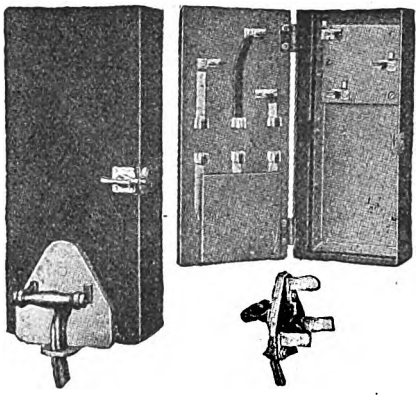
TERMINAL ARRANGEMENT AT TOP AND TANK REMOVED IN BOTTOM VIEW

alternating-current motors whose full load current does not exceed 30 amp. at 600 volts or less, provided that the momentary starting current is not greater than 110 volts, 150 amp.; 220 volts, 125 amp.; 440 volts, 100 amp., and 550 volts, 80 amp.

Complete electrical protection is insured in these motor starters, it is claimed. The trip coils afford protection against overloads and short circuits, and automatic disconnection is prevented during the starting period. Upon the reëstablishing of lost voltage the motor is instantly disconnected without the customary undervoltage attachment, while an additional undervoltage attachment automatically disconnects the motor on the reduction or loss of voltage. Time limits prevent momentary surges from disconnecting the motor. A latch compels proper starting of the motor, and in addition the handle cannot be left in the starting position.

Plug Box for Temporary Motor Connections

To make temporary connections for portable motors a substantially built safety power plug box has been brought out by the Leonard Electric Company, Cleveland, Ohio. This box is so built that the door operates as a switch han-



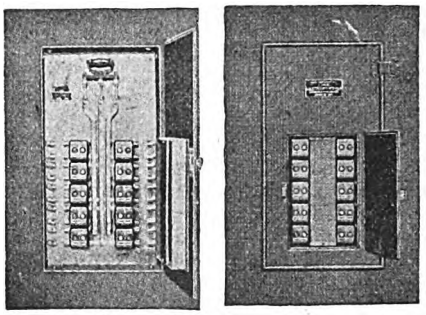
FUSES CANNOT BE REPLACED WHEN CONTACTS ARE ALIVE

dle. Opening the door breaks the circuit ahead of the fuse so that fuses cannot be replaced when they are alive. A three-point staggered receptacle is provided so that the three-point plug can be inserted only in one position, thus elimniating possibility of polarity reversal. This device may be used on three-phase three-wire, two-phase three-wire, single-phase two-wire, or two-wire direct current. When used on a two-wire system the middle fuse and connections are not utilized.

Simply Constructed Safety Lighting Panels

There are two protective doors in the safety panelboard cabinets made by the Penn Electrical & Manufacturing Company of Irwin, Pa. The large door is locked so that no unauthorized person can tamper with fuses or live parts, and only the safety operating switches are exposed when the small door is opened. When the larger door is unlocked and opened the entire panel, including busbars and fuse, is exposed so that repairs and renewals may be made with the same ease as in non-safety panels.

Each standard panelboard circuit switch used in these panels is an independent unit and can be removed from the front without interfering with the



LARGE DOOR GIVES ACCESS TO LIVE PARTS, SMALL DOOR TO DEAD ONES

rest of the panel. The slate frames are slotted for mains and branches, making installation easy. A card holder is furnished for each circuit switch so that in case of trouble on a circuit the correct switch can be operated. Large doors are equipped with special Yale locks having spring catches.

Airtight Ash-Pit Door

Perfectly tight ash-pit doors are essential to prevent combustion in the ash pit and also to prevent excess air from entering the boiler through some types of stokers. Recently the American Steam Conveyor Corporation, New York City and Chicago, designed and placed upon the market the "American" ash-pit door of heavy cast iron, with a heavy ventilated cast-iron liner to prevent contact with the hot ashes and consequent warping, and a machined bearing surface to make an air-tight joint with the frame. The frame is of an angle design, fits well back into the setting, and is easily fastened into the pit wall by four bolts, one in each corner. The bearing surface is carefully machined while the hinge lugs are said to be of ample strength to meet hard usage.

The hinge bars are pivoted to the frame to give a distributed pressure over the door and to keep a tight joint. The door can be swung entirely out of the operator's way, and by means of the wing nuts at the end of the hinge bars and door it can be easily, quickly and tightly locked shut.

Portable Water-Tight Marine Lamp

One of the water-tight fixtures recently brought out by the Seidler-Miner Company of 34 East Larned Street, Detroit, Mich., is a portable lamp fitted with a handle and a hook for hanging. All the metal parts are made of brass with bright or black oxidized finishes. The lamp guard, in which no solder is used, screws on the base with standard threads. A metal tube, accommodating

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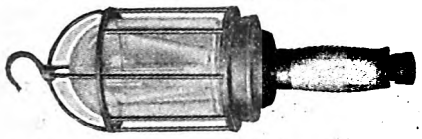
a large-diameter portable cable, extends through the wooden handle. The stuffing-tube cap at the end grips the cable and takes the strain instead of the socket. The screw globe which encircles the lamp is made of lead glass and is said to withstand severe temperature changes.



STUFFING-TUBE CUP RELIEVES STRAIN FROM WIRE

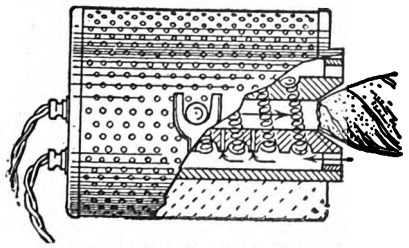
Tractor-Type Storage Batteries

A complete line of storage batteries developed especially for farm-tractor starting and ignition service has been brought out by the Electric Storage Battery Company of Philadelphia. These batteries, according to their maker, have been subjected to severe shock and vibration tests without failure, and their design is such as to withstand extreme neglect with minimum injury. The plates are of heavy and rugged design, and the separators are a combination of treated wood and perforated hard rubber, which is said to possess the good points of each. Plate groups are supported on soft-rubber bridges, offering an additional protection against shocks or vibration. Jars and covers are made of "Giant" compound, so that breakage is practically eliminated.

The elements of the battery are proportioned to fit the jars tightly, and heavy sealing nuts are used on the pillars to anchor them in place. Jars are set in compound in the carrying cases, and as an additional precaution the latter are equipped with through bolts so that the sides can be drawn together holding the jars firmly in place. Intercell connectors are of flexible copper, in order to prevent crystallization and consequent breakage under severe vibration and are lead-plated to prevent corrosion.

Electric Cigar Lighter

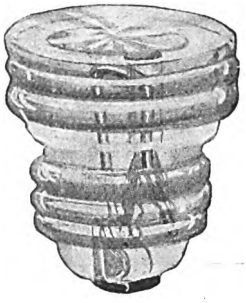
Lighting cigars by freshly heated air without contact is accomplished by means of the Appel electric cigar lighter, marketed by the Electric Sales Corporation, 1812 Ninth Avenue South, Seattle, Wash. The lighter comprises a perforated metal cylinder containing an electric heating element and mounted on a stand for counter attachment. Since tobacco or other foreign substances do not come in contact with the heating unit, long life is obtained, and since no flame or spark is produced outside of the lighter a high factor of safety is present, says the maker. The lighter weighs about 3 lb. (1.3 kg.) and has an energy consumption of 60 watt-hours.



CIGAR IS UNTOUCHED BY FLAME

Fuse Plug Refillable Without Tools

Only four parts, exclusive of the ribbon or wire fusible element, form the refillable fuse plug recently placed on the market by the Betts & Betts Corporation, 511 West Forty-second Street, New York City. These are the porcelain body, the metal cap, the threaded metal band for screwing into the socket, and the clamp contact which grips the lower end of the fuse strip and stays securely in the bottom of the plug, thus assuring positive contact with the socket. The opposite end of the fuse element makes contact with the fuse shell and is said to make a contact equal to that of a soldered terminal. No tools are required in renewing the plug, and the handling of screws, nuts and washers is eliminated. These refillable plugs may be obtained in 5-amp. to 30-amp. sizes for 125 and 250 volts.

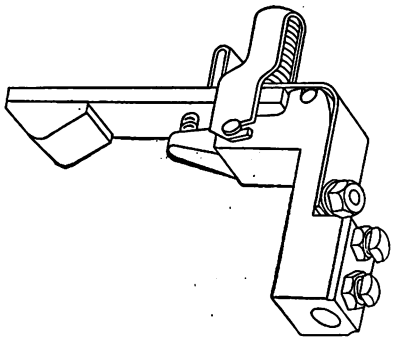


MAY BE USED FOR SEVERAL SIZES OF FUSE WIRE

Drum Controllers with Easily Removable Fingers

The continual making and breaking of circuits in drum controllers pits the fingers, making it necessary to have them dressed frequently, which usually involves considerable time and expert effort. This dressing problem is simplified by the use of a drum controller finger now made by the Union Electric Manufacturing Company of Milwaukee, Wis., which does away with cotter pins, washers, bolts, etc. A file and sandpaper are the only tools required for dressing these fingers. The spring casing, which eliminates the use of a stud post, is released, and the finger is shown for inspection and dressing with one movement of the hand.

The finger consists of a strip of hard-drawn brass, hinged at the back and fitted into a bearing which is part of the finger base. On the opposite end is a renewable tip of cast copper held in position by two rivets. This tip can be removed by knocking off the rivet heads and inserting a new casting.



TENSION SPRING EASILY SLIPPED OFF FINGER

The fingers are held firmly against the copper cylinder segments by a steel coiled tension spring inserted in a copper-plated steel cap. Adjustment is accomplished by means of a set screw which is locked and held in place by a brass lock spring. A laminated copper strip runs from the finger bar to the base, thus making a good electrical contact. Another feature of these drum controllers is that the finger board can be removed from the drum without disturbing any other part of the controller.

NOTES ON RECENT APPLIANCES

Electric Transfer Iron

Light-weight electric transfer irons are now being made by the Berks Engineering Company, Reading, Pa.

Series Lighting Socket

Made in two pieces and equipped with a film for puncturing at a low rated voltage, the Kyle series lighting socket is being marketed by the Line Material Company of South Milwaukee, Wis.

Heater for Nitrous-Oxide Regulating Valve

To warm the nitrous-oxide regulating valves of anesthetizing apparatus the Heidbrink Company of Minneapolis, Minn., is marketing an electric warmer for lamp-socket attachment.

Farm-Lighting Plants

"Porta-Power" is the name of a farm-lighting plant made by the L. A. Young Industries, Detroit, Mich., which may be operated by an automobile instead of the customary stationary engine.

Hand-Wrought Lighting Fixtures

Chandeliers, brackets, lanterns and ceiling types are included in the line of hand-wrought iron lighting fixtures just designed by the Beardslee Chandelier Manufacturing Company, 216 South Jefferson Street, Chicago.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The British-Australian Machinery Company, Ltd., 50 Broad Street, New York City, desires contact with manufacturers wishing to enter and develop their trade in the Australian market. The company handles electric conduit, electric cranes and power plants.

An American firm (No. 28,763) which is establishing an office in Spain desires to secure an agency for the sale of electrical specialties and motors.

An agency is desired by a man in France (No. 28,766) for the sale of washing machines and motors. Correspondence may be in English.

A man in Italy (No. 28,771) desires to secure an agency for the sale in southern Italy of electrical machinery and supplies. Correspondence should be in Italian or French.

Maurice Broussard, who is the manager of the firm of G. Gilbert, Thouars, France, importers and utility construction engineers, is in the United States for the purpose of making arrangements to represent American manufacturers of electrical and mechanical material in France. This firm has a number of contracts to erect power plants in various places in France not now served with electricity, and it proposes to use American equipment in these places. Mr. Broussard may be reached at the Hotel Commodore, New York City.

ENGINEERING ADVERTISERS' ASSOCIATION FORMED.—Advertising and sales managers representing manufacturers in various engineering lines in and around Chicago met in that city on March 11 and organized the Engineering Advertisers' Association. The officers elected were: President, H. L. Delander, Crane Company; vice-president, H. Colin Campbell, Portland Cement Association; secretary, G. H. Eddy, Green Engineering Company; treasurer, Edward J. Pratt, Kellogg Switchboard & Supply Company. The board of directors includes: G. S. Hamilton, American Steam Conveyor Corporation; J. J. Arnsfield, Fairbanks, Morse & Company; A. P. Hauck, Allis-Chalmers Manufacturing Company; H. W. Clarke, Chicago Pneumatic Tool Company; P. A. Powers, Benjamin Electric Manufacturing Company, and J. C. Kinsley, A. M. Davis Regulator Company.

THE FEDERAL PRODUCTS CORPORATION at Providence, R. I., is the new name of the Rhode Island Electrical Instrument Company.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., announces that it has discontinued the sale of insulating joints and hickeys. All orders now in the works will be filled, but no further orders can be taken.

THE UNION ELECTRIC MANUFACTURING COMPANY, Milwaukee, Wis., announces the appointment of the P. I. Perkins Company, 141 Milk Street, Boston, Mass., as its representative in Massachusetts, Vermont, Rhode Island, New Hampshire and Maine. Mr. Blachford will be in charge of the handling of the company's line of manually operated starting and controlling equipment, both face-plate and drum types.

THE UNITED GAS IMPROVEMENT COMPANY, Philadelphia, has formed a new company called the United Gas Improvement Contracting Company, with Paul Thompson, vice-president of the parent company, as president; J. A. P. Crisfield as vice-president in charge of engineering, and D. J. Collins, vice-president in charge of sales. This company will engage in engineering, construction and sale of water-gas apparatus and gas plants, the design and erection of power plants, and, together with the sale of residuals of all kinds, will have a division to construct and maintain roads and highways under contract. It also expects to make paints. The company offices will for the present be in the United Gas Improvement Building.

THE ELECTRICAL ALLOY COMPANY, Morristown, N. J., has discontinued its office at 135 Broadway and gives its only address as Morristown.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburgh, Pa., announces the appointment of Robert T. Lozier as special representative.

THE REPUBLIC ELECTRIC COMPANY, Cleveland, Ohio, has moved its wholesale department from the downtown retail store to Eighteenth Street.

H. G. LEWIS, sales manager of the Electric Service Supplies Company, Philadelphia, has been elected vice-president of that company. He will continue his work as vice-president and sales manager.

WOODS, HUDDART & GUNN, 444 Market Street, San Francisco, Cal., have been incorporated under the name of Gunn, Carle & Company. In addition to iron and steel products the company is prepared to furnish electric furnaces, cranes, industrial trucks, plant equipment and supplies.

THOMAS CASEY has been elected vice-president in charge of general sales for the Hurley Machine Company of Chicago. Mr. Casey's career with this company has been

THOMAS CASEY

one full of inspiration and interest. Starting with it seven years ago he has progressed through the positions of stenographer, correspondent, office manager and sales manager to vice-president in charge of sales.

THE W. A. JONES FOUNDRY & MACHINE COMPANY, Chicago, Ill., manufacturer of power-transmission apparatus, special foundry and machine work, and also of the Jones spur-gear speed reducer, has opened an Eastern office at 30 Church Street, New York, under the direction of Lemuel C. Biglow, who for a number of years acted in a similar capacity with the Morse Chain Company, Ithaca, N. Y.

THE EPPING-CARPENTER PUMP COMPANY, Pittsburgh, Pa., announces the appointment of F. S. Healey as manager of sales in addition to his former office of chief engineer, vice F. F. Woods, who is now in New York City as Eastern sales manager. Albert A. Schenck of the sales department has been appointed assistant sales manager, and Paul D. Goodman, formerly of the McClary-Jemison Machinery Company, Birmingham, Ala., has been added to the sales personnel.

THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE has issued in one bulletin the statistical details of Germany's foreign trade from 1909 to 1913. These figures show the lines that are open to development by American exporters and answer the questions so frequently asked as to the classes of merchandise that can be marketed in foreign countries. The most valuable tables are those showing imports and exports with each country by articles. There are also tables showing the total imports and exports and others that show the trade by principal articles, arranged in the order of their importance. Copies can be obtained for 10 cents from the Superintendent of Documents, Washington, D. C., or any of the district or cooperative offices of the Bureau of Foreign and Domestic Commerce.

Trade Publications

DISHWASHER.—The Couch-Dean Corporation of Hartford, Conn., is distributing a folder about the "Autosan" dishwashing machines.

FANS.—A leaflet descriptive of its 1919 electric fans has been prepared by the Pittsburgh Electric Specialties Company, 396 Broadway, New York City.

CIRCUIT BREAKERS.—Industrial-type circuit breakers are the subject of bulletin No. 520 recently issued by the Roller-Smith Company of 233 Broadway, New York City.

INSULATING MATERIAL.—A booklet about the line of insulating material marketed by the T. C. White Electrical Supply Company, St. Louis, Mo., has been issued by this concern.

IRONS.—The Hotpoint Division, Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is distributing to dealers a folder pointing out the advantages of selling Hotpoint irons.

ELECTRICAL SUPPLIES.—The Manhattan Electrical Supply Company, 17 Park Place, New York City, is distributing its catalog No. 29, whose 264 pages contain "Something Electrical for Everybody."

BATTERY-CHARGING SETS.—Individual vehicle-charging sets for lead or Edison storage batteries are illustrated and briefly described in a leaflet from the General Electric Company, Schenectady, N. Y.

FUSES.—The features of the National renewable fuse made by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, are pointed out in a mailing folder being sent out by this company.

DOUBLE OUTLET PLUG.—How to sell three two-way plugs for $3.50 is explained to dealers in a folder distributed by the Benjamin Electric Manufacturing Company, 806 West Washington Boulevard, Chicago.

DISCONNECTING HANGERS FOR REFLECTORS.—The Thompson Electric Company, 5006 Euclid Avenue, Cleveland, Ohio, has issued booklet B-18, which is about safety disconnecting hangers for reflectors.

DISHWASHERS.—F. G. Street & Company, 60 Broadway, New York City, are distributing a leaflet which illustrates and describes four models of the "Haustetter Victor" electrically operated dishwashing machines manufactured by them.

New Incorporations

THE METROPOLITAN DETROIT ELECTRIC AUTOMOBILE COMPANY of New York, N. Y., has been chartered with a capital stock of $10,000 by L. Weiner, W. Behrens and E. E. Parrack, 66 Seamen Avenue, New York City.

THE MINE SERVICE EQUIPMENT COMPANY of Scranton, Pa., has been incorporated by Francis H. Coffin of Scranton and others. The company is capitalized at $20,000 and purposes to manufacture electrical and mechanical appliances.

THE INDIANA ELECTRIC SERVICE COMPANY of East Chicago, Ind., has been incorporated with a capital stock of $10,000 to manufacture electrical goods. The incorporators are Philip N. and John Sendak and Samuel Samuels of East Chicago.

THE MOE-BRIDGES COMPANY of Milwaukee, Wis., has been incorporated for $25,000. The president is H. Moe and the secretary-treasurer is C. A. Bridges. The company will manufacture lighting fixtures for the trade and will job glassware.

THE OWENS ELECTRIC WELDING COMPANY of Washington, D. C., has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 to manufacture welding equipment, etc. The incorporators are W. J. Dow, L. F. Sarscer and K. King Cromwell.

THE DETROIT (MICH.) ELECTRIC CAR COMPANY has been incorporated with a capital stock of $600,000 to manufacture chassis for the Anderson Electric Car Company. The plant formerly occupied by the Peter Smith Heater Company has been leased by the Detroit company. W. C. Anderson is president.

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New England States

BIDDEFORD, ME.—The City Council has granted the York County Power Company permission to extend its lines on a number of streets in the city which now have not electrical service.

CLARK'S MILL, ME.—An act has been introduced in the State Legislature authorizing the Clark Power Company to construct and maintain a dam or dams on Saco River in the cities of Saco and Biddeford.

LEBANON, N. H.—The capital stock of the Grafton County Electric Light & Power Company has been increased from $200,000 to $250,000.

MILTON, N. H.—Plans are under consideration by the Farmington River Power Company for a hydroelectric plant on the Farmington River, near Windsor, to cost about $500,000. L. W. Jones of Milton is engineer.

BRANDON, VT.—The Hortonia Power Company is contemplating extending its electric transmission line to connect with the lines of the Rutland Railway, Light & Power Company at East Pittsford.

BOSTON, MASS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until April 14, under Specification 3477, for furnishing six electric traveling bridge cranes, for the extension to the machine shop and foundry at Boston, Mass. The cost is estimated at $175,000.

PROVIDENCE, R. I.—The contract for the construction of the new power house and smokestack for the Revere Rubber Company at Providence has been awarded to the J. W. Bishop Company of Worcester. The cost is estimated at about $110,000.

NEW MILFORD, CONN.—The capital stock of the New Milford Electric Light Company has been increased from $100,000 to $200,000.

WILLIMANTIC, CONN.—The Hall & Bill Printing Company has purchased a site, 35 ft. by 100 ft., adjoining its property, on which it will erect a two-story addition, to be used for a new power plant and storage purposes.

Middle Atlantic States

AMSTERDAM, N. Y.—The Adirondack Electric Power Corporation is planning to place its wires in underground conduits on the principal streets of the city.

BROOKLYN, N. Y.—Plans are being prepared by H. J. Nurick, architect, 957 Broadway, for an addition to the Beth Moses Hospital, Hart Street and Stuyvesant Avenue, to cost about $350,000.

DRESDEN, N. Y.—An election will be called to vote on the proposal to install an electric lighting system. Electricity to operate the proposed system will be secured from the Taylor Chemical Works.

GOSHEN, N. Y.—Plans have been prepared by F. H. Dexter, 891 Eighth Street, Brooklyn, for alterations and improvements to the power plant of A. E. Ludlam at 144 Reade Street. The cost is estimated at about $10,000.

GOWANDA, N. Y.—Plans have been prepared for the installation of motor-driven pumping apparatus and electrical equipment at the Indian Reservation of the Gowanda State Homeopathic Hospital, to cost about $8,500; also for improvements and alterations in the power house and boiler equipment at the institution. Clarence A. Potter is medical superintendent.

NEW YORK, N. Y.—A group of factory buildings on Eleventh Avenue, from Fifty-sixth to Fifty-seventh Street, has been leased by the Chevrolet Motor Company, Broadway and Fifty-seventh Street, to be used as new motor manufacturing plant and will be operated in conjunction with the company's plant at Kingsland Point, Tarrytown. Plans have been prepared for rebuilding of the portion of the Tarrytown plant recently destroyed by fire.

PERRY, N. Y.—Preparations are being made by the Perry Electric Light Company to install a 500-kw. turbine to supplement its present power equipment. E. L. Phillips & Company, 50 Church Street, New York, N. Y., are engineers. C. W. Torrey is treasurer and superintendent

ROCHESTER, N. Y.—The Public Service Commission has granted the Rochester Railway, Light & Power Company permission to issue $500,000 in capital stock. The cost of improvements for the electric department is estimated at $335,000 and that of the underground conduit system at $40,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

TONAWANDA, N. Y.—The J. S. Spaulding & Sons Company is considering the erection of a five-story paper mill at its plant on Wheeler Street; the cost including equipment is estimated at about $500,000.

UTICA, N. Y.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 18 for conduit and wiring, lighting fixtures, etc., in the United States post office, custom house and court house at Utica.

CAMDEN, N. J. — Contract has been awarded to J. W. Geistert, 813 Newton Avenue, for electric wiring in connection with the construction of eight new garage buildings, to be erected on Byron Street.

DOVER, N. J.—The Dover Boiler Works are contemplating the installation of electric welding equipment at its local plant.

NEWARK, N. J.—Plans are under consideration by the Board of Education for the installation of a new electric lighting system throughout the Monmouth Street Public School.

PERTH AMBOY, N. J.—Plans are under consideration by the Board of Aldermen for the installation of 1400 new 600-cp. incandescent lamps and 500 lighting units of smaller candlepower. William C. Wilson is chairman of committee on lamps and lighting.

KINGSTON, PA.—Notice has been filed with the Public Service Commission by the Luzerne County Gas & Electric Company of an issue of $484,000 in bonds, part of the proceeds to be used for extensions and improvements.

PHILADELPHIA, PA.—Permit has been granted to the Philadelphia Rapid Transit Company for an addition, 22 ft. by 29 ft., to its power plant at 963 Beach Street.

CUMBERLAND, MD.—The Edison Electric Illuminating Company is completing the installation of a 5000-kw. General Electric turbine and coal-handling machinery. W. M. Roberts, Jr., is general manager.

ROANOKE, VA.—Arrangements are being made by the United States Potash & Brick Corporation, recently organized, for the construction of a new plant, to cost about $500,000. Electrically operated machinery will be used wherever possible. H. O. Spangler is president.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Account, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 25, East and West, Schedule 3858—miscellaneous bells and buzzers, salvo-firing buzzers. Brooklyn, N. Y., Schedule 3889—11,000 ft. of interior communication cable. Until April 11, Norfolk and Philadelphia, Schedule 3861—two turren track-turning machines, complete, with motor drive. Until April 29, Norfolk, Va., Schedule 3861—portable woodworking machine, with motor drive, complete for service. Until April 22, East, Schedule 3880—100 storage batteries, 120 volts, 140 amp.-hour. Bids will also be received in the near future for the following supplies: East and West, Schedule 3894—miscellaneous hard brass wire, hard and soft copper wire, bronze phosphor wire; East and West, Schedule 3895—miscellaneous flexible brush-holder cable, single-conductor ignition cable; Schedule 3896—miscellaneous magnet wire. Boston, Mass., Schedule 3895—500 ft. searchlight cable. Applications for proposals should designate the schedule desired by number.

North Central States

DETROIT, MICH.—General contract has been awarded by the Detroit Edison Company for the construction of a power house at Congress Street and Cass Avenue.

MARINE CITY, MICH.—The Banner Salt Company is contemplating the construction of a new power station, 50 ft. by 100 ft., one story.

AKRON, OHIO.—The Northern Ohio Traction & Light Company is contemplating the construction of a substation, to cost about $15,000.

ASHTABULA, OHIO.—The Northern Ohio Hydroelectric Company, recently incorporated with a capital stock of $300,000, is planning to construct a hydroelectric plant and three large dams in Ashtabula County to supply electricity in Ashtabula. George R. McKay, Raymond R. Oliver and others are interested in the company.

CLEVELAND, OHIO. — Arrangements have been made by the City Council for a bond issue of $800,000 to provide for extensions and improvements to the municipal electric light plant.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until April 11, for electric meters. Specifications may be obtained upon application to room 204, City Hall.

JACKSON CENTER, OHIO.—A board of trustees has been appointed by the Council to take charge of the construction of an electric lighting system. The cost is estimated at $15,000.

LORAIN, OHIO.—The Cromwell Steel Company, it is reported, will purchase new equipment for its rolling mill, including motors, generators, rolling mill machinery, etc., at a cost of about $190,000. J. C. Cromwell, Guardian Building, Cleveland, is president.

MILLERSBURG, OHIO.—The Millersburg Traction Company is planning to construct an electric railway from Millersburg to Dover.

MINERVA, OHIO.—Plans are under consideration for improvements to the municipal electric light plant. J. Sheldon, Madison and Water Streets, Toledo, is consulting engineer.

SANDUSKY, OHIO.—Work will soon begin on the new power house to be erected by the Erie Tire & Rubber Company at the old Suspension Roller Bearing Company, which will be taken over by the Erie company the latter part of this month.

BRAZIL, IND.—Arrangements are being made by the Terre Haute, Indianapolis & Eastern Traction Company for improving the electric lighting service in Brazil and vicinity. The company will erect a transmission line from the Water Street Station in Terre Haute to a point where the Clinton and Brazil high-tension lines diverge. It is also proposed to extend the high-tension line south of Terre Haute into the coal fields of Sullivan County and back through Clay City to Brazil.

GARY, IND.—The electrical department of the Gary Screw Bolt Works, was recently destroyed by fire, causing a loss of about $100,000.

LARWILL, IND.—A company has been organized to construct and operate an electric light plant in Larwill.

SEYMOUR, IND.—The erection of an electric transmission line between Southport and Seymour is under consideration by the Interstate Public Service Company to provide more electricity along the line of the Indianapolis, Columbus & Southern Traction Company. The first section, it is understood, will be built between Seymour and Columbus.

UNIONDALE, IND.—Steps have been taken by farmers near Uniondale to organize a company to supply electricity to a territory 4 miles north of Uniondale. Electricity to operate the system will be secured from the Wabash Valley Utility Company.

BLOOMINGTON, ILL.—The Bloomington & Normal Railway & Light Company is planning to extend its service to take in a large rural territory at Meadows.

CHICAGO, ILL.—Wilson & Company of Chicago, it is reported, are contemplating the construction of a new power plant in connection with their canning works to be erected at Forty-fourth Street and Western Avenue.

CHICAGO, ILL.—Work has begun on the erection of the first unit of the proposed ice-manufacturing plant to be built by the Federal Refrigerating Company, affiliated wits the Hygienic Ice Company, on a site between Halstead Street and Racine Avenue and 140th Street and 142d Street, Riverdale, Chicago. The cost of the entire plant is estimated at $1,000,000.

GILLESPIE, ILL.—Initial steps have been taken by the Southern Illinois Light & Power Company for the erection of a new power plant in Gillespie, to cost about $80,000. Electricity for the local system is now transmitted from the Hillsboro plant.

GRAFTON, ILL.—The City Council has granted Roscoe Johnson of St. Louis, Mo., president of the Grafton Clay Products Company, a franchise to install and operate an electric light plant in Grafton for a period of twenty years.

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HAVANA, ILL.—Plans are under consideration by the City Council for equipping the waterworks pumping station for electrical operation. The cost of two pumping units complete with motors is estimated at $2,390.

HIGHWOOD, ILL.—The Chicago, North Shore & Milwaukee Railroad Company, it is reported, is contemplating extending its Libertyville branch to Crystal Lake.

MILTON, ILL.—The installation of an electric light plant at Milton is reported to be under consideration. Virgil Hoover is interested.

JANESVILLE, WIS.—Bids, it is understood, are being taken by the Parker Pen Company for the construction of a new three-story factory, office and power plant, to cost about $100,000. Frank A. Carpenter of Rockford, Ill., is architect.

BELGRADE, MINN.—Plans are under consideration to secure electricity for the municipal electric system and to sell the municipal generating plant. If the project is carried through it will necessitate changing from 220-volt equipment to 110-volt and rewiring all feed wires. E. A. Johnson is superintendent.

BAGLEY, IOWA.—As soon as conditions will permit work will begin on balancing up the lines of the municipal electric system, as the positive line connects with about twice as much load as the negative. The system is three-wire, 110-220 volts, direct current. The storage battery installed in the plant six years ago needs rebuilding, and this will be undertaken as soon as funds are available for the work. Preparations are being made by H. C. Fountain, manager of the municipal electric plant, for selling and installing Westinghouse electric ranges and hot plates.

APPLETON, MO.—Improvements are being made to the municipal electric light plant, including the installation of a 100-hp. Fairbanks-Morse type Y oil engine, one General Electric direct-current generator, switchboard panel, circuit breaker, ammeter, voltmeter, etc., W. B. Rollins & Company, Railway Exchange Building, Kansas City, Mo., are engineers. E. R. Wells is chief engineer.

COLUMBIA, MO.—The University of Missouri contemplates the erection of a women's dormitory, astrological observatory and home economics building, on the campus, to cost about $190,000; also to build a cattle barn and alterations to power house, to cost about $60,000. A. R. Hill is president.

KANSAS CITY, MO.—The contract for the erection of a group of buildings for the House of the Good Shepherd has been awarded to T. H. Lishear. The power house, garage, etc., will be located apart from the other buildings. The initial expenditure will be in excess of $150,000.

MARYVILLE, MO.—The Maryville Electric Light & Power Company is contemplating extending its electric system to Guilford. C. C. Hellmers is superintendent.

ST. JOSEPH, MO.—The St. Joseph Street Railway, Light, Heat & Power Company is contemplating extensive improvements to its plant and system, involving an expenditure of about $1,000,000. Most of the machinery in the power house will be replaced with new equipment. Additional pumps will be installed so that the company will not be dependent upon the city water supply. Most of the equipment, it is understood, has been purchased. J. H. Van Brunt is general manager.

BISMARCK, N. D.—The Capitol Street Railway Company is planning to extend its street railway to the Minneapolis, St. Paul & Sault Ste. Marie Railroad and to the Capitol grounds.

LAKOTA, N. D.—Contracts, it is reported, will soon be awarded by the city for two concrete wells, two motor-driven pumps, two pump houses, an electric transmission line, a 50,000-gal. tank, heating system for elevated tank, two 3-in. motors, laying cast-iron pipe, hydrants, etc.

MADISON, S. D.—An election will soon be called to vote on the proposal to issue $125,000 in bonds for the construction of a new electric light plant in Madison.

OSWEGO, KAN.—An election will be held April 1 to vote on the proposal to issue $50,000 in bonds for the installation of a municipal electric light plant. A. C. Moore of Joplin, Mo., is engineer.

SHARON SPRINGS, KAN.—The City Council is considering calling an election to submit the proposal to issue $40,000 in bonds for improvements to the municipal electric light plant and waterworks system. The proposed work includes the erection of new power house, one 150-hp. and one 100-hp. engine, improvements to distribution system, a 75,000-gal. tower and tank, etc.

UNIONTOWN, KAN.—The question of establishing a municipal electric light plant in Uniontown is under consideration.

Southern States

BURLINGTON, N. C.—The Mutual Power & Light Company, recently incorporated, is contemplating the installation of a central power plant to furnish electricity to various cotton mills and industrial plants. The company is capitalized at $125,000. Eugene Holt, L. B. Williamson and others are interested.

TROUTMANS, N. C.—The Troutmans Light & Power Company, recently organized, is planning to transmit electricity from Barium Springs to Troutmans for light and power purposes. J. B. Waugh is secretary and treasurer.

ALBANY, GA.—The Georgia-Alabama Power Company is contemplating a 10,000-hp. development on Flint River near Albany, to cost about $2,000,000. Mees & Mees of Charlotte, N. C., are engineers.

MIAMI BEACH, FLA.—The Miami Beach Electric Company, recently incorporated with a capital stock of $250,000, proposes to construct and operate an electric light plant and ice factory in Miami Beach. A. C. Newby and others are interested in the company.

PENSACOLA, FLA.—Surveys have been completed and plans submitted to the County Commissioners for the construction of an electric railway from Pensacola to Flomaton, Ala., a distance of about 40 miles. Herbert A. Smith, of Gonzalez, Fla., is interested in the project.

SARASOTA, FLA.—Bonds to the amount of $80,000 have been voted for the installation of an electric light plant.

NEW ORLEANS, LA.—At the convention held recently at Bay St. Louis, Miss., an executive committee was appointed to make arrangements for the construction of a municipally owned electric interurban railway to connect New Orleans, La., and Mobile, Ala., with all the Mississippi coast towns. John J. Kennedy of Biloxi, Miss., is chairman of the committee.

COALFIELD, TENN.—The power house of the Coalfield Coal Company was recently destroyed by fire, causing a loss of about $15,000.

RIPLEY, TENN.—An election will be called about May 1 to vote on the proposal to issue $150,000 in bonds to construct lighting, water and sewerage systems.

BLYTHEVILLE, ARK.—Arrangements are being made by the Missouri Southeastern Utilities Company to erect a power plant to supply electricity in Blytheville, Marmaduke, Paragould, Ark., Caruthersville, Hati, Greenway, Rector and Kenneet, Mo. The plant may be located in Blytheville.

HELENA, ARK.—The Helena Gas & Electric Company is reported to be considering the construction of a new electric plant in the near future.

LITTLE ROCK, ARK.—The capital stock of the Arkansas Hydro-Electric Development Company has been increased from $50,000 to $500,000.

MONROE, LA.—Municipal improvements are contemplated by the city of Monroe, involving an expenditure of more than $1,000,000, which will include enlargements of the waterworks system, additions to the municipal electric light and power plant and extensions to the municipal street railway system.

ADA, OKLA.—The Oklahoma Power & Transmission Company, it is reported, is contemplating extending its electric transmission system to Davis and Sulphur.

BLANCHARD, OKLA. — Arrangements have been made by the City Council for a preliminary survey of the town for the purpose of securing an estimate of the cost of installing a municipal electric light and water plant.

CHICKASHA, OKLA.—The Chickasha Peanut Oil & Products Company, recently organized, is planning to install pressing machinery, power plant, equipment, etc. D. C. Hybarger is president.

MARIETTA, OKLA.—Bonds to the amount of $15,000 have been issued for improvements to the electric light plant and waterworks system.

MIAMI, OKLA.—Preparations are being made by the Southwestern Light & Power Transport Company, Commerce Building, for a water-power development on Grand River, northeastern Oklahoma, to include seven dams (15,000 hp. each). The company also plans to build an auxiliary plant of 10,000 hp. capacity in Miami, which will hold the peak load in case of low water or flood. The company, it is understood, will need a 10,000-hp. turbine within sixty days. W. T. Croslen is president and chief engineer.

PAWHUSKA, OKLA.—The City Council is considering issuing $250,000 in bonds for improvements to the municipal electric light plant and water and sewerage systems.

RENFREW, OKLA.—The local electric light plant was recently destroyed by fire.

TAHLEQUAH, OKLA.—The City Council is considering calling an election to submit the proposal to issue $65,000 in bonds for the construction of a new electric light plant.

TULSA, OKLA.—Surveys have been completed by the Oklahoma Union Railway Company for an electric railway from Keifer to Okmulgee, via Mounds and Beggs. The company also contemplates the construction of a railway from Tulsa northward to Nowata, via Collinsville.

EL PASO, TEX.—Plans will be prepared by the city engineer for improvements to the Scenic Drive. The installation of arc lamps, etc., is the first work contemplated.

Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by the Board of Public Works until April 9 for furnishing the various city departments with approximately 400,000 incandescent lamps.

PORTLAND, ORE.—The Portland & Oregon City Railway Company is contemplating the construction of a car line from Oregon City through the timber belt, 18 miles in length.

ATWATER, CAL.—Preliminary plans are being prepared by the Fruitland Drainage District of Atwater for the installation of a series of electrically operated pumping plants for irrigation purposes.

BAKERSFIELD, CAL. — Arrangements are being made by the San Joaquin Light & Power Corporation to extend its electric transmission lines to provide service for 200 additional pumping plants in Kern County. The company has 700 applications for electrical service in the valley. D. L. Wishon is local manager.

HANFORD, CAL.—The California Packing Corporation, 101 California Street, San Francisco, is contemplating the construction of a factory and power house and a number of cottages in Hanford. P. Bush, 101 California Street, San Francisco, is architect.

INDEPENDENCE, CAL.—The Board of Public Service has entered into a contract with the Big Pine Water Users' Association of Inyo County whereby the city of Los Angeles acquires sites for three power plants and two reservoir sites. Construction will not be undertaken for some time. W. Mullholland of Los Angeles is chief engineer.

RIVERSIDE, CAL.—The Southern Sierras Power Company is installing additional equipment at its plant at Inyo canyon, including one 2200-hp. Pelton turbine, one 1500-kva. Westinghouse generator with switchboard equipment, and three 1000-kva. Westinghouse outdoor type transformers. C. O. Poole, chief engineer, is in charge of the work.

BRIGHAM, UTAH. — Bonds to the amount of $15,000 have been voted for extensions and improvements to electric distribution system, including new street lighting equipment.

BAKER, MONT.—The Baker Light & Power Company is contemplating improvements to its system, including the installation of one 3-kw. and one 5-kw., 2300-110-220-volt transformer. Material for overhead line work will include fifty three-wire racks, one barrel of 2200-volt insulators and 5000 ft. No. 8 weatherproof wire; also ten 5-amp. and five 10-amp. meters. Ernest G. Heinrich, owner, is in charge of the work.

KALISPELL, MONT.—The City Council has awarded contract for lighting thirty special improvement districts in the city to the Mountain States Power Company. Resolutions creating three new special lighting districts have been passed and contracts let for electric lamps not included in the lighting districts.

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WIBAUX, MONT.—The Eastern Montana Light & Power Company is contemplating extensions and improvements to its local plant and also to its systems in Glendive, Mont., and Beach, N. D.

PAGOSA SPRINGS, COL.—The electric plant of the Moore Electric Light & Power Company of Pagosa Springs has been purchased by Hersch, Catchpole & Shields. The new owners, it is understood, will make improvements to the plant, including the installation of new machinery.

Canada

VIKING, ALTA.—The installation of an electric lighting system is under consideration by the Town Council. W. McAthey is clerk.

WINNIPEG, MAN.—Bids will be received by the Department of Public Works, Ottawa, Ont., until April 16 for construction of an extension, 110 ft. by 122 ft., to power house and laundry at the military hospital, Tuxedo. The cost is estimated at $75,000. R. C. Wright, care Department of Public Works, is architect.

TORONTO, ONT.—A by-law authorizing an expenditure of $200,000 for the installation of an electric light and power system will be submitted to the ratepayers. W. A. Clark, 40 Jarvis Street, Toronto, is clerk.

LAKE EDWARDS, QUE.—Plans are being prepared by the Department of Public Works, Ottawa, Ont., for the construction of a power house at the military hospital. R. C. Wright is architect.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom. 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual meeting, New York City, April 3-5.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF MUNICIPAL ELECTRICAL ENGINEERS OF ONTARIO. Secretary R. A. Clement, 190 University Ave., Toronto, Ont., Can. Annual convention, Niagara Falls, Ont., June.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 110 West 40th St., New York City. Annual meeting, White Sulphur Springs, May 1-3.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Annual meeting, Hot Springs, Va., June.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB, Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

Directory of Electrical Associations

Printed in the First Issue of Each Month

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary, H. C. Hoffman, St. Paul Gas Light Co., St. Paul, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, L. D. Gordon, Jackson Light & Traction Co., Jackson, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass. Annual meeting, Springfield, Mass., Oct. 13 and 14.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City. Annual convention, Atlantic City, N. J., May 19.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal. Annual meeting, San Diego, Cal., April 30-May 2.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual meeting, Galveston, Tex., May 12-14.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

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Record of Electrical Patents

Notes on United States Patents

(Issued Feb. 25, 1919)

1,295,500. FAUCET; Louis R. Hibbard, Los Angeles, Cal. App. filed July 2, 1917. Has controlling valve, by which cold, warm or hot water is delivered.

1,295,501. BOILER ALARM; John J. Hines, Halifax, N. S., Canada. App. filed Aug. 27, 1917. For marine use.

1,295,502. COMBINED FIRE-ALARM AND WATCHMAN'S SERVICE SIGNAL SYSTEM; Albert W. Hitchcock, Hinsdale, Ill. App. filed July 26, 1916. Code signaling mechanism in signal boxes readily switched from fire-alarm circuit to watchman's circuit.

1,295,509. HEATING DEVICE; Frank C. Ingalls, Newark, N. J. App. filed June 28, 1916. Inserted in intake line of internal-combustion engines using gaseous fuel.

1,295,528. IGNITION SYSTEM; George L. Lang, Newark, N. J. App. filed Dec. 27, 1915. Sparks obtained regardless of slow engine speed.

1,295,548. ELECTRICALLY OPERATED MUSICAL INSTRUMENT; Alcide H. Maitre and Victor H. G. Martin, Rouen, France. App. filed March 27, 1914. Auxiliary excitation used for initial quivering of strings completely suppressed when amplitude of vibration of vibrant member becomes sufficient to be self-exciting.

1,295,553. SIGNAL-CORRECTING SYSTEM; Robert C. Mathes, New York, N. Y. App. filed Aug. 14, 1918. Corrects for wandering zero and makes possible accurate reception of cable signals.

1,295,563. ELECTRIC FIXTURE SWITCH; Harry J. Morey, Syracuse, N. Y. App. filed March 7, 1916. Readily wired from front of ordinary outlet box and serves as cover therefor.

1,295,567. PORTABLE ELECTRIC LAMP; David A. Murphy, Portland, Ore. App. filed April 6, 1918. Displays different lights, colored as desired, and has chamber for holding extra light bulbs.

1,295,570. WELDING ELECTRODE; Thomas E. Murray, New York, N. Y. App. filed Dec. 4, 1918. Has cavity for receiving elongate object to be welded.

1,295,572. APPARATUS FOR CAUSING A PREDETERMINED VARIATION OR PREDETERMINED VARIATIONS IN A PHYSICAL EFFECT; Ralph W. Newcomb, Greenwich, Conn. App. filed Feb. 23, 1918. For electromagnetically controlling heat, light, sound or electrical apparatus.

1,295,588. LAMP-SOCKET SWITCH; Roscoe C. Peleager, Philadelphia, Pa. App. filed June 1, 1917. For use in candelabra.

1,295,599. ELECTRIC GONG SUPPORT; Henry E. Reeve, Brooklyn, N. Y. App. filed July 14, 1917. Inconspicuous in use, unbreakable and easily handled and transported.

1,295,613. ELECTRIC MOTOR OR DYNAMO; William R. Scott, Norwich, Eng. App. filed May 20, 1915. Conductors effectually fill armature slots wider at top than at bottom.

1,295,633. IMPULSE STARTING COUPLING; Henry Tiedeman, Newark, N. J. App. filed July 15, 1918. For internal-combustion engines.

1,295,643. RUBBER-TIRE-REPAIR VULCANIZER; Sidney Le F. Varvel, Sydney, N. S. W., Australia. App. filed Sept. 7, 1917. Electrically heated vulcanizing plate supplied with current from low-voltage storage battery.

1,295,646. TELEGRAPH SOUNDER; Sylvester Voorhies, Enderlin, N. D. App. filed Oct. 15, 1917. Operates directly in main line without use of local battery.

1,295,660. STORAGE-BATTERY SEPARATOR; Theodore A. Willard, Cleveland, Ohio. App. filed May 5, 1917. Formed of rubber and has ribs not easily broken off.

1,295,691. ART OF AND APPARATUS FOR GENERATING AND DISTRIBUTING MUSIC ELECTRICALLY; Thaddeus Cahill, New York, N. Y. App. filed Feb. 17, 1904. Subscribers' instruments supplied with musical electrical vibrations from single central-station instrument.

1,295,709. CIRCUIT-CONTROLLING SWITCH; Robert M. de Vignier, Hollis, N. Y. App. filed July 16, 1918. Controls large number of independent circuits.

1,295,714. PROTECTOR; Joseph F. Ebert, New York, N. Y. App. filed April 18, 1916. Powdered mica and talc insulating material used in lightning protection.

1,295,752. APPARATUS FOR THE ELECTRIC DISSOLUTION AND PRECIPITATION OF METALS; Edward R. Holden, Los Angeles, Cal. App. filed April 17, 1917. Plurality of currents of different emf. are distributed simultaneously in different parts of an electrolyte.

1,295,777. ELECTRIC CIRCUIT CLOSER; Earl M. McGrath, Helena, Mont. App. filed Jan. 8, 1918. Causes current to flow through devices either in series, in parallel or in multiple groups.

1,295,783. DIRECTION INDICATOR; Willard M. Mathews, New Bedford, Mass. App. filed Oct. 2, 1915. Operable from seat of driver to indicate at both ends of vehicle the direction to be taken.

1,295,787. ELECTRIC WELDING MACHINE; Thomas E. Murray and Harry R. Woodrow, New York, N. Y. App. filed Sept. 23, 1918. Effective means for cooling parts of transformer.

1,295,797. TELEGRAPHY TYPEWRITER; Harry O. Rugh, Chicago, Ill. App. filed Dec. 11, 1914. Single circuit needed between point of control and point where printing takes place.

1,295,816. TESTING APPARATUS FOR FOUR-WIRE REPEATER CIRCUITS; John F. Toomey, New York, N. Y. App. filed Oct. 16, 1917. Transmission may take place through repeater station when repeater has been disconnected for testing purposes.

1,295,823. DIMMER; Jesse C. Osborn, Benton, Harbor, Mich. App. filed Dec. 11, 1917. Moving core into magnetic field decreases voltage delivered to lamps.

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1,295,852. HOOD AND ELECTRIC LIGHT SUPPORT; George W. Cassidy, New York, N. Y. App. filed March 15, 1918. Also constitutes wire-way for electric circuit.

1,295,853. ELECTRICAL MEASURING INSTRUMENT; Lewis W. Chubb, Pittsburgh, Pa. App. filed Aug. 10, 1916. For measuring distortion factors of alternating-current waves.

1,295,854. DISTRIBUTING SYSTEM FOR ELECTRIC RAILWAYS; Almon W. Copley, Wilkinsburg, Pa. App. filed Dec. 14, 1915. Series transformers interlinking trolley conductor with feeder conductor.

1,295,857. PROCESS OF TREATING ZINC ORES; Augustus P. Craft, Galena, Ill. App. filed June 23, 1917. Lime, iron pyrites and other impurities easily removed.

1,295,860. BRUSH HOLDER; John S. Dean, Wilkinsburg, Pa. App. filed Jan. 4, 1916. Flexible conductor prevented from coming into accidental contact with holder body.

1,295,877. STATION INDICATOR; George H. Egbert, Evansville, Ind. App. filed June 8, 1918. Constitutes reversible double reel and web marked with names of stations or streets.

1,295,885. RELAY SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed March 4, 1915. Operates to suppress ground or open circuit when circuit becomes grounded.

1,295,886. DISTRIBUTING SYSTEM FOR ELECTRIC RAILWAY; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed June 5, 1916. Minimizes inductive disturbances from adjacent circuits.

1,295,887. SYSTEM OF DISTRIBUTION; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Nov. 7, 1918. Disturbances from distributing system substantially neutralized.

1,295,894. SYSTEM OF CONTROL; Rudolf E. Hellmund, Swissvale, Pa. App. filed March 1, 1917. Accelerating or regenerative operation of main machine or machines accomplished without use of resistors.

1,295,906. SPEED CONTROL FOR INDUCTION MOTORS; Benjamin G. Lamme, Pittsburgh, Pa. App. filed Jan. 5, 1915. Speed regulated by returning energy to supply circuit through frequency converter.

1,295,909. TELEPHONE-EXCHANGE SYSTEM; Eric R. Lundius, Brooklyn, N. Y. App. filed May 11, 1918. Disagreeable clicks in receiver of answering operator prevented.

1,295,912. CIRCUIT CONTROLLER; Ray H. Manson, Rochester, N. Y. App. filed May 18, 1914. Push-button easily operated at any point.

1,295,913. PUSH-BUTTON SWITCH; Ray H. Manson, Elyria, Ohio. App. filed May 18, 1914. For signal warning apparatus of vehicles.

1,295,914. CIRCUIT CONTROLLER; Ray H. Manson, Rochester, N. Y. App. filed May 18, 1914. Button of large area causes actuation of warning signal device, no matter where touched.

1,295,915. CONTROL APPARATUS AND SYSTEM; Paul L. Mardis, Altoona, Pa. App. filed May 3, 1915. To govern operation of fluid-actuated drum controller for plurality of railway motors.

1,295,921. PARALLEL-FLOW REACTANCE COIL; John F. Peters, Edgewood Park, Pa. App. filed Sept. 10, 1914. Comprises plurality of spaced copper strands connected in multiple.

1,295,930. CONTROL SYSTEM; Samuel B. Schenck, Wilkinsburg, Pa. App. filed May 3, 1915. For four-motor equipments commonly employed on railway cars.

1,295,933. DISTRIBUTING SYSTEM FOR ELECTRIC RAILWAYS; Charles F. Scott, New Haven, Conn. App. filed March 8, 1917. Minimizes inductive disturbances.

1,295,950. AUTOMOBILE WARNING DEVICE; Bruno Zabel, Edgewood Borough, Pa. App. filed Sept. 5, 1916. Bell rung when unauthorized person releases brake.

1,295,966. SWITCH MOVEMENT; Samuel Buchsbaum, Chicago, Ill. App. filed July 21, 1917. Contains but two moving parts exclusive of finger piece which operates them.

1,295,995. TERMINAL BOX; Martin Luther, Chicago, Ill. App. filed May 16, 1917. Covering for open face of outlet box utilized as terminal chamber for conductors.

1,295,998. TELEGRAPH PRINTER; Benjamin F. Merritt, East Orange, N. J. App. filed May 11, 1918. Comprises rigid frame to which printing magnet and its armature are attached.

1,296,000. FLOAT-OPERATED SWITCH; James G. Michael, Windber, Pa. App. filed May 15, 1918. Works in connection with starter or in direct connection with motor, none of the parts, except switch blade and contact, being "alive."

1,296,006. SPARK ENERGIZER; Abraham Press, Washington, D. C. App. filed June 11, 1917. Will not deteriorate and keeps adjustment at all times relative to spark plug gap.

1,296,015. CONTROL SYSTEM; Karl A. Simmon, Edgewood Park, Pa. App. filed March 9, 1917. Inductive coil connected to field windings of motors by one switch.

1,296,104. SEMI-AUTOMATIC TELEPHONE SYSTEM; Harry W. Munsell, Indianapolis, Ind. App. filed Sept. 25, 1915. Only necessary to operate one key to call any subscriber in the exchange.

1,296,126. SPARK-PLUG ATTACHMENT; Guy M. Sherrill, Eastland, Tex. App. filed June 15, 1918. Renders plug useful even after porcelain is badly cracked.

1,296,136. SPEED-CONTROL SYSTEM FOR INDUCTION MOTORS; Wilfred Sykes, Pittsburgh, Pa. App. filed Oct. 24, 1916. Flexible in operation and substantially free from surging.

1,296,142. TELEGRAPH-SOUNDER CIRCUITS; Sylvester Voorhies, Enderlin, N. D. App. filed March 11, 1918. Has two windings, one energized from local and other from main-line circuit.

1,296,175. RELATING TO THE TESTING OF INSULATION; Sydney Evershed, Chiswick, London, Eng. App. filed March 21, 1914. Instrument measures resistance and resistance difference.

1,296,176. RELATING TO THE TESTING OF INSULATION; Sydney Evershed, Chiswick, London, Eng. App. filed March 21, 1914. Portable apparatus for determining any significant part of characteristic curve of electrical insulation.

1,296,177. AËRIAL FOR WIRELESS SIGNALING; Charles S. Franklin, London, Eng. App. filed Nov. 27, 1915. Has maximum value in one direction only.

1,296,188. PROCESS FOR MAKING ANODES OF SOLID MANGANESE PEROXIDE; Max Huth, Berlin-Charlottenburg, Germany. App. filed Nov. 3, 1914. Hardening and increasing the density and conductivity of the anodes is accomplished.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Growth of the Central-Station Industry

AN INCOME of more than half a billion for 1917, which represents an increase of 200 per cent in a decade, is a performance very creditable to the electric light and power industry of the United States. The census reports show that, roughly speaking, the output doubles itself every five years, and that this is largely made up of industrial load is evident from the fact that the growth in output for the decade was more than 333 per cent. The number of municipal stations has increased within the last five years almost 50 per cent, whereas the number of private stations has increased only 15 per cent; but the drift toward larger stations and greater transmission networks naturally will result in fewer private stations and these will continue to turn out the great bulk of the energy used in the country. The question arises whether the lighting industry can keep up the performance and have to its credit in 1922 an output of 50,000,000,000 kw.-hr. More than that amount can be absorbed in that time if the same impetuous spirit which has thus far spurred the central stations onward prevails. The saturation point is nowhere in sight. Greater industrial expansion must ensue in this country because the immense war debts must be paid. This means greater use of electricity in industry. As for domestic use, the surface has barely been scratched, for out of a total income of $526,000,000,000 probably less than 2 per cent was derived from the sale of appliances. It is impossible to foresee at this time any diminution in the rate of increase of electrical output. During the present period of uncertainty and doubt this rate of increase, of course, does not obtain, but as soon as normal conditions again prevail the growth should be greatly accelerated. The prospects are exceedingly bright, and never in the history of the industry were there greater opportunities.

Hydroelectric plants require the same scrutiny of operating characteristics as steam stations. Water is now far too valuable to be wasted, and if it is to be used to its fullest economic advantage, waterwheels cannot be left to look after themselves.

Engineers in Civic Affairs

APPARENTLY there is a desire on the part of some engineers to become greater factors in the settlement of public questions which have been considered beyond the scope of the profession. This is a laudable purpose; but if the engineer has not heretofore had proper consideration in the discussion of public administration and policies not involving engineering, is it not because he has not consistently interested himself in such problems and has not exerted himself to serve in a political capacity? That can all be changed; but it will depend entirely on whether the engineer will act. Citizenship carries with it certain obligations, not the least of which is responsibility for full political functioning. Sociological problems are among the most salient to be solved at this time, and the engineer can render great public service by directing his logical, analytical mind to conditions for which visionaries are suggesting dangerous panaceas.

The author of the resolution by which the telegraph and telephone lines were seized by the government laments the fact that rates have been increased thereby and apologizes for government control. This, he says, "means the death knell of government ownership of telephone, telegraph or railroad lines." Hindsight, hindsight, but never foresight!

One Engineering Feat Accomplished During War

NITRATE power plant No. 2, which is described in this issue, serves the largest single industrial-plant load in the world. More significant still is the fact that its average load will be greater than Brooklyn's peak load was in 1917. Despite the limited period in which the plant had to be built and the difficulty of securing equipment, reliability of service and economy of operation were not overlooked. In fact, it bids fair to be one of the most economical stations so far erected.

It is situated in a ravine near the level of the Tennessee River as near high-water level as safety permitted, a precaution doubly necessary since a very large amount of water is required for the processes as well as for the boilers. Owing to this location the coal comes in by rail high above the boiler room and is fed by gravity to the crushers. One of the minor puzzles which had to be faced in the station design was some uncertainty as to just what type of coal would, at least for the time being, be available for the stations, and extra boiler capacity had to be allowed on this account. The boilers themselves offered another problem. The Emergency Fleet Corporation with its huge demand for boilers automatically eliminated certain types from the possibilities, but eventually a standard water-tube boiler of 1500 hp. nominal rating was selected as the unit, built for 275 lb. pressure and with provision for 200 per cent of superheat. These figures represent a very material advance over ordinary practice, made necessary because of the high economy which must be maintained for commercial operation of the system after the war. All these boilers were equipped with underfeed stokers, with sufficient capacity to force the boilers to 250 or 300 per cent of their rating when

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necessary. The immediate necessities of the plant, bearing in mind the power to be obtained by transmission, were met by laying hands upon a 60,000-kw. turbo-generator already under order by a central station. It is a rather interesting machine, as being of three-unit type, with one high-pressure and two low-pressure elements, each driving its own generator but all tied together electrically, any one of the three units being available independently when necessary. Two additional 30,000-kw. units are included in the final project. All auxiliaries in the plant except the boiler-feed pumps are electrically driven, the power for the purpose being generated by a pair of independent turbines. The electric furnace load to be handled is a singularly steady one, and it is believed that, operating as it will at somewhere nearly 90 per cent load factor, the plant will develop power at an extraordinary high efficiency.

Bureaucracy is not entirely symptomatic of public ownership. It also exists in private ownership and can be detected in every do-nothing organization. Just because of this many communities have turned to government ownership, feeling that they could not fare worse. The want of initiative and imagination in any business eventually leads it to the scrap heap.

Keep Coal Cost in the Rates

COST of fuel in the operation of steam plants of central-station companies will have to be taken into specific account in rate making for an indefinite future period by all properties which do not own their sources of fuel supply. It was as a war-time expedient that the companies introduced coal clauses in their power contracts. This means of protecting themselves against heavy increase in cost found ready approval from the regulating commissions, and its justice was recognized by consumers. It simply included abnormal fuel cost in the price paid by the consumer in a way which stamped that as a fluctuating element in total cost. The fluctuation was upward, but companies as well as consumers felt that the rapid advance might be succeeded by reaction when the war-stimulated demand for fuel should be over. It is safe to assume that there will be some fluctuation in coal cost, as in other raw material costs, before anything like steadiness is reached; but it would be most decidedly unsafe to assume that coal will return to the old low levels.

One central-station executive whose policy has been notably successful held that much coal was sold below cost in pre-war days. It was his conclusion that eventually coal would be unobtainable except at fair cost figures. His individual station needs were safeguarded by the purchase of coal-mining properties. Not only did the subsequent events bear out the accuracy and wisdom of this forecast but there are in addition other elements which complicate the question of coal price level. That is to say, not only have the great body of owners of coal mines learned to put a higher value on the product as they liquidate the assets, but the labor required has also demanded and obtained an increased return for its service. And to the increase in wages of labor at the mine there are added advances in transportation rates and wages, and in all other costs of handling the fuel from the seam in the ground to the stoker in the power plant. There is no assurance that these costs will be any less, there is undoubted possibility that they will tend to still higher levels. They are so plainly a part of the expense of furnishing energy that the central stations cannot afford not to keep them permanently as a variable factor in their rates.

Margin of profit for a central station on a contract for a large block of power is small. It is in fact kept slender by actual or potential competition. And even slight change in the figures which aggregate the basis of the rate to the consumer may mean the difference between profit and loss. Therefore it will be well for the companies to watch with the greatest care all other cost fluctuations which affect operating expense. Following an example already set, it may be advisable for some of the properties to introduce labor clauses similar to coal clauses. But if there is reasonable stability in labor cost it will be simpler on the whole to avoid the addition of variables affecting rates too frequently. However, it will be expensive to fail to check and recheck continually rates and basic costs in any future conditions where fluctuations or sharp advances affect final results in substantial degree.

The general public does not take kindly to higher rates, yet a way in which to keep down the rates is to have fewer and larger generating systems and actual coöperation through interconnection and interchange of energy for the good of all. Material savings are thereby possible, and yet there are those who cannot see the advantages of such action.

Working Hydroelectric Plants

ALMOST every hydroelectric plant has some idiosyncrasies of its own which require rather close investigation if the very best operation of which the plant is capable is to be attained. Some very practical suggestions by L. W. Wyss in another column give important hints as to things for which the operator should be steadily on the lookout. Wherever steam and hydraulic plants are working together, as is now the rule rather than the exception, all the output which can be wrung from the latter relieves the former of its unpleasant burden of fuel consumption. The charge against the water-power plant is mainly overhead, and the more fully it can be loaded the better from the standpoint of economy. One of the very practical considerations taken up by Mr. Wyss is the proper treatment of excess water. Of course, in so far as possible this should be stored against the period when the water supply slackens, but there is a limit beyond which storage cannot go, either with regard to the practical safety of the dam or flashboards or because of the flowage rights above and below the plant. If water has to go to waste, it may or may not be a matter of indifference as to when and how this wastage takes place.

The case Mr. Wyss considers is the not uncommon one in which high tailwater proves more of a nuisance than lowered head above the dam. Backing up of water in the tailrace is a very common occurrence, particularly when everything is wide open in an effort to utilize as much water as possible, and if this condition develops it is a case either for getting after the tailrace or, if this is temporarily impracticable, working the plant just up to the point where the loss from back water overbalances the gain from sending more water through the wheels, as it sometimes does, particularly when it

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begins to be difficult to keep up the speed at the reduced head. To keep the tailrace clear and store all you can above the dam are the two maxims always to be kept in mind. Another very practical point raised is the effect of power factor. When this falls considerably the generators may reach their heating limit of capacity before the wheels are overloaded, in which case remedial measures directed at the power factor are imperative. In the case considered by Mr. Wyss it was impossible to operate the waterwheels at their maximum capacity and hence utilize the flood water, because the power factor was low. To remedy the situation the generators in the auxiliary steam plant were overexcited to improve the power factor; this was feasible because they were underloaded anyway and could safely carry some additional wattless current. In this way extra power was developed without any expenditure except for coal to overset the loss in the steam-driven generators due to increased wattless currents.

The operation of hydroelectric plants is full of situations like this, where the operator has to do, not the thing which he would wish to if he were redesigning the plant, but that which can be done on short notice to relieve an awkward situation. Leaks in the dam, too, are ever-present possibilities in most small plants. When a plant is afflicted with bad low-water conditions leakage, under ordinary circumstances an insignificant matter, may amount to a very perceptible fraction of the whole available output, particularly when considered with reference to storing water, and stopping leakage may save greatly at the coal pile. A little study of the water that gets by when the gates are shut down is sometimes an eye opener.

No commission really fulfills its obligations to the legislature which created it unless it interprets the desire of that legislature and the will of the people to the utilities which it regulates. Few commissions recognize this duty, and as a consequence many public utilities are kept in the dark as regards the state of public opinion.

Economic Use of Static Condensers

WHEN a system of alternating-current power transmission or distribution is affected by a low power factor, the delivery of current over the system per kilowatt-hour of delivered energy is necessarily increased. Thus, if power is being delivered electrically to a factory by three-phase conductors, at a delivery pressure of 1 kv. to neutral on each wire, if the power factor is unity, or 100 per cent, each ampere of current in a line will deliver 1 kw. of active power. If, however, the power factor of the factory load falls to 50 per cent, which may easily happen with underloaded induction motors, it will take 2 amp. on the line to deliver 1 kw. This doubled current will fill up the generator, the line wires and the transformers. If the whole distribution system has this power factor, the operating expense may be greatly increased, partly by having to operate more generators than should be necessary for the kilowatt load to be carried and partly by increase in the cost of conductors which may have to be installed in order to carry the increased current with the proper drop of pressure, and so as to avoid the dissatisfaction caused by poor regulation of pressure at customers' premises.

There is only one known remedy for a low power factor, once it has become established, and that is to install either synchronous or static condensers. In either case the procedure involves expense. A synchronous condenser is a particular type of synchronous motor designed so as to be able to run with overexcited field magnets, thereby forcing it to supply condensively reactive power, compensating and annulling the inductively reactive power of the motors on the system. A static condenser is a stationary apparatus which produces the same result.

The article appearing on the economic use of static condensers in this issue by Prof. Waldo V. Lyon deals with the annual cost of condensively reactive power as obtained by the installation of static condensers. This annual cost is taken as a certain fixed charge for the first element of condenser, plus a charge proportional to the capacitance of the condenser. Then, so far as concerns economy in line copper versus condensers, there is shown to be a certain relation between the installation costs and the various other factors at which it will pay to install the condenser. Otherwise it will be more economical to increase the size of the copper line wires.

Of course, the best plan is to avoid the development of a lower power factor in the system by encouraging the growth of lighting and discouraging the installation of induction motors, especially when they are selected too large for their duty and run for long periods underloaded. It may be said that customers on the system are unaware of the troubles they may produce for the central station when they install many induction motors with large margins of service capacity. Nevertheless, it is only fair to the power station and to the other customers supplied therefrom that a certain increased rate per kilowatt-hour should be charged when reactive power is absorbed. Contracts for alternating-current service should include a clause for an increase in the power rates, acccording to an equitably established sliding scale, if the average power factor of the customer's load falls below an assigned value. It would then be to the customer's advantage to insist that the motors or other apparatus he may purchase and install shall not involve him to an unwarranted degree in operating expenses.

Incandescent lamps attain almost exactly the ideal 100 per cent power factor. Induction motors, and iron-clad apparatus in general, absorb inductively reactive power and lower the power factor. Overexcited synchronous motors and static condensers absorb condensively reactive power and raise the power factor, but they are expensive. Up to the present time no other device has been produced or discovered which, while useful on its own account, also absorbs condensively reactive power. Inventors have sought in vain for a useful electric device which would improve the power factor by acting as a condenser during the time of its operation. Incandescent lamps help the system power factor, but only by diluting the motors already connected. Static condensers certainly help, as Professor Lyon shows, and by direct reactive operation; but they are expensive and they are of no use in themselves. No one at present wants to connect a condenser to the mains on his premises for any purpose except to compensate some of the idle magnetizing current in inductive apparatus and thereby raise the power factor.

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Economic Use of Static Condensers—I

Problems of Power-Factor Correction by Static Condensers Are Analyzed for Purposes of Improving Voltage Regulation and Reducing Copper Losses—When and to What Extent It Pays to Install Condensers

BY WALDO V. LYON
Assistant Professor of Electrical Engineering, Massachusetts Institute of Technology

FOR fixed voltage the capacity of generating and transmission equipment is limited by current and not by power. For this reason any energy-absorbing device that operates below unity power factor puts an additional burden on the central station. Since it costs more to generate and to distribute one kilowatt-hour at 0.7 power factor, for example, than at unity power factor, a consumer should pay for the kilowatt-hours he receives, and in addition a charge determined by the power factor of his load. This procedure enhances the virtue of operating at a high power factor, and logically tends to increase the use of power-factor-correcting devices, the simplest of which is the static condenser. The object of this paper, then, is to discuss some of the economic principles involved in the installation of static condensers for power-factor correction. Only a brief outline of the theory is given, but examples are worked out showing the application of formulas.

The fundamental principle is that the entire annual cost that may be charged against the installation of the condenser shall not be greater than the annual saving it accomplishes. The standard net profit that is here adopted is the greatest that can be obtained. That is, the size of condenser will be determined which will make the net profit (the difference between the annual saving the condenser accomplishes and its own annual cost) a maximum. There is one exception to this statement. When a condenser is used to improve the voltage regulation of any circuit the saving may in part be capitalized as the asset "good will." "Good will," being more or less indefinable, is not considered here. Neither is construction or installation of condensers dealt with.

Problems of increasing the capacity of generators already installed and reducing the equipment required in a new plant by the use of condensers will be taken up in the second installment.

FACTORS TO BE CONSIDERED

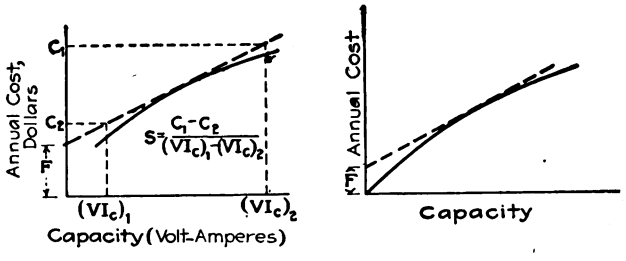
The annual expense of installing and operating the condensers may be divided into the following items: (1) Interest, taxes and insurance on the first cost as installed; (2) depreciation and repair; (3) housing; (4) attendance or control.

(1) The current that a condenser takes varies directly with the frequency, so that the size of a condenser that will take a given leading current varies inversely with the frequency. For this reason condensers would have to be very cheap to warrant their use on a 25-cycle circuit. It might be economical to build condensers to operate at some fixed voltage and to connect them through transformers to any circuit with a higher or lower voltage. The first cost is, of course, somewhat higher when transformers are used. The economic and electrical characteristics of a condenser depend principally upon the dielectric which is employed. A dielectric material which is cheaply produced and has better mechanical and electrical properties, particularly in regard to its specific inductive capacity, than any in common use to-day would stimulate the use of condensers for power-factor correction.

(2) On account of the simplicity of construction and the absence of moving parts, the annual charges for depreciation and repair should be very low.

(3) Condensers may be placed either in the central station or the substation or at other points in the distribution system. In the former case the cost of housing may be balanced by the cost of providing space for generating apparatus which would be necessary if condensers were not used. In the latter case the condensers may be placed upon transmission poles or underground in manholes, reducing the cost of housing to a very small amount, or they may be placed in rented space, the cost of which will vary greatly, depending upon local conditions.

(4) The attendance that condensers require is of the simplest sort—that is, the closing and opening of a switch at stated times of the day. The cost of this, however, may be a large proportion of the total yearly expense, especially with small units. But there are two ways of reducing this cost. The first is a system of remote control by which the opening and closing of the condenser switch may be performed at the power house or substation. The second is an automatic device which would open and close the condenser switch at stated times of the day or when the wattless current in the circuit has a predetermined value, closing the switch when the wattless current rises above a certain value and opening the switch when the current falls below this value.



TOTAL ANNUAL EXPENSE OF CONDENSER INSTALLATIONS
Fig. 1—Including charge for housing. Fig. 2—Where housing cost is zero

The total annual expense of the condenser is best represented by plotting the annual cost against volt-ampere capacity and then drawing a smooth medial curve such as shown in Fig. 1. The abscissas of this curve are the volt-ampere capacity of the condenser, while the ordinates are its total annual cost in dollars. The simplest method of analysis is, having determined the approximate volt-ampere capacity by preliminary calculation, to draw a tangent to the cost curve at this predetermined point and then assume that this tangent line expresses the true relation between the annual cost

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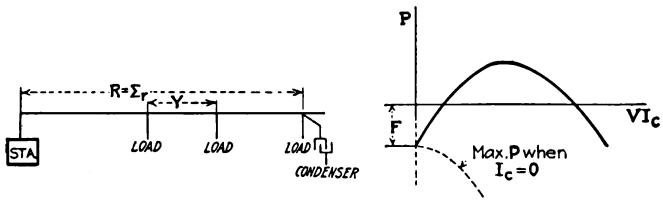
and the volt-ampere capacity. The tangent relationship for the annual cost, C, is

$$C = SVI_c + F \qquad (1)$$

In this expression S is the "slope cost" and F is the "fixed cost." These terms will subsequently be referred to a number of times. (See Fig. 1.)

If the cost-capacity curve is essentially a straight line, it will not be necessary to make any preliminary calculations. Should it be deemed advisable to do this, however, the approximate value of the condenser capacity may be found by inserting in the proper equations—(4), (13) and (21)—an *average* value of the "slope cost" of the condenser. The value of the "slope cost" is determined principally by items (1) and (2), while the value of the "fixed cost" is determined principally



FIGS. 3 AND 4—CONDENSER INSTALLATION FOR REDUCING COPPER, AND ANNUAL PROFIT CURVE

by items (3) and (4). Of course neither S nor F is constant, the former decreasing and the latter increasing with the size of the condenser. If there are no charges for housing and attendance, the fixed cost, F, although it may be quite small, is not zero, as indicated in Fig. 2.

PURPOSES SERVED BY CONDENSERS

Condensers may be added to a new installation for the purpose of reducing the necessary generating and transmission equipment, or they may be added to an existing system to increase its capacity, to reduce the copper loss or to improve the voltage regulation. In any commercial problem a combination of these advantages would probably be sought, but for the purpose of analysis it is much clearer to consider each case separately. This is done in the present analysis.

Commercial condensers operate at so low a power factor that the power they absorb may be disregarded without appreciable error. The entire analysis is further much simplified if it be assumed that the phase of the line voltage is fixed throughout the transmission system. The error that is thus introduced is so small and the complication that is avoided is so great that the assumption is fully justified.

When considering three-phase circuits it is probably least confusing if the calculations are made for one phase only. If the condensers are to be connected in Y, the phase voltage is the line voltage divided by $\sqrt{3}$, the phase current is the line current, and the phase power is the total power divided by 3. If the condensers are to be connected in Δ the phase voltage is the line voltage, the phase current is the line current divided by $\sqrt{3}$ and the phase power is the total power divided by 3. The volt-ampere capacity of the condensers is the same for either connection.

IMPROVING VOLTAGE REGULATION

Except as stated above, the use of condensers for the sole purpose of improving the voltage regulation does not primarily involve economic principles. With a load taking constant power—a motor load for example—an increased load voltage results in a decreased current consumption and a reduced line copper loss. On the other hand, a load of approximately constant resistance—a lamp load, for example—consumes more power and thus entails a greater copper loss if the line voltage is increased. The change in the line loss brought about in this manner would ordinarily be small and of secondary importance. If we disregard the effect that the increased load voltage may have on the line current and power factor, the increase in voltage obtained by the use of condensers is essentially equal to the product of the line reactance and the current taken by the condensers; that is, is nearly proportional to the capacitance of the condensers. The most economical use of a given capacitance is to place it all at the point where the voltage is to be raised. There is no advantage in subdividing the condenser and placing the parts at several points along the line. It is for this use only that there is any advantage in adding condensers until the resulting current is a leading one. When considering line loss or the capacity of generating and transmission equipment, a leading current is essentially just as undesirable as a lagging one. The necessary volt-ampere capacity of the condensers for raising the line voltage k per cent is $kV^2/100X$, where V and X are respectively the line voltage and the line reactance between the generating station and the point at which the condensers are installed. The annual expense of increasing the voltage this amount is then obtained from the cost-capacity curve (Fig. 1).

Example 1.—A three-phase, 60-cycle transmission line 10 miles long with transformers at each end consists of No. 0 conductors in the same plane, with 30 in. (76.2 cm.) between the center and outer conductors. The transformers have a combined resistance and reactance drop of 2 and 10 per cent respectively. The line supplies a load of 2700 kw. at 0.6 power factor and 13,200 volts. Compare the cost of duplicating this line on the same poles with the cost of condensers that will give the same increase in the voltage regulation.

Resistance and reactance of single line $= 5.18 + j6.64$

Resistance and reactance of transformers $= 0.77 + j3.87$

Total resistance and reactance $= 5.95 + j10.51$

Line current referred to line voltage $= 118 - j157.5$

Line drop $= 118 \times 5.95 + 157.5 \times 10.51$ approximately
$= 2357$ volts approximately.

Resistance and reactance of double line and transformers
$= 3.36 + j7.19$

Line drop $= 118 \times 3.36 + 157.5 \times 7.19$ approximately
$= 1529$ volts, approximately.

Reduction in line drop $= 2357 - 1529 = 828$ volts.

Necessary kilovolt-ampere capacity of condenser to accomplish this same reduction

$= 828/10.51 \times 13{,}200/\sqrt{3}$ volt-amp.
$= 601$ kva. per phase

Cost of duplicate line:*		Cost of condensers at $15 per kva.:	
Cross-arms	$310	3×601×$15 =	$27,100
Insulators	576		
Copper, at 17 cents	8,700		
Labor	1,000		
Total	$10,586		

REDUCTION IN COPPER LOSS

The saving in power in any section of a distribution system due to the introduction of condensers at the end of the section is equal to $r(2I_wI_c - I_c^2)$ where r is the

* Data taken from "Overhead Electric Power Transmission," by Alfred Still.

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resistance of this section of the system, I_w is the wattless lagging component of the current in the section before the addition of the condensers, and I_c is the leading current which the condensers take. The copper loss is reduced if I_c is not greater than twice I_w. The greatest reduction is obtained when I_c equals I_w; that is, when the power factor of this section of the system is increased to unity. The effect of adding the proper amount of capacitance at any point in a system is to reduce the copper loss in all sections between this point and the central station. In order to effect the greatest saving in line loss, a given capacitance should therefore be removed from the central station until the capacitance current is as nearly equal as possible to, but not greater than, twice the initial lagging wattless current at this point. If it is possible, however, to subdivide this given capacitance into smaller units, the greatest saving in line loss will be obtained when the capacitance is distributed along the line so that the power factor is unity in as many sections as possible. This latter arrangement is, of course, much more expensive in every respect.

Economy of Adding Condensers to Reduce Copper Loss

The general problem of determining whether or not it is economically feasible to add condensers for the sole purpose of reducing the copper loss in the distribution system is too complicated to express in any simple equation. The general method of solution can be indicated clearly enough by considering a single transmission circuit which supplies power to several loads connected to it at irregular intervals. (See Fig. 3) Let p represent the cost in dollars per watt-hour of energy at the switchboard, and H the hours per year that the condensers are in operation. The resistance of any section of the line between adjacent loads is r, and the average wattless current due to the loads in the section while the condenser is in operation is I_w. The annual cost of the condenser is $SVI_c + F$; S and F are determined as shown in Fig. 1. The net annual profit, P_r, in dollars, considering both the reduction in the copper loss and the cost of the condenser, in any section of the line, is

$$P_r = pHr\ (2I_wI_c - I_c^2) - SVI_c - F \qquad (2)$$

This equation for the profit is a parabola, as shown in Fig. 4. The total profit, P, in all of the sections between the point where the condenser is connected and the generating station is thus

$$P = -1000\ pHRI_c^2 + (2pH\Sigma rI_w - SV)\ I_c - F \qquad (3)$$

The condenser, of course, does not affect the line beyond the point at which it is connected. Differentiation of this equation for the net annual profit shows that it has its greatest value when

$$VI_c = (V\Sigma rI_w/R) - (SV^2/2pHR) \qquad (4)$$

If this greatest profit occurs when the condenser current is zero, as shown by a parabola with its vertex on the P axis, it will never pay to add a condenser. This condition determines the greatest value that S can have. That is, if S is greater than $(2pH/V)\Sigma rI_w$, the addition of a condenser will occasion a loss which will increase as the size of the condenser increases. If S is less than this critical value, there will be a net profit or loss depending upon the value of F. The critical value of F is readily found. If the value of I_c which makes the profit a maximum is substituted in the general equation for the net profit, the maximum profit is found to be

$$P_m = pHR\left(\frac{\Sigma rI_w}{R} - \frac{SV}{2pHR}\right)^2 - F \qquad (5)$$

F in this equation must be less than

$$pHR\left(\frac{\Sigma rI_w}{R} - \frac{SV}{2pHR}\right)^2$$

or P_m represents a loss. Thus the general relations which must hold for the annual cost of the condenser if the installation is to produce a profit are

$$S \text{ less than } (2pH/V)\Sigma rI_w \qquad (6)$$

$$\text{and } F \text{ less than } pHR\left(\frac{\Sigma rI_w}{R} - \frac{SV}{2pHR}\right)^2 \qquad (7)$$

Example 2.—A three-phase, 60-cycle, 13,200-volt transmission line of No. 6 conductor is 7 miles long. A single balanced load at the far end takes 600 kw. at 0.4 power factor, 2000 hours per year. The resistance drop in the generator and transformers at this load is 4 per cent. Assume that the cost of energy at the station, with coal at $5.50 per ton, is $0.0053 per kw.hr.

Line current $= 600/(0.4 \times \sqrt{3} \times 13.2) = 65.6$ amp.

Line current referred to line voltage $= 26.2 - j60.1$.

Total resistance per phase $=$

$7 \times 2.12 + (0.04 \times 7620)/65.6 = 19.5$ ohms.

By (6) the critical value of S is

$$(2 \times 0.0106)\ (19.5 \times 60.1/7620)$$

or $3.26 per kva.

Assume cost of condenser as installed to be $18 per kva., and annual charges—items (1) and (2)—to be 12 per cent, then

$$S = 0.12 \times \$18.00 = \$2.16 \text{ per kva.}$$

The proper capacity of condenser is by (4)

$$VI_c = 7620 \times \frac{19.5 \times 60.1}{19.5} - \frac{0.00216 \times 7620^2}{2 \times 0.0106 \times 19.5} \text{ volt-amp.}$$

$$= 155 \text{ kva. per phase.}$$

By (7) the fixed charge—items (3) and (4)—must be less than $3 \times 0.0106 \times 19.5 \times (20.3_2)^2$, or $240.

The power factor is increased so that

$$\tan\theta = (60.1 - 20.3)/26.2.$$

The resulting power factor is 0.55.

If the actual cost of generating energy at the station is twice as much—*i.e.*, $21.2 per kilowatt-year—the critical value of S is also twice as great, *i.e.*, $6.52 per kilovolt-ampere.

The proper capacity of condenser is then:

$$VI_c = 7620\left(60.1 - \frac{2.16 \times 7620}{2 \times 21.2 \times 19.5}\right) \text{ volt-amp.}$$

$$= 306 \text{ kva. per phase.}$$

The critical value of F is now $3 \times \$0.0212 \times 19.5 \times (40.2)^2$, or $2,000. If the housing and attendance charge is $500 per year, the annual profit is $2,000 — $500 = $1,500.

The new power factor is now 0.80.

In order that condensers may show a profit when they are installed to reduce copper losses, the cost of generating energy per kilowatt-year must be high, the line loss must be high, the power factor must be low, considerable power must be transmitted, and the fixed charges on the condenser must not be excessive.

According to Kelvin's law, the best size of conducto for this transmission is No. 0, assuming cost of generating energy at $21.20 per kilowatt-year, copper at 22 cents a pound and interest and depreciation, etc., at 12 per cent. With this size of conductor the critical value of S is $0.00277 per volt-ampere and the critical value of F is but $93. In such a case the installation is hardly advisable.

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Water Economy in Hydroelectric Plants

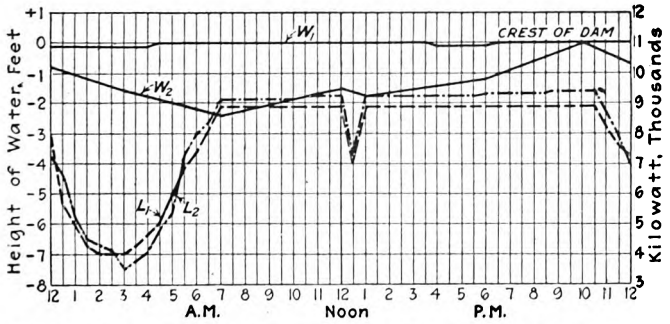
Intelligent Conservation of Excess Water May Save Coal in the Operation of Combined Hydroelectric and Steam Plants—In Some Cases the Power Factor of the Hydro-Generator May Be Raised in Order to Utilize Available Water

BY L. W. WYSS
Peninsular Power Company, Iron Mountain, Mich.

WHERE hydroelectric plants are synchronized with steam generating plants it is of the utmost importance that the efficiency of the hydroelectric plants be watched as closely as that of the steam plants, because a loss at the hydroelectric plants results in more coal being used at the steam stations. There are so many local conditions which govern the operation of any hydroelectric plant that the writer will not attempt to generalize on the subject; it is his intention rather to explain some ideas which have been worked out in the actual operation of plants in the belief that these may be applied where local conditions permit.

One of the most important considerations in connection with the operation of a hydroelectric plant is the proper conservation of excess water. During high-water periods when the waste gates are opened high tailwater may decrease the effective head at the dam unless the water has a good chance to run off. The loss of effective head due to high tailwater sometimes decreases the output of a plant more than the loss of head due to low headwater. A considerable increase in the daily load can be obtained by wasting the bulk of the flood water during the hours when the total output of the plant cannot be used, as at night and early morning.

In the accompanying diagram the load and water elevation curves furnish an example of the bad effects of high tailwater, and it is shown how these effects may be overcome. The load curve and water elevation for



OUTPUT OF PLANT INCREASED BY ALLOWING EXCESS WATER TO RUN OFF AT NIGHT

one day are found by referring to curves L_1 and W_1. In this case the flood water is regulated through the waste gates to keep the headwater at the crest of the dam. It is noticed that the maximum load of the plant is 8900 kw. From 7 a.m. to 12 noon and from 1 p.m. until about 10:30 p.m. the waterwheel gates are wide open and the steam plants are doing the regulating. On the same diagram another day's load and water elevation curve are shown, curves L_2 and W_2. In this case the flood water is wasted through the gates during the night when the full capacity of the plant cannot be used. In doing this the headwater is lowered 2.4 ft. (73 cm.) before morning. At 7 a.m., then, when the full capacity of the plant can be used the waste gates are closed and the tailwater drops to normal. It is seen that the plant can handle from 200 kw. to 450 kw. more in case of low tailwater than on the day the headwater was kept at the crest of the dam, even though the headwater did not reach the crest of the dam until 10 p.m. In this case the noon hour also was used to discharge the excess water. The argument applies particularly to the case of a hydroelectric plant in which the tailwater cannot be discharged freely.

On the other hand, in case the channel of the river permits a ready discharge of tailwater the excess water of the system should be handled differently. In this case the water may be raised to a point above the crest of the dam on Sundays and holidays, thus making use of the volume of water represented by the area of pondage times the height of the water surface above the crest of the dam. It is assumed, of course, that the factor of safety of the dam design and construction is sufficient to permit the additional pressure caused by the higher water elevation. For a specific example may be taken the case of a 44-ft. (13.4-m.) dam with a pondage of 1020 acres (410 hectares). In August the river flow was seen to decrease, and the indications were that a drought was in prospect. During the previous week the headwater had been pulled down 0.8 ft. (24 cm.) below the crest of the dam, but it had again reached the crest at 7 p.m. Sunday on account of the light Sunday load. Instead of opening the waste gates at 7 p.m. Sunday, the water was allowed to rise above the dam, and at 7:30 Monday morning it was 0.45 ft. (14 cm.) above the crest. Eleven days later the water had fallen 3.5 ft. (1.07 m.) below the dam crest and the auxiliary steam plant was started to help supply the load since there had not been sufficient rainfall to promise relief from the drought. It was not deemed advisable to pull down the head any more at this time because of the decreased efficiency of the plant under low head.

It may now be understood that under these conditions the water saved from 7 p.m. Sunday until 7:30 Monday morning made possible a large saving in coal. The water which flowed over the crest of the dam and gates was negligible in this case since this cross-section is small compared with the saving effected in the stream reservoir.

Now to determine how much coal was saved:

$$1020 \text{ acres} = 44{,}431{,}200 \text{ sq.ft.}$$

$$44{,}431{,}200 \times 0.45 = 19{,}994{,}040 \text{ cu.ft.}$$

The hydroelectric units deliver 1200 kw. when water is flowing through them at the rate of 400 cu.ft. per second.

$$400 \times 3600 = 1{,}440{,}000 \text{ cu.ft. per hour.}$$

$$19{,}994{,}040 \div 1{,}440{,}000 = 13.9$$

This extra stored water, therefore, would deliver 1200 kw. to the line for 13.9 hours or about 16,680 kw.-hr.

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To find the coal saved with the steam plant burning 4 lb. per kilowatt-hour:

$$16{,}680 \times (4/2000) = 33 \text{ tons (approximately) of coal saved.}$$

HYDRO-GENERATOR POWER FACTOR IS RAISED

Another idea which might not occur to the operator of a combined hydroelectric and steam generating system is to raise the power factor of the hydroelectric generator, in order to use water corresponding to the full kilowatt capacity of this generator. At first thought it might be suggested that a synchronous condenser be used for power-factor correction, but there are sometimes other machines on the line which are not fully loaded and which may be used to raise the power factor on the hydro-generators.

Take, for example, a system composed of hydroelectric and auxiliary steam plants in which the load increased so that the hydroelectric plant could not handle it alone during the heavy-load periods. A 2800-kva. steam turbine was operating on the system, delivering from 200 kw. to 1500 kw., or more when the water supply is full. Two generators at the hydroelectric plant rated at 1820 kva. were unable to generate over 1400 kw. without dangerous heating because the power factor of the system was between 0.7 and 0.75. The turbines, however, were rated at 2400 hp., or 1790 kw., and by increasing the field excitation of the steam turbine generator so that the hydro-generators could deliver power at 0.9 to unity power factor, the hydroelectric plant was able to run with turbine gates wide open, delivering approximately 1800 kw. instead of 1400 kw. The increased field excitation of the steam-driven generator caused a considerable wattless current to flow in this machine. But since the steam-driven generators were not loaded the increased heating was not serious, and a very substantial saving in coal was effected by running the hydroelectric units at full rated capacity.

COAL SAVED BY CLEARING TRASH RACKS

As pointed out in an article by E. A. Gibbs in the ELECTRICAL WORLD for Jan. 4, 1919, the trash racks should be kept clean in order to avoid a loss of head in the racks. The writer once observed an instance of failure to clean the racks in the case of a 5700-hp. plant. The water level averaged about 6 in. (15 cm.) lower inside the racks than outside, the effective head being 32 ft. (9.75 m.). The loss of 6 in. (15 cm.) of head represents 1.5 per cent of the capacity of the plant. In the case of the plant in question the full capacity of the plant could be used about 400 hours during each month. The horsepower capacity thus rendered useless at the hydroelectric plant and the consequent burning of ocal at the steam plant is estimated as follows:

$$1.5 \text{ per cent of } 5700 = 85.5 \text{ hp., or } 63.8 \text{ kw.}$$

$$63.8 \times 400 = 25{,}540 \text{ kw.-hr.}$$

This the steam plants had to generate using 4 lb. of coal per kilowatt-hour. Consequently some 50 tons of coal were wasted each month, whereas fifteen hours of labor would have kept the racks clean. The fact that hydroelectric units operate efficiently at certain loads near full capacity, moreover, must not be lost sight of.

It is good operating practice when water is abundant to have plenty of machines in service, so that an unexpected failure of one of them will not disturb the service. When water is scarce, just enough machines should be kept running to handle the peak loads. Each unit then operates at maximum efficiency. Without proper supervision the operating force may fail to take advantage of this possible saving. The reason is that the operators realize the difficulty of synchronizing another machine when the generators on the system are so overloaded that it becomes difficult to keep the frequency steady. Modern hydroelectric units and their governors are reliable enough to permit full confidence to be placed in them if they are attended to properly. Some preventable governor failures are now mentioned, caused by (1) worn parts which should have been replaced, (2) loss of oil pressure due to pump failure or operator's mistake in handling valves, (3) delicate moving parts obstructed by friction due to dirt or lack of oil, (4) dash pot, relay valve or regulating-valve packing glands drawn up too tight. (5) important adjusting levers, etc., being moved unintentionally by attendants while wiping, (6) breakage of governor belt.

Leakage of water through the dam should be prevented, as this often amounts to considerably more power than would at first thought be expected. The water flowing from small leaks spread along a dam a quarter of a mile long would make a good-sized stream if combined.

STOPPING LEAKS AT WASTE GATES

Most of these leaks can be prevented in some way. Common places to find them are at the sides and bottom of waste gates. Ordinary cinders are adapted to stop these leaks as their specific gravity is such that they sink very slowly, allowing the current due to the leaking water to lodge them in the right places to stop the leaks. Front-end cinders from locomotives are recommended where the leaks are small as their specific gravity is more uniform, but they are too fine for most purposes.

Another method which has been tried with good results is to drag water-logged wood from the river and cut it into chips and then use these in place of cinders.

Cinder spouts can be made to guide cinders to the leaks where obstructions prevent dropping them directly above the leaks. Where rubber gaskets are used on waste gates they often get worn out or torn and should be replaced. A common fault causing leakage is that the concrete walls on the sides of the waste gates are rough and uneven so that it is impossible for the gate gaskets to prevent leakage of water. This leakage increases each time the gates are moved, under these conditons, as the gasket will soon wear out.

When planning a new dam a smooth finish should be specified for places where leaks may occur. Strips of tin inside the wooden forms where the gate gaskets will come in contact are advisable.

THE most vicious wrong in democracy is the abuse of power—the betrayal of the people by their own agents—and the only protection from this evil, when the rights of persons and property are concerned, is to be found in courts of justice. We have, of course, a government of men—there is no other government—but we have a government of men whose duties are defined by law, and hence a government of law, and there never should be hesitancy to unmask the officer who usurps power.—*Charles E. Hughes.*

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Features of Muscle Shoals Station

Factors Considered in Building Steam-Power Plant Which Serves Largest Single Industrial Load in World, with Load Factor of 90 per Cent—Rapid Construction, Continuous Service and High Economy Were the Main Desiderata

BY EDWARD R. WELLES AND W. A. SHOUDY
Mechanical Division the J. G. White Engineering Corporation

WHEN the United States government decided to build its second nitrate plant* at Muscle Shoals (near Sheffield, Ala.) the demands for nitrates had so greatly increased that its rated output was set at about four times that of Plant No. 1. The total power requirements were estimated at 70,000 kw. to 90,000 kw., the average expected load being about 75,000 kw. This is probably the largest load required by a single industrial plant in the country, if not in the world. Some idea of the magnitude is obtained when it is remembered that the *average* power requirement of this plant nearly equals the winter peak of the Brooklyn Edison Company system for 1917.

No designs for this station existed when the contract was assigned to the engineers, nor had any apparatus been purchased or the station load determined, yet only one year was allowed for its erection. In spite of the serious delays in the delivery of material the work was apparently up to schedule when the armistice was signed and rush work stopped.

A year was too long to wait for the delivery of nitrates, and since it was found that a portion of the process buildings could be erected in quicker time than that required for the complete power station, it was decided to obtain a part of the necessary electric power from the Alabama Power Company, transmitting the energy over a high-tension line approximately 85 miles (135 km.) long. Somewhere between 20,000 kw. and 30,000 kw. will be taken over this line; the average load carried by the station will therefore be in the neighborhood of 50,000 kw. to 55,000 kw.

The desire eventually to manufacture nitrates commercially, instead of for war purposes, made it desirable to adopt a design which would assure high operating economy if this would not delay the erection program. The great importance of nitrates to the carrying on the war also required that after once starting this plant there should be no voluntary shut-down until peace was declared. Such conditions required a design of buildings and a selection of apparatus which would insure the following results: (1) Rapid construction; (2) continuous service; (3) high economy.

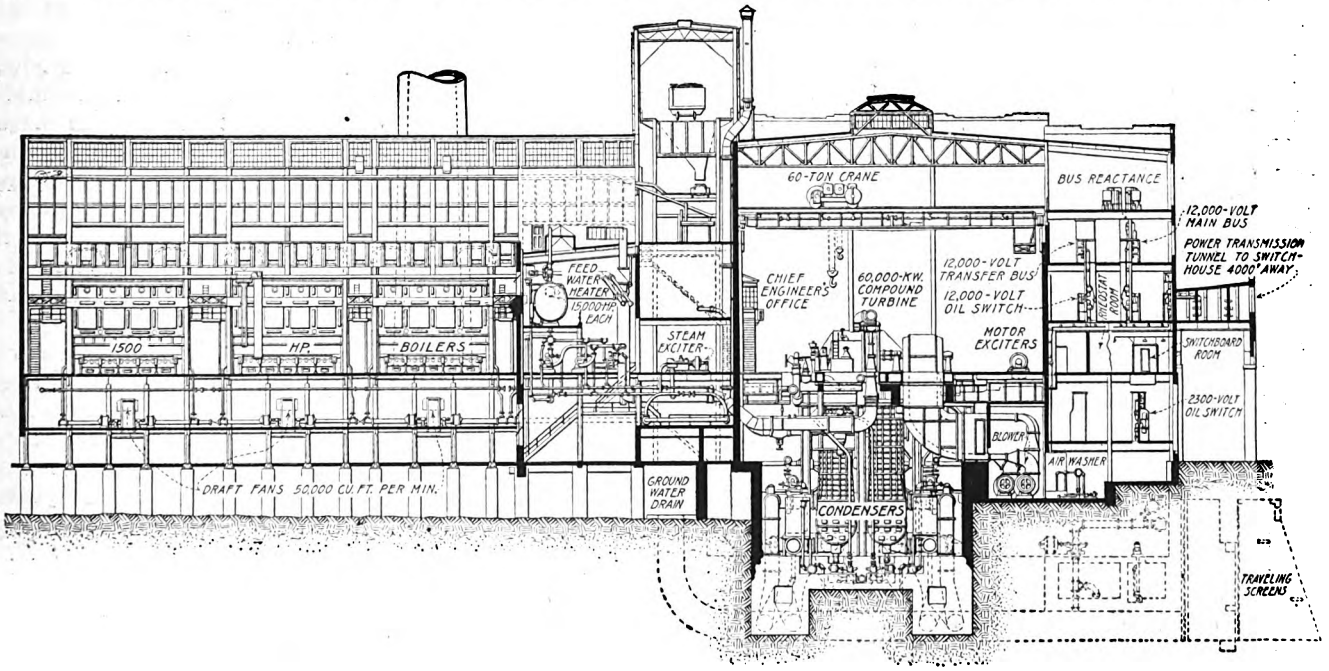

FIG. 1—CROSS-SECTIONAL VIEW OF THE POWER PLANT

EFFECT OF LOCATION ON DESIGN

The process buildings of nitrate plant No. 2 are located on a tableland about 125 feet (35 m.) above the Tennessee River, this tableland extending to the edge of the river, where it drops very abruptly. Owing to the large quantity of cooling water required by the generating station, it had to be placed as near the river level as practicable, so it was erected in one of the narrow ravines near the site of the process buildings. The area available for the station was so limited that at the elevation of the turbine-room and boiler-room floors the station completely fills the ravine. Because of this condition it was possible to make the substructure serve as a sort of dam that would protect the station against

*See the issue of the ELECTRICAL WORLD for April 5, 1919, regarding conditions that led up to building of Muscle Shoals plants.

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a total river rise of about 37 ft. (11 m.), or the maximum head that would likely arise more than once in fifty years.

The cost of constructing a discharge tunnel at low-water elevation was found to be so expensive that it was decided to place this tunnel about 4 ft. (1.2 m.) above this level. This elevation was selected because the extreme low-water conditions would prevail for only a few months each year and the additional cost of pumping these few feet would not warrant the expenditure for a discharge tunnel at a lower elevation. To provide for a full siphon effect for the circulating-water system, the condensers were so set that the highest point in the system would not exceed 25 ft. (8 m.) above the level of the water in the discharge tunnel, thus necessitating the excavation of a condenser pit 50½ ft. (15.4 m.) below the turbine floor. It was necessary to excavate still further to provide for the condensate pumps.

Between 30,000,000 gal. and 40,000,000 gal. (115,000,000 l. to 150,000,000 l.) of water per day must be taken from the Tennessee River for the process work, so it was decided to combine the intake for the power house and that for the process buildings into one unit and place the pumps for the process building in the power house. The intake and discharge tunnels were constructed in the bed of the ravine, the intake tunnel being carried out into the river and a six-section revolving screen being installed at the power house. Inside of the screen the intake tunnel is in two sections and so designed that one-half may be closed for repairs and still permit operation. To minimize excavation the pumping equipment was placed as shown in Figs. 1 and 3.

All of the coal supplied this plant will be delivered over a railway trestle about 65 ft. (20 m.) above the boiler-room floor, this elevation corresponding to that of the ground on each side of the power house. From the coal hopper, which is situated between the turbine and boiler rooms, the coal is emptied into a crusher discharging onto a belt conveyor, which in turn delivers the coal to the bunkers. It was expected that the ash would be used for some years for filling in the ravine or around the process buildings, so arrangements have been made for cars to be run directly under the ash hoppers and taken to either place by electric locomotives. The coal and ash handling system is probably the simplest that can be found in any station.

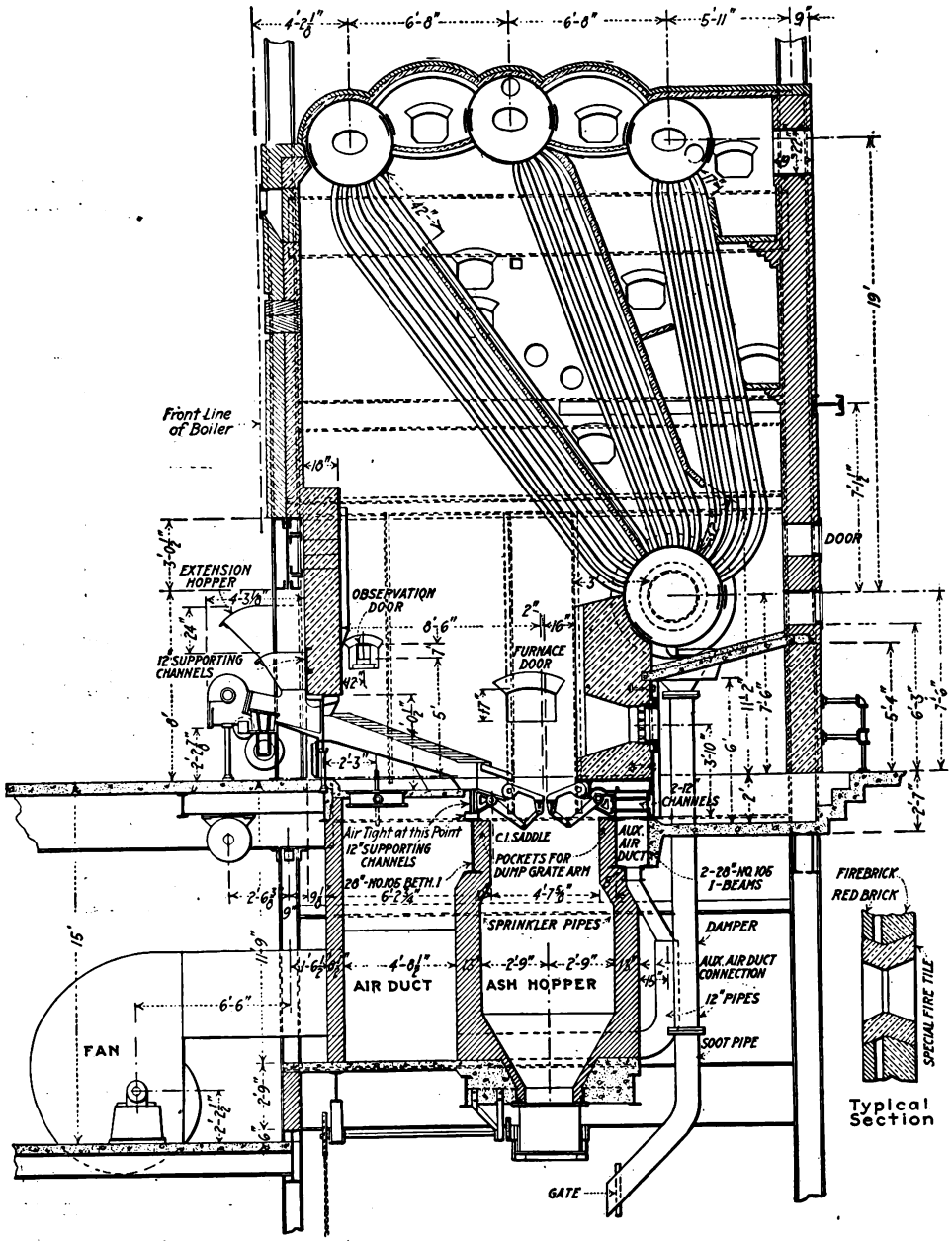

FIG. 2—BOILER, FURNACE AND STOKER CROSS-SECTION

It was impossible to learn definitely the type of coal that would be available for this station because of the existing shortage, although it was expected that coal would probably come from the Alabama or Tennessee district. Because of this uncertainty and the absolute necessity of maintaining continuity of service, it was decided to install 18,000 hp. in boilers. These should provide sufficient reserve in case the transmission line fails at a time when the coal is of bad quality.

The great demand for steel plate, due to the large shipbuilding program under way, made it doubtful whether steel chimneys which could be erected upon the building could be obtained promptly, whereas erecting brick stacks upon the building would have required heavier structural work. However, brick stacks built from the ground up could be erected with a minimum interference with other building construction. They were therefore chosen and erected outside the building.

The question of induced draft and economizers was very carefully studied, but because of the high feedwater temperature, which will be explained later in this article, and the fact that the life of the station

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was problematical, it was eventually determined to depend upon brick chimneys for the necessary draft.

The problem of providing for large boilers and still affording ample light and ventilation and minimum steam piping was solved by dividing the boilers into two rooms and placing one chimney between these rooms and one at each of the other sides. This also permitted completing one room and operating half the boilers without interfering with the construction of the other room.

FACTORS THAT AFFECTED BOILER INSTALLATION

At the time the boilers were purchased all manufacturers making the straight-tube type were crowded with orders for the Emergency Fleet Corporation, so a limitation was placed on the kind of boiler that could be secured. Besides, the high steam pressure required limited the size of boiler units obtainable. With a reasonable promise of delivery the maximum size of unit which could be purchased was 1500 hp. The boiler eventually decided upon was the Stirling type. By using standard-size superheaters, superheat temperatures of about 175 deg. Fahr. (97 deg. C.) at 150 per cent rating and 193 deg. Fahr (107 deg. C.) at 200 per cent rating could be expected. This being so, the steam characteristics of the station were set at 275 lb. (19 kg.) gage at the turbine throttle and approximately 175 deg. Fahr., although all apparatus was purchased for a minimum of 200 deg. Fahr. (112 deg. C.) superheat. Because of the extremely uniform nature of the load in this station it was expected that the boilers would be operated at nearly constant rating continuously. However, because of the extreme importance of maintaining uninterrupted service, no chances could be taken in operating these boilers at high ratings, with the concomitant rapid deterioration of boiler furnaces and other troubles experienced with high ratings. It was, therefore, determined to operate these boilers at about 175 per cent rating continuously. Because of the possibility of trouble in the transmission line it was necessary to provide for occasional additional demands of about 20,000 kw. At such times the boilers can be forced to higher ratings to take care of this overload.

For the foregoing reasons it was decided to install Westinghouse underfeed stokers (because of the flexibility of this type) with sufficient retorts so that the boilers might be forced to 250 or 300 per cent rating. The stacks were designed to provide sufficient draft to carry 250 per cent of rating with vacuum in the furnace. The large size of the boiler units offered an excellent opportunity for using individual blowers at each boiler and individual motors for each stoker. The logical place for the blowers, which are Green units, was in a gallery directly below the firing aisle. By joining these two galleries with one below the coal viaduct a U-shaped passage was formed which made an ideal pipe gallery, thus placing all principal piping out of the way, yet making it easily accessible.

Since the time required for completion of this station necessarily rested upon the rapidity with which the generating unit could be obtained, an effort was made to obtain a generating unit or units which had already been ordered for work that could be postponed without great inconvenience to the other parties. In this the engineers were successful, a three-phase, 60-cycle, 12,000-volt turbo-generator and condensers, which had been ordered by the Duquesne Light Company, being secured and used without modifications except for minor details.

This turbine is a three-element cross-compound machine rated at 60,000 kw. at 85 per cent power factor and 70,000 kw. at 90 per cent power factor. The three generators employed are tied together electrically. Steam is supplied to this unit through two 18-in. (46-m.) leads. In case of emergency one of these lines may be cut out of service and the entire steam supplied through the other at the expense of a slight pressure drop. The steam leaving the high-pressure element divides and passes to the two low-pressure turbines placed on each side of the first element. Each of the low-pressure elements exhausts into two condensers, having 25,000 sq.ft. (2335 sq.m.) surface apiece, making a total of 100,000 sq.ft. (9300 sq.m.) for the entire unit.

The turbine is so designed that any of the three elements may be operated separately or in combination; *i. e.*, the high-pressure element may be operated with the two low-pressure elements out of service; the high-pressure element may operate in conjunction with either of the two low-pressure elements, one being out of service; the two low-pressure elements may operate

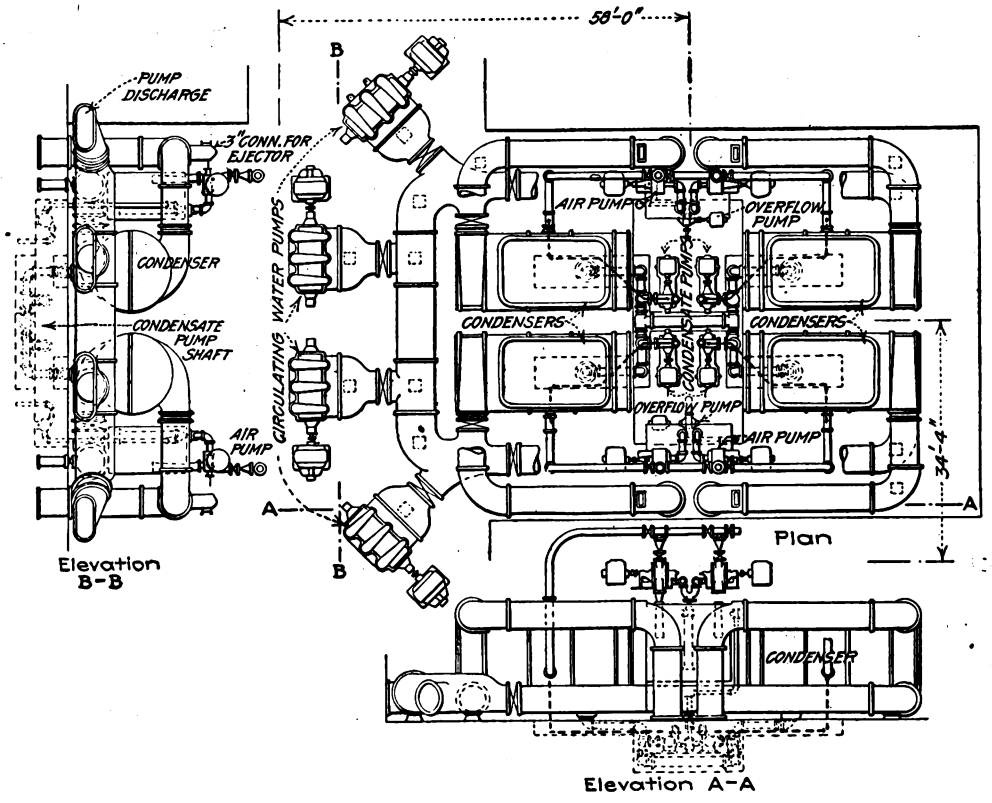

FIG. 3—LAYOUT OF CONDENSERS AND AUXILIARIES AT BOTTOM OF 50-FT. PIT

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with the high-pressure element out of service, or either of the low-pressure elements may be operated separately. The governing mechanism is so designed that in case of trouble, electrical or mechanical, in any one of three elements, that element will be cut out of service automatically and the load distributed between the remaining two elements. It is also possible to erect each of these elements separately and put each into service before the entire unit is installed.

Thus the 60,000-kw. turbine will give the same degree of insurance against interruption as three independent 20,000-kw. units, with the additional advantage that, because of its large size, very much lower steam consumption can be obtained. Room is provided for a 30,000-kw. unit, and a third may be installed by extending the turbine room. The turbo-generators, condensers and auxiliaries are Westinghouse units.

Since it was necessary to construct a standard-gage track down the ravine for the delivery of heavy freight, the track was made a permanent one and extended into the turbine room. Heavy machinery may, therefore, be unloaded by the crane from the original cars and deposited at any point in the room. Hatches in the main floor permit the removal of apparatus in the basement and the delivery of them by crane direct to the railroad car. Material for the boiler house will be delivered on the same siding and unloaded at the boiler-room floor wall.

Because of the deep condenser pit employed it was necessary to install immense connecting pieces between each turbine and the condenser shells measuring over 30 ft. (9 m.) long and 15 ft. (4.6 m.) by 10 ft. (3 m.) in cross-section. To make it possible to ship these connecting pieces each was divided into four sections slightly under 8 ft. (2.4 m.) in length. The great length of the exhaust connection between turbine and condenser necessitated taking care of considerable expansion. Because of certain conditions that prevented building the connections with a circular cross-section it was deemed inadvisable to consider the mercury type of expansion joint. Therefore it was decided to suspend the condenser and exhaust connecting piece from the turbine foundation. This construction also eliminated to a large extent the unequal foundation loading which would otherwise be caused by variations of vacuum.

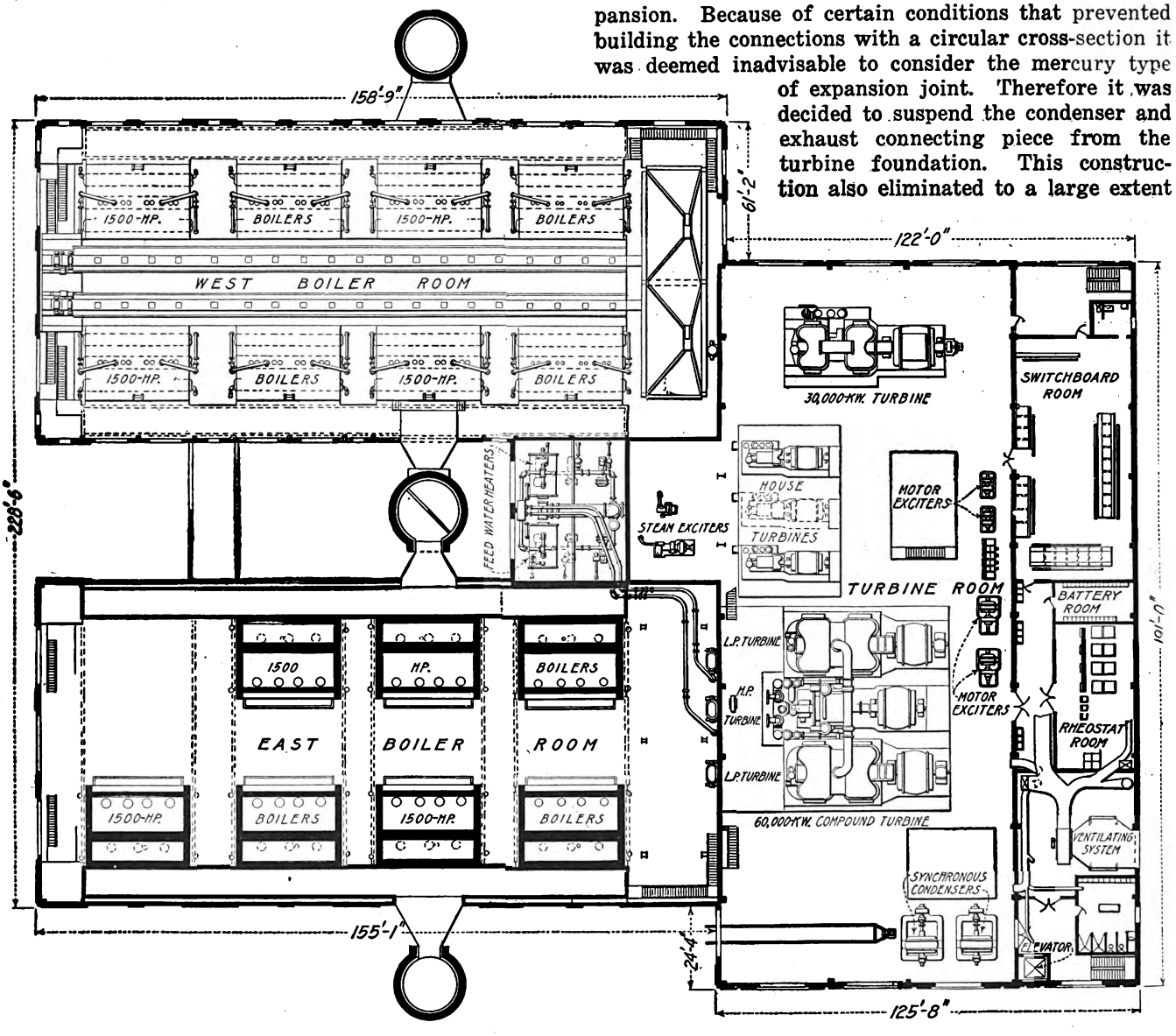

FIG. 4—PLAN OF THE STATION, SHOWING THE COMPLETE LAYOUT AS DESIGNED

Since 132,000 gal. (500,000 l.) per minute of water will be required for circulating purposes under normal operating conditions, four 44,000-gal. (167,000-l.) circulating pumps were connected with a header serving all condensers. With two pumps in service the circulating water will be reduced only about 25 per cent. Four centrifugal-type air pumps are provided, any two of which may be used in the ordinary operation, the other two serving as spares.

Condensate is delivered to two Cochrane feed-water heaters through a dividing box, while make-up water is

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supplied through either a 3-in. (7.6-cm.) or 10-in. (2.5-cm.) float-operated valve, depending on how low the water level drops. Water tapped from the condensate lines is also used to cool the turbine-bearing oil and to seal the glands. About one-half of the condensate will be required for the first purpose, in which service it will be heated from 80 deg. to 130 deg. Fahr. (27 deg. to 54 deg. C.). Oil for the main turbine will be filtered by the continuous system, whereas that for the auxiliary turbine will be treated by the batch system, Richardson-Phenix equipment being used.

Electric Drive of Auxiliaries

With the exception of the boiler-feed pumps, which are Worthington units, all auxiliaries are motor-driven. The power is generated by two non-condensing turbines, the exhaust from which is used for heating the boiler-feed water. One factor in this selection was the desire to reduce piping to a minimum because of the high steam temperature and the possibility of delay in obtaining steel valves. Furthermore, the heat balance of the station gave higher economy with electric drive.

The auxiliary turbo-generators are connected with a 440-volt auxiliary bus, which in turn is tied to the main bus through a transformer. In case of failure of the auxiliary turbines the auxiliary load will be carried by the main unit. At the normal station load, which will be about 55,000 kw., approximately 2000 kw. will be required to supply the auxiliaries. However, to maintain the feed-water temperature at about 210 deg. to 215 deg. Fahr. (99 deg. to 102 deg. C.) it will be necessary for the auxiliary turbine to exhaust steam equivalent to a 2400-kw. load. This excess 400 kw. may therefore be used for operating the process pumps, which require a total of about 700 kw. under normal conditions. Four-sevenths of this load will therefore be carried at an energy expenditure equal to the difference between the total heat of the steam at boiler pressure and that at atmospheric pressure. The remaining three-sevenths will be carried by the main turbine through the auxiliary bus. One of these turbines will be operated at a uniform loading near its point of best economy. The second unit will carry any additional load, the exact amount being determined by the back pressure in the exhaust, this being controlled by an automatic valve. It will therefore be possible to operate this station with a feed-water temperature which will not vary more than a few per cent throughout the entire day, and at no time will there be a waste of exhaust steam to the atmosphere.

Since all of the condenser auxiliaries may be operated at practically constant speed, alternating-current motors were selected for this service. In the case of the stoker, however, it was necessary to operate them by direct-current motors because of the wide adjustments necessary in stoker speeds. The motors selected for operating the stoker blowers were alternating-current.

As has been said before, it was decided to operate the boilers at an average rating of about 175 per cent, but there will be times when higher ratings will be required. At such times it will be necessary to operate the fans at a speed higher than normal. Two sets of motors are, therefore, installed, one to operate the fans at their normal speed and the other to drive them at the higher speed, thus securing the best efficiency in each case. In case of failure of one fan two stokers can be operated from one fan through an auxiliary duct, the fan being operated at the higher speed. In case higher ratings are demanded only temporarily, the fan's speed may be changed by using the larger motor.

The electric furnace load which is carried by this central station is an ideal one, and because of its great uniformity it is expected that the load factor will be about 90 per cent. The turbine is one of the most economical yet installed, and so long as the apparatus is maintained in good condition there is little that the operating force can do toward improving the economy of the turbine if the operators must take the load as given to them. It is in the boiler room that the economy may be made or lost. Great attention has been given to this fact. The steam generated is measured by Bailey flow meters and draft conditions are shown by "Three-in-One" draft gages. The speed of the stoker shaft is shown by indicating and recording tachometers. Each boiler is set at sufficient height to provide a combustion space of 17.4 cu.ft. per square foot of projected grate area. Openings are cut into the rear wall so that the firemen may inspect the condition of the fire from the rear as well as from the side. Although each boiler should be operated as an individual unit, it was of the utmost importance that the boiler room be designed so that the room itself could be operated as a unit. Therefore recording instruments and motor controls were installed at one point in the boiler room, where they are under the control of one man. It is expected that the combustion engineer will instruct the gage-board operator regarding the control of each fire.

The space directly over the feed pumps and between the boiler and turbine rooms was set aside for the chief engineer's office. A slightly bayed window in this room makes it possible to view the entire turbine room without leaving this office. This location places the chief's office in the geographical center of the station at a minimum distance from each department. It also made possible the placing of the recording mechanism of both feed-water meters and condensate meters within this office, together with such other instruments as will permit keeping a constant watch over the station operation. These daily records, together with the usual pressure, temperature and vacuum readings, will permit a daily check on the station economy and will amount almost to running the station under test conditions constantly. In fact, an effort was made throughout so to install apparatus that test conditions would be maintained practically at all times.

WHILE the public has the right to exercise intelligent control over corporations which serve it with public necessities, government ownership and management of these utilities would be unwise from every standpoint. It must be remembered by those who so foolishly demand public ownership that year by year the great public utility corporations are becoming more and more the property of the public. Millions of our people have a direct and personal interest in the public serving business, and they are not going to be misled by any of the unsound and theoretical beliefs of the socialists on government ownership. It is but necessary to learn of the numerous disastrous failures of government operations in European countries to indicate what might happen here.—*Cardinal Gibbons.*

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Advantages of Spot Welding

The Effectiveness of Spot Welding as Compared with Riveting Is Shown, and It Is Pointed Out that Rivets May Be Driven Noiselessly with Welding Devices—Contact Electrode Shapes Are Also Discussed

BY G. A. HUGHES AND R. H. POOL
Electrical Engineer and Assistant, Truscon Steel Company, Youngstown, Ohio

THE substitution of spot welding for riveting of steel plates, as originally proposed for shipbuilding, has received considerable attention of late, and many interesting applications of welding processes have been developed. It is the present purpose of the authors to point out the use of welding apparatus as a noiseless and effective method of driving rivets and to show how the work may be speeded up by dispensing with rivets. A general outline of spot-welding methods is given, with illustrations to show the effectiveness of electrical welds.

Electric welding processes may be grouped under three heads, arc welding, spot welding and butt welding, and combinations of these methods are in use. In arc welding the work is brought to a welding heat by means of an electric arc, either alternating current or direct current, drawn, (a) between the work itself and a carbon electrode; (b) between two carbon electrodes and the arc thus formed between the carbons, which is held in the form of a V used to heat the work; (c) between the work itself and a metal electrode. In the first and second cases a metal rod is used to fill in the weld, while in the third case the metal electrode itself serves as the fill-in metal. By using the proper size of elec-

FIG. 1—ARC-SPOT-WELDING TWO PLATES

trode and the proper current both the work and the metal electrode are brought to the fusing point and the electrode is deposited in the weld. It is evident that the metal so deposited is cast steel and that it has the properties of cast steel. The weld may be porous, depending upon the chemical properties of the fill-in rod, the amount of current and voltage used, the length of the arcs and the number of interruptions while making the weld. Hence in the welding of sheet steel, plates, shafting, etc., a given cross-section of the weld cannot be so strong as a similar cross-section of the material welded.

A SUBSTITUTE FOR RIVETING

In arc spot welding (Fig. 1) the upper plate *m* is punched and is laid on lower plate *m*,' which is not punched. The holes *h* are then filled with an arc welder by one of the methods described above, the spots acting as rivets. It has some advantages over the usual spot welding since the machines are cheaper and more easily handled. The advantage over riveting is that only one plate need be prepared, skilled labor is not required to lay out the holes, and the equipment to weld the plates is far cheaper than air equipment to drive rivets. This method is still in the experimental stage and the data are limited as to the strength of the welds and the cost for the different-size plates.

The principle of spot welding by the resistance method (and likewise in butt welding) consists in passing an alternating current of high amperage and low voltage through metals at the point of contact, and when the metal is in a molten state pressure is applied

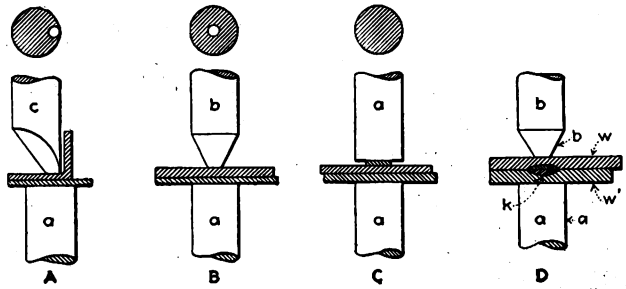

FIG. 2—CONTACT ELECTRODE SHAPES

to force the metals together. The principle is that in a series circuit heat is produced in proportion to the resistance of any particular portion of the circuit. Now, if the conductors leading from the source of supply of current be of low resistance and a piece of metal be inserted, the heat produced will be at point of contact. This is an ideal condition for spot welding.

In Fig. 2D the resistance between copper contact electrode *b* and work *w* and electrode *a* and work *w'* is made less than that between work *w* and *w'*. As a result the greatest heat is produced at point *k* just where it is needed. When the metal in contact with the electrode *b* is in a welding state, added pressure at *b* forces the molten metals together and makes a weld at *k*.

There are three important factors in spot welding—

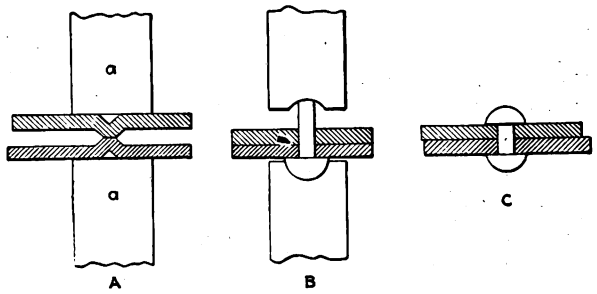

FIG. 3—PROJECTION WELDING AND RIVETING BY WELDING DEVICES

(1) clean stock, (2) pressure at weld, (3) current used —and upon these depend the time required to make a weld. The greater the pressure the less is the resistance. As the resistance becomes less more current is required to make a weld. But too light a pressure causes arcing at point of contact and work, and rusty stock may produce arcing and soon burn away the contact electrodes[1].

The pressure[2] required varies as the thickness of the

[1]See Oct. 19, 1918, issue of ELECTRICAL WORLD, page 743.
[2]See Oct. 19, 1918, issue of ELECTRICAL WORLD, page 742, Table III; page 743, last line.

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work, chemical properties of material, and current used. Two pieces of No. 14 gage ordinary sheet steel, free from rust, require about 300 lb. (130 kg.) pressure at weld, and 15 kw. No. 16 gage sheet steel requires 220

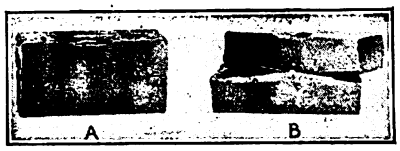

FIG. 4—HALF-INCH PLATES SPOT-WELDED

lb. (100 kg.) pressure at the weld and 12.5 kw. for $\frac{5}{16}$-in. (7.8-mm.) spot. The current flowing through the work averages 7000 amp.

Some materials that can be spot-welded are galvanized iron to galvanized iron (galvanizing will be destroyed at weld), sheet brass to sheet brass or sheet steel, German silver, zinc and nickel.

CONTACT ELECTRODE SHAPES

The different types of contact electrodes used in spot welding are shown in Fig. 2 (A, B and C). To determine the proper kind of contact electrodes to use in welding material, from No. 20 gage to No. 12 gage, a test was made by taking two machines doing the same work, one machine being fitted with contact electrodes, type B (Fig. 2), while the other machine was equipped with contact electrodes as shown in Fig. 2B. At the end of one month's run the saving in contact electrodes on the machine using the electrodes as in Fig. 2B was as much as 50 per cent, while production was speeded up about 3 per cent owing to the time saved in dressing the points of the electrode.

Fig. 2A shows the use of a contact electrode for close work, as in corners, while Fig. 2C illustrates the "button" method of spot welding. A "slug" or "button" is placed between the contact electrodes and the work.

In Fig. 3A "projection" welding is illustrated. This method of welding has proved satisfactory on small work where the projections can be made at the same

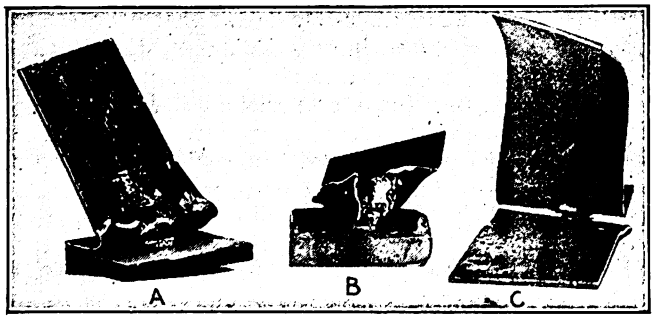

FIG. 5—EXAMPLES OF EFFECTIVE SPOT WELDING

A—No. 14 gage steel sheet welded to ¼-in. (6.3-mm.) plate
B—No. 14 gage sheet and ¼-in. (6.27-cm.) steel plate arc-welded
C—Two No. 14 gage sheets spot-welded

time material is formed or stamped, one die performin both operations. The method has been used in making brush holders for motors and generators.

DRIVING RIVETS WITH WELDING APPARATUS

A method of riveting plates together by means of a spot-welding machine is shown in Fig. 3B, and the finished rivet in Fig. 3C. It is successful when the ordinary 30-kw. spot welder is used, up to $\frac{3}{8}$-in. (8.5-mm.) rivets. Rivets over this size require special apparatus as the copper-contact electrodes are too soft for upsetting the rivet. This method of riveting is ideal since the rivet is hottest where completely upset and in cooling makes a tighter joint. The method is also preferred in some instances since it is noiseless and the equipment costs less than forge and air equipment necessary to operate air guns. In some instances it has proved economical by speeding up of production over the air guns in driving rivets.

In Fig. 4A a piece of sheet steel is shown welded to a steel plate. A chisel was driven on each side of the weld, and then the spot was pulled through the sheet and the sheet drawn back, showing the weld. Fig. 4B shows another sheet and plate welded together. The piece was placed in a milling machine and cut through the center of the weld, the end being polished to show the union of metals. The No. 14 gage strip was pounded up, showing the weld to be perfect. This is conclusive evidence that it is not necessary for both pieces to be of the same thickness. In Fig. 4C are shown two pieces of No. 14 gage sheets welded with a $\frac{3}{8}$-in. (9.5-mm.) spot.

Fig. 5 shows two pieces of ½-in. (1.27-cm.) material successfully welded, the size of spot being $\frac{3}{8}$-in. (9.5-mm.). The piece was cut through center of weld and polished to show union of metal. Note the width of weld, it being a little under $\frac{3}{4}$ in. (1.9 cm.). Fig. 5B shows same piece after it was torn apart by driving a chisel on each side of the weld. Note how the metal is battered in tearing the pieces apart. All these pieces were welded on a 30-kw. spot welder[3]. This machine was not mechanically strong enough to press the ½-in. (1.27-cm.) pieces firmly together. The pressure exerted in this case was a little over 700 lb. (320 kg.).

The thickness of the plates that can be welded will depend upon the size and shape of material to be welded. Special machines are now being used that will weld two pieces of $\frac{3}{4}$-in. (1.9-cm.) plates, hydraulic pressure being used on the plates while heating and for forcing the molten metals together after reaching a welding heat. It is that final "squeeze" that makes a perfect weld.

[3]Oct. 19, 1918, issue ELECTRICAL WORLD, page 743, Figs. 1 and 2.

IN TURN, various groups of mining men, representing companies producing certain metals, attorneys for oil companies and executives of power companies have appeared in Washington, have carefully and patiently explained to various committees the need of constructive legislation, and in regular rotation bills have been introduced in one or both houses of Congress only to die in committee or in conference. From time to time promises of legislation have been made and Presidential messages have been written in regard to the development of power and the release of withdrawn lands. But the temporary withdrawals still stand, and the producer of power from water and the producer of power from oil are both prevented from developing the resources of the nation. This policy of repression was inconsistent and unfair before the war; it was almost fatal to the prosecution of the war, and if continued will certainly be fatal to the development of a national constructive program for peace.—*D. M. Folsom, Pacific Coast Petroleum Administrator.*

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Effect of Prohibition on Lighting Revenue

Analysis of Experience of Companies in Communities Already Dry Indicate What May Be Expected to Happen After July 1 in Those Places Where Liquor Is Now Sold

WHEN the sale of liquor is stopped in a community an immediate effect is to reduce the revenue of the local central station. This reduction may range from a few per cent to 50 per cent of the lighting revenue. However, within a short period, varying from two months to a year, the loss is usually all regained. When still more time has elapsed it is discovered that the community has benefited by the abolition of the liquor trade and that the central station's revenue has increased in proportion to the general benefit which the community has received.

EXPERIENCE OF SEVENTY-FIVE CENTRAL STATIONS

The above statement summarizes the experience of about seventy-five central stations operating in several states that were voted dry at different times between the years of 1881 and 1918. The information on which the statement is based was secured by the ELECTRICAL WORLD to assist in predicting what will happen to the revenue of central stations operating in territory that is now "wet" but that will go "dry" on July 1. Some of this experience, which is given in detail in this article, may be of value also in showing methods that may be used and policies that can be adopted to shorten the period required to restore earnings to the level they had attained before the dry law went into effect.

Obviously the thing that causes the great reduction in earnings in most cities is the closing of the stores used as saloons. While saloons are not users of liberal intensities of light, they are excellent producers of revenue because they are long-hour users. It is usually agreed that, unless local laws restricting them are enforced, saloons use lamps on an average nineteen hours a day. When the saloons are permanently closed the buildings which they occupied produce no revenue until some other business is started there. It is unlikely also that any business which succeeds a saloon in a given location will be such a "long-hour user." It is probable, however, that a greater connected load will be used by the new customer. Average experience as to whether the net profit is greater in one case than in the other is difficult to secure, but it seems to be generally conceded that when the saloon locations are all taken up by other businesses the central-station lighting revenue will have returned to approximately its former proportions. It is also noticeable that companies in the larger cities seem to suffer more, proportionately, than do those in the small towns or the cities of moderate size.

In order to show how this works out under different conditions, the experiences of some of the stations which have kept records on this topic are given herewith in tabular form. The data are grouped by states because that will assist in showing more clearly how the severity of the blow caused by loss of revenue shrinks in significance as it passes into history. In Kansas, the second state to go dry, it is difficult to find companies that have records or men that remember how the revenues were affected. The experience of Kansas and Tennessee does show, however, the difficulty of enforcing prohibition laws when they are unpopular. For nearly ten years after Kansas was voted dry saloons flourished in the larger cities. In such cases the decrease in lighting revenue was deferred until the law was enforced. In states where prohibition has prevailed for years opinion is unanimous that the ultimate result of abolishing the liquor trade was beneficial to the central station. In states that went dry in 1918 the thought is expressed that the ultimate result may be beneficial, but the tone of some letters indicates that as long as store buildings are vacant the real benefits cannot clearly be seen. It is distinctly noticeable, however, that where two or three years of experience in dry territory has fallen to the lot of a public utility executive he becomes an ardent advocate of prohibition for business reasons, regardless of his personal inclination.

Certain types of business always show activity during the period of transition from saloons to other customers. It seems generally conceded that with the abolition of saloons there have been increases in the demand for house-wiring among working people. Electrical devices have been easier to sell. Collections of electric service accounts have been better. Better lighting fixtures and different types of fixtures and reflectors, particularly those used in poolrooms and restaurants, are sold to replace types used in saloons. Places of legitimate amusement have flourished and increased in number. While the readjustment is being made, however, central-station revenues suffer. To make this period of transition as short as possible has been the aim of central-station sales departments in some of the states already dry.

One of the methods that seem to assist in this work is to be of all service possible to the men who attempt to start mercantile businesses in the locations vacated by saloons and the men who start legitimate entertainment enterprises. Such propositions usually turn out to be permanent businesses. The saloons that are converted into "near-beer parlors" probably come as close as any other customers to being long-hour users like the saloons, but in many cases these "near-beer parlors" are reported to be poor pay. On the whole, the thing to do seems to be to help all legitimate ventures and to keep a watchful eye on the credit of doubtful new businesses.

TESTIMONY FROM THE DRY STATES

To show what some of the men in the public utility business in dry states think about the situation now faced by operators in wet states some quotations are given from letters received by the ELECTRICAL WORLD. The general manager of an Indiana company wrote:

"I have had the unique experience of operating plants in four cities, in three different states, at times when the towns were wide open when I went to them and either the town or state went dry within two years after I took charge of the properties. When I say wide open I mean very wide open, with saloons in a ratio of one to every 300 of population and all that

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goes with it. My experience in none of the above cases has been that the business of selling either gas, electricity or street-railway transportation has been adversely affected by the communities going dry. As a matter of fact, if there was any effect noted, it would be a favorable effect."

All of the four cities mentioned by this Indiana manager are thriving communities of from 10,000 to 100,000 people in the Middle West and South. Moreover, something of the same thought is expressed in a letter from the president of a company in a prosperous city in Michigan. He said:

"Our eight years' experience as a dry city shows that there is a big change for the better, and the utility has received its share. With a nearly stationary population, our residence and commercial light earnings have increased just about 50 per cent and the number of light meters has increased 80 per cent. The general tone of business is much better than before, and dependency and crime are greatly reduced. Bank deposits have more than doubled; the tax rate is no higher than it was when we were getting the saloon revenue. All of our reputable business men are a unit in declaring that nothing could induce them to go back to saloons, and I figure that where such conditions exist it is the utility's own fault if it does not share in the increased prosperity."

TABLE I—DATA ON REVENUES FROM LOCATIONS IN SEATTLE OCCUPIED BY SALOONS PRIOR TO THE PASSAGE OF THE PROHIBITION LAW IN THE STATE OF WASHINGTON

Address	Class of Business	Yearly Revenue	Hours Run per Month	Maximum Demand, Kw.
716½ First Ave.	Saloon	$289.10	400	4.5
	Poolroom	446.90	400	5.2
709 First Ave.	Saloon	647.00	400	7.0
	Amusement parlor	378.50	530	3.9
S.W. cor. 1st and Seneca	Saloon	365.05	480	4.0
	Soft-drink parlor	332.15	320	4.0
405 Pike	Saloon	404.35	350	4.3
	Meat market	463.55	400	5.3
111 First South	Saloon	241.45	500	2.5
	Café	213.50	650	2.2
200 Second South	Saloon	293.15	320	3.5
	Cigar stand	296.45	320	3.5
214 Jefferson	Saloon	403.45	220	5.2
	Barber shop	358.20	300	4.7
117 Washington	Saloon	174.00	600	2.0
	Restaurant	301.85	650	4.0
157 Washington	Saloon	309.95	260	3.7
	Clothing store	153.50	300	2.0
219 Union	Saloon	379.85	340	4.3
	Refreshment parlor	416.20	260	5.0
323 First South	Saloon	214.10	310	2.5
	Express and cigars	95.10	190	0.8
112 First South	Saloon	235.90	370	2.7
	Soft drinks	84.80	320	1.0
1609 First Ave.	Saloon	480.60	200	6.0
	Poolroom and billiards	131.70	260	1.8
820 Second Ave.	Saloon	295.90	480	3.2
	Stationery company	279.00	240	3.7
1315 First Ave.	Saloon	412.45	350	5.3
	Lunch and soft drinks	190.70	450	2.0
1119 First Ave.	Saloon	257.60	340	2.8
	Soft-drink parlor	49.25	380	1.6
1214 First Ave.	Saloon	271.70	435	2.7
	Cards and poolroom	212.70	190	3.0
1222 Second Ave.	Saloon	539.80	550	5.2
	Jeweler and boot shop	271.00	240	3.5
5231 Ballard	Saloon	153.25	200	1.8
	Soft-drink parlor	172.40	260	2.5
5129 Ballard	Saloon	205.50	200	2.6
	Soft drinks	94.70	150	1.6

	Average Kw.-Month Rate	Average Yearly Revenue	Average Hours Run per Month	Average Maximum Demand, Kw.
Saloons	7.25	$328.67	365½	3.8
Miscellaneous	6.80	252.13	340½	3.1

Managers of some companies have collected data on certain phases of the wet and dry question as it affects the electric service business. For instance, the Detroit Edison Company made a canvass the day before the saloons in Michigan closed to see what kinds of business the city's 1600 saloon keepers would undertake. The results of this investigation (given in Table II) showed that soft-drink places predominated. Observation of conditions since that time, however, show that the soft-drink places are not all proving profitable and some are going out of business or are starting other businesses.

The city electric light department of Seattle, Wash., made an investigation to determine the comparative characteristics of saloon loads and the loads of business that followed saloons in the same locations. The average yearly revenue from the saloons investigated was $328.67, as against $252.13 from the businesses that succeeded them. The number of hours' monthly use was 365.6 and 340.5 respectively, while the average maximum demand was 3.8 kw. and 3.1 kw. The data from Seattle are given in detail in Table I. A survey of these figures might be taken to indicate that with some sales efforts the lighting intensities could be improved with profit both to the customers and to the city's lighting department.

The Gary (Ind.) Heat, Light & Water Company made an interesting analysis of conditions in that Hoosier steel center, where the large percentage of foreign population made the saloon business an important part of the city's retail businesses. While these figures may not be conclusive owing to the short time Gary has been dry (since April 2, 1918), they at least indicate what happens under such conditions.

The consumption for January and February, 1918, of fifty-five saloons selected at random in Gary was 16,440 kw.-hr., and for the same period of 1919 it was 9730 kw.-hr., a decrease of 41 per cent. There were seventeen lightless nights in January and February, 1918, and increasing 1918 consumption to allow for decrease due to this fact, the apparent decrease of 1919 over 1918 will be approximately 55 per cent. By actual demand test on a block which was composed entirely of saloons on the lower floors and generally of rooming houses above the demand dropped from 29 kw. while wet to 18 kw. about ten months after the dry law went into effect, a reduction of about 38 per cent. Comparing the percentage of reductions in demand and consumption, there is apparent a considerable decrease in average hours' use.

Nearly all managers who have operated properties in cities that have been dry for a few years speak of the increased revenue from residential customers of the working class. Their impressions in this respect are necessarily more or less general. However, some information that has a specific bearing on the subject has come from the Ware County Light & Power Company of Waycross, Ga. R. E. Tresher, assistant treasurer of the company, writes:

"We have always been under the impression that moving-picture theaters were high-class revenue producers in that they paid comparatively large bills. We recently discovered during two 'flu' bans that our peak load was considerably higher with theaters, etc., closed. This is simple when we consider that 300 to 500 families at home would certainly consume more light than would be consumed by a theater which they might attend for from one and one-half to three hours."

Companies operating in resort cities naturally expect to suffer. Some may suffer, but there is consolation for many of them in what W. H. Plummer of Asheville,

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TABLE II—DETAILS OF CONDITIONS FOLLOWING PROHIBITION REPORTED BY FORTY-ONE LIGHTING COMPANIES

Name of Company and Date State Went Dry	How Did Closing Saloons Affect Company's Revenue	Rate of Growth of Lighting Business Before and After State Went Dry	Number of Saloon Customers Prior to Dry Period	Types of Customers Replacing Saloons in Locations Vacated	Estimated Average Hours' Use of Light in Locations Vacated by Saloons	Increase or Decrease in Revenue from These Locations	Effect on Show-Window Business	Remarks
Atchison (Kan.) Ry., Lt. & Pwr. Co., 1881, enforced 1902	Favorably	.....	35	Various, all filled	.....	Decreased	Increased	Easier to sell service, easier to collect bills
Leavenworth (Kan.) Lt., Ht. & Pwr. Co., 1881; enforced, 1908	Increased	1906, $141,200; 1907, $193,800; 1908, $192,500; 1909, $210,100; 1910, $246,800	110	All sorts	.....	Increased	Increased	.....
Augusta (Ga.) - Aiken Ry. & Elec. Corp., 1908; enforced 1917	Decreased for few months, then increased	Increase in revenue and customers prior to 1917, 8 per cent per annum; since then, 11 per cent	100 total, 15 large ones	Dry-goods, cigar stores, automobiles, groceries, drugs	Winter, three hours maximum demand, nine hours part load	Increased 15 per cent	(1) Increased materially	.....
Athens (Ga.) Ry. & Elec. Co., 1883	Not at all	No effect	7	Poolrooms, dry goods, fruit and soda stands	.....	No effect	None	.....
Durham (N. C.) Tract. Co., 1909	Increased revenue from light, ice and traction business	.....	21	Various	Smaller	Decrease at first, then increase	(2) Better	Better domestic conditions
Potomac Elec. Pwr. Co., Wash., D. C., 1917	Decrease $50,000 to $60,000 a year	.....	350	Lunch rooms, delicatessen, cigar stores, small goods stores	3	Decreased $50,000 to $60,000 a year	Decreased	.....
Corsicana (Tex.) Gas & Elec. Co., 1909	Temporary decrease	.....	15-20	Groceries, dry goods, fruit, candy, pool halls, soft drinks	Shorter	Decreased	(3) Increased	Net effect is increase because of more revenue from homes
Brush Elec. Co., Galveston, Tex., 1918	Adversely	.....	158	Soft drinks	.....	Decreased 50 per cent	Decreased	.....
American Pub. Serv. Co., Dallas, Tex., 1918	Not noticeable	.....	.....	.....	.....	.....	.....	.....
Fort Worth (Tex.) Pwr. & Lt. Co., 1918	Not noticeable	.....	.....	.....	.....	.....	.....	.....
Eastern Tex. Elec. Co., Beaumont, Apr., 1918	Counterbalanced by general prosperity of city	1916, 10 per cent; 1917, 15 per cent; 1918, 15 per cent	70	Restaurants, soft drinks	5	Decreased 10 per cent to 15 per cent	(4) None	
Texas Pwr. & Lt. Co., Dallas, 1918	Temporary decrease 10 per cent	10 per cent a year until 1918	500, one saloon for every 100 customers	Soft-drink stands, pool halls, picture shows	50 per cent of saloon figure	Temporary decrease, 10 per cent	None	Net result, company did not suffer
An Iowa company, July, 1911	Decrease of $4,000 to $5,000 from light and steam heat	.....	22	.....	.....	Temporary decrease, gain in residence customers	.....	Saloon locations on side streets slow to come back as customers
Clinton (Iowa) Gas & Elec. Co., 1916	Increased	10 per cent	29	All kinds	Same	Increased	.....	.....
Citizens' Gas & Elec. Co., Waterloo, Ia., 1916	Increased generally	.....	26	Soft drinks	One-third former amount	Temporary decrease, $3,600 a year	Decreased	Credits better
An Iowa company, 1916	Change made gradually by reducing number of saloons. Shows some decrease	.....	100	Pool halls, barber shops, soft drinks	Less	Temporary decrease	None	.....
Citizens' Gas & Elec. Co., Council Bluffs, Ia., 1916	Not noticeable	.....	29	Merchandising, soft drinks	Same	Increased 10 per cent	No	Merchandising and credit conditions improved
An Iowa company, 1916	Increased	.....	47	Restaurants	Longer	Same	No	.....
Jackson (Tenn.) Ry. & Light Co., 1909	Temporary decrease	.....	46	.....	.....	Decreased 10 per cent	No	In long run company benefited
Memphis (Tenn.) Gas & Elec. Co.; enforced, June, 1914	$36,000 decrease on annual basis, locations vacant six months to year	.....	400	Good class of stores	.....	Decrease	No	Net result is betterment
A Tennessee company, 1907	.....	Per cent increase: 1906, 23; 1907, 20 1908, 3; 1909, 4.	115	Motion-picture shows, drug-stores, poolrooms, etc.	6	Decreased temporarily	No	Effect of 1907 depression marked
Miami (Fla.) Elec. Lt. & Pwr. Co.	Not noticeable after 60 days	.....	20	Soft-drink and other stores	5 to 7	Increase, due to growth of town, 400 per cent	No	.....
Washington Water Pwr. Co., Spokane, 1916	Slump for first month after closing	.....	270	Every class of business	About the same	Not much change	No	.....
Ltg. Dept., Seattle, Wash., Jan., 1916	Increased	Total revenue: 1914, $1,048,393; 1915, $1,063,730; 1916, $1,206,695; 1917, $1,328,647	Total 300, 150 on city lines	Show stores, cigar stores, poolrooms, restaurants, clothing stores, barber shops, soft drinks	340 hours per month	Slight decrease	No	Conditions so much better, want to forget saloon days
Puget Sound Trac., Lt. & Pwr. Co., entire territory, part 1912, part 1916	Increase in some places, decrease in others	.....	.....	Amusement places, merchandising establishments	.....	Temporary decrease	No	Abolition of saloons a distinct aid to business
Bellingham, Wash.	Temporary decrease 8 per cent	.....	40	Cigars, billiards, dry goods	Same	Increased	No	.....

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TABLE II—DETAILS OF CONDITIONS FOLLOWING PROHIBITION REPORTED BY FORTY-ONE LIGHTING COMPANIES—Continued

Name of Company and Date State Went Dry	How Did Closing Saloons Affect Company's Revenue	Rate of Growth of Lighting Business Before and After State Went Dry	Number of Saloons Customers Prior to Dry Period	Types of Customers Replacing Saloons in Locations Vacated	Estimated Average Hours' Use of Light in Locations Vacated by Saloons	Increase or Decrease in Revenue from These Locations	Effect on Show-Window Business	Remarks
Detroit (Mich.) Edison Co., May, 1918	.....	.....	1600	Immediate result: 69 per cent soft-drink places, 6 per cent other business, 3 per cent undecided, 22 per cent out of business	.....	Decreased	Better	Soft-drink places changing to other stores
Michigan city of about 25,000, 1918	Approximately $4,000 decrease first year	.....	46	Soft-drink places	3	Decreased 60 per cent	Not much	.....
Citizens' Lt. & Pwr. Co., Adrian, Mich., 1910	Decreased temporarily, increased thereafter	Per cent: 1908, 2 per cent; 1909, 3 per cent; 1910, 2.6 per cent; 1911, 6.6 per cent	32	Shoe stores, soft drinks, groceries, lunch rooms	About half former	Decreased 40 per cent	(a) Tended to reduce hours of business, but standards of intensity increased	.....
Bay City (Mich.) Elec. Lt. Dept., 1918	$1,000 decrease per annum	.....	400	Soft drinks	Same	No change	Increased	.....
A Michigan c mpany	Decreased for 60 days	10 to 12 per cent per year steadily	35	Everything from soft drinks to millinery	.....	Decreased 50 per cent	Increased very much	Decreased railway excursion business
Sault Ste. Marie (Mich.) Elec. Co., 1918	Slight decrease	.....	25	Soft drinks	Same	About same	(a) More light used	.....
An Indiana city of 100,000, 1918	Decrease $8,500 annually	11 per cent increase was growth before prohibition; since then there is 1 per cent decrease	275	Restaurants, soft drinks, 63 still vacant	1800 hours per year	Total revenue decreased 20 per cent	(a) Some signs discontinued	.....
Indiana General Service Co., Muncie, closed three times and opened again	No effect after 60-day slump	No effect on any occasion by loss of saloon business	26	Various	.....	No change	No	.....
Northern Ind. Gas & Elec. Co., Hammond, May, 1918	Effect of decrease for only six or eight months	.....	450	Soft drinks, mercantile stores	70 per cent of saloon business	Decreased	No	Feel that ultimate effect will be beneficial
Hydro Elec. Lt. & Pwr. Co., Connersville, Ind., May, 1918	Slightly less	.....	25	All kinds	.....	Slight decrease	No	Collections better, workmen better satisfied
Huntington (Ind.) Lt. & Fuel Co.	All saloons used gas lights	.....	13	Soft drinks	.....	Decreased	No	.....
Ind. Ry. & Lt. Co., Kokomo	Slight temporary decrease in commercial business and immediate increase on residential revenue	.....	30	Mercantile	.....	Increased	(a) No	.....
Merchants' Ht. & Lt. Co., Indianapolis, 1918	Some decrease	.....	Only a few of the city's saloons	Soft drinks	.....	.....	No	.....
Indianapolis (Ind.) Ht. & Lt. Co., May, 1918	Decrease $25,000 per year	Per cent: 1917, 21½; 1918, 26½.	660 total, 370 on company's lines	Mercantile business	Less	Decreased 33 per cent	Sign business decreased	.....
Gary (Ind.) Ht., Lt. & Water Co., 1918	Decreased	.....	150	Pool and billiard halls, groceries, produce markets, soft drinks	50 per cent of saloon business	Decreased 55 per cent	Sign lighting decreased	.....

(a) Residential business increased while income from breweries converted into soft-drink factories was doubled. (a) More lighting in homes. (a) Y. M. C. A. and Elks' Club lighting increased. (a) Small loss in fan business. (a) Residence lighting and house wireing increased. (a) Average income per lighting customer increased. (a) Loss from social clubs lighting revenue, $2,000 per year. (a) Increased rate of residential growth.

N. C., has said: "As you know, Asheville is one of the most popular and attractive resort places in the United States, and we felt that when prohibition came it was going to affect us adversely. The contrary has been the result."

M. C. Linn, general manager of the Des Moines (Iowa) Electric Company, wrote: "I have had experience in several communities and believe from that experience that the loss of revenue is only temporary in any community. All saloon buildings are gradually taken up by different lines of business, and the average community should recover in the course of a year or a year and a half."

While general collections as a rule are better for the absence of saloons, the ability of cities and towns to pay for street lighting is sometimes temporarily impaired. This may necessitate carrying street-lighting accounts for a period. A. C. Marshall of Detroit, whose company serves a large number of dry towns, summarized this situation:

"Some of the smaller villages in our territory experienced a slight financial stringency in the first months after the state went dry. This lasted only until the next tax money was received, and since that time we have noted no difference in our collections. In the larger part of the municipalities served by us, fully 75 per cent, there was no difference."

To summarize the data and impressions on this topic it seems fair to say that the immediate effect is a slump in lighting revenue as the saloons close. Then business picks up again as the saloon locations are reoccupied. The greater buying power of the working people soon makes itself felt in several ways, and the final result is beneficial to the electric company and the community. Any work that sales departments can undertake to assist in making the transition from saloons to other permanent businesses seems to be worth while as it shortens the period of depression.'

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Census Report on Electric Central Stations

Government Returns for 1917 Show that Output of Energy in That Year Was More than Double That for 1912 and More than Quadruple the 1907 Total—Aggregate Income, $526,000,000

ACCORDING to a report about to be issued by Director S. L. Rogers of the Bureau of the Census, Department of Commerce, the electric light and power stations in the United States during the year 1917 generated more than 25,000,000,000 kw.-hr. of electrical energy, producing an income of more than $500,000,000, and gave employment to more than 100,000 persons, whose salaries and wages aggregated nearly $100,000,000. The output in 1917 was more than double that for 1912 and more than quadruple the output for 1907.

This report, which was prepared under the supervision of Eugene F. Hartley, chief statistician for manufactures, covers both commercial and municipal plants, but does not cover electric plants operated by factories, hotels, etc., which generate energy for their own consumption, plants operated by the federal government and state institutions, nor plants that were idle or in course of construction.

The figures show great strides in the industry during both of the five-year periods 1907-12 and 1912-17. The output of electrical energy by the light and power stations increased at a considerably greater rate and their expenses at a slightly greater rate than their income, and the rate of increase in the number of persons employed was much smaller, particularly during the later five-year period, than that in the amount of business.

The total number of establishments increased from 5221 in 1912 to 6541 in 1917, the latter comprising 4224 commercial and 2317 municipal establishments. The increase indicated by these figures is somewhat misleading, since 2296 new establishments came into existence between 1912 and 1917, but as a result of combinations in the commercial systems and various other changes, the net increase was only 1320, comprising 565 commercial and 755 municipal stations.

The total income of the stations in 1917, of which 95.3 per cent represented electric service, amounted to $526,886,408, an increase of 74.3 per cent as compared with 1912 and of 200 per cent as compared with 1907. The total expenses were $427,136,049, or 82.1 per cent more than in 1912 and 218.3 per cent more than in 1907. The employees of the light and power stations numbered 105,546, an increase of 33 per cent over 1912 and of 121.6 per cent over 1907, and their salaries and wages aggregated $95,239,954, an increase of 55.7 per cent as compared with 1912 and of 168.9 per cent over 1907.

The total primary power in 1917 amounted to 12,857,998 hp., an increase of 70.8 per cent as compared with 1912 and of 213.7 per cent over 1907. Of this power nearly two-thirds—8,389,389 hp.—was derived from steam; almost one-third—4,251,423 hp.—from water, and the remainder—217,186 hp., or less than 2 per cent—from internal-combustion engines. The corresponding proportions for 1912 and 1907 differed but slightly from those just stated. The average horsepower per steam engine shows a very great increase—from 334 in 1907 to 631 in 1912 and to 1124 in 1917. The average horsepower of the waterwheels also shows a marked increase from census to census, but in the case of the internal-combustion engines there has been a decline.

The total dynamo capacity, 9,001,872 kw. in 1917, represents an increase of 74.3 per cent as compared with 1912 and 232.2 per cent over 1907, these rates of increase being slightly greater than the corresponding ones for total primary power. The output of electrical energy aggregated 25,438,611,417 kw.-hr., an increase of 119.9 per cent for the period 1912-17 and of 333.9 per cent for the decade. Of the 6541 establishments reported for 1917, those which purchased all their electrical energy from other establishments numbered 1422, as against 507 in 1912 and 227 in 1907.

CENSUS BUREAU REPORT OF ELECTRIC LIGHT AND POWER STATIONS IN THE UNITED STATES—1917

	1917	1912	1907	Per Cent of Increase (*) 1907 to 1917	1912 to 1917	1907 to 1912
Number of establishments	6,541	5,221	4,714	38.8	25.3	10.8
Commercial	4,224	3,659	3,462	22.0	15.4	5.7
Municipal	2,317	1,562	1,252	85.1	48.3	24.8
Income	$526,886,408	$302,273,398	$175,642,338	200.0	74.3	72.1
Electric service	$502,100,346	$287,138,657	$169,614,691	196.0	74.9	69.3
All other	$24,786,062	$15,134,741	$6,027,647	311.2	63.8	151.1
Total expenses, including salaries and wages	$427,136,049	$234,577,277	$134,196,911	218.3	82.1	74.8
Number of persons employed	105,546	79,335	47,632	121.6	33.0	66.6
Salaries and wages	$95,239,954	$61,161,941	$35,420,324	168.9	55.7	72.7
Total horsepower	12,857,998	7,530,044	4,098,188	213.7	70.8	83.7
Steam engines:						
Number	7,464	7,847	8,054	-7.3	-4.9	-2.6
Horsepower	8,389,389	4,949,778	2,693,273	211.5	69.5	83.8
Internal-combustion engines:						
Number	2,946	1,116	463	536.3	164.0	141.0
Horsepower	217,186	111,035	55,828	289.0	95.6	98.9
Waterwheels:						
Number	3,357	2,939	2,481	35.3	14.2	18.5
Horsepower	4,251,423	2,469,231	1,349,087	215.1	72.2	83.0
Kilowatt capacity of dynamos	9,001,872	5,165,439	2,709,225	232.2	74.3	90.7
Output of stations, kilowatt-hours	25,438,611,417	11,569,109,885	5,862,276,737	333.9	119.9	97.3
Stationary motors served:						
Number	554,817	435,473	167,184	231.9	27.4	160.5
Horsepower	9,216,323	4,130,619	1,649,026	458.9	123.1	150.5
Number of street lamps:						
Arc	256,838	348,643	(†)	—	-26.3	—
Incandescent, etc	1,389,382	681,957	(†)	—	103.7	—

*A minus sign (-) denotes decrease. † Not available.

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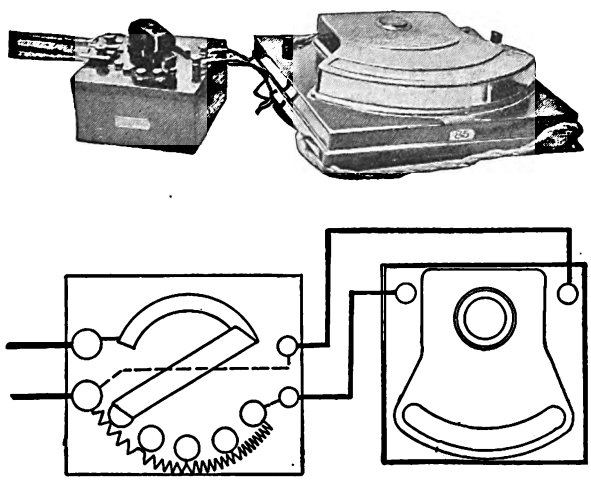
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

MULTI-RANGE AMMETER WITH EXTERNAL SHUNTS

Laboratory-Type Millivoltmeter Arranged with Five-Tap Shunt, of Which Any Tap Can Be Brought Into Main Circuit by Handle

For the measurement of the current employed in photometric tests of incandescent lamps, in magnetic tests of iron bars and in the lamps of optical pyrometers, the Electrical Testing Laboratories, New York City, have developed a multi-range ammeter which consists of a millivoltmeter with a five-tap shunt controlled by a handle. The accompanying diagram shows the circuit connections of the apparatus, which em-



PHOTOGRAPH AND DIAGRAM OF INSTRUMENT WHICH EMBODIES THE PRINCIPLE OF THE AYRTON SHUNT

bodies the principle of the Ayrton universal shunt. As the handle is turned from the shunt of lowest resistance and largest current range, the various shunts which are connected in series and which up to that instant have constituted a part of the series resistance of the instrument circuit are transferred to a position in the main line.

The apparatus illustrated herewith allows ranges of 0.75, 1.5, 3, 7.5, and 15 amp. when connected to a meter having a 200-millivolt range and a resistance of about 8 ohms. An unlimited number of uses can be found for this method, because it can be extended for building shunts of about 500-amp. range.

The rotating multiple-leaf contact blade is made broad enough to bridge the gap between the contact studs so that the main-line circuit can never be opened. Shunt adjustment by comparison with a standard ammeter is somewhat tedious but not at all difficult since the resistances of the various steps desired can be readily computed. It is probably easier, however, to adjust each shunt by comparison with a standard resistor using the Kelvin double-bridge method. Obviously the contact resistance of the rotating switch does not affect the accuracy of the indications of the instrument.

This information was contributed by Gordon Thompson of the Electrical Testing Laboratories.

ELECTRIC BRASS FURNACES DISPLACE OTHER TYPES

One Company Uses 2500 Kw. for Melting in Three-Phase Furnaces, Another Requires 800 Kw. for One-Phase Induction Furnaces

Brass manufacturers who recently met in the convention of iron and steel electrical engineers at Pittsburgh said that they knew from experience that there are now electric brass furnaces whose metallurgical efficiency justifies their use in preference to fuel-fired furnaces. W. R. Clark, works manager of the Bridgeport (Conn.) Brass Company, spoke on the experience of his company, which has in operation a total of 800 kw. in the Ajax Metal Company's "Wyatt" single-phase, 60-cycle induction furnaces melting brass. He said that the largest furnace has a demand of 75 kw. at 75 per cent power factor, and its pouring capacity is from 500 lb. to 600 lb. (340 kg. to 290 kg.) per hour. These furnaces have melted and poured from 6 lb. to 9 lb. (2.7 kg. to 4.1 kg.) of brass per kilowatt-hour, and the linings are being used for as many as 2000 heats each. A 75-kw. rating is not the largest for which this type of furnace can be built, but when designed for 60-cycle operation the power factor drops rapidly with increased size. The induction furnace is found to have the advantage of heating the bath from within, automatically stirs the molten metal and has very little tendency to give off spelter. However, the furnace is limited in size and has the disadvantage that it must be started with molten metal from another furnace. This latter characteristic is more of a drawback in a foundry than in a brass mill.

The Bridgeport (Conn.) Brass Company is increasing its electric melting capacity by the addition of a 1-ton (900-kg.) "Detroit" rocking-type brass furnace which has opposed arcs from electrodes entering through the center of an oscillating drum. The voltage across the arc is 65, and the maximum demand is from 250 kw. to 300 kw. per ton. This furnace is expected to melt a ton of brass with from 225 kw.-hr. to 300 kw.-hr. of energy. The higher consumption is for mixtures high in copper, which require a greater temperature.

It was stated in an informal discussion after the close of the meeting that whereas oil-fired furnaces are limited to a capacity of about 1000 lb. (450 kg.) of brass each, there are now in operation "Bennett" three-phase brass furnaces with capacities up to 5 tons (4500 kg.) of brass each. These furnaces have not yet been placed on the market, but there was said to be an installation in actual operation aggregating some 2500

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kw. demand. The demand of these furnaces is about 150 kw. and the energy consumption 300 kw.-hr. per ton. These figures are for the net amount of metal poured, not charged, and include the transformer losses, the energy for the furnace auxiliaries and the losses due to the shut-downs on holidays and week-ends.

The cost of power in melting brass is too small an item relatively to be considered, the brass men agreed. The quality of the mixture and the spelter loss determine the value of an electric furnace to a brass operator. It is known that electric furnaces have cut the spelter loss to but a fraction of the loss in oil-fired furnaces, but owing to the absorption of the furnace lining it is difficult to calculate exact values. It is this absorption of zinc and lead that limits the useful life of the furnace lining. One per cent of all the metal poured is often reclaimed out of the furnace lining.

One of the engineers said that the spelter loss depends to a large extent on the mixture used. Some electric furnaces which can melt red brass successfully cannot melt brass containing zinc without an excessive metal loss. One large Eastern brass mill which uses over 160 different mixtures is experimenting to find the type of furnace in which each mixture can be melted to the best advantage. It will probably be two years, however, before the investigation is complete. The same company is also looking into the labor requirements of the different furnaces.

It was stated that the large electric brass furnaces are conducive to better working conditions. There is less but more interesting work for the operator, and this makes it easier to attract high-grade men, who will be able to carry out the specific instructions which can be given when electric brass furnaces are used.

DATA ON INSTALLATION OF INDUCTION MOTORS

Western Association of Electrical Inspectors Adopts Standard Sizes of Conductors and Fuses for Induction Motors

The National Electrical Code does not specify the size of wire which should be used to connect up any given motor, nor does it give the sizes of starting and running fuses to be used. A committee of the Western Association of Electrical Inspectors therefore compiled tables based on the code rules which give this much-needed wiring information for single-phase, two-phase and three-phase motors. Excerpts from the report and the recommendations for three-phase motors follow:

SQUIRREL-CAGE THREE-PHASE INDUCTION MOTORS EQUIPPED WITH COMPENSATORS

Average Hp.	Full-Load Amp. 220 Volts	Full-Load Amp. 550 Volts	Starting Fuse Amp. 220 Volts	Starting Fuse Amp. 550 Volts	Running Fuse Amp. 220 Volts	Running Fuse Amp. 550 Volts
0.5	1.8	0.7	5	5	5	5
1	3.5	1.3	10	5	5	5
2	6.5	2.6	20	10	10	5
3	9.5	3.8	30	10	15	5
5	15.4	6.2	40	15	20	10
7 5	22 4	9	60	25	25	15
10	29	11.8	70	30	35	15
15	42.5	17.4	85	40	45	20
20	55	22.5	110	55	60	25
25	68	27	140	65	75	30
30	80	32	160	70	90	35
35	94	37	190	75	110	40
40	105	42	210	85	115	45
50	130	52	260	110	145	60
60	155	62	310	125	170	70
75	192	77	390	160	210	85
100	252	101	500	200	280	110
150	368	148	730	300	410	160
200	484	195	920	390	530	215
250	595	240	1200	480	650	265
300	710	285	1420	570	780	31[illegible]

No consideration was given to limiting the voltage drop at the motor. Motors without a starting device and those operating at less than 600 r.p.m. require, in the majority of cases, one size larger wire or cable than the table calls for. The wires in the table are calculated for two and one-half times the full load current of motors up to 30-amp. rating and for twice the full-load current of larger motors.

Wire or cable sizes for other types of continuous-duty induction motors should be based on the following multiples of the full-load current: Squirrel-cage motors up to 7.5 hp. without starters, three times full-load current; squirrel-cage motors with star-delta starting switch, one and a half times full-load current; wound-rotor motors with resistance in rotor, one and a tenth times full-load current, and single-phase repulsion motors up to 15 hp., twice, and single-phase motors with split-phase starting, three times full-load current.

THREE FIREMEN ARE FOUND TO BE CHEAPER THAN TWO

Sufficient Coal Has Been Saved by Changing from Twelve-Hour to Eight-Hour Shifts to More than Pay the Increase in the Payroll

Operating costs have been reduced in a number of power plants by changing the boiler-room crew from two twelve-hour shifts to three shifts of eight hours each, according to statements made at the last meeting of the station operating committee of the Ohio Electric Light Association. From 5 per cent to 7 per cent of the entire fuel expense was saved, and this was more than enough to pay for the 50 per cent increase in the boiler-room payroll. This saving cannot be effected when the firemen handle only a small amount of coal; in the cases cited above the cost of fuel was 70 per cent or more of the total operating costs.

However, cost is not the only consideration. Those who have had experience with both two and three shifts say that the eight-hour day makes working conditions easier and reduces the labor turnover. Furthermore, it attracts a better grade of fireman, and as a result the proper boiler pressure is maintained more constantly and the service is improved.

Unit-Cost Estimates for Small Hydro Plants

The high cost of fuel is causing the investigation of many small water-power possibilities, and the following data from an estimate of the construction cost of a 180-kw. installation in Massachusetts are suggestive. The total estimated cost of the development was $50,000, or about $277 per kilowatt (March, 1919, prices). The unit costs in the estimate included:

Earth excavation, per cubic yard	$1.50
Ledge excavation, per cubic yard	4.00
Two 90-kw. generators, per kilowatt	40.00
Installation of generators, per kilowatt	8.33
Two 42-in. turbines, 21.4-ft. head, per kilowatt of plant generating capacity	38.80
Installation of turbines, per kilowatt plant generating capacity	8.33
Gates and racks, per kilowatt	2.78
Concrete wheel casing and draft tube installation, per kilowatt	5.55
Power plant building, per square foot (brick)	6.00
Concrete canal and forebay, per kilowatt	28.80
Concrete penstock (length 740 ft., inside diameter 5 ft. 6 in.), per kilowatt	55.50
Engineering and incidentals	24.50

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

EFFICIENCY MEETINGS FOR COMPANY EMPLOYEES

Texas Company Handles This Work by Bringing Together Department Members for the Purpose of Discussion

Employees of the Texas Power & Light Company have inaugurated a series of efficiency meetings. The objects of the meetings are (1) to discuss how to do every duty with the least possible effort, (2) to learn how to coöperate with other employees, and (3) to discuss safety for the employees. These meetings are being held by departments. Thus at the meeting of the members of the commercial department the following special topics were discussed and in a number of instances new and better ways of conducting the company's business were decided upon: Handling of telephone calls; handling and filing of orders; time for securing information from new customers; handling complaints; daily balance of customers' ledgers; "disconnects" of customers leaving town; handling of old balances in customers' ledgers and deposit reserve accounts; safety first; merchandising; routing list; delinquent accounts, and miscellaneous discussion.

A STUDY OF SERVICE EXTENSION POLICIES

State Commission Rulings on Extensions Public Service Corporations Shall Make Gratis and What They Shall Charge in Other Cases

A. J. Geodjen, statistician of the Wisconsin Public Service Company, Milwaukee, recently made a study of service extension policies laid down by state commissions. He found several different service extension methods and rules employed by commissions, among which the outstanding ones follow: First—Deposits made by consumer toward construction of an extension considered strictly as a loan, the utility to refund a percentage of the revenue received monthly from the extension and to refund the entire loan with interest within five years. Second—The Illinois pre-war rules granting each consumer a two-pole extension. If extension is beyond two poles per consumer, a deposit is made covering the balance. For each consumer added within ten years a refund of the equivalent of a free extension is made. The total refund shall not exceed the original deposit and no interest is to be paid. Third—The Indiana rules, similar to the Illinois rules except that the allowable free extension is equal in amount to twice the estimated yearly revenue. No interest is paid. Fourth—In various specific cases the consumer is required to guarantee a yearly revenue in excess of the ordinary minimum charges in order to give the utility some assurance of results. The term of this protection to the utility is sometimes short and sometimes indeterminate. Although frequently used in individual cases, to Mr. Geodjen's knowledge there are no cases where this method has been used in a general rule covering all extensions a utility may be called upon to make.

This whole subject was covered in detail by Mr. Geodjen in a paper recently read before the Wisconsin Electrical Association. After making this summary the author expressed his preference for the Indiana commission's rule for the following reasons: (1) That every consumer may have a free extension in proportion to the estimated revenue. (2) This free extension can be operated by the utility without loss. (3) The consumer takes the risk in that part of the investment not warranted by revenues at the beginning of the extension. (4) The utility assumes additional investment in the line if within ten years other consumers are added to the lines. This makes the original depositor finally sacrifice only that part of the entire investment in the line which is not warranted by the revenues from the line after ten years of development. (5) Adjustment in rates or variation in construction costs are automatically included in the calculation. (6) Utility's capital account will not be likely to be overloaded by unprofitable investments.

In the discussion B. F. Lyons of Beloit stated that commissions evidently discriminate against the present customer of the utility company in favor of the prospective customer by making the returns on the investment from an extension pay only common interest rates, whereas they are willing for the general run of business of the company to pay around 8 per cent. He expressed the belief that the present high cost of money should be taken into consideration in fixing this charge. It was also suggested in the discussion that the minimum charge rather than the estimated revenue should be the basis for computing income on any extension. In general it appeared from the remarks that the central-station companies of Wisconsin are planning to go ahead with extensions.

A representative of the Public Utilities Commission, speaking in the discussion, expressed the belief that public utility commissions are getting away from the policy of making general rules. It has been learned by experience that general rules will outlive the situations which they are created to cover, and that they thus outlive their usefulness and are very apt to create an embarrassing situation. This speaker also pointed out that a great many new-business men in central-station organizations are in the habit of referring to rules of the company or of the commission at times when a customer requests an extension which the new-business department does not feel justified in making on the basis of the revenue it will return. This not only antagonizes the customer, making him feel resentful against the company, but it also angers him so that he writes to the public utility commission to explain his grievance. This business of "passing the buck" to the public utility commission, the speaker thought, should be stopped.

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INDUSTRIAL DEPARTMENT CREATES NEW BUSINESS

Outline of Accomplishments of Such a Department in the Communities Served by Wisconsin-Minnesota Company

A review of the accomplishments of the industrial department put into effect about three years ago by the Wisconsin-Minnesota Light & Power Company in its endeavor to encourage the securing of industries for the communities it serves was made by N. J. Whelan before the recent meeting of the Wisconsin Electrical Association.

This department was organized for the purpose of carrying out several clearly defined lines of work. First, a complete survey was made of the resources of the community served by the corporation. Data were collected as to the number of factories in each community, the number of people employed, the number of unemployed help available in contiguous localities, wage scales, price of factory sites, railroad facilities, housing accommodations, and the adaptability of communicating with various lines of manufacturing. Furthermore, this department was placed at the disposal of each community to help in the organization of commercial bodies, or where such organizations existed to help in industrial development.

While the company does not claim credit for all the developments made, still it believes that a considerable number of these industries that have been developed there would not have been in existence in that locality had it not been for the direct and indirect assistance given through the company's industrial department.

In placing industries a survey was made of the conditions existing in close proximity to the community involved as well as in the city. For instance, it was found that in some localities, on account of the existence of various kinds of timber, woodworking factories would be desirable. A special survey, therefore, was made of the woodworking field by a member of the board of directors of the company, and as a result there is one establishment turning out crates and boxes, employing at this time eighty-five people. In addition, a toy-manufacturing company has been organized and is doing a large volume of business. A phonograph factory is now in operation, and at no time since the beginning of this business has it been able to keep pace with the orders for its output.

Of value to the agricultural interests has been the erection of a canning factory, two salting plants and one sauerkraut factory. In a land survey undertaken by one of the communities attention was called to a large tract of clay land, and now there is in a preliminary stage of creation a plant for the manufacture of brick, sewer pipe, tiling and paving brick. A number of other factories have been placed, turning out iron and steel, rubber, automobile and other products. All told, the industries placed in these communities require the employment of 975 people, which is, of course, of direct and indirect benefit to both the communities and the utility company.

"Besides giving the company in a community a valuable knowledge of the community and industrial conditions," Mr. Whelan states, "and bringing community and company in close relationship, there is also the satisfaction on the part of the company of seeing industry develop, and it is gratifying to the officers of that organization to be able to say that the company was instrumental not alone in building up its own projects and organization but in helping to develop that entire portion of the state."

PARALLEL PLAN OF SELLING HELPS UTILITY AND DEALER

Better Distribution of Electrical Appliances Obtained Through the Combined Efforts of the Two Branches of the Industry

"It is necessary for the central station and for the dealer that they both sell electrical devices," said W. S. Heald, manager commercial service department of the Duluth (Minn.) Edison Electric Company, in a paper read recently before the Minnesota Electrical Association. The reasons back of Mr. Heald's statement and what he believes each of the two branches of the industry should do for the common good are as follows:

The central station receives a direct financial gain from every good electrical appliance a dealer sells, and the more successful dealers there are in business the easier it becomes for consumers to buy such devices. The dealer, on the other hand, benefits by the indorsement the central station gives to the use of energy-consuming devices, he profits by the utilities' advertising, by its general missionary work and by the large number of consumers who become familiar with the dealer's goods through visits to the central-station offices.

The central station is more interested in the number of devices sold than in who sells them. If the dealers will sell more, the central stations may sell less, but usually the central stations have to sell more because the dealer does not sell enough.

It is considered to be the function of the central station to encourage the use of electrical appliances by having a properly designed rate schedule for the purpose, by having attractive display rooms, efficient demonstrators and a repair shop where users may have their appliances repaired promptly and with little effort on their part. The central station should also conduct campaigns to educate the public in the advantageous use of the electrical devices which can be used in a home, and it should work with the architects to have a multiplicity of receptacles installed in all new homes. The lighting companies can help all dealers by maintaining list prices and can greatly assist the less experienced dealers in developing efficient merchandising methods.

The dealer, on the other hand, greatly benefits by the demand for his product created by the central station. The dealer should supplement the work of the utility by maintaining an attractive-looking store, he should only handle reliable merchandise and should be prepared to give his customers service after the sale has been made.

Both interests should combine to perfect ethical and more aggressive business methods, they should arrange to advertise the same things simultaneously in order to reap the advantage of cumulative advertising effect, and they should agree not to make conflicting statements about the operating costs and characteristics of any appliance.

The merchandising efforts of the central station and the dealer are complementary rather than competitive, and if this fact is remembered there will be better feeling between them and more merchandise sold.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

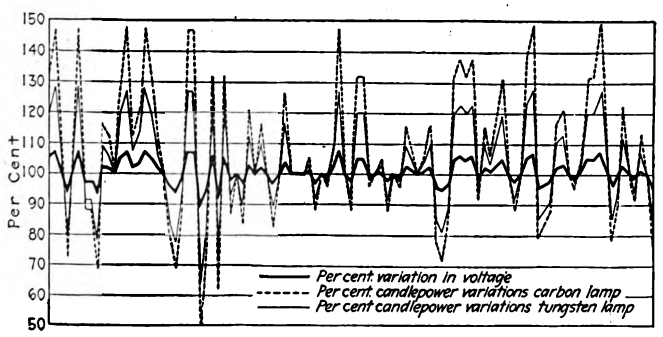
Winding Coils for Old Armatures.—Greater precautions are necessary in winding coils for repairing armatures than when the coils are to be installed in new armature cores. Additional insulation is necessary at corners and between leads where clearance with core is small and large radius bends give greater flexibility for rewinding. Several types of armature coils in different stages of manufacture are illustrated. It is also stated that coils should be tested under pressure while hot.—*Electric Railway Journal,* March 22, 1919.

High-Speed Rotors in Theory and Practice.—R. NEUMANN.—After referring, with references to the original sources, to the various authors who have dealt with the problem of rotating flywheels and their stresses and to the uncertainty involved in the calculations, the author advocates the large-scale factory testing of such parts as built-up rotors. A specially equipped testing pit, of "bomb-proof" construction, used by the A. E. G. for this purpose is then described.—*Science Abstracts, Section B,* Jan. 31, 1919. (Abstracted from *Elekt. Zeits.,* Aug. 8 and Aug. 15, 1918.)

Lamps and Lighting

Illumination of Hotel Rooms.—W. F. LITTLE and A. C. DICK.—A very comprehensive table of the illumination in various parts of hotels is given in this paper. One of the features brought out is that the guest rooms are not commonly illuminated sufficiently for writing and reading purposes.—*Transactions I. E. S.,* Feb. 10, 1919.

Urban Rapid Transit Car Lighting.—C. W. WILDER and A. E. ALLEN.—The study refers particularly to the underground rapid-transit systems of New York City. Investigations of illumination in cars carrying passengers indicate that, owing to fluctuations and contrasts, a minimum of 3 foot-candles is necessary for car lighting in order to avoid complaints from the traveling public. The fact that the starting load of a ten-car train is approximately 4000 amp. and that of a six-car train 2800 amp. results in a voltage at the operating car as low as 450. It is not felt, however, that the use of more copper in the feeders is justified in order to obtain better illumination alone. The curves shown herewith give an idea of the voltage fluctuation and consequent candlepower changes during a typical run in one of these systems. Conclusions from this study may be summed up as follows: (1) Under favorable conditions a satisfactory illumination may be obtained in a rapid transit car with about 1.4 watts per square foot of floor area; (2) the design of the car roof and the type of illumination may well be considered together, although it will not necessarily follow that the roof design can be subordinated entirely to the illumination; (3) about twenty units are necessary for proper distribution of light in cars within the dimensions of the two cars under discussion; (4) the location of the lighting units along the center line of the ceiling will not provide a satisfactory illumination under certain operating conditions that occur frequently.—*Transactions I. E. S.,* Feb. 10, 1919.



VOLTAGE AND CORRESPONDING CANDLEPOWER DURING A TYPICAL RUN

Generation, Transmission and Distribution

Saving Coal in Steam Power Plants.—Economy in any power-plant operation demands definite knowledge as to whether coal would be saved by purchasing power on the one hand or generating the power in a privately owned plant on the other hand. If the decision is in favor of the latter alternative, the problem how to save coal and obtain maximum production with minimum waste must be solved. A diagrammatic insert is attached to the paper which shows where and how much heat is lost in the plant. The main sections of the paper are headed: "Check Operation Closely," "Principal Losses in the Plant," "Power Plant Records," "Engine Room," and "Use of Exhaust Principal Factor."—*Reprint of Engineering Bulletin No. 2,* United States Fuel Administration (*Technical Paper 217,* Bureau of Mines).

Colloidal Fuel.—Under the direction of the Submarine Defense Association a considerable amount of work has been done during the war on the problem of combining coal with petroleum fuel oils. It is said that this problem has been very successfully attacked. It is now possible to combine in a stable liquid fuel about 45 per cent oil, 20 per cent tar and 35 per cent pulverized coal, thereby replacing over one-half of the oil, securing equal or greater heat values per barrel and saving considerable cost. Various combinations of these ingredients are given in the report, together with estimates of the possible savings through such combinations.—*Report of Submarine Defense Association,* March 1,1919.

Single-Wheel Compound Water Turbines and Multistage Centrifugal Pumps.—H. BAUDISCH.—Very narrow Francis turbines yield unsatisfactory efficiency. The lower limit of runner-wheel entrance breadth to runner-wheel entrance diameter is from one-fifteenth to one-twentieth, corresponding to a specific speed of about 60 r.p.m. There is a gap between the range of applicability of the Francis slow runner and that of

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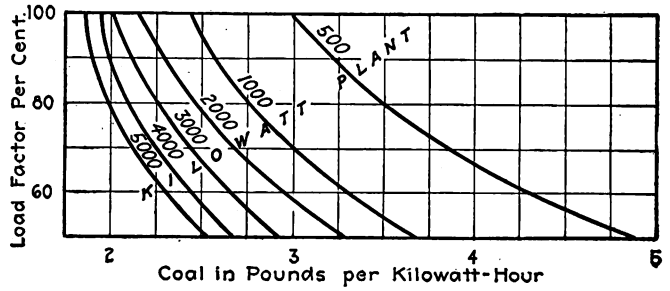
the free-jet high-speed runner, the highest specific speed of which with single nozzle is about 35 r.p.m. This gap is filled by the Pfarr compound turbine, in which water flows in series through several runners on one shaft. It is claimed that better results can be obtained at lower capital cost by allowing the water to flow twice or more through the same wheel. The guide and outlet chamber are divided into two equal parts. Half of the guide equipment is connected to the high-pressure pipe and half of the outlet chamber to the turbine suction pipe; the second half of the outlet chamber is connected to the second half of the guides. This single-wheel compound turbine has 100 per cent higher specific water volume than the Pfarr turbine and the same specific speed. It can be built as an axial or radial turbine or as a combination type; it can also be built as a spiral turbine with the spiral for each stage over one-half of the runner wheel. The use of a double-sided outlet on the runner wheel overcomes the axial thrust of the axial radial turbine.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Zeits. Ges. Turbinenwesen*, 1 and 2, 1918.)

Rate of Coal Consumption in Various Electric Generating Stations and Industrial Establishments in Canada and the United States.—This material is worked up from data on electric power stations which use coal for fuel and use it entirely for generating steam. Tables



RATE OF COAL CONSUMPTION IN MANY PLANTS

are produced which give coal consumption in central stations ranging from 1000 kw. to 50,000 kw. The accompanying curve gives rate of coal consumption per kilowatt-hour for various sizes of plants.—Report of Hydro-Electric Power Commission of Ontario, Feb. 15, 1918.

COAL CONSUMPTION OF CENTRAL STATIONS

Station Capacity, Kw.	Maximum Load, Kw.	Kw.-hr. Generated	Kw.-yr. Generated	Per Cent. Load Factor	Lb. per Kw.-hr.	Tons per Kw.-yr.	Coal: B.t.u. per Kw.-hr.	Coal: B.t.u. per Lb.	Consumption, Tons per Year	Kw.-hr. per 100,000 B.t.u.	Efficiency, Per Cent.
650	425	1,123,820	128	29.3	7.65	34.60	95,600	12,500	3,930	1.04	3.5
2,980	1,570	4,703,600	538	34.2	4.30	19.00	55,500	12,900	9,230	1.80	6.2
7,230	3,820	10,422,000	1,190	31.7	4.07	17.80	48,500	11,900	20,200	2.06	7.0
24,600	10,760	33,500,000	3,820	36.0	2.90	12.75	39,600	13,600	48,030	2.50	8.6
96,000	62,060	200,679,750	23,650	36.9	2.00	8.80	28,000	14,000	201,420	3.57	12..1
149,000	92,080	360,218,000	41,000	44.7	1.92	8.40	25,900	13,500	345,580	3.86	13.1

Installations, Systems and Appliances

Electric Drive for Machine Tools.—A. SOULIER.—A well-illustrated article dealing particularly with the substitution of automatic for manual control in motor-starting apparatus. Starters actuated by push buttons and by means of contactors are described, as is the equipment of an electrically operated machine tool, and the method of installing motors upon machine tools comes in for examination.—*Revue Générale de l'Electricité*, March 8, 1919.

Electrophysics and Magnetism

Thermal Expansion of Molybdenum. — LLOYD W. SCHAD and PETER HIDNERT.—From a preliminary determination of the thermal expansion of molybdenum it is suggested that the most accurate equation between —142 and —19 deg. C. is: $L_t = L_o(1 + 5.15t \times 10^{-6} + 0.00570t^2 \times 10^{-6})$.—*Scientific Paper No. 332*, Bureau of Standards, Jan. 29, 1919.

Electrochemistry and Batteries

International Competition in the Products of the Electric Oven.—An editorial in the *Journal du Four Electrique* of Paris, dealing with the effect on the electrochemical and electrometallurgical industry of the change from war to peace, figures things out in this rather interesting way: "It seems indeed that from the point of view of international competition the most favored countries for production should be, first, those like France and Switzerland where the electrochemical and electrometallurgical factories work with electrical energy which belongs to them, because it is evident that they are able to count it at the minimum in their price of manufacture and to dispose of it at a profit to other industries if this be necessary. Next come the Scandinavian countries, where the power houses make long-term contracts for energy, the financial dependence of the system being compensated for by the relatively low price of electricity and the permanance of the supply, periodic service being the exception in that country. Finally, in the last category, must be placed countries like England, in which the energy is derived from the consumption of coal—that is to say, costs much more than hydroelectric energy—or those like the United States, where the cost of producing energy is much higher than in Europe, even for important and long-term contracts."

Metallic Carbides, Borides and Silicides. — JEAN ESCARD.—From the point of view of their manufacture these products belong to the domain of electrothermics. As regards their employment they are characterized by diverse qualities, such as their hardness, their metallurgical nature, the substances which on contact with certain bodies they form, etc. They tend to become more and more industrial products. The article here noted reviews them at length from this point of view.—*Revue Générale de l'Electricité*, March 1, 1919.

Units, Measurements and Instruments

Calibration of Base-Metal Thermocouples.—C. S. CROUSE.—The author takes up the subject of keeping base-metal thermocouples and pyrometers in a condition for accurate temperature control and gives a description of the equipment required. It has been found that the proper adjustment of such apparatus has resulted in marked improvements in the treatment of steel. It is

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suggested that other industries interested in temperature control should find the material in this paper useful.—*Engineering and Mining Journal*, March 8, 1919.

Measurement of Water Flow by Orifice Buckets.—M. L. ENGER.—The orifice bucket is designed to meet rather special conditions and is peculiarly adapted for the measurement of water where a device which is portable, simple in construction and low in cost is essential. It is particularly suitable for the measurement of water when the water is discharged with considerable momentum from the end of a vertical pipe. The measuring capacity, moreover, covers a considerable range. The design of such a bucket for the measurement of water discharged from deep-well pumps is given in the bulletin with calibration curves which indicate that the apparatus is accurate within 5 per cent when properly applied.—*University of Illinois Bulletin No. 105*, May 13, 1918.

Instrument for Recording Sea-Water Salinity.—A. L. THURAS.—A new method of obtaining a continuous record of the surface salinity of ocean water by the measurement of electrical conductivity is described.—*Journal Washington Academy of Sciences*, Dec. 19, 1918.

Telegraphy, Telephony and Signals

Electrical Oscillations in Antennas and Inductance Coils.—JOHN M. MILLER.—The theory of circuits having uniformly distributed electrical characteristics, such as cables, telephone lines and transmission lines, has been applied to antennas. It is said that the results of this theory do not seem to have been clearly brought out, and it is hoped that in this paper some misunderstandings may be cleared up. No attempt has been made to show how accurately the theory applies to actual antennas. The transmission-line theory can also be applied to the treatment of the effects of distributed capacity in inductance coils.—*Scientific Paper No. 326*, Bureau of Standards, Oct. 23, 1918.

Safety and Fire Protection Engineering.—The report deals with the possibility of training disabled soldiers for service in safety and fire protection engineering.—*Report Federal Board of Vocational Education*, January, 1919.

Ground Telegraphy in the World War.—LIEUT. WILLIS L. WINTER.—The development of ground telegraphy in the war zone is described in this article, with the suggestion that this system of communication may be of interest as applied to civil life.—*Journal of Electricity*, March 1, 1919.

Unification of Telephone Systems.—D. E. WISEMAN.—The unification of the manual and automatic telephone systems of Los Angeles has been accomplished. The two systems had been operating side by side for over sixteen years, and the automatic system was the largest of its type in the country. For this reason the successful unification of these systems is of considerable interest.—*Journal of Electricity*, March 1, 1919.

Miscellaneous

Bureau of Mines' New Laboratories.—In this article a complete description of the new laboratories of the Bureau of Mines in Pittsburgh is given. A complete outline of the work proposed by the Fuel Section is also given.—*Power*, March 18, 1919.

Difficulties in Electric House Heating.—JOSEPH F. MERRILL.—Figures given by the author indicate that electric house heating is not a practicable load for the average power company at the present time nor is it likely to become so without radical advances in the economical generation of electricity.—*Journal of Electricity*, March 1, 1919.

Filing System for Central-Station Use.—G. C HOGAN.—After much experimentation the Dewey decimal system was decided on by the Southern Sierras Power Company as the only adequate basis for a filing system. The actual system as adopted by this company is given as an example of how the general system may be fitted into the needs of such an organization.—*Journal of Electricity*, March 1, 1919.

Conservation of Meter Department.—J. T. KERMODE.—The writer outlines the experience of one company during the war, with particular reference to the operation of the meter department with what might have been considered an insufficient force. He says that certain of the men were selected as the most competent and these were assigned to positions of responsibility. In some instances they worked longer hours than normal, but the company was able to pay the men accordingly by the reduction of expenses in other ways. All clerical work and work of a mechanical nature was performed by women or younger men so that the expenses for this class of work could be reduced sufficiently to pay the good men better wages. With regard to the meter readers the company attempted to make use of a bonus system, depending upon the number of meters read, but considerable difficulty was encountered in that the meter reader would fail to visit the customer's premises and would put down fictitious readings which sometimes got the company into difficulties. Women have been used in the work of reading meters, and the company has applied the same scale of wages to them as to men provided they were able to read as many meters as the men formerly had been able to read.—*Ohio Electric Light Association Monthly*, February, 1919.

Future of the Electrical Industry in Rumania.—A communication from the Rumanian Minister of Public Instruction on the efforts making to substitute French influence for the former German control of the Rumanian electrical industry. The Minister sees a bright future for his country, which has great undeveloped natural resources and also abundant water power, permitting their economical development. With trifling exceptions the entire industry was before the war divided between the three great German companies, which, in adition to their exploitation of Rumanian resources, exported from Germany to Rumania about $6,000,000 worth of electrical products every year.—*Revue Générale de l'Electricité*, March 8, 1919.

Conversion of Complex Quantities.—W. H. GRINSTED.—The writer points out that in dealing with impedances the complex form is particularly useful in connection with addition and subtraction, but that the exponential form is preferable for multiplication and division. He describes a slide rule which may be used for the ready conversion of complex quantities into those of the exponential form and vica versa.—London *Electrician*, Feb. 14, 1919.

Functions of the Engineer.—W. A. J. O'MEARA.—The author analyzes the education and training of the engineer to show just how much his success in various positions depends upon the development of the different faculties. These faculties are divided into financial, commercial, technical, custodianship, bookkeeping and administrative. In particular the requirements for the various executive positions in a street railway undertaking are analyzed.—London *Electrical Review*, Feb. 21, 1919.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY

Report Opposing Government Operation of Hydroelectric Systems Is Adopted—Power Survey Is Favored—W. D. Bancroft President

The thirty-fifth general meeting of the American Electrochemical Society convened at the Chemists' Club, New York City, April 3, 4 and 5.

At the annual business meeting the committee on public relations presented a resolution placing the society on record as opposed to government ownership and operation of hydroelectric systems. The report was adopted by a large majority. Its text follows:

It is understood that this report does not consider the question of the government ownership of sources of hydroelectric energy nor of government control and regulation of hydroelectric systems, but simply operation by the government of hydroelectric systems in comparison with operation thereof by private companies. As regards this aspect of government ownership, it is the opinion of your committee:

(1) That anything which affects, either for good or evil, electrochemical industries will affect in a corresponding way the people as a whole.

(2) That in general all activities of an industrial nature undertaken by governments, at least in democratic countries, are inefficient, uneconomical and open to numerous inherent objections.

(3) That all activities of an industrial nature which can be carried on by private enterprise should not be undertaken by governments.

(4) That the inherent defects of governmental activities in industrial enterprises will be found in government ownership of hydroelectrical systems and will affect the electrochemical industries dependent on such systems adversely.

(5) That the Ontario Hydro-Electric Commission, the only available example of a government-owned hydroelectric system, illustrates the dangers and defects of governmental activities of this sort.

That the American Electrochemical Society, being interested in and representing the electrochemical industries of the United States, should strongly oppose all attempts at governmental operation of hydroelectric systems.

It is needless to present any evidence to the members of the American Electrochemical Society that the electrochemical industries are of vast importance to the whole nation and to every individual composing it.

Even a superficial examination of numerous governmental activities shows that those which can only be undertaken by the government leave much to be desired in their results, and that when these are of an industrial nature they are invariably inefficient, uneconomical and subject to numerous glaring defects which are obviously inherent in governmental work of this kind in a democracy, when the present state of human character is considered. Under an autocratic government certain causes of the defects of such governmental activities do not exist; but, as recent experience has shown, even when the existence of a democratic nation is threatened by external aggression and a temporary reversion to autocratic government becomes necessary, governmental industrial enterprise is far inferior to private undertakings of this nature.

It is the belief of all American citizens that governments are instituted among men to secure certain unalienable rights, among which not the least is individual liberty, and that the reason why their country has prospered so wonderfully is because those intrusted with its administration have not only confined themselves within their constitutional spheres but have refrained from encroaching on and consequently diminishing the fields of activity of its citizens. Most of our citizens who have given the matter careful thought also believe that governmental encroachment in such fields will greatly overbalance in permanent evil any partial or transient benefit which it may yield.

There is no evidence that governmental ownership of hydroelectric systems will be any freer from defects than other kinds of governmental industrial enterprise, but quite the contrary.

Your committee believes that the American Electrochemical Society should have an opportunity to go on record as opposed to government ownership and operation of hydroelectric systems and that this record should be given the widest publicity.

The society also approved the proposal that a water-power survey of the country should be made by the United States Geological Survey and that a special investigation of the power supply of all kinds in the industrial region of the North Atlantic seaboard should be undertaken. The resolution urged upon Congress the appropriation of $50,000 for a general survey of the country and $200,000 for the North Atlantic seaboard.

Election of Officers

Officers for the ensuing year were elected as follows: President, W. D. Bancroft; vice-presidents, J. V. N. Dorr, W. R. Whitney and Carl Hering; managers, H. C. Parmelee, R. E. Zimmerman and E. Blough; treasurer, P. G. Salom; secretary, J. W. Richards.

The society delegated F. A. Lidbury to attend the meeting of the national service committee of the Engineering Council in Chicago, April 23-25, with instructions to support the establishment of a department of public works.

The technical feature of the meeting was a symposium on released information relating to the war work done by electrochemists. Colonel Walker gave an illustrated address on the Edgewood Arsenal. Several papers were presented on the subject of smoke used as screens by the navy, the materials being silicon-tetrachloride and titanium. There were some important papers on electro-deposition of gold, silver, nickel and lead. G. B. Klugh of Anniston, Ala., described the production of silico-manganese in the electric furnace, using silica rock, manganese ore, limestone and bituminous coal as raw materials. The furnaces were three-phase with three electrodes in line. The current was transformed down to 65-100 volts. The power consumption was 9000 kw.-hr. per ton of metal. Another electric furnace paper was presented by T. F. Baily, who described heat treatment of anchor chain, draw-bar knuckles and airplane parts.

The social features of the meeting were a smoker and an excursion to some industrial plants on Long Island.

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MAINE WATER POWER COMMISSION IS FORMED

New Body Authorized by Legislature Through Appropriation of $40,000 Will Investigate Water-Power Resources and Recommend Policies

A special commission to investigate further the water-power resources of the state and to recommend future policies of development was created by the Maine Legislature during the closing days of the recent session. The commission is to take over the water-resources data of the Public Utilities Commission, and an appropriation of $40,000 has been authorized to cover the cost of the investigation. A report is to be made to the Legislature of 1921 through the Governor and Council, and among the subjects to be considered are the flow of rivers and their drainage areas, storage facilities existing and potential, state rights in developed and undeveloped water power, transmission of energy outside the state, and the private versus State development and ownership of water powers.

The commission, known as the Maine Water Power Commission, receives authority to employ engineers and other assistants and is to be assigned quarters in the State Capitol at Augusta. It is to be composed of ten members, including three members of the Seventy-ninth Legislature and one delegate each from the Maine State Board of Trade, Maine State Grange, Maine State Federation of Labor and Savings Bank Association of Maine. Commissioners not members of the State Legislature are each to receive $5 per day while engaged in commission work, and all commissioners are to be allowed expenses connected with these duties.

The agitation on behalf of public ownership and development of water powers which was such a prominent feature of the previous session's work failed this year to gain headway and appears to have lost ground as well. An absolutely open and above-board newspaper campaign against public ownership was run last fall on a coöperative basis by about a dozen leading public utility and industrial companies utilizing water-power developments.

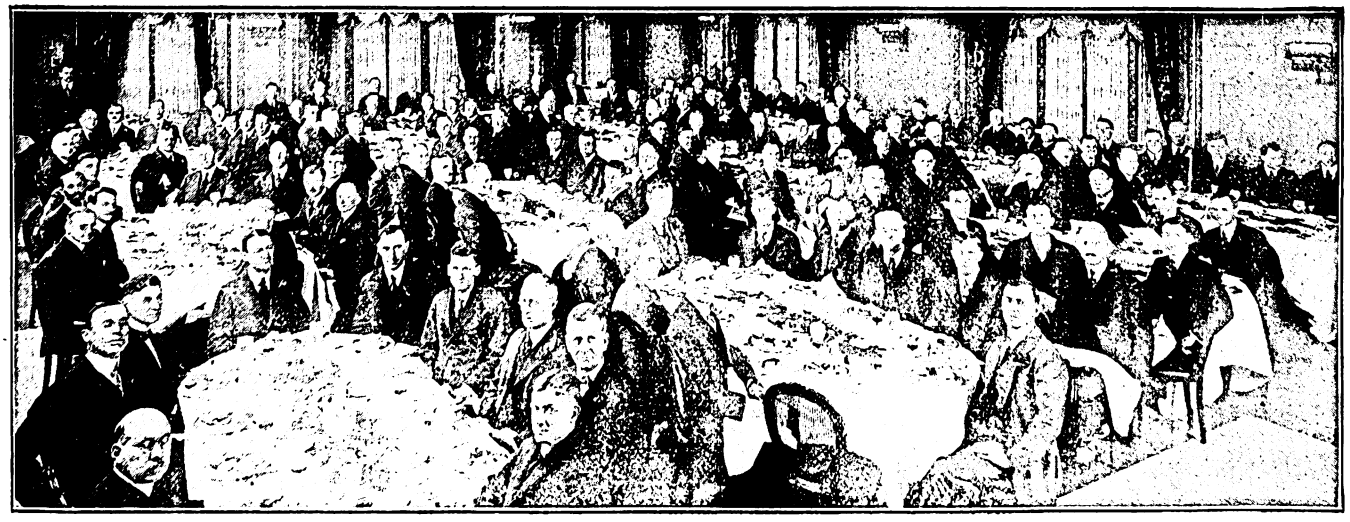
This campaign, which was noted in the ELECTRICAL WORLD as an unusual example of effective publicity, culminated in two pamphlets which were sent to every member of the 1919 Legislature and to others before the session opened. One pamphlet recapitulated the points against public ownership which were emphasized in the signed press advertisements, and the other one brought out various unfavorable aspects of the public ownership and development of water power by the Hydroelectric Commission of Ontario as contrasted with the claims often advanced in support of the latter organization's work and policy.

In his message to the Legislature Governor Milliken pointed out that "the financial obstacles in the way of State ownership make such a course for the present absolutely out of the question, whatever merit it might otherwise have," and commended the admirable and exhaustive report of the Public Utilities Commission on water-power resources in Maine as the basis of any constructive program for the development of these resources that may be entered upon.

Western Society of Engineers Discusses Legislation

On March 31 the Western Society of Engineers in conjunction with a large number of other engineering societies held a public affairs session to discuss important legislation pending before the Illinois State Legislature and the City Council in Chicago. The discussion was led by James J. Barbour, State Senator; Bert H. Peck, electrical engineer Public Utilities Commission of Illinois, and Douglas Southerland, secretary of the Civic Federation of Chicago. Mr. Peck outlined the organization and the accomplishments of the Illinois commission since it was formed in 1914.

Banquet Given to Colonel Junkersfeld by His Chicago Associates



One hundred and thirty friends of Peter Junkersfeld, formerly of the Commonwealth Edison Company, gathered at a banquet in his honor at the Chicago Athletic Club, Chicago, on April 5. L. A. Ferguson, vice-president of the Commonwealth Edison Company, acted as toastmaster. The speakers—Britton I. Budd, Chicago Elevated Railways, W. L. Abbott and R. F. Schuchardt of the Commonwealth Edison Company—expressed the sentiments of the assemblage in wishing Colonel Junkersfeld farewell and good luck in his new work with Stone & Webster.

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THE VICTORY LIBERTY LOAN

BY JOHN PRICE JONES

Assistant Director of Publicity Liberty Loan Committee, New York

NO ONE whose life is spent over matters electrical need be told of the manifold uses of electrical apparatus in the war. The electrical engineers have done a work of which the country may well be proud. And now, with all other Americans, they are called on for one last "bit" in the war — the financial part. The Victory Liberty Loan — the last of the popular loans — will be put out in April.

In the first place, much of the money is to be spent in bringing back the troops from overseas, and that will include the electrical engineers and electrical men of every branch of the trade who are now in the A. E. F.

In the second place, there is a special provision in the Victory Liberty Loan bill, as passed by Congress and signed by the President, which is (or should be) of great importance to electrical men. This is the special provision for the extension of credits for the promotion of American foreign trade.

Germany previous to 1914 had built up an enormous foreign trade, no small portion of which was in electrical apparatus, machinery and novelties. Germany will, of course, recover some foreign markets. Our allies will seek to capture some, and some should open readily to us.

But attempts to gain a footing in foreign fields frequently have failed because the home firm could not obtain extended banking credits to carry it through the slow process of getting established in the new market. Foreign consignees — especially in South America — have always demanded long credits from the consigning firm, longer credits than American firms could usually obtain in this country.

The Victory Loan act will permit American exporters—and behind them American manufacturers—to develop foreign business with a feeling of security. And this includes in no small measure manufacturers in the electrical field.

Are not these cogent reasons for electrical men to get behind the Victory Liberty Loan? We know that they are, and we know that the readers of the ELECTRICAL WORLD will do a mighty bit in putting the loan across!

INDUSTRIAL LIGHTING RULES ARE FORMULATED IN OHIO

Code Consists of Four Rules and a Lengthy Appendix —Latter Made Necessary Because of Lack of General Knowledge of Illumination

Establishing grades or classes of industries and trades each calling for a different intensity of illumination and requiring that objectionable glare shall be eliminated from either natural or artificial light are the important features of the proposed Ohio Industrial Lighting Code as explained by Prof. F. C. Caldwell, Ohio State University, before a recent meeting of the new-business committee of the Ohio Electric Light Association. The code proper consists of only four rulings, but a lengthy appendix fills the purpose of giving educational and advisory methods for carrying out the code rules. The first five sections of the appendix are strictly informational, defining the most important terms used in connection with the work on lighting. The minimum and the preferred values of intensity for given working conditions are included for the convenience of the reader. A section on the character of illumination undertakes to give such information with regard to glare as will permit the successful enforcement of the rule regarding that objectionable characteristic of improper lighting. The last twelve sections of the appendix are all informational in character and take up briefly such subjects as the value of good illumination, accident prevention, location of lighting units, lamp accessories, maintenance, cleaning and inspection, etc.

EXHIBIT OF THE "NEW SPIRIT OF LIGHTING"

Special Lighting Exhibit by N. E. L. A. Lamp Committee and Lighting Sales Bureau to Be Feature at Atlantic City Convention

An interesting feature is being planned for the coming convention of the National Electric Light Association at Atlantic City for the purpose of expressing to the industry what has been called "the new spirit of lighting." Through the coöperation of the N. E. L. A. lamp committee and the lighting sales bureau of the Commercial Section, the more interesting aspects of modern lighting are to be presented in the form of a special exhibit to occupy a conspicuous position in the exhibition hall.

This special lighting exhibit will be composed of ten separate booths or sections, the outstanding features of which will be elaborate presentations of industrial, store, window and home lighting. The industrial lighting exhibit, for instance, will be a typical modern machine shop with machinery representing several classes of industry installed and running. Illumination will be provided by three systems of lighting. One will show the too prevalent scale of poor lighting, another a good standard of illumination, and a third will present what is considered the best productive intensity. These several systems of illumination will be operated from a control pedestal and will be demonstrated by the man in charge to all interested visitors. At other times this control pedestal will be automatically operated by a flasher as a constant demonstration of the effectiveness and efficiency of good lighting in a factory.

For the purpose of demonstrating the best modern standards of show-window illumination a life-size show window will be installed in which there will be a practical display of merchandise. It is expected that this display will be changed daily during the convention under the guidance of some prominent Atlantic City or Philadelphia department store. This show window will be equipped with about fifteen different systems of show-window lighting, demonstrating different intensities of illumination from different directions. These systems also are to be operated from a central control table and automatically demonstrated at periods when they are not specially displayed.

There will be another space devoted to home lighting, which will comprise a number of typical rooms characteristic of a modern moderate-priced dwelling and will represent in large measure the home-lighting problem of the day. These rooms will be illuminated by a flexible system of lighting which will enable the operator to demonstrate the advantages of different types of fixtures and different ideas in the arrangement and

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location of lighting outlets. There will be a variety of portable lamps in use, not as an exhibition of the lamps themselves but merely as incidental to the illumination.

Then there will be other sections given up to the display of indoor lighting equipment and outdoor lighting equipment. There will be a room devoted to the newer applications of lighting, such as the moving-picture field and the use of projector lighting. There will be a room given up to central-station lamp practice, illustrating the report of the lamp committee on the standardization of voltage, recent experience in the merchandising of lamps and other data showing what central stations are doing in the lighting field. In another section will be gathered together the educational literature available on lighting subjects. Here will be files giving a key to the different items of equipment featured in the different parts of the exhibition, standard and special equipment now in use in varying phases of lighting prospects and other general information.

The foyer of the lighting exhibit will be attractively furnished as a rest room and illuminated entirely by portable lamps. At the end of the foyer will be a moving-picture screen where a large number of exceedingly interesting films on both lighting and other electrical subjects will be shown.

Undoubtedly this year will see great acceleration in the popular interest in lighting subjects and in the general activity of the central-station industry in the development of this field. Much has been learned through the war period of the economic influence and value of specific types of lighting under definite conditions, and the effort of the industry will be to apply this knowledge more broadly. It is this new spirit of lighting which this special lighting exhibit will define and present to the convention, and it is believed that it will be helpful and stimulative. For the benefit of men who will be unable to attend this convention this lighting exhibit will be carefully photographed and a report will be published for general distribution.

BENEFITED BY LESSONS FROM WAR CONDITIONS

W. S. Barstow & Company Point Out Favorable Position of Power and Lighting Companies, Instantly Adaptable to Peace Conditions

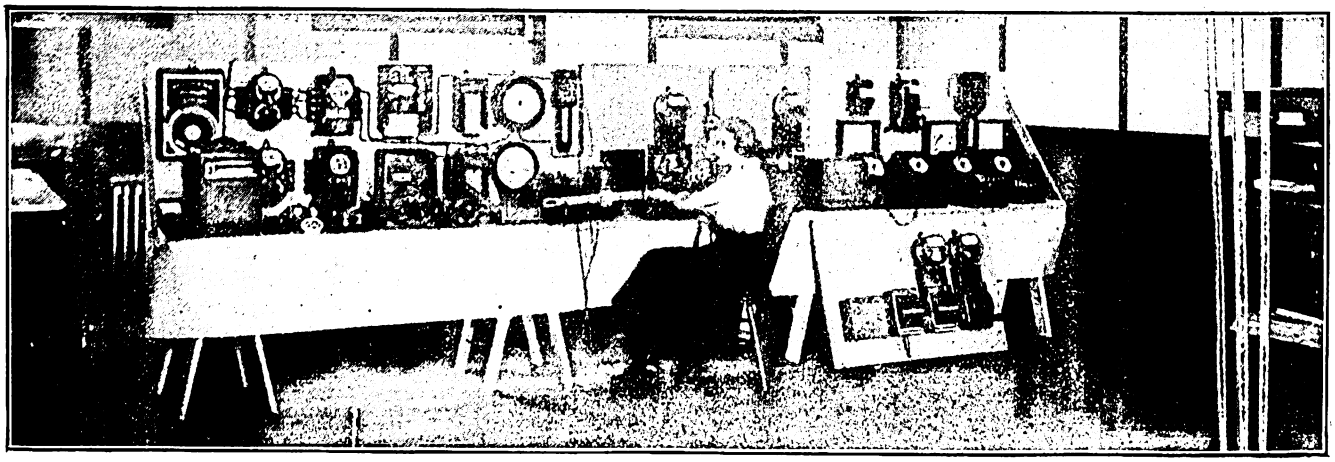
A review of the public utility situation by W. S. Barstow & Company, New York, says in part:

The law of supply and demand set aside during the war by the government must gradually begin to function before any permanent recovery can take place. Many laws heretofore thought constructive had actually proved in practice to be destructive, and this legal condition must be corrected without delay. In many cases it remained for the government itself to bring forcibly to light the glaring defects of past legal policies. Readjustment of these laws will require time and careful thought, but the quicker corrections are made the sooner industrial activity will begin.

Many industries have been created for war needs only, and the dismantling of these and the building up of new enterprises to take their place will require financial aid. Whether such aid will be immediately forthcoming will depend much upon the government's attitude in demobilizing war industries and establishing by law a constructive policy for steam railroads, other public utilities and industrial enterprises.

While many manufacturing establishments must either discard or change their machinery and class of labor in the shift from war to peace conditions, public utilities occupy an especially favorable position in this respect. The power and lighting companies during the past two years have confined their services to war requirements. They have installed machinery and transmission systems to meet the war-time conditions, but the same machinery and transmission systems would have been installed during peace-time conditions, so that they are now ready, with no involving financial adjustments, not even in the class of labor or reconstruction, to adapt themselves instantly to peace conditions. The demand during the last two years on the part of the government for services rendered by public utility companies has taken the place of expensive selling campaigns, as the use of electric power has been forced to the front by necessity of manufacturers who required instant relief and adopted this class of service without question.

Electrical Interest Stimulated by Worcester Company Section, N. E. L. A.



Through the Worcester (Mass.) Electric Light Company section of the N. E. L. A. increasing interest in electrical affairs is being locally stimulated, and contractor-dealers as well as central-station employees are coöperating to secure mutual benefit. The section is resuming activities interrupted by the war, and all the women employees of the company have become associate members. The first open meeting of the year was recently held and addressed by G. M. Hardy, superintendent of the service department, the subject being "Meters." Various types and makes were shown as illustrated herewith, including speed counters, watt-hour, demand, recording, voltage and curve-drawing outfits, and a demonstration was given by Miss Cook of the company laboratory of the testing of a Sangamo 5-amp. single-phase wattmeter. H. D. Stokes is chairman of the company section and meetings are held every month.

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CONTRACTORS' BUREAU OF EDUCATION AND RESEARCH

Announcement by the National Association of Its New Organization to Lead Contractor-Dealers to Develop Their Business and Improve Their Methods

A Bureau of Education and Research is to be established by the National Association of Electrical Contractors and Dealers, New York. The bureau is designed to collect and compile data and statistics in order to show what is needed to increase the retail distribution of electrical merchandise and place it on a more efficient basis and to place this information before the industry. Through this means it is proposed to enable those in the industry through local coöperation to bring about the desired results in modern electrical retail shops.

The committee in charge is composed of W. Creighton Peet, Peet & Powers, New York, national chairman; M. Edwin Arnold, M. E. Arnold & Company, Philadelphia, chairman national membership committee, and A. Penn Denton, Economy Electric Construction Company, Kansas City, Mo.

The work of the bureau is to be carried out by obtaining in the various localities throughout the country coöperation between the manufacturers, jobbers, central stations and retailers, so that all branches will be working together to increase the retail distribution of electrical material.

Preparatory work will be conducted through suitable printed matter laying out the aims and objects of the movement and what is necessary to accomplish the results. This is to be followed by personal field work. The foregoing will be supplemented by lectures on management, selling, accounting, estimating and installing. The lectures will be prepared by the bureau in such form that they can be furnished to any locality, but the entire arrangement for and delivery of the lectures will be under local supervision and at properly advertised open meetings. Where circumstances do not warrant the delivery of lectures the subject matter will be furnished in printed form.

Field men will call on the various interests in the industry in the different localities for the purpose of getting them to work together on a broad coöperative plan to improve the distribution of electrical material. They will be prepared to show the retailer when requested how to improve his store and business methods along economic lines, how to install and carry on proper cost accounting and bookkeeping systems and to take up any other subject on which assistance is requested.

While it is felt to be necessary that this work be carried on by the retailers' organization, it is recognized that the retailers are not in a position at present to finance this educational work unaided. Financial support is asked from manufacturers, jobbers, central stations and others interested in obtaining the results outlined.

As subscribers will be directly benefited by the increased sale of resale material and energy-consuming devices which will be produced by the work of the bureau, they are asked to subscribe on a yearly basis a sum approximately equal to 25 cents on each thousand dollars' worth of sales of such resale material, or in the case of the central station, the sale of energy, with a minimum subscription of $50 per year and a maximum of $10,000 per year, excluding sales of material for export and any sales to governmental or state departments. Individual subscriptions will not be made public.

The money contributed will be expended by and through the National Association of Electrical Contractors and Dealers with the understanding that part will be for general work covering the entire country and part will be on special work in the different localities in proportion to their numerical membership in the national association. The result will be that each locality will receive benefits in proportion to the activity and interest shown in such locality.

Subscribers will be accorded privileges of associate members of the National Association of Electrical Contractors and Dealers. A list of subscribers will be distributed.

There will be an advisory committee of representatives from each branch of the industry—manufacturers, central stations, jobbers, engineers and electrical press—to be selected through consultation with subscribers from each branch. Matters of policy will be passed on by this committee before being finally acted on by the managing committee.

It is expected that the work will result in stabilizing the contracting business by inducing contractors to operate retail stores requiring a fixed permanent investment in their business. Increase in number of retail stores, education of the retailer to handle appliances properly and the increase of suitable wiring installations for the use of appliances must of necessity, it is pointed out, increase sales of materials, and through the sale of energy-consuming devices increase largely the use of electricity.

It is especially noted that the funds for the bureau are not to be applied to regular work of the national association, which in 1918 cost approximately $35,000 and is on a self-sustaining basis. The benefit to the national association arises from improvement in general business conditions of the electrical contractor-dealer and the increase in membership, which will tend of itself to improve, increase and stabilize distribution.

MEMBERS FOR ELECTRIC FURNACE ASSOCIATION

Campaign to Be Extended to Cover Manufacturers of Furnaces and Supplies, Power Companies, Manufacturers of Furnace Products, Etc.

A meeting of the newly formed Electric Furnace Association was held on April 3 at the Chemists' Club, New York, at the call of the president, Acheson Smith, and a large number were present. Reports of the various standing committees were made, and a tentative draft of the constitution and by-laws was submitted.

Resolutions were passed adopting the constitution as drawn for a temporary period until the new membership committee, which is to be created at once, can secure a representative list of members from the various industries interested in the work of the association. After such membership is formed the draft of the constitution will again be considered and accepted in final form.

An aggressive campaign for membership will be undertaken at once, and all manufacturers of electric furnaces, electric furnace supplies, power companies, manufacturers of electric steel, electric brass and other electric furnace products, designers, inventors of furnaces, etc., will be invited to become members.

An early meeting of the directors of the association will be held to go into further details.

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ADVOCATE REFORMS IN PATENT OFFICE SYSTEM

Employees Organize Patent Office Society for Purpose of Advocating Changes in Administrative Branches of the Department

Employees of the United States Patent Office, Washington, have organized, under the name of the Patent Office Society, for the purpose of advocating certain reforms in the administrative branches of the department which, it is claimed, will bring about a higher efficiency in the system. Committees on legislation and publicity have been appointed with a view to educating the public to the necessity for an immediate improvement of the present Patent Office system and to push Congressional enactment to broaden the scope of the department.

The plan includes the separation of the Patent Office from the Department of the Interior and provides for an executive officer who shall be an industrial and efficiency expert, the position eventually to be that of a Cabinet officer when the department shall have assumed the proportions to warrant such a distinction.

The main contention is that the Patent Office is separate and distinct from the Department of the Interior in its administration and functions and that no progress can be made until a separation is effected. A lack of close affiliation appears, it is claimed, from which the Patent Office must necessarily suffer in matters of proper appropriation for maintenance and expansion and for many other reasons.

The views of the society have been set forth by James H. Lightfoot, the examiner of the Patent Office, in papers presented by him before the examining corps of the department. Mr. Lightfoot makes the following assertions regarding the inefficiency of the present system:

1. That all patents granted are still merely prima facie evidence of the rights of inventors to their invention, whereas the grant itself and the Constitution provide for the grant of unconditional, secure and exclusive rights.

2. That, although the statute (4886) requires as a condition precedent to the grant that the alleged invention sought to be patented must have been in fact invented, patents have been granted and are still granted for things not invented because of insufficient time and inadequate facilities for the proper consideration of this important question, and patents have been and are still refused because of the want of the proper system requiring the presentation of practical evidence indicating invention for the consideration of the examiner.

3. That, although the statute requires as a condition precedent to the grant that the alleged invention sought to be patented must be new, patents have been granted and are still granted for things not new.

4. That, although the statute requires as a condition precedent to the grant that the subject matter sought to be patented must be useful and, under Statute 4893, that it must be "sufficiently useful and important," patents are still granted for theoretical and sometimes practically useless alleged inventions, which have later constituted bars to the grant of patents to inventors of real inventions which would have practically promoted the industrial arts.

5. That although the statute (4886) requires as conditions precedent to the grant (a) that the alleged invention must not have been known or used by others in this country before the applicant's invention or discovery thereof; (b) that the alleged invention must not have been in public use or on sale in this country for more than two years prior to the application, (c) and that the alleged invention must not have become abandoned, patents generally have been granted without any investigation of these important questions affecting validity.

6. That although the revised statute (4903) requires that helpful information be furnished to applicants to aid them in obtaining proper protection, patents are still granted the claims of which are so limited in scope as to be valueless to the inventor for want of a uniform standardized system of examining the applications.

7. Although the provisions of the revised statute (4904) provide for notice in all cases of interfering applications or interfering applications and patents, patents are still granted which are rendered practically valueless and the industries based thereon practically ruined by the subsequent grant of interfering patents on copending applications of which the former patentees had no statutory notice during the copendency of such applications.

8. That patents are still litigated in courts which, with some few able exceptions, are not specially qualified promptly and properly to determine the technical questions arising under the patent laws.

Mr. Lightfoot recommends in the reorganization of the Patent Office Society the establishment of five bureaus, namely, Bureau of Information and Education, Bureau of Patents and Publications, Bureau of Utility, Bureau of Validity Examinations, and Bureau of Priority of Inventions. These recommendations have been approved by the Patent Office Society.

This greater and broader Department of Invention and Discovery may possibly also include a Bureau of Licenses and Sales, just as the Department of Agriculture has a Bureau of Markets.

The society is publishing a monthly journal in the interests of the principles advocated in the reorganization of the Patent Office.

The officers of the society are as follows: President, N. H. Coulston; vice-president, J. H. Lightfoot; secretary, Bert Russell; treasurer, W. F. Avery; executive committee, A. W. Cowles, E. S. Glascock, G. A. Lovett, C. H. Pierce, M. E. Porter, E. D. Sewall, W. L. Thurber and W. J. Wesseler.

The business manager of the journal is W. J. Wesseler.

SALE OF THE BRITISH WESTINGHOUSE HOLDINGS

Chairman Tripp, Returning from England, Announces Sale of Interests and New Commercial Alliance Looking to Development of Export Business

Gen. Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Company, returned to New York this week from a trip to England. He said that the British interests have practically been sold.

"Subject to the successful accomplishment of certain legal details in Europe, which, however, may be waived by the Westinghouse company if thought desirable," said General Tripp, "an agreement has been reached with certain important British interests under which the Westinghouse company sells for cash its British holdings and enters into a commercial alliance looking to the development of export business.

"The commercial plan will be instituted immediately upon the assumption that the whole deal will be consummated on one of the bases above indicated. No further details can be given out at this time."

General Tripp believes that foreign trade prospects depend on the successful outcome of the peace conference. Some method of international financing to provide for the obligations growing out of the war must be found, he declared, before normal commercial conditions can be expected.

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Census Bureau Report of Electric Light and Power Stations—1917

	Missouri			Pennsylvania			Michigan		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	293	190	54.2	284	284	.....	241	235	2.6
Commercial	206	125	64.8	232	239	—2.9	132	127	3.9
Municipal	87	65	.....	52	45	.....	109	108	0.9
Income	†$14,434,506	†$9,746,600	48.1	‡$52,259,350	‡$24,387,863	114.3	¶$24,095,328	¶$11,518,256	109.2
Electric service	$13,974,980	$9,299,495	50.3	$49,677,404	$23,482,208	111.6	$23,560,198	$11,127,031	111.7
All other	$459,526	$447,105	2.8	$2,581,946	$905,655	185.1	$535,130	$391,225	36.8
Total expenses, including salaries and wages	$12,790,796	$7,484,853	70.9	$42,899,262	$18,174,684	136.0	$19,216,138	$9,784,138	96.4
Number of persons employed	3,766	2,434	54.7	10,735	7,300	47.0	4,738	3,876	22.2
Salaries and wages	$2,776,597	$1,883,844	47.4	$9,598,492	$5,098,265	88.3	$5,223,067	$2,843,371	83.7
Total horsepower	226,030	182,095	24.1	1,290,190	615,994	109.4	612,632	377,182	62.4
Steam engines:									
Number	309	301	2.6	529	615	—14.0	272	319	—14.7
Horsepower	199,950	177,721	12.5	1,194,086	465,968	136.9	411,603	250,477	64.3
Internal-combustion engines:									
Number	177	22	.....	85	84	.....	76	27	.....
Horsepower	7,415	2,472	200.0	19,496	17,733	9.9	3,014	1,626	85.4
Waterwheels:									
Number	12	5	.....	133	136	—2.2	312	245	27.3
Horsepower	18,665	1,902	881.3	166,608	132,293	25.9	198,015	125,079	58.3
Kilowatt capacity of dynamos	166,813	122,786	35.8	910,434	427,304	113.1	450,716	247,789	81.9
Output of stations, kilowatt-hours	266,431,159	232,828,763	14.4	3,049,493,792	989,665,167	208.1	1,504,239,843	525,615,508	186.2
Stationary motors served:									
Number	10,710	15,429	—30.6	64,227	29,119	120.6	37,799	18,400	105.4
Horsepower	174,861	116,971	49.5	1,139,935	333,414	241.9	348,811	174,009	100.4
Number of street lamps:									
Arc	4,410	6,687	—34.1	43,521	45,596	—4.6	18,102	16,220	11.6
Incandescent, etc	30,079	16,719	79.9	114,706	28,630	300.6	41,365	22,425	84.4

* A minus sign (—) denotes decrease; percentages omitted where base is less than 100.
† Exclusive of $1,665,408 in 1917 and $551,422 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $1,031,954 in 1917 and $708,458 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $326,581 in 1917 and $426,444 in 1912, reported by street and electric railway companies as income from sale of electric energy.

	South Dakota			North Dakota			Alabama		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	130	77	.....	127	42	.....	882	69	.....
Commercial	95	64	.....	101	33	.....	37	34	.....
Municipal	35	13	.....	26	9	.....	45	35	.....
Income	†$2,050,067	†$1,162,522	76.3	$2,003,826	$873,111	129.5	‡$3,152,709	‡$1,257,720	150.7
Electric service	$1,885,697	$1,095,922	72.1	$1,712,441	$835,504	105.0	$3,018,778	$1,234,540	144.5
All other	$164,370	$66,600	146.8	$291,385	$37,607	674.8	$133,931	$23,180	477.8
Total expenses, including salaries and wages	$1,733,635	$965,763	79.5	$1,647,691	$714,294	130.7	$2,895,713	$980,169	195.4
Number of persons employed	446	338	32.0	419	232	80.6	806	456	76.8
Salaries and wages	$408,670	$264,159	54.7	$343,741	$197,983	73.6	$602,050	$286,936	109.8
Total horsepower	32,176	27,748	16.0	29,079	16,169	79.8	182,793	34,473	430.2
Steam engines:									
Number	55	50	.....	117	74	.....	120	94	.....
Horsepower	15,800	16,003	—1.3	24,679	15,851	55.7	79,232	24,574	222.4
Internal-combustion engines:									
Number	178	86	.....	157	8	.....	8	2	.....
Horsepower	10,006	4,832	107.1	4,400	318	1,283.6	705	19	.....
Waterwheels:									
Number	11	15	.....	.....	.....	.....	18	15	.....
Horsepower	6,370	6,913	—7.9	.....	.....	.....	102,856	9,880	941.0
Kilowatt capacity of dynamos	24,248	20,032	21.0	20,041	10,824	85.2	128,509	24,477	425.0
Output of stations, kilowatt-hours	31,810,487	24,703,754	28.8	22,978,006	12,298,553	86.8	330,771,965	48,602,553	580.6
Stationary motors served:									
Number	3,143	1,394	125.5	2,281	1,145	99.2	1,583	1,065	48.6
Horsepower	19,673	13,619	44.4	11,102	6,128	81.2	17,363	11,148	55.7
Number of street lamps:									
Arc	386	904	—57.3	497	644	—22.8	1,702	2,314	—26.4
Incandescent, etc	7,558	4,382	72.5	11,028	5,074	117.3	7,212	2,805	157.1

* A minus sign (—) denotes decrease; percentages omitted where base is less than 100.
† Exclusive of $49 in 1917, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $1,402,496 in 1917 and $1,017,134 in 1912, reported by street and electric railway companies as income from sale of electric energy.

	Ohio			Texas			Wisconsin		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	335	304	10.2	254	253	0.4	269	251	7.2
Commercial	186	186	.....	230	235	—2.1	171	173	—1.2
Municipal	149	118	26.3	24	18	.....	98	78	.....
Income	†$23,019,289	†$11,905,111	93.4	‡$10,232,709	‡$6,783,972	50.8	¶$11,923,367	¶$6,274,589	90.0
Electrical service	$22,149,767	$11,514,628	92.4	$10,000,025	$6,654,616	50.3	$11,594,068	$5,955,194	94.7
All other	$869,522	$390,483	122.7	$232,684	$129,356	79.9	$329,299	$319,395	3.1
Total expenses, including salaries and wages	$20,703,414	$8,722,293	137.4	$8,211,360	$4,924,093	66.8	$9,715,528	$5,321,258	82.6
Number of persons employed	4,713	3,131	50.5	2,531	2,021	25.2	2,719	1,921	41.5
Salaries and wages	$4,143,689	$2,264,892	83.0	$1,968,423	$1,348,966	45.9	$2,475,971	$1,227,013	101.8
Total horsepower	581,774	337,272	72.5	184,829	126,616	46.0	368,211	145,411	153.2
Steam engines:									
Number	425	506	—16.0	311	385	—19.2	262	272	—3.7
Horsepower	556,230	317,160	75.4	156,762	113,611	38.0	219,534	72,145	204.3
Internal-combustion engines:									
Number	117	93	.....	214	99	.....	92	46	.....
Horsepower	11,928	11,252	6.0	24,714	9,502	160.1	4,622	4,500	2.7
Waterwheels:									
Number	33	33	.....	26	18	.....	231	176	31.2
Horsepower	13,616	8,860	53.7	3,353	3,503	—4.3	144,055	68,766	109.5
Kilowatt capacity of dynamos	420,431	244,182	72.2	133,917	84,564	58.4	252,646	98,839	155.6
Output of stations, kilowatt-hours	1,083,514,202	399,101,309	171.5	317,581,985	149,008,819	113.1	517,539,925	215,402,974	140.3
Stationary motors served:									
Number	35,950	29,022	23.9	15,334	8,445	81.6	10,428	6,699	55.7
Horsepower	265,260	145,331	82.5	163,477	50,869	221.4	87,230	72,525	20.3
Number of street lamps:									
Arc	23,498	30,893	—23.9	5,569	5,504	1.2	7,305	9,187	—20.5
Incandescent, etc	49,042	20,168	143.2	20,981	9,567	119.3	25,783	10,888	136.8

* A minus sign (—) denotes decrease; percentages are omitted where base is less than 100.
† Exclusive of $10,190,446 in 1917 and $3,766,405 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $1,967,667 in 1917 and $568,641 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $892,146 in 1917 and $613,694 in 1912, reported by street and electric railway companies as income from sale of electric energy.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

E. S. J. A., Pacific Division.—This division of the Electrical Supply Jobbers' Association will meet at Coronado Beach, Cal., on April 28 and 29.

Ohio Electric Light Association.—Cedar Point, Ohio, is the place and July 15-17 are the dates fixed for the annual convention of the Ohio Electric Light Association.

Electric Club of Chicago.—Elmer D. Brothers had "The League of Nations" for the subject of his address given before the meeting of the Electric Club of Chicago held on April 3.

A. A. E., Kansas City Club.—J. E. Jacoby and R. N. Clarke were elected president and secretary respectively of the Kansas City Club, American Association of Engineers, on March 21.

San Francisco Electrical Development League.—J. D. Fernstermacher, sales manager of the Columbia Steel Company, gave an illustrated talk at the March 24 meeting of the league on "Making Steel Electrically."

N. E. L. A., New England Section.—C. R. Dooley of the Westinghouse Electric & Manufacturing Company gave a talk in Boston on March 21 before the New England Section of the National Electric Light Association, his topic being "The Work of the Westinghouse Company in the War."

Jovian Electric League, Kansas City.—The close relations between the Jovian Electric League of Kansas City, Mo., and the Chamber of Commerce were further cemented when on March 7 J. M. Guild, general secretary of the Chamber of Commerce, addressed the league on prospects of coöperative constructive work by the two organizations.

Ohio Electric Light Association.—Two reports, one by A. H. Bryant, Cleveland Electrical Illuminating Company, entitled "Scheduling Service Tests of Small-Capacity Alternating-Current Meters," and the other by J. L. Wright, Toledo Railway & Light Company, on "Training Men for Meter Work," will be presented at an open meeting of the meter committee of the O. E. L. A. in Dayton on April 18.

Seattle Joint Electrical Meeting.—Under the auspices of the local section of the A. I. E. E. a joint meeting of men of the electrical fraternity was held in Seattle on March 29 to hear Paul Lincoln, Westinghouse Electric & Manufacturing Company, on the subject of "The Development of Electrical Transmission," and John B. Fisken, Washington Water Power Company, on the subject of "Engineering—Its Opportunities and Its Responsibilities."

A. A. E., Pittsburgh Chapter.—F. E. N. Thatcher, 1312 Fulton Building, Pittsburgh, Pa., has been chosen as the secretary of the Pittsburgh Chapter of the American Association of Engineers.

N. E. L. A., Philadelphia Electric Company Section.—The April 8 meter department branch meeting of this section of the National Electric Light Association was addressed by R. T. Pierce, Westinghouse Electric & Manufacturing Company, on "Indicating and Graphic Instruments."

N. E. L. A. and A. I. E. E., Portland Sections.—At the March meeting of the Portland (Ore.) sections of the American Institute of Electrical Engineers and the National Electric Light Association Colonel Zinn read a paper on the organization and work of the North Pacific division of the government service, of which he is engineer.

Seattle Engineers Discuss Organization Problems.—A joint meeting of engineers was held in Seattle on March 27 to hear Calvin W. Rice discuss the problems which engineers face along organization lines. There were represented the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Chemical Society, Pacific Northwest Society of Engineers, American Institute of Mining Engineers and the Associated Engineering Societies of Seattle. There was a general discussion of the best plan for carrying out further organization of engineering societies in Seattle to the end that centralization and closer coöperation might be secured.

American Institute of Electrical Engineers

Toronto Section.—H. Lester Woodbridge presented a paper on "Storage Batteries" at the meeting of March 21.

Philadelphia Section.—Lieut.-Col. J. W. Hubbell, U. S. A., lectured on "Field Communication, First Army Corps, American Expeditionary Forces," at the March 10 meeting.

Pittsburgh Section.—The April 8 meeting was devoted to a talk by G. H. Kendrick, district supervisor of equipment Western Union Telegraph Company, about the new Pittsburgh quarters of that company, and a visit was made to the office itself.

Toledo Section.—E. H. Brown spoke on the growth of the Park Exchange of the Ohio State Telephone Company at the Feb. 27 meeting, and E. B. Thurston, Haughton Elevator Company, lectured on "General Operation of Electric Elevators" at the March 27 meeting.

Rochester Section.—At the meeting of the section held on March 28 H. A. Winne, General Electric Company, gave a lecture on "Electric Furnaces and Electric Welding." On April 25 Prof. V. Karapetoff of Cornell University is to be the speaker, while on May 23 E. Blough, Aluminum Company of America, will give a talk on "Commercial Applications of Aluminum."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rate Increase in Missouri.—In passing on an application of the Hamilton Light & Power Company for authority to increase rates the Missouri Public Service Commission laid down the following principles: Rates to certain classes of consumers, not yielding a full return but resulting in some profit to an electric utility, need not be increased, although the rates to other consumers are increased, as this commission will not allow the latter rates to be increased further on account of the failure to increase all rates. An electric utility having rates yielding approximately 4 per cent on an assumed investment of $40,000 is permitted to put into effect rates yielding a net income of 9 per cent for return and depreciation, in substance, per kilowatt-hour as follows: Commercial lighting: first 100 kw.-hr., 12 cents; next 50, 10 cents; next 50, 10 cents; all over 200, 9 cents; minimum charge, $1; commercial power: first 100 kw.-hr., 8 cents; next 100, 7 cents; all over 200, 6 cents; minimum charge per horsepower, $1. An increase in electric rates for commercial power service from 6 cents to 10 cents for the primary step is unreasonable and a rate of 8 cents is substituted therefor.

Wages for Plant Owners.—The Missouri Public Service Commission in granting increased rates to the Owensville Electric Light Company holds that an allowance of 50 cents per hour to each of two partners owning and themselves operating an electric plant as firemen, engineers and outside repairmen for such time as is actually devoted to such tasks is proper under present abnormal conditions, as the ownership of the plant should not estop them from receiving a fair wage for duty performed. The commission also ruled that an electric utility operating in a town of about 1000 inhabitants is required to give street-lighting service from dusk until 11 p.m., and Saturday service until 12 midnight, and from 5 a.m. until thirty minutes before sunrise from Oct. 15 to March 15, the commission not permitting a reduction of such service or requiring its extension to all-night service under the evidence presented. The following increased monthly rates per kilowatt-hour for electric service by a utility operating at an actual loss under existing rates in a town of 1000 inhabitants are deemed reasonable: Commercial lighting: first 50 kw.-hr., 15 cents; over 50, 10 cents; minimum, $1; street lighting; forty-five lights of 40 watts, $60; each additional light, $1.30.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrically Cooked Dinner for Louisville Company Employees.—An electrically cooked dinner was served to 130 employees of the Louisville Gas & Electric Company at the company's office recently. The object of the dinner was to stimulate interest in electric cooking. A. S. Witmer, commercial manager of the Louisville Gas & Electric Company, was in charge of the affair. The plan was to hold nine public demonstrations of electric cooking at suburban locations about Louisville during the following days.

Value in Scrap.—The Pacific Gas & Electric Company reports that war demands, and the unprecedentedly high prices arising therefrom, brought about an exceptional opportunity for the disposition of all kinds of scrap materials during the year 1918. Full advantage was taken of this condition, and there is to-day probably less scrap and discarded apparatus on the system than at any other time in the company's history. Total sales during the year of classified scrap, ranging all the way from platinum to old rubber boots and floor sweepings, aggregated more than 3,505,000 lb., for which $168,427 was realized.

New Jersey Power & Light Company to Resume Ice Manufacture.—When the Bernardsville Electric Light & Water Company was acquired by the New Jersey Power & Light Company, it was operating an ice plant in connection with the electric light plant. This ice plant had an ice-making capacity of 10 tons daily and was operated by steam. The New Jersey Power & Light Company operated the ice plant until it shut down the Bernardsville electric light plant. At that time it also shut down the ice-making plant, as it did not pay to run it for ice manufacturing only. Because of the natural ice shortage that will no doubt occur during the coming summer, due to the very mild winter, and therefore the excellent opportunities for the sale of artificially made ice, the New Jersey Power & Light Company will resume the manufacture of ice in the old plant, making use of one of the many improvements in the manufacture of artificial ice that have made their appearance since the plant was shut down—that of the raw-water process—a process by which an air system is used to agitate the water while it is being frozen. The plant will be operated by electricity instead of by steam, as formerly. Several inquiries and bids have already been received for taking the entire output.

Federal Propaganda in Public Schools.—The board of governors of the Associated Manufacturers of Electric Supplies has sent to members a pamphlet issued by the National Industrial Conference Board, entitled "A Case of Federal Propaganda in Our Public Schools." In writing to members, Charles E. Dustin, general secretary of the Associated Manufacturers, says that the purpose of the board in sending the pamphlet is to call to their attention specifically and directly what it believes to be a serious attempt of a partisan element in the federal government to disseminate its propaganda through the medium of the public schools. That the child who absorbs these teachings must obtain a warped view of social and economic relations and one utterly unfair to industry and ultimately productive of great harm seems obvious, Mr. Dustin adds. Members are urged to read the pamphlet carefully and to use their influence with their local school board to prevent the use of the lessons in question, about 3,000,000 copies of which have already been circulated. The National Industrial Conference Board will send the pamphlets on request. The address of this board is 15 Beacon Street, Boston, Mass.

Expansion of the Industry.—In the New York *Evening Post* "Utilities and Engineering Review," March 29, W. H. Hodge of H. M. Byllesby & Company writes: "A widespread, active construction period will hardly get under way in 1919, but next year should see unprecedented building, particularly of electric transmission lines, water power and steam-turbine power stations. . . . A time of wonderful expansion in the electrical industry cannot be long postponed, however, if the United States is to continue its course of industrial prosperity. The war brought to the foreground the dependence of modern production upon mechanical power and the superiority and economy of electrical power produced by large central stations. Every power company in a manufacturing district was seriously pressed to supply additional industrial demands during the war, and it is safe to say that nearly all of the new business gained or its equivalent will be permanently retained, and the demands for electric power will continue to grow with every factory expansion and the establishment of every new industry. The use of electricity in households also is a growing demand which in the aggregate is of enormous proportions."

National Foreign Trade Council Program.—Names of speakers at the Sixth National Foreign Trade Council, to be held in Chicago on April 24 to 26, have been announced. Among the speakers are: Fred I. Kent, vice-president Bankers' Trust Company, New York, "America's Financial Equipment for Foreign Trade"; Hugh Frayne, "Interest of Labor in Foreign Trade"; William Pigott, president Seattle Car & Foundry Company, "Element of Labor Costs in American Exports"; Edward Prizer, president Vacuum Oil Company, "Effect of Increased Productive Capacity Upon Our Foreign Trade"; William S. Culberson, United States Tariff Commission, "A Bargaining Tariff"; John M. Parker, president Mississippi Valley Association, "The Mississippi Valley and Foreign Trade"; J. W. Hook, president Allied Machinery Company of America, "Stabilizing Effect on American Industry of a Definite Foreign Trade Policy"; James E. Smith, president Mississippi Valley Waterways Association, "The Relation of Inland Waterways to Foreign Trade"; Frank O. Lowden, Governor of Illinois, "The Meaning of Foreign Trade to the Middle West"; James A. Farrell, president United States Steel Corporation, "An American Maritime Policy"; Breckenridge Long, Third Assistant Secretary of State, "The Relation of Diplomacy to Foreign Trade"; Edward N. Hurley, chairman United States Shipping Board, "Future of Our Foreign Trade."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Appeal from Commission.—The appellate jurisdiction of the Supreme Court is limited by the constitution to the review of decisions of the district courts or the judges thereof, and it cannot entertain an appeal directly from the Public Utilities Commission, according to the Supreme Court of Idaho (178 P. 271).

Review of Order of Commission.—Where an order of the Public Service Commission was affirmed by the Appellate Division on certiorari and the Court of Appeals denied an appeal, it was held by the Supreme Court of New York (174 N. Y. S. 708) that in subsequent proceedings to enforce the order of the commission the matter cannot be reviewed.

Company Liable for Injury to Trespassers.—Where the employees of an electric company, instead of removing wire not in use, attached the same to a high-power wire, and trespassers on the right-of-way, seeking refuge in a storm, came in contact with such wire, it was held by the Court of Appeals of Kentucky that the spring-gun theory applied and the electric company was liable. Where the employees of an electric company, instead of putting wire used for repair in a safe place, connected it with a high-power wire with the avowed intention of injuring thieves, it was held that such employees were not acting within the scope of their employment so as to render the employer liable, under the spring-gun theory, to trespassers who came in contact with the wires. (Craig vs. Kentucky Utilities Company. 209 S.W. 33.)

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W. Dusenberry, formerly manager of the waterworks at Maryville, Mo., has been appointed manager of the Greenville district of the Southern Illinois Light & Power Company.

H. P. Blogdett, who for the past two years has been superintendent for the Central Maine Power Company at Gardiner, has been chosen to succeed A. C. Hopkins as superintendent of the Penobscot Bay Electric Company at Belfast, Me.

H. M. Ferguson, formerly superintendent of steam-heating operations of the Utah Power & Light Company, Salt Lake City, has been promoted to be manager of the Salt Lake division of the company. Mr. Ferguson has been associated with the company for somewhat more than two years, having before that been in charge of the commercial department and steam-heating business of the Missoula (Mont.) Light & Water Company. He went to the Missoula utility from the Westinghouse-Church-Kerr Company.

C. R. Young, sales manager of the Pacific Power & Light Company, Portland, Ore., has resigned his position with that company and will be associated with the securities selling department of the Electric Bond & Share Company, New York. Mr. Young has been with the Portland company for eight years and has been sales manager for three years. During that time he had charge of all the company's sales campaigns, including the sale of preferred stock to the company's customers. During 1918 the company sold $150,000 worth of its preferred stock to its customers and employees. It is understood that the Electric Bond & Share Company will extend the principle of security sales to customers into a number of its affiliated and controlled operating companies, the work being in charge of C. M. Hamilton. Mr. Young will be assistant in charge of this work and leaves the Pacific company on April 1.

D. W. Blakeslee, electrical engineer, formerly assistant superintendent of the Penn Electrical & Manufacturing Company, after having served in the Engineers, United States Army, has returned to his civil occupation with the Jones & Laughlin Steel Company, Pittsburgh, Pa. Mr. Blakeslee held his commission of first lieutenant for about two years. During his year in France he acted as company commander of Company A and Company C, Fifty-sixth Engineers, after which he did the scientific experimental and devolpment work of the American Expeditionary Force in connection with anti-aircraft searchlights and single-station sound-ranging apparatus. Since returning to the United States he has been stationed in the office of the Chief of Engineers, Washington, D. C. Mr. Blakeslee has specialized in mill and factory lighting and power applications. He is a member of the American Institute of Electrical Engineers, the Illuminating Engineering Society, the American Electrochemical Society, the Society for the Promotion of Engineering Education, the American Association for the Advancement of Science and the American Metric Association.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

M. C. Osborn has severed his connection with the Washington Water Power Company, Spokane, Wash., as contract agent and is at present traveling in the East. Mr. Osborn has been associated with gas and electric utilities in the Far West for the past thirty-five years. He entered the utility field in 1894 with the Virginia City (Nev.) Gas Company, which he operated for twelve years. From there he went to Marysville, Cal., with the Yuba Power Company. When this property was absorbed by the Pacific Gas & Electric Company, Mr. Osborn continued with the latter company as advance man in explaining the system and policy of the company to the numerous communities served by it. Later he was employed by the Denver (Col.) Gas & Electric Company, from which he resigned to become business manager and manager of the gas works of the Butte (Mont.) Electric & Power Company. After two years here he entered in 1905 the service of the Washington Water Power Company, with which property he has continued up to the present time. Mr. Osborn has always been active in association work on the Pacific Coast. He was at one time president of the Pacific Coast Gas Association and in 1916 was elected president of the Northwest Light & Power Association. Mr. Osborn has also been a member of the electric range and water-heating committee of the Northwest association since its inception four years ago.

M. C. OSBORN

Obituary

John J. Cummins, formerly president of the Syracuse (N. Y.) Lighting Company and later chairman of the board of directors, died on March 17 at his home in Syracuse at the age of fifty-five years.

Prof. Carey Foster, the well-known English scientist, died Feb. 9 in his eighty-fourth year. He was professor of physics at the University College, London, from 1865 to 1898 and principal of the college from 1900 to 1904.

Harnett J. Fuller, who for some years maintained offices as a consulting engineer at Tacoma, Wash., died recently at Tacoma. Mr. Fuller came to the United States about twenty years ago from England and for a time was a member of the engineering staff of Stone & Webster at Boston.

Burnett C. Kenyon, formerly president of the Diehl Manufacturing Company and during the past two years purchasing agent for the Crocker-Wheeler Company, died suddenly from pneumonia at his home in East Orange, N. J., on April 5 at the age of fifty-four years. Mr. Kenyon had been associated with the electrical manufacturing industry for many years. He grew up in the Diehl company from salesman, through the general managership, to president. Before being employed with the Diehl company in the nineties, he was associated with the New York Electrical Equipment Company. Mr. Kenyon resigned from the presidency of the Diehl Manufacturing Company about four years ago and, after taking a long and well-deserved rest, again entered business, becoming associated with the Crocker-Wheeler Company.

Sir William Crookes, known throughout the world for his discoveries and researches in the realms of chemistry and physics, died in London, England, on April 4. He was born in 1832 and in college specialized in chemistry. His connection with the electrical industry dates back to his first important discovery in 1861, when he succeeded in isolating thallium. During the determination of its atomic weight in subsequent research he discovered the principle of "repulsion resulting from radiation." This led to the invention in 1875 of the radiometer for illustrating such phenomena. In this fashion he was brought to his famous researches on electric discharge in high vacuums. The tubes used have come to be universally known as "Crookes tubes." It is to this work that the world owes its present electronic theory. Sir William's researches led him into many fields, including rare earths and precious stones. He was knighted in 1897 and had been the recipient of many medals and other tokens of recognition of his work. He was a past-president of the British Institution of Electrical Engineers and the British Association for the Advancement of Science. Sir William's discoveries have had no small bearing on the late developments in the fields of radiotelegraphy, the X-ray and electric lighting.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

IMPROVED MARKET FOR SECOND-HAND APPARATUS

Prices in Middle West Higher—Smaller Apparatus Moving Better than Larger Machinery

The volume of business in the second-hand market of the Middle West has improved materially in the last sixty days. While there is still small demand for units of 100 hp. and larger, the number of orders for the smaller material makes up for this. The second-hand dealers expect business to continue good.

As to prices, dealers say they are offering to pay more for machines than they were a few months ago. For a time offers on second-hand machinery were scarce and bids consequently were low. When it was learned that the government did not intend to sell $3,000,000 worth of motors it had on hand, the second-hand situation was considerably helped. These are not included in the government motors which it is reported are to be used in settling with munitions contractors.

Items that central stations buy are showing striking activity in comparison with that of the last few months. Meters, for instance, are quite active at prices not far out of line with those quoted in 1914. Induction meters of 5-amp. rating are selling at $7.

ABSORPTION OF EXCISE TAX ON FANS BY THE TRADE

Many Different Methods Employed by Manufacturers and Wholesalers to Take Care of 1918 5 per Cent Levy

In the absence of direct ruling regarding the collection of excise taxes on electric fans under the provision of the revenue act of 1918, passed in 1919, manufacturers have made certain provisions of their own for paying this tax. The government collects the tax on portable electric fans from the manufacturers. The method by which this tax is passed on to the wholesaler, to the dealer and finally to the consumer has been left, at least so far, to the discretion of the manufacturer.

Since the tax was imposed some manufacturers have issued new price lists which are 5 per cent higher than the old ones. Under this arrangement the tax does not appear as a separate item on the jobber's bill but is absorbed by the manufacturer. Other producers charge their former prices and add the tax separately.

The difference in the two plans can be shown as follows: By the first method a fan listing at $50 would be increased to $52.50. If the discount were 50 per cent, the jobber would then pay the $26.25 net and the manufacturer would pay the government 5 per cent on $26.25, which is $1.31, and would therefore receive $24.94 net for the fan. Under the second plan, where the list price is not changed, the manufacturer receives $25 net for the fan and shows the tax of $1.25 as a separate item on the bill. The jobber pays the same either way.

There are also manufacturers who are combining both plans. They bill the jobber the old price and add the tax separately but have issued new price lists 5 per cent higher for the use of dealers and users. Some jobbers are also issuing new price lists for their trade.

In changing lists by 5 per cent, however, manufacturers are careful not to claim that the increase is a tax increase. The 5 per cent tax is paid on the price received by the manufacturer and the government insists that on resale the customer must not be charged an increase for taxes which is greater in dollars and cents than is paid to the government. This does not mean, however, that the price cannot be increased for other reasons.

Attention has also been called to the fact that all fans are not taxed. Some manufacturers report that the government is only collecting the tax on oscillating and non-oscillating fans while exhaust fans, ceiling fans and hat-cleaning motors have been exempted.

SUITABLE COMPENSATION FOR WAREHOUSING LAMPS

Bookkeeping Costs Bring Request for Additional Compensation on Lamps Shipped from B Agents' Stocks During 1918

Representations have been made to the lamp manufacturers that sell on a consignment basis by jobbers for a further compensation for B agents on lamps shipped from jobbers' warehouses during 1918. Lamps shipped to customers from factory stocks are not to be included. There appears to be a disposition, it is reported, on the part of the producers to grant some such additional compensation to jobbers who have acted as something other than mere order takers. It is known that a compensation in the neighborhood of 1 to 2 per cent has been suggested. As yet, however, so far as can be learned, nothing definite has developed.

A request for an additional compensation on 1918 sales from agents' stock came as a result of the additional bookkeeping involved in the matter of prices. Price changes during the year caused the B agents no end of trouble.

While this is but a temporary condition, lamp manufacturers are very much opposed to the present form of compensation, which provides for a uniform discount to B agents based on the value of lamps sold during the year. For that reason there appears to be a possibility later of a change in compensation. Shipments from agents' warehouses may get a higher and more liberal compensation, while those agents relying wholly or partly on factory stocks may be proportionately penalized.

EFFECT OF ARTIFICIAL STANDARDS OF PRICE

Abridging of Economic Laws by Industrial Board Leads Sooner or Later to Instability in Business

When the new and lower iron and steel prices were announced a few weeks ago, it seemed as though the signal had been given for industry to proceed. In fact, that was what was expected when the Industrial Board was asked to lend its aid to stabilize the market by establishing a fair price. Numerous manufactured products made largely of iron and steel were reduced in price almost immediately. On other products producers were figuring costs preliminary to lowering prices during the opening days of April. Orders to go ahead on a number of building projects were given, and industry generally became quickened.

Then the railroad administration and other government and buying departments came forward with the statement that they had never promised to be bound by the board's

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prices. In fact, the railroad administration does not purpose at the present time to pay the proposed price on rails but is asking for one much lower.

As a result industry is again hesitant. The lower prices still prevail, but buyers are waiting to see if this fundamental raw-materials market is to be free and open or virtually tied up by agreed prices to remain in force until 1920. Orders are again being held up and expected price changes are not forthcoming.

Each time there has been an attempt on the part of the government to abridge the laws of economics and establish false and arbitrary standards of price, business has found itself in a hesitant mood. During the war there may have been justification for such action to prevent profiteering.

Just now, however, when industry was beginning to find itself, when the retail trade was once more buying, when building was slowly opening up, when spring was starting the seasonal tide of business—in other words, after the worst is past—it is not so easy to understand why there should be this interference.

Such action might bring about confidence on the part of business in the immediate future, but what of the fall and winter months?

There are many who are calling for a free and open market in iron and steel. Such people believe in the fundamental laws of economics. They believe that industry will be strengthened if it cures its own ills. It does seem now that business generally will be on a better basis with less chance for future hesitation if such artificial standards are not utilized.

METAL MARKET SITUATION

Most Metals Show a Continued Upward Tendency with Market Stability

In the last five weeks the tone of the copper market has changed from one of depression to one of considerable optimism. It is about that length of time since the metal stopped declining in price and struck its low level just under 15 cents, which level it maintained for about two weeks. It gradually rose through 15 cents and 15¼ cents to 15½ cents a pound and remained at that latter figure for two weeks. During this time the sales of copper exceeded the previous months of the year and gave evidence of a rather hopeful outlook for the immediate future. The reversal met by the Industrial Board through the Railroad Administration has affected the whole metal market appreciably.

In the past week prices have continued to show upward tendencies in several metals. Antimony, spelter and aluminum have increased slightly, and in the old-metal market scrap copper is moving constantly upward, and with it is going brass.

This upward tendency all along the line has given the market a much stronger tone.

NEW YORK METAL MARKET PRICES

	April 1	April 8
Copper:	£ s d	£ s d
London, standard spot	78 0 0	79 0 0
	Cents per Pound	Cents per Pound
Prime Lake	15.75	16.00
Electrolytic	15.50	15.50
Casting	15.25	15.30
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.25
Antimony	6.62½	6.80
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.55 to 6.60	6.52½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	29.00	30.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.00 to 13.25	13.50 to 13.75
Brass, heavy	7.25 to 7.50	7.50 to 8.00
Brass, light	6.00 to 6.50	6.50 to 7.00
Lead, heavy	4.25 to 4.50	4.25 to 4.50
Zinc, old scrap	4.25 to 4.75	4.25 to 4.75

THE WEEK
IN TRADE

FROM all sections of the country comes evidence of the strong expectation of increased business activity in the near future. The biggest cause for this feeling appears to be in the resumption of building activities noted throughout practically all the states. Not that so much has already been started, but contracts have been let and work is about to start.

Reports from jobbers indicate that March business has generally been better than business for last March. Especially has the retailer found this true for household appliances. The industries in some sections are expanding, and line work is being carried on in the West and Middle West especially. In general, conditions in the electrical trade show a more settled tone.

Labor troubles are smoothing out, and men in many sections of the country are returning to work. Collections are continuing to come in in a satisfactory manner.

NEW YORK

New building should be stimulated by the announcement last week that the contractors' price of cement alongside the docks in New York has been reduced 50 cents per barrel. Forty cents of this is for bags. As an additional help to investors it is planned to put building financing on a definite basis by the establishment of a national building bank to be operated under existing laws and as a part of the Federal Reserve banking system. Brooklyn is working out a coöperative apartment-house proposition.

The labor supply in the state is not greatly in excess of the demand, but the condition in New York City is made worse because many soldiers who are discharged in this district come to the metropolis instead of returning to their homes. Labor in general is much quieter.

Collections are better than before the war because the stringent credit requirements of the war are still being maintained in many instances and sellers are not taking chances. Manufacturers and jobbers have refused to sell to old customers who were rated by their collection departments as slow pay.

MOTORS, LARGE AND SMALL.—Standard speed alternating-current motors up to 50 hp. are now in stock, but direct-current motors are not so plentiful. One manufacturer took last week an order for $150,000 worth of motors and rotaries for a new industrial plant. There is very little demand for the unprecedented stock of new alternating-current motors up to 500 hp. in the warehouses of Eastern machinery dealers. Manufacturers' deliveries on such motors have been cut practically in half since the signing of the armistice.

FRACTIONAL-HORSEPOWER MOTORS.—The demand is greater than supply. One manufacturer is quoting three to four months' delivery. Another expects to catch up with back orders in sixty days.

FANS.—Manufacturers are building up large stocks, and 1919 fan sales are expected to beat all records. One manufacturer has secured more orders this year to date than ever before. The industrial and residential use of fans this year is expected to more than offset the large government purchases of 1918. The general use of four-blade portable fans during the war is being continued. The demand for ceiling fans is falling off.

SOCKETS.—Jobbers report large sales to fixture manufacturers. This business is earlier than might have been expected from conditions in the building trade.

FRICTION TAPE.—One line was reduced about 35 per cent and another line dropped about 15 per cent within the past three weeks. These changes brought the price of both brands practically together.

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IRONS.—The list prices of two more makes of irons have been reduced 50 cents each. The manufacturers' stocks are said to be below normal. This is not a reduction in the Hoskins schedule. On large orders it is reported that manufacturers now above schedule prices are quoting as low as the schedule.

STEEL REFLECTORS.—Prices are being maintained, but sales are light.

RUBBER-COVERED WIRE.—There is practically no change in the bases quoted this week, 20 cents prevailing. The demand, however, for the product is showing an improvement, but most of it is purchased for the West.

GALVANIZED WIRE.—Galvanized stranded wire and telephone wire both dropped about 5 per cent within the last three weeks.

POLE-LINE MATERIAL.—Orders for line hardware and cross-arms have increased noticeably during the past month, but there has been little movement in poles.

CHICAGO

The past week has been quiet, with a firm, steady undertone. A general air of optimism pervades all selling organizations, based not so much on orders that are being closed as on the unmistakable signs that central stations are quite active. Line construction, plant betterments and all sorts of work are going ahead. Telephone work is said to be a little more active than central-station work. Where central-station companies did not have munition industries to serve they have put off doing all kinds of work until now it has become absolutely necessary to do some of it. Some jobbers report a better business in March, 1919, than in March, 1918, although the feeling is that profits have not been so large. The tendency is very marked for dealers to put more efforts on specialties than on other lines on account of the slowness in building.

Nevertheless, there seems to be a considerable amount of activity in the building field, as is evidenced by reports of building permits. Up to a few weeks ago the building permits of the city of Chicago ran about $200,000 or less per week. For the week ended March 5 they showed a total of $1,124,100. The month of March has showed a volume of building permits which is twice what it was in March last year and is the biggest month in more than two years.

COPPER WIRE.—The market has been a little steadier this week with an upward tendency of prices. During the price changes the market was somewhat active. Rubber-covered and weatherproof are both on a 20-cent base.

NON-METALLIC FLEXIBLE CONDUIT.—This product is down about 35 per cent compared with what it was at the time the armistice was signed.

FLEXIBLE METALLIC CONDUIT.—This product has declined slightly.

WASHING MACHINES.—It has been reported that about $25,000,000 worth of washing machines were sold during 1918. The demand continues to be great.

SHOW-WINDOW REFLECTORS.—A campaign which is being conducted in show-window reflectors is producing excellent results.

FLOODLIGHTING PROJECTORS.—While it was expected that the bottom would fall out of the projector market when the armistice was signed, the effect has not been so great as was then expected. Quite a steady business in standard lines has developed, and while this demand is not so active as it was during the war time, it is very much better than was expected. Furthermore, so many of these units were put out during the war that quite an active business in parts has developed.

TURBINES.—The high prices of coal will probably dictate the installation of a number of turbines within the next six or twelve months in plants which had previously installed units around 2500 kw. Units of this size which were bought about six years years ago show a steam rate of around 21 lb. or 22 lb., while new units which might be bought to replace them would show around 15 or 16 lb.

MOTORS.—In the fractional-horsepower sizes for domestic appliances the demand continues strong.

LIGHTING FIXTURES.—There will apparently be an opportunity to sell a considerable quantity of lighting fixtures to banks in view of the way building operations are being opened up by these financial concerns. There are at least ten banks in Chicago that are contemplating building, and a score or more in the surrounding agricultural country have asked bank architects in Chicago to submit propositions.

BOSTON

Business holds up reasonably well, although not much large work is being done at present. Collections are a little slow, without much change compared with last week. Circular-loom discounts are showing considerable fluctuation, apparently due to local competition. The smaller contractors are getting busier as the season advances. Building operations are still greatly restricted by high prices of labor. It was announced last week that Henry Ford is negotiating for a 50-acre tract in Boston upon which to build a plant capable of employing at least 15,000 persons. The General Motors Company is also to build a five-story service station on the edge of the Back Bay district.

Jobbers' stocks are fairly large at present, with few exceptions. Galvanized conduit is a little short in supply, and conduit shows a tendency to run low in smaller sizes. Prices are off four or five points. Other material and equipment prices hold up steadily, and wire seems to have reached a low point for the present. Labor conditions are rather unsettled. Textile outputs are reported to be rapidly increasing in the Berkshire district of Massachusetts, with the prospect of the early resumption of night work. The printing trade is exceedingly active at Boston just now, and the demand for improved motor drives is a feature of the market. Small motors of the direct-current type are in considerable call.

FARM-LIGHTING SETS.—Stocks are well filled and inquiries are increasing. The outlook is good for an active season. At a convention at the factory of a prominent manufacturer of these equipments it was announced that present prices will hold through 1919.

WIRE.—A large number of small wiring jobs are being handled, but no shortage of wire is reported. Stocks appear ample to meet the present demand, with room for considerable expansion as well. Rubber-covered wire is being quoted on a 20-cent base this week.

SEWING-MACHINE MOTORS.—These are moving well, and an exceptionally good year is anticipated.

CONDUIT.—Smaller sizes of pipe are in somewhat increased demand, and the supply appears to be a trifle low. Galvanized pipe in particular is reported as somewhat scarce. A new card (No. 42) has been published, giving reductions of four to five points.

ELECTRIC TRUCKS.—Interest in road trucks continues to increase and some sales are being made. A meeting to stimulate trade and secure broader coöperation among dealers is scheduled for the Engineers' Club, Boston, at 8 p.m., April 17, under the auspices of the electric vehicle committee of the New England Section of the N. E. L. A.

LIGHTING FIXTURES.—The demand is increasing for fixtures for mercantile service. Prices show little evidence of decreasing at present, in view of the cost of brass and of labor. Local stocks are being well maintained. One Boston agency sold $60,000 worth of fixtures last year and is making plans for double this business this year. It will be some time, apparently, before all fixtures purchased before the armistice are disposed of. Novelties are in fair demand.

WASHERS AND CLEANERS.—Trade holds up well, and a brisk campaign is yielding excellent results in Maine.

MOTOR-DRIVEN COAL-LOADING EQUIPMENT.—Sales are increasing somewhat and inquiries are coming in well. A representative make shows about 10 per cent reduction in the latest quotations, effective April 1, due in part to easier prices of steel and other material involved. Stocks are in good shape for immediate delivery, and sales are well scattered.

ELECTRIC RADIATORS.—These are showing little movement at present, but a spurt in trade is looked for shortly, when furnace fires are let out.

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ATLANTA

A more pronounced feeling of optimism pervades the Southeast this week. Following a reduction in price of certain staple metal products, an increasing stimulation in orders and inquiries is noted, while transactions in general, covering a wide line, are being well maintained. On the whole, the outlook this week shows a marked improvement over the past few weeks. The majority of manufacturers report continued activity and the manufacture of seed and peanut-crushing equipment for export trade is becoming a large factor in this section. Wholesale and retail trade is good and still ahead of the previous year. The tendency to await lowering of prices seems to be gradually disappearing. Labor troubles so far are scattered.

That normal conditions are returning rapidly is evidenced by a tentative survey of realty and building conditions in Atlanta. Real estate transfers for the first quarter of 1919 show an increase of 22 per cent over the first quarter of 1918, and cash transactions 20 per cent, breaking all records since 1915. Building permits over the same periods increased 30 per cent, and their value increased 57.2 per cent. The average value of permits for the first quarter of 1918 amounted to $1,936, and for 1919, $2,370, indicating that building operations are assuming larger proportions. In addition to this activity, it is reported that a new two-million-dollar hotel, a four-hundred-thousand dollar theater and a five-hundred-thousand-dollar business building will be started soon.

CONDUIT.—A decline of five points is noted for black and white conduit this week. Manufacturers and jobbers report that the demand is growing rapidly. This is accounted for to some extent by the sporadic requirements from industrial sources. Stocks are in excellent condition, especially at Birmingham and New Orleans. Quick shipments are being secured from Eastern points. Fittings have sagged about 5 per cent, followed by an increasing number of inquiries, which have tended to liven an otherwise stagnant market. Local stocks are ample and shipments good.

STEEL-ARMORED CABLE.—Prices are off 10 per cent, and manufacturers have been flooded with inquiries and orders. In one quarter the volume and value of transactions are 50 per cent over last week. Stocks are somewhat low, but factory shipments are coming through on good time.

STAMPED STEEL BOXES.—A reduction of 10 per cent was recorded in these and a sluggish market has been stimulated.

FLEXIBLE STEEL CONDUIT.—A slight improvement is noted over the previous week. Jobbers are expanding their stocks. This is reflected in larger orders received by the manufacturers. This week's quotations are five points off the prevailing market. No difficulty is being experienced in securing prompt factory shipments.

SEATTLE—PORTLAND

Seattle jobbers as a whole report business slow during the past week. Retailers state that sales of electrical appliances, particularly ranges and washing machines, show a slight increase over the past two weeks. Jobbers give as a reason for the small sales volume the fact that prior to the shipyard strike, even prior to the armistice, various yards had purchased in excess of their needs. Now they are absorbing that surplus. With one or two exceptions Seattle yards, both steel and wooden, are operating full blast, running day and night shifts.

Commercial business is picking up, although it has not reached the peak volume attained before the shipyard strike. Apparently prospective purchasers of electrical machinery and equipment are still cherishing false illusions in thinking that prices will drop to the pre-war status. Jobbers are of the opinion that prices will drop, but that the process will be so slow as to be hardly noticeable. However, new industries are awaiting this very thing, and so are rural central stations which are planning extensions and betterments. Lumbering and logging interests are buying some electrical equipment, but not to the extent they would were prices lower. It is believed that with lower prices these industries will gradually change from steam to electric operation.

As a whole the electrical industry reports collections good. This applies to rural dealers as well as those in Seattle and other Puget Sound cities. No new extensions of credit or new credits of any particular significance were made during the past week.

Retail electrical interests in Portland state that business in their line was appreciably better for the month of March than for the same month last year. This also represents business in all lines of electrical merchandising.

Increased activity in construction of residences in Portland and towns throughout the state has been noted in the past ten days. Business conditions, on the whole, are more conducive to optimism than they were a month ago. The non-employment situation throughout Oregon has considerably improved.

DOMESTIC APPLIANCES.—Seattle dealers report a slight increase in sales of ranges and washing machines. It is believed this increase will continue until well into the summer. Sales of labor-saving devices this spring have been larger than originally anticipated. Stocks in most cases are reported in excellent condition. Many sales show marked decrease due to the coming of spring and longer days, the daylight-saving plan and the elimination of night shifts in some plants heretofore engaged in war work.

MOTORS.—Sales of larger sizes are light, while smaller sizes are moving in a comparatively satisfactory way, although not in the volume expected with the opening of the lumbering and logging industry. Stocks are in good condition and prices are firm.

SAN FRANCISCO

The machinists' strike in the San Francisco yards has been arbitrated, and the men are returning to work. For the present at least, the big shipyards will continue in operation. In other directions the labor situation is quiet. A proposed master electrician bill has been tabled by the California Assembly.

Building is a little brisker than during last month under the stimulation of slightly lower prices in building material and in electrical supplies. The United States government is discontinuing the cantonment at Camp Fremont, about 35 miles from San Francisco, and a vast quantity of lumber and other supplies will be thrown on the market.

WEATHERPROOF WIRE.—The market has been unsteady for several weeks, the base price in coil lots now being 22 cents a pound with very little demand.

RUBBER-COVERED WIRE.—The coil price of rubber-covered wire No. 14, single-braid, is now about $12.50 per 1000 ft. A big increase in demand is reported, and large stocks are being accumulated in expectation of the building boom anticipated about the middle of the year. The demand for larger sizes than No. 12, with the exception of a certain call for No. 6, the range-wiring size, is small, and sales of circular-mil wire are negligible.

SCHEDULE MATERIAL.—Switches and plates are slow. Sockets, especially brass-shell sockets, are moving steadily, although in smaller lots than the average order of last year. A job requiring about 100 hospital signals is reported by the Marine Hospital on the San Francisco government reservation, and several other hospital wiring jobs are in sight, owing to the determination of various California counties to erect their own sanitariums to take care of tuberculosis and other infectious diseases.

FLASHLIGHTS.—Dealers report an increased demand for flashlights and batteries, probably because of the spring conditions that influence campers, trampers and sportsmen.

VIBRATORS.—The long wet winter has produced many cases of rheumatism, neuritis and similar diseases, so that drug stores all over the state are stocking vibrators.

IRONING MACHINES.—A more intensive effort is being made to sell ironing machines, and new sources of distribution are being sought. Several large department stores are now handling them. The popular size in California is the 42-in. size, although in the Middle West it seems to be a 46-in. size.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft	10%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
1	50	13.00
1¼	50	21.00
1½	50	26.00
2	25–50	35.00
2½	25–50	45.00
3	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅛	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00	$20.00	$18.00
¼-in.—	30.00	24.00	21.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$60.00	$30.00	$26.00–26.50
¼-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
⅛	$0.08½
¼	.08½
⅜	.08½
½	.11½
¾	.17
1	.23
1¼	.27½
1½	.37½
2	.58½
2½	.76½
3	

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
⅛	$0.05	$0.19
¼	.06	.19
⅜	.07	.19
½	.10	.25
¾	.13	.37
1	.17	.45
1¼	.21	.50
1½	.28	1.10
2	.40	1.80
2½	.60	4.80
3		

DISCOUNT—NEW YORK

	⅛ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	7% to 12.1%	9% to 14.1%
2500 to 5000 lb.	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	⅛ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.18
Coil to 1000 ft	25.94

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%-38%	20%-33%
$10.00 to $50.00 list	36%-47%	31%-43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%-32%	10%-27%
$10.00 to $50.00 list	30%-40%	20%-35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $17.00
1/5 to std. pkg	12.00 to 14.00
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00-$24.15
1/5 to std. pkg	17.85- 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$16.00	$22.00
1/5 to std. pkg	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00-$18.40	$32.00-$36.80
1/5 to std. pkg	11.50- 16.00	27.20- 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.38
No. 18, full spools	.36

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15-$14.50	$10.50-$12.65	$10.50-$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00-$20.00	$13.00-$15.00	$11.50-$13.00
12	17.50- 21.63	17.55- 21.63	17.55- 18.54
10	24.05- 28.91	24.05- 28.91	21.16- 24.78
8	33.35- 39.34	33.35- 33.72	29.35- 33.72
6	52.95- 61.74	46.60- 52.92	46.60- 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$25.25
25 to 50 lb	25.25
50 to 100 lb	24.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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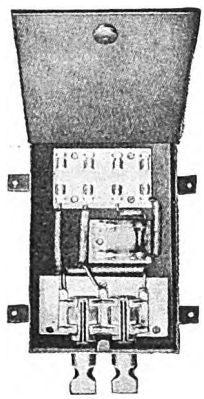
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Lighting Plug Box

The lighting plugging boxes now being manufactured by the Leonard Electric Manufacturing Company, Cleveland, Ohio, are arranged to be placed in convenient places in shops or rooms for connecting portable lights. They are designed for simplicity and

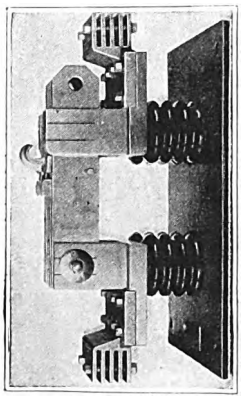


FOR CONNECTING PORTABLE LAMPS IN A SIMPLE MANNER

to withstand long and rough usage. The boxes contain mountings for four fuses, a switch, contacts for the plug and the necessary wiring connections. Drilling is provided for either loom or conduit as desired. The boxes are rated at 15 amp. and 110 volts.

Adjustable High-Rating Disconnecting Switches

In heavy-capacity bus structures the cost of installing disconnecting switches can be materially reduced if means are

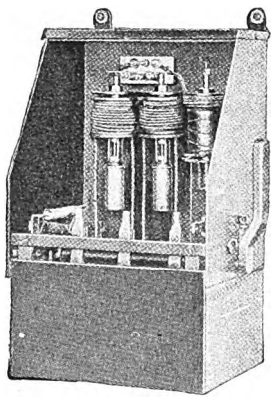


SEPARABLE TERMINAL AVOIDS BENDING OF BUSBARS

provided for eliminating the necessity of bending buses to line up with fixed heights of switch contacts. With the unit-type 4000-amp. switches manufactured by the Delta-Star Electric Company, 2433 Fulton Street, Chicago, the separable terminals are made in various heights and numbers of bus slots, so that by selecting a terminal of the proper size bending of the bus is unnecessary. A further adjustment in height between switch base and contact can be secured by raising the insulator supports by means of standard base fillers under the insulator units. With this adjustable switch the cost of installation can be maintained at a minimum figure.

Oil Starters for Polyphase Motors

For starting squirrel-cage motors where conditions do not necessitate using auto-starters or compensators, the Condit Electrical Manufacturing Company of South Boston, Mass., is making type G-1 oil starters, which



HANDLE RETURNED TO "OFF" POSITION WHEN COVER IS REMOVED

are applicable to alternating-current motors of 5-hp. to 35-hp. size. In the construction of these starters all live parts, coils and mechanism have been inclosed in a dust-proof case. The cover and oil tank are easily removable, permitting inspection or the making of wiring connections. When the cover is removed the handle returns to the "off" position, thus eliminating possibility of danger to a repairman. Interchangeable, reversible "knockout" plates placed in the top of the starter and on the side opposite the operating handle accommodate a wide range of sizes and combinations of conduits.

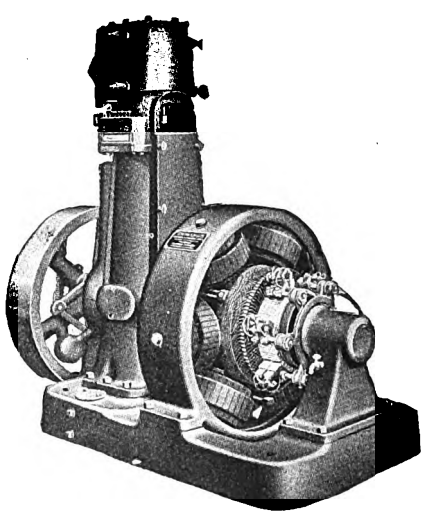
In operating these starters the handle is thrown into the position marked "start," and with the movable contacts in the starting position the overload coils are excluded except when motors are started "star-delta." After the motor has arrived at synchronous speed the handle is shifted quickly into the running position, which includes the trip coils in the motor circuit. To stop the motor the tripping lever placed on the front of the starter is thrown upward.

This arrangement, the manufacturer points out, permits the overload coils to be set at a sufficiently low value to protect the motor against overloads and single-phase running, and also precludes the motor from being disconnected during the starting period by the excessive starting current. Time limits prevent the starter from being disconnected on momentary current surges in excess of the overload setting.

Durably Constructed Direct-Current Generating Sets

For lighting and power service in factories, hotels and office buildings, for dredges, steam shovels and magnet cranes, for marine lighting, etc., Engberg's Electric & Mechanical Works of St. Joseph, Mich., are manufacturing direct-current generating sets in 1-kw. to 50-kw. size.

Accessibility and ease of adjustment of all working parts have been aimed at in designing the engines used in these sets. Removable side doors on each side of the engine frame allow access to the cross-head, wrist pin and all adjacent parts, while the hand-hole plates on the opposite side of the frame allow the lower end of the connecting rod to be reached. The piston and rod, the connecting rod, the cross-head, the



STRONGLY CONSTRUCTED, COMPACT SET

crank shaft and the valve are all said to be well made, simplicity and strength being features. The governor controls

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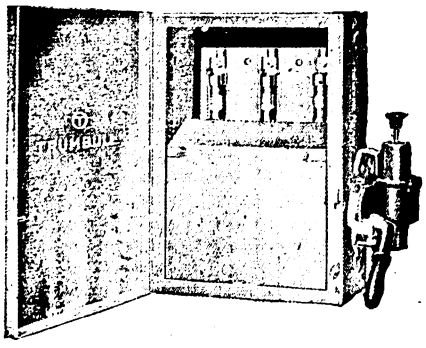
the speed within 2 per cent from no load to full load. Should it be necessary to change the engine speed, means are also provided for changing the tension on the governor springs.

These dynamos are of the multipolar type and customarily compound-wound for 115 volts. The shunt and series coils are separate and form-wound of cotton-covered magnet wire. The commutator is made of copper bars insulated with mica plate and is very heavy to insure long and continuous operation without renewal. It is built upon a separate sleeve and bolted to the armature drum so that the shaft can be removed without disturbing the windings.

Motor-Starting Switch with Safety Shield

In order to insure safety to the electrician who re-fuses motor-starting switches the Trumbull Electric Manufacturing Company of Plainville, Conn., is placing a shield of non-conducting material over the parts of the switch which are always connected to the supply circuit. This safety is completely assured because the door of the switch can be opened only when the switch is in the "off" position.



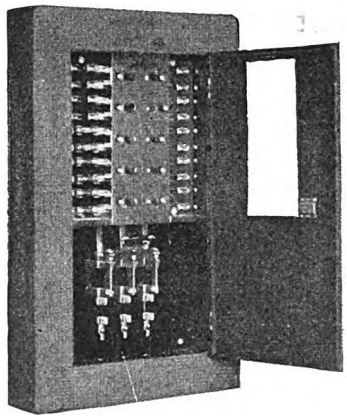
NO LIVE CONTACTS CAN BE TOUCHED WHEN RENEWING FUSES

The shield is hinged to the side or bottom of the switch box and can only be opened by the electrician who has access to the box, which is kept locked. A seal indicates whether or not the switch has been tampered with.

The switch illustrated herewith is equipped with an undervoltage release coil inclosed in a dust cap, but the shield can also be adapted for use with the ordinary manually operated knife switch made by this company.

Safety-Type Lighting Panels

With the safety-type lighting panels being manufactured by the Leonard Electric Manufacturing Company, Cleveland, inexperienced persons may operate the circuits without any danger of getting shocked or burned. For while the switch buttons are always accessible, the fuses and the main switch, should one be used, are protected by the door of the locked cabinet. The switches used in these panels are standard 10-amp. push-button type, of rugged construction, and are covered over with a steel plate through which the buttons



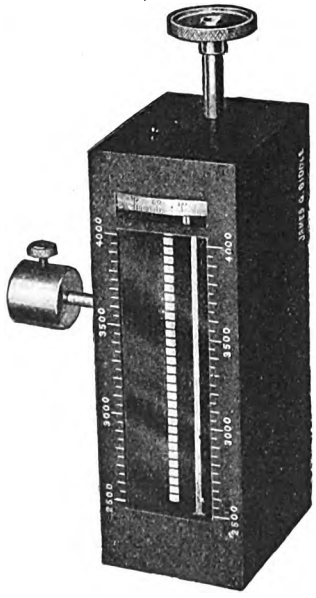
LOCKED DOOR BARS ACCESS TO LIVE PARTS

alone protrude. Arrangements are made for either N. E. C. or open-link fuses, the maker states, since the fuses are normally inaccessible and experienced men can replace open-link fuses with sufficient safety.

Snap switches are also supplied in place of the push-button type if desired. These lighting panels are obtainable in two-wire, 110-volt double-branch style and in three-wire, 110-220 volt type. They are furnished for from two to twenty-four circuits, with main switch ratings of 30 amp. to 100 amp. and with fused switch in mains, with switch in mains, with fuse in mains, or with main lugs only.

Instrument for Determining Vibration

The development of high-speed rotating machinery has made the question of vibration of great importance because it may cause excessive wear and



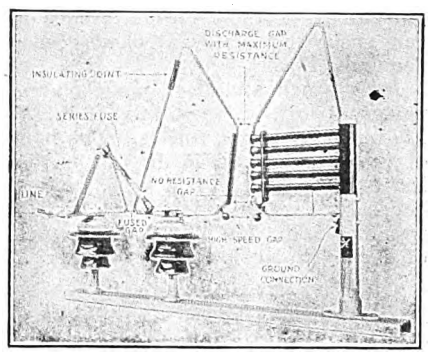
INDICATES AMPLITUDE OF VIBRATION (INSTRUMENT SITTING ON ONE END)

tear on the machine, noisy operation and vibration of surrounding structures. A reed-type instrument known as the "Jagabi Vibrometer" is being marketed by James G. Biddle, 1211 Arch Street, Philadelphia, which indicates both the frequency and amount of vibration. This instrument, as shown herewith, has, in addition to an r.p.m. scale, an amplitude scale located at right angles to the former. An index wire is provided, which, supported by a turnable frame and two posts, can be set by means of the projecting knurled head so as to indicate the amplitude of vibration of the reeds. A counterweight is used to increase or decrease the amplitude of vibration.

The most frequent causes of vibration, such as improper balance of rotating parts, improperly assembled or aligned bearings, pulsations of steam in blades and piping of turbines, and improper fitting of carbon or metallic packing in impulse turbines, may be detected with this instrument. The instrument is especially desirable for comparative tests.

Lightning Arrester with Fuse

Combining the advantages of the series fuse with those of an auxiliary gap, lightning arresters are now being made by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago. The



AUXILIARY GAP PROTECTS CIRCUIT WHEN SERIES FUSE HAS BLOWN

series fuse used in these arresters is mounted at the necessary 45-deg. operating angle so that it is readily accessible with fuse tongs from the grounded end of the arresters or from a point below the arresters. This fuse is shunted by an adjustable auxiliary gap, the latter becoming effective only when the fuse blows, thus avoiding the non-protection of the circuit until the fuse has been replaced. The arrester is regularly furnished with 25-amp. fuses for voltages up to 25,000, while for service above 25,000 volts 10-amp. fuses are furnished. Fuses of other ratings can be furnished if desired.

Motor-Driven Tool Grinders

Electrically driven tool grinders in both floor and bench types have just been developed by the Janette Manufacturing Company, Singer Building, New York City, and 617 West Jackson Boulevard, Chicago. The ½-hp. motors used with these grinders are furnished for alternating and direct current in

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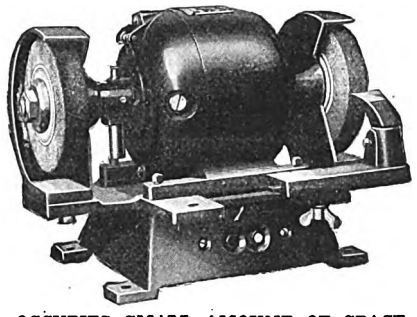
all voltages and have a speed of 3500 r.p.m. with an ample overload capacity. Connection is made to any lamp socket by a 6-ft. (1.8-m.) extension cord. Located in the base of the grinders directly below the motor is a push-button switch which is designed to withstand hard use.

Spindles are made of 90-point carbon



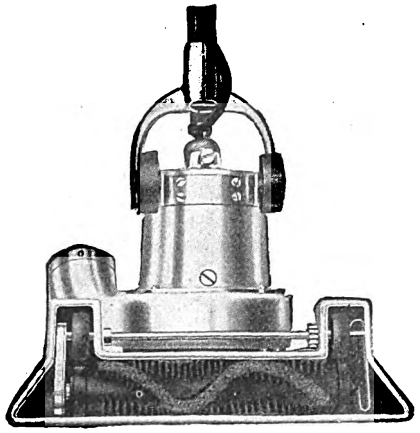
OCCUPIES SMALL AMOUNT OF SPACE

steel, hardened and ground to size. Hard-drawn phosphor-bronze bearings are standard equipment, but S.K.F. ball bearings can also be obtained. Grease and wick-type lubrication is employed, an oil cup being installed on the upper bearing which is arranged with holes for returning the oil back into the oil well. Heavy guards protect the grinding wheels two-thirds of their circumference and can easily be removed when occasion demands.

Both bench and floor models accommodate two ¾-in. by 5-in. (19-mm. by 127-mm.) grinding wheels. The height of the floor type is 46 in. (1.1 m.) and its weight 105 lb. (47.6 kg.), while the bench type is 10 in. (0.25 m.) high and weighs 55 lb. (24.9 kg.). The width of each grinder is 14 in. (0.35 m.).

Positive Gear-Driven Vacuum Cleaner

Removing threads and lint without injuring the carpet by means of a positive gear-driven floating brush is the

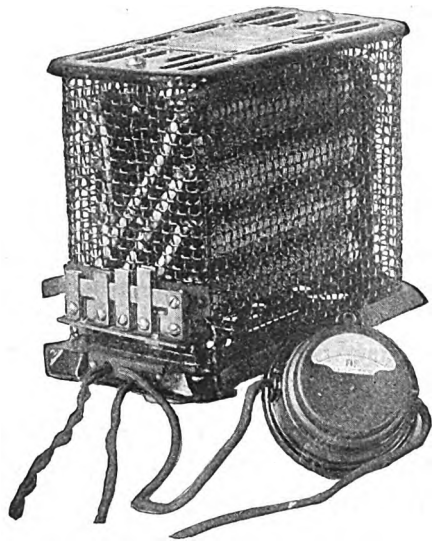


HEIGHT OF NOZZLE ADJUSTED BY KNOB ON COLUMN

feature of the vacuum cleaner being marketed by the Regina Vacuum Cleaner Company, 47 West Thirty-fourth Street, New York City. Carpets and mattresses can be thoroughly cleaned, according to the makers, by regulating the position of the suction nozzle to meet various conditions. The illustration shows the construction and the method of brush drive. This brush can be easily removed for cleaning.

Direct-Current Battery-Charging Rheostat

Where the voltage of an available charging circuit is much higher than that of the battery to be charged, some method must be used for reducing the voltage the necessary amount. For use on direct-current lines of 110 volts the France Manufacturing Company of Cleveland, Ohio, has recently developed a charging rheostat with charging rates of 1½, 3, 4½ or 6 amp. for batteries ranging from 2 volts to 18 volts. The back pressure from a battery of higher voltage than this causes only a slight reduction in the ampere charg-

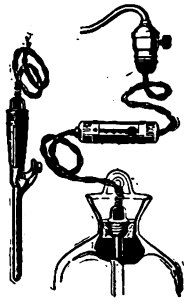


GIVES CHARGING RATES OF 1½, 3, 4½ OR 6 AMP.

ing rates. The rheostat consists of a series of high-resistance coils together with a current-regulating switch for varying the charging rate. An ammeter, a long extension cord and plug, charging leads and battery clips complete the outfit, which is finished in black enamel, weighs about 10 lb. (4.5 kg.) and has dimensions of 5 in. by 7 in. by 9 in. (12 cm. by 17 cm. by 22 cm.). This rheostat can be used on current furnished by 24-volt or 32-volt direct-current farm-lighting plants for charging ignition batteries of automobiles, tractors, etc.

Combination Hot-Water Bottle Heater and Curling Iron

An interesting appliance is being marketed by the Christian Heater Sales Company, 532 Grand River Avenue, Detroit, Mich., in the form of a combination curling iron and hot-water-bottle heater. It consists of the electric heater proper, a curling-iron handle and a heat-regulating switch. To use the heater in a regulation water bottle it is screwed into the neck of the bottle and the plug is inserted in any light socket with direct or alternating current at 90 volts to 125 volts. The heat is regulated by the switch at three temperatures — high,



THREE HEATS OBTAINED BY SWITCH

low and medium. It is pointed out that after the water is heated to the desired temperature it may be maintained at that degree without the water boiling by shifting the switch to a lower heat. Also it is said that the heat has a tendency to keep the rubber of the bottle soft and pliable. The heater is inserted into the handle for use as a curling iron and the temperature controlled by the regulating switch.

NOTES ON RECENT APPLIANCES

Electric Hair Cutter

The Barbers' Electric Specialty Company, 4204 Troost Avenue, Kansas City, Mo., is marketing an electrical hair-cutting machine which operates from a trolley.

Renewable Fuses

The construction of the National renewable fuses made by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, has been improved.

Lighting Plants

Assembled in fifteen, twenty and twenty-five-light units, Aerothrust lighting plants are being marketed by the Aerothrust Engine Company of Laporte, Ind.

Clothes-Washing Machine

The Wash-Easy Company, Fourteenth Street and Western Avenue, Chicago, is manufacturing an improved model of the rocker-type Wash-Easy "Copper" washer.

Two-Header Superheaters

Stationary power-plant steam superheaters for application to all fire-tube or water-tube-type vertical or horizontal boilers are now being marketed by the Locomotive Superheater Company, 30 Church Street, New York City, and People's Gas Building, Chicago.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The A. B. Knislingeverken, Knislinge, Sweden, importers and exporters of electrical machinery, desire to make connections with American manufacturers.

A man in France (No. 28,787) desires to secure an agency for the sale of electrical apparatus and electrical cars for factories. Correspondence should be in French.

A company in Italy (No. 28,789) desires to secure an agency for the sale of electrical apparatus. Correspondence may be in English.

A firm in Italy (No. 28,782) desires to secure an agency for the sale of electrical heating and cooking devices, such as stoves, flatirons and boilers. Correspondence may be in English.

A man in the Azores (No. 28,784) desires to secure an agency and possibly purchase all articles and supplies connected with the construction and installation of a hydroelectric plant of 3000 hp. and the construction and equipment of an electrical railroad system of approximately 50 miles. Correspondence may be in English.

A firm in Brazil (No. 28,788) with a branch office in New York City wishes to secure exclusive agencies for the sale of electrical supplies.

A British Indian company (No. 28,794) with buying headquarters in New York City wishes to purchase direct from manufacturers. Payment will be made against documents in New York.

A firm in France (No. 28,813) desires to purchase and also secure an agency for the sale of electrical apparatus and equipment, such as heaters, private telephone lines, electromedical equipment, motors, transformers and rheostats. Correspondence should be in French.

A company in France (No. 28,817) desires to secure an agency for the sale of electrical equipment. Correspondence may be in English.

An electrical engineer in France (No. 28,826) desires to secure an agency for the sale of electrical motors and electrical apparatus. Correspondence should be in French.

A firm in Italy (No. 28,834) desires to secure an agency for the sale of electric welders, butt and spot. Correspondence may be in English.

A firm of commercial agents in Italy (No. 28,838) desires to secure an agency with a stock of goods for the sale of electrical fittings. Quotations should be given f.o.b. New York or port nearest to manufacturer. Cash will be paid. Correspondence may be in English.

A firm in Ecuador (No. 28,841) desires to receive catalogs, either in English or Spanish, of electrical materials, wire, lamps, fixtures, etc.

A man in Italy (No. 28,848) wishes to secure an agency for the sale of electrical appliances. Correspondence should be in Italian.

An agency is desired by a man in Italy (No. 28,851) for the sale of electrical machines. Correspondence may be in English.

A merchant in France (No. 28,868) desires to secure an agency for the sale of electrical apparatus. Correspondence should be in French or Spanish.

An editor of a newspaper in Greece (No. 28,881) desires to purchase printing-press machinery and electric motor to operate. The buyer wishes catalogs with full information regarding prices and terms. Payment will be guaranteed through bank.

A man in France (No. 28,889) wishes to purchase or secure an agency for the sale of electrical supplies. Correspondence should be in French.

A Norwegian company (No. 112,342) is in the market for an electric generator of 5200 kw., alternating current, with the auxiliary machinery, to be delivered and installed in the company's power station at Svelgen, in Bremanger. If the machinery proves satisfactory after delivery and use, opportunity will be given to bid for larger orders, as the power available is more than 30,000 hp., so that later electrical machinery aggregating 33,000 kw., with turbines to correspond, will be installed. Blueprints of the generator may be examined at the Bureau of Foreign and Domestic Commerce or its district offices.

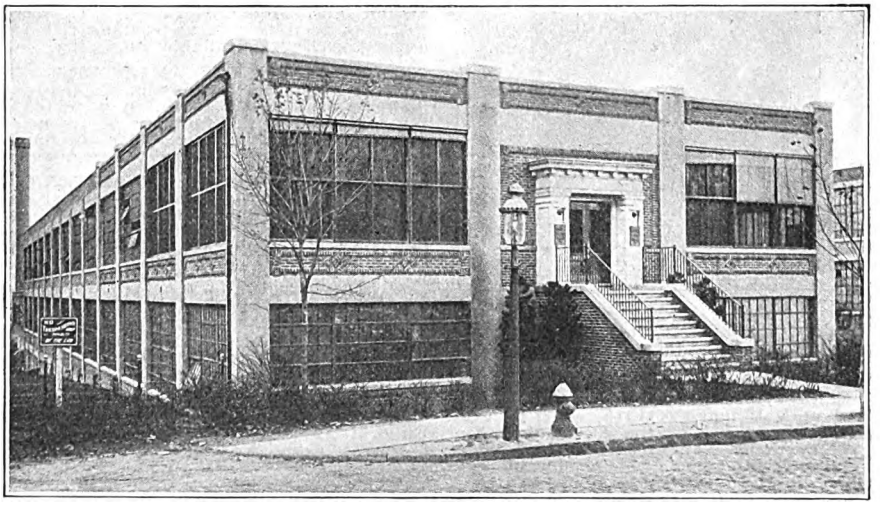
WESTINGHOUSE JOBBER - AGENTS TO MEET.—It is reported that Westinghouse jobber-agents are to meet in Del Monte, Cal., from May 4 to May 11.

REVISED FREE LIST.—"Free List" is now applicable to exportations to Denmark, Norway, Sweden, Holland, Finland, Switzerland, Luxemburg and the occupied Rhine territory, and licenses for exportation of electrodes and iron or steel lighting fixtures will be issued.

BRITISH IMPORTS.—The Comptroller of Import Restrictions lists the following articles for admission freely under general license: electrodes, telephones and telephone parts except telephone brackets and parts, telephone switchboards and parts and brass terminals for electric fuse boards.

CATALOGS WANTED.—The Purchasing Agents' Association of Northern California, with headquarters at San Francisco, is starting, for the benefit of its members, a general catalog file. The association, through its secretary, D. B. Gray, 230 California Street, San Francisco, invites manufacturers and dealers generally to send complete sets of their latest catalogs and trade publications to the above address. Catalogs covering machinery, mechanical goods, hardware, iron and steel products, etc., are especially requested.

THE CHELTEN ELECTRIC COMPANY, Philadelphia, has recently occupied its new factory at 4859-65 Stenton Avenue. The company is prepared to market a line of plug cut-outs which have just been approved by the Underwriters' Laboratories and is arranging to manufacture several new types of switch boxes and outlet boxes.



THE CHELTEN ELECTRIC COMPANY'S NEW FACTORY IN PHILADELPHIA

T. W. BEHAN, for the last twenty years with the General Electric Company, Fort Wayne, Ind., has resigned to accept the position of factory manager of the 1900 Washer Company at Binghamton, N. Y. Mr. Behan has for many years been in charge of the fractional-horsepower motor-sales department of the Fort Wayne plant of the General Electric Company. He was presented with a handsome leather traveling bag by his department associates. He is succeeded by A. H. Francis, who has been with the Chicago office of the General Electric Company for a number of years.

W. J. HUDDLE & COMPANY, Chicago, announce that an organization headed by W J. Huddle and doing business under the above name has taken over the business formerly carried on by Sloan, Huddle, Feustel & Freeman, consulting engineers. For the past two years Mr. Feustel has been president of the Fort Wayne & Northern Indiana Traction Company and has given the larger portion of his time to this work. In the future he will devote all of his attention to street railway operation and advisory engineering work in this field and will be stationed at Fort Wayne, Ind. W. F. Sloan is connected with the Post Office Department as advisory telephone engineer. W. J. Freeman also retires from the firm but will continue in consulting engineering. Mr. Huddle, who was actively connected with the various lines of work carried on by the old firm now has associated with him a number of the old organization, and other former members of the staff will probably rejoin him as soon as they are released from military service. W. J. Huddle & Company will continue to specialize in public utility matters and are now in a position to undertake work in all of the lines in which the organization formerly engaged. Their offices will continue at 1745 Conway Building, Chicago.

THE TERRY STEAM TURBINE COMPANY, Hartford, Conn., announces that its reduction gears are again on the market. They were not obtainable during the last year owing to the concentration of the company almost entirely on turbines for destroyers.

B. A. WAGNER, manager of the Electric Agencies Company, Inc., has secured the Pacific Coast agencies for the Collyer Insulated Wire Company, manufacturer of rubber-covered and weatherproof wire, and the Tubular Woven Fabric Company, manufacturer of "Duraduct."

GEORGE K. HEYER is the new assistant telephone sales manager of the Western Electric Company, having been advanced from the position of railway sales engineer. He has been with the company in New York since 1902 and will remain there with headquarters at 195 Broadway.

E. I. DU PONT DE NEMOURS & COMPANY, Wilmington, Del., announce the transfer of T. E. Doremus to the E. I. du Pont de Nemours Export Company as general Eastern manager with headquarters in Shanghai, China. E. R. Galvin succeeds Mr. Doremus as manager of the sporting powder division.

THE ELECTRIC BUREAU, INC., Park Row Building, N. Y., is the recently incorporated American branch office of the Elektrisk Bureau of Christiania, Norway, importers and wholesale distributers of electrical household appliances, labor-saving devices, supplies for high and low tension and lighting units.

R. D. HARRINGTON has joined the staff of the Electric Storage Battery Company's New England sales office, with headquarters at Boston, and will devote special attention to the industrial electric truck market. Mr. Harrington was graduated from Tufts College, department of electrical engineering, in 1915, and for the past ten months has been on the electrical staff of Fay, Spofford & Thorndike, designing engineers of the Boston army base. His earlier experience included a term of service in the engineering department of the Cumberland County Power & Light Company, Portland, Me.

FIRST LIEUT. S. A. KOENIG of the Coast Artillery has been discharged from the service and has joined the forces of the Advance Machinery & Supply Company, Denver, Col., as sales engineer. Lieutenant Koenig was graduated from the electrical engineering department of the University of Colorado in 1913 and has spent about four years in the employ of the General Electric Company, Schenectady, N. Y. The last two years of this time was spent in

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the experimental department. The Advance Machinery & Supply Company is Western representative for electrical specialties and mine, mill and power-plant supplies.

THE HURLEY MACHINE COMPANY of Chicago has opened a shop under the name of the Thor Electric Shop at 908 Walnut Street, Des Moines, Iowa. Charles A. Ellen, who has been department manager in the Chicago office, will be in charge.

RUSSELL C. TIRRELL has been appointed quality manager of the Hygrade Lamp Company, Salem, Mass., succeeding George W. Fox, resigned. Mr. Tirrell entered the company's service about a year ago, and was an assistant in the quality department at the time of his promotion.

J. E. KEARNS, who has been placed in charge of the St. Louis office of the General Electric Company, was born in 1880. Upon his graduation from the University of Michigan he started to work for the General Electric Company, and he has constantly retained his connection with that concern over sixteen years. During that time he has worked in the testing, direct-current designing, power and mining and

J. E. KEARNS

lighting departments. In May, 1916, he was transferred to the company's Chicago office, and in the fall of 1918 he was appointed manager of apparatus sales for the Chicago district, which position he retained until January of 1919, when he was appointed manager of the St. Louis office of the company. Mr. Kearns has a wide acquaintance and has had considerable experience in the electrical field, having represented his company as technical engineer for several years on the electrical apparatus committee of the National Electric Light Association, of which committee he is now an honorary member. He was among those instrumental in the preparation of the handbook on overhead-line construction published by the National Electric Light Association, and he gave material assistance in the preparation of the American Institute of Electrical Engineers' rules.

THE UNDERWRITERS LABORATORIES, Chicago, according to W. H. Merrill, the president in "Safeguarding America Against Fire," inspected approximately 100,000,000 items of material, machinery and supplies ordered by the government for war purposes. For the Navy Department the Laboratories inspected 1,000,000 ft. of lead-covered cable, and for the Quartermaster's Corps 7500 acres of roofing were tested, besides fire extinguishers, fire doors and electrical appliances of various kinds.

E. L. SIMPSON has been appointed manufacturing superintendent of the Fort Wayne (Ind.) plant of the General Electric Company. He has spent the last two years at Fort Wayne, going there from Schenectady, N. Y. He will have for his two assistants Max Holz and A. Kaysor. Mr. Holz went to the Fort Wayne plant from Madison, Wis., where he was employed as a special designer. He had also held the same position at Fort Wayne. Mr. Kayser for some time has been superintendent of section A of the Fort Wayne plant, or that part of the works east of Broadway.

Trade Publications

SERIES SOCKET.—A circular devoted to the "Kyle" series socket has been issued by the Line Material Company, South Milwaukee, Wis.

ANODE HOOK.—The "Ever Ready" anode hook is described in a folder of the Niagara Insul-Bake Specialty Company, Niagara Falls, N. Y.

REFLECTORS AND FITTINGS.—Reflector Hand Book No. 11, describing Burr reflectors, is being circulated by the A. B. Wilson Company, Leader-News Building, Cleveland, Ohio.

INDICES.—Dated April, 1919, an index to its descriptive bulletins and sheets and one to its supply-part bulletins have been published by the General Electric Company, Schenectady, N. Y.

SAFETY PANELS AND CABINETS.—Bulletin No. S-10 from the Penn Electrical & Manufacturing Company of Irwin, Pa., contains information about Penn safety panels and cabinets.

STEEL POLES.—A mailing folder about its steel poles for various services has been prepared by the Bates Expanded Steel Truss Company, Continental & Commercial Bank Building, Chicago.

WOOD PRESERVATION.—"Long Life for Wood at Low Cost" is the title of a booklet recently issued by the Barrett Company which tells when, where and how to use "Carbosota" Creosote Oil.

REFILLABLE FUSES.—A folder about the refillable cartridge fuses made by A. F. Daum, 1157 Hodgkiss Street, Pittsburgh, Pa., has been issued, as well as a leaflet about the Daum refillable fuse plug.

DIRECT-CURRENT AMMETERS.—The Weston Electrical Instrument Company of Newark, N. J., sets forth, in a folder of recent issuance, the features of its model 354 direct-current ammeters for automobile use.

DIRECT-CURRENT AMMETERS.—Flush and surface type direct-current ammeters are shown and described in a new folder from the Ballman-Whitten Manufacturing Company, 440 Olive Street, St. Louis, Mo.

SUPERHEATERS.—Its new superheaters for stationary power plants have been described and illustrated in detail by the Locomotive Superheater Company, 30 Church Street, New York City, and People's Gas Building, Chicago, in bulletin No. T1.

BATTERY-CHARGING EQUIPMENT.—Bulletin 24 issued by the France Manufacturing Company, Cleveland, Ohio, contains descriptive matter about "F-F" battery-charging equipment. Bulletin 25 of this company is a new price list for these "battery boosters."

INDUSTRIAL APPARATUS.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces the issue of five separately bound catalogs, Nos. 30, 33, 36, 38 and 45, covering industrial apparatus, to supersede No. 3002. These cover direct-current motors and generators, alternating-current motors, control apparatus, small motors and generators and mill, crane and hoist motors.

STEAM-BOILER COMBUSTION.—Written in a clear and simple manner, the book entitled "Principles of Combustion in the Steam-Boiler Furnace," issued by the Babcock & Wilcox Company, New York, outlines the principles involved in the study of what happens in the combustion chamber of furnaces. Fundamentals of the chemistry of combustion are given and formulas are developed which show the relation between temperatures, volumes and pressures. Discussing density, weight and volume of gas, heat of combustion, specific heat, temperatures developed in combustion, air and combustion, Arthur D. Pratt, the author of the booklet, constructs the formula of the air required for combustion. Combustion losses and smoke are discussed and methods of reducing these losses are given. In case formulas and derivations prove too complicated for the reader he can still get invaluable information from the examples of how to determine the amount and speed of the air. In addition combustion data are given for coal, oil, natural gas and by-product coke-vein gas. The computations involved in the determination of the distribution of losses in a boiler test—that is, the heat balance—are carried out in full.

PLUGGING BOXES.—Bulletin "G," issued by the Leonard Electric Company, Cleveland, Ohio, has for its subject plugging boxes for light and power.

VACUUM CLEANERS.—The Regina Vacuum Cleaner Company, 47 West Thirty-fourth Street, New York City, has prepared a circular giving the features of Regina vacuum cleaners.

METAL REPLENISHER FOR LINOTYPES.—The Fortified Manufacturing Company of Kansas City, Mo., has prepared a booklet describing its electric "Metalfeed" for type-casting machines.

METAL PARTS.—A two-color folder is being distributed by the Maximum Silencer Company, 81 Homestead Avenue, Hartford, Conn., showing the various complicated parts which can be produced from steel tubing by the Maxilent process.

MOLDED INSULATION.—"C-H Molded Insulation" is the title of a new two-color, sixteen-page booklet which describes "Thermoplax" and "Pyroplax," the heat and fire resisting insulations made by the Cutler-Hammer Manufacturing Company of Milwaukee, Wis. Numerous photographs illustrate more than 200 different pieces molded from these materials. They include such pieces as attachment plug and cord connector parts, heater connectors, ignition wire spacers, switch and starter bases, stove, hot-plate and heater bases, marine wiring devices, switch and rheostat handles, radiator caps, and a 24-in. field rheostat base. The booklet gives the physical properties and characteristics of these two materials and describes the method of manufacture.

New Incorporations

THE HOUSTON-GUADALUPE WATER POWER COMPANY of Houston, Tex., has been incorporated with a capital stock of $200,000 by H. A. Halverton, F. T. Beadle, C. L. Kolb and others.

THE EMPIRE ELECTRIC & MACHINE COMPANY of Terre Haute, Ind., has been chartered with a capital stock of $25,000 to manufacture electrical specialties. The incorporators are Charles F. Behringer and C. A. Epling.

THE E. J. WIGGINS ELECTRICAL CORPORATION of Buffalo, N. Y., has been incorporated by E. J. Wiggins, C. G. Babcock and R. Seimer. The company is capitalized at $75,000 and proposes to manufacture electrical apparatus and appliances.

THE STANDARD LIGHTING & HEATING COMPANY of Springfield, Mass., has been incorporated with a capital stock of $50,000 to manufacture heating and lighting appliances. The incorporators are Arthur G. Taylor, Ralph H. Benson and R. L. Meyer.

THE MANUFACTURERS' EQUIPMENT EXCHANGE of New York, N. Y., has been incorporated by R. Grant, H. E. and A. C. Ackerly, 914 Ditmas Avenue, Brooklyn, N. Y. The company is capitalized at $50,000 and proposes to manufacture motors, electrical equipment, boilers, etc.

THE NORTHERN OHIO HYDROELECTRIC COMPANY of Ashtabula, Ohio, has been incorporated by George R. McKay, Raymond R. Oliver and others. The company is capitalized at $300,000 and proposes to build a hydroelectric plant in Astabula County to supply electricity in Ashtabula.

THE UNITED GAS IMPROVEMENT CONTRACTING COMPANY. United Gas Improvement Building, Philadelphia, Pa., has been organized as a subsidiary of the United Gas Improvement Company to manufacture gas and electric appliances and equipment. Paul Thompson is president of the company.

THE CENTRAL ELECTRIC TOOL COMPANY of Pittsburgh, Pa., has been chartered with a capital stock of $5,000 by John A. Metz, 2800 Espy Avenue, Dormont, Pa.; S. E. Wentley, West Elizabeth, Pa., and John H. Martin, Bridgeville, Pa. The company proposes to manufacture electrical appliances, machines and devices.

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New England States

HIRAM, ME.—The bill introduced in the State Legislature by Senator Charles E. Gurney, providing for improvement of storage and reservoir conditions on the Saco River, would make possible a development of 38,000 hp. on that river. The project would include not only development of the storage basin at Hiram but also that of the Great Ossipee. The cost of the work is estimated at $1,978,000.

FAIRHAVEN, VT.—The Western Vermont Power & Light Company has secured a number of contracts for furnishing electricity to operate a number of creamery plants in this section.

WEST BROOKFIELD, MASS.—The Town Council is considering plans for extensions to the street-lighting system. The service is supplied by the Central Massachusetts Electric Company of Palmer.

NORWICH, CONN.—The Gas and Electric Commissioners have entered into a contract with the Admore Woolen Company to erect a new electric transmission line to Yantic to supply additional power to the company. About 5 miles of wire will be strung. The cost of the work is estimated at $20,000 to $25,000.

PUTNAM, CONN.—Arrangements have been completed by the Nightingale-Morse Mills, Inc., for the construction of a hydroelectric plant to supply electricity to operate its mills.

Middle Atlantic States

COBLESKILL, N. Y.—Considerable electrical equipment will be required in connection with the proposed improvements and alterations in the home economics building at the Schoharie State School of Agriculture. D. D. Frisbie is president of the board of trustees.

JAMESVILLE, N. Y.—Considerable electrical equipment will be required in connection with the installation of the new refrigeration plant in the Onondaga County Penitentiary, for which contract was recently awarded.

MINEOLA, N. Y.—Arrangements it is reported, are being made by the Nassau Light & Power Company for improvements to its system in Manhasset. The company is also contemplating extensions to its street-lighting system in the Port Washington district.

NIAGARA FALLS, N. Y.—Plans are being prepared by Mills, Rhines, Bellman & Nordhoff, architects, of Toledo, Ohio, for extensions to the plant of the United States Light & Heat Corporation on Highland Avenue. The company manufactures batteries, electric lighting equipment, etc.

POUGHKEEPSIE, N. Y. — Notice has been filed with the Public Service Commission by the Central Gas & Electric Company of an increase in capital stock from $2,500,000 to $2,600,000, to provide for extensions.

TOMPKINSVILLE, N. Y.—Bids will be received at the office of the lighthouse inspector, Third District, Tompkinsville, until April 23, under proposal 4161, for furnishing motors, etc., to convert Niles bending rolls.

WESTFIELD, N. Y.—Plans have been filed by Armour & Company of Chicago, Ill., for the construction of a new factory in Westfield. Arrangements have been made for the construction of a power plant in connection with the project. The cost of the entire work is estimated at $300,000.

DOVER, N. J.—Negotiations are under way between the New Jersey Power & Light Company and the Newton (N. J.) Gas & Electric Company whereby the former will furnish the latter with electricity for distribution in Newton and vicinity. This will require the erection of 12 miles of 33,000-volt, three-phase transmission line and a substation, which the Newton company will own.

TRENTON, N. J.—The Public Utility Commissioners have granted the Trenton & Mercer County Traction Corporation permission to issue $200,000 in bonds, part of which will be used for extensions and improvements. The proposed work will include the installation of new equipment to cost about $10,000; new generating unit for power plant, $20,000; for the installation of a system for the mitigation of electrolysis, $10,000; a new pit lighting system, $1,000, and other improvements.

LEHIGHTON, PA.—The Mauch Chunk & Lehighton Transit Company is contemplating the purchase of new equipment for its power plant, and is also planning improvements to its power lines. Ives & Davidson, 61 Broadway, New York, N. Y., electrical engineers, are in charge of the work.

PHILADELPHIA, PA.—The Western Electric Company has filed plans for the alterations and improvements in its building at 1100 York Street. Contract has been awarded to the Matthews Company.

HAGERSTOWN, MD. — Arrangements have been made by the Maryland Smelting & Refining Company of Hagerstown for the construction of a metal-concentrating plant, with electrical and other equipment. A one-ton brass melting furnace will be installed.

QUEENSTOWN, MD.—The Town Commissioners have decided to secure electricity from the municipal plant at Centerville to operate the local electric lighting system. The electric transmission line will be erected by the Town Commissioners of Queenstown. The municipal generating plant has been closed down for several weeks.

BLUEFIELD, W. VA.—The question of improvements and extensions to the ornamental lighting system is under consideration by the Chamber of Commerce.

MILLVILLE, W. VA.—The Northern Virginia Power Company of Winchester is contemplating building an addition, 50 ft. by 57 ft. and 33 ft. by 50 ft., to its local plant.

WINDSOR, W. VA.—The Wheeling Electric Company, controlled by the American Gas & Electric Company, is planning to build an addition, about 200 ft. by 300 ft., to its local plant. The proposed extension will be equipped with three steam-driven generating units having a capacity of about 180,000 kw. The cost is estimated at about $1,000,000.

WASHINGTON, D. C.—P. T. Moran has been made chairman of a committee appointed by the Chamber of Commerce to make investigations and report upon the improvement of Great Falls as a power site.

WASHINGTON, D. C.—Bids will be received by the Procurement Division, Purchase Section, Radio Branch, Room 2542, Munitions Building, Washington, D. C., until April 15, under requisition 1130-1, CP, for furnishing 60 loop radio-telegraph sets, spark type, SCR112. Further information may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the United States Soldiers' Home, War Department, Washington, D. C., until April 24, for furnishing a 500-kw. turbogenerator. Specifications and further information may be obtained upon application to the secretary-treasurer of the United States Soldiers' Home, Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Post Office Department, Washington, D. C., until April 29 for furnishing electrical supplies, including motors, carbons and fuses, as they may be ordered for the use of the postal service from time to time during the fiscal year beginning July 1, 1919, and ending June 30, 1920. Blanks for proposals with specifications can be obtained upon application to the purchasing agent.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until April 22, for furnishing at Philadelphia, Pa., Mare Island, Cal., and Charleston, under Schedule 3894, miscellaneous bronze copper and brass wire. Bids will also be received until April 29, under Schedule 3897, for furnishing at South Brooklyn miscellaneous solid wire, condulets, tape sockets, sheet copper, copper rods, fuses, lead sleeves, brass, bronze and copper wire and one battery outfit.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Account, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until May 2, at the Eastern and Western yards, Schedule 3896—miscellaneous magnet wire. Until April 29, Philadelphia, Pa., Schedule 3906—lighting and power wire. Pensacola, Fla., Schedule 3906—rubber-covered wire. Brooklyn, N. Y., Schedule 3913—miscellaneous communication cable; Schedule 3914—solid braided wire and weatherproof wire. Washington, D. C., Schedule 3916—electrical wire. Brooklyn, N. Y., Mare Island, Cal., Portsmouth, N. H., and Philadelphia, Pa., Schedule 3915—hard-drawn phosphor copper, manganese bronze, commercial and naval rolled brass. Until April 25 South Brooklyn, N. Y., Schedule 3924—miscellaneous steel conduit pipe. Until April 15, Washington, D. C., Schedule 7912½—miscellaneous single-conductor wire. Applications for proposal blanks should designate the schedule desired by number.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

BAY CITY, MICH.—The Electric Light Department is contemplating the purchase of three switchboard panels and feeder, 300 Cutter suspension incandescent lamps, 500 Duncan meters and overhead-line material for normal requirements. C. J. De Bates is manager.

DETROIT, MICH.—The Detroit Edison Company is reported to be contemplating an addition to its Delray power plant, increasing the output by 30,000 kw.

DETROIT, MICH.—Plans have been announced by the General Motors Corporation for extensions of its plants in various parts of the country to be completed during the present year, involving an expenditure of more than $37,398,000, the distribution to be as follows: Detroit, $12,650,000; Flint, $6,715,000; Pontiac, $2,150,000; Lansing, $2,450,000; Saginaw, $2,427,000; Toledo, Ohio, $543,000; St. Louis, Mo., $4,135,000; Janesville, Wis., $4,500,000; Bristol, Conn., $1,978,000, and Muncie, Ind., $800,000. In the allotment to Detroit is included an item of more than $6,000,000 for a fifteen-story office building. In addition to the amount to be expended in the United States the company is planning to erect a new plant in Walkerville, Ont., Can., where a new plant for the Cadillac Motor Car Company division will be erected.

TIPTOP, MICH.—The installation of an electric lighting system in Tiptop is under consideration. Electricity will be obtained from Clinton.

BERLIN HEIGHTS, OHIO.—The local electric plant and substation of the Lake Shore Electric Railway Company was recently destroyed by fire, causing a loss of about $15,000.

COLUMBUS, OHIO.—The City Council has passed an ordinance authorizing the purchase of 30,000 lb. of copper for the municipal electric light plant.

JACKSONVILLE, OHIO.—The Jacksonville Railway & Light Company has received authority from the Public Utilities Commission to issue $125,000 in capital stock.

NORWALK, OHIO.—Bids, it is understood, will soon be asked by the city officials for a 500-kw. generator and condensers for the municipal electric light plant.

OXFORD, OHIO.—Bids will be received in the near future for the installation of electrically driven pumps. The cost of the work is estimated at about $40,000 and will include the erection of 1 mile of high-tension transmission line and a 200,000-gal. elevated tank and installation of pumps. L. A. Boulay, Nicholas Building, Toledo, is engineer.

PERRYSBURG, OHIO.—The Council has engaged F. H. Froelick of the Froelick & Emery Engineering Company of Toledo to prepare plans and estimate of cost of the installation of an ornamental street-lighting system in the business section.

TIFFIN, OHIO.—The Central Power Company of Tiffin is considering extending its electric transmission lines from Shelby to Bucyrus, connecting with Crestline and Galion. The company is seeking a contract to furnish electrical service in Bucyrus.

WELLSVILLE, OHIO.—A power plant will be built in connection with the new yards and car shops of the Pennsylvania Lines West, now under construction at Wellsville. The cost of the entire project is estimated at about $1,000,000.

LOUISVILLE, KY.—Bids will be received at the U. S. Engineer Office, Louisville, until April 30 for furnishing accumulators for lock No. 41 and operating machinery for lock No. 43, Ohio River.

EDWARDSPORT, IND. — The Public Service Commission has granted the Indiana Power & Water Company permission to issue $160,000 in capital stock and $340,000 in bonds, the proceeds to be used for extensions and improvements.

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GOSHEN, IND.—The Hawks Electric Company of Goshen has petitioned the Public Service Commission for permission to issue $125,000 in bonds, the proceeds to be used to finance improvements and to make extensions to its plant.

INDIANAPOLIS, IND.—Residents in Indianapolis Heights and Rockville Gardens have petitioned the Merchants' Heat & Light Company to supply electrical service in those districts.

PREBLE, IND. — The Preble Light & Power Company has petitioned the Public Service Commission for permission to issue $8,000 in capital stock, the proceeds to be used for extensions.

CHICAGO, ILL.—Bids will be received by the clerk of the Sanitary District of Chicago, 910 South Michigan Avenue, until April 24, for the Des Plaines River sewage treatment works, including electrical equipment, under Division P, consisting of three vertical shaft-cage induction motors, each of 50 hp.; four horizontal-shaft, slip-ring wound-rotor motors, each of 150 hp.; two horizontal-shaft squirrel-cage induction motors, one 75 hp. and one 30 hp.; four 300-kva. transformers, oil-switch equipment and miscellaneous appurtenances. Division R—Blowers, including six blowers of the horizontal hydro-turbine type. Specifications and forms of proposals may be obtained upon application to the above office upon deposit of $2.50 for each copy. John McGillen is clerk of board.

COLUMBIA, ILL.—Preliminary plans have been adopted by the Mayor and City Council for new equipment for the municipal electric light and power plant, consisting of extension to building, installation of boilers, engine, generator, switchboard, steam specialties, piping, etc., and erection of chimney. Bids for the work will be asked for in about sixty days. Fuller & Beard, Chemical Building, St. Louis, Mo., are engineers.

DECATUR, ILL.—The Central Union Telephone Company, it is reported, is planning to erect a new building at the corner of Church and North Streets, to cost about $280,000, provided the increased rates petitioned for are allowed by the Illinois Public Utilities Commission.

ROCKFORD, ILL.—The Rockford & Interurban Railway Company has installed a transformer at the village of Rockford and will furnish electricity for lamps and motors in that village.

CLEAR LAKE, WIS.—The electric plants at Glenwood City, Downing and Boyceville, owned by the Wisconsin-Minnesota Light & Power Company, have been purchased by the Clear Lake Electric Company. The plants, which are now driven by steam power, will be connected with the power plant at Little Falls on Apple River as soon as high-tension electric transmission lines can be erected.

NORTH FREEDOM, WIS.—The North Freedom Canning Company is planning to install a steam generating plant and a boiler house in connection with its proposed new plant. The cost of the work is estimated at about $50,000.

SHEBOYGAN, WIS.—The Badger State Tanning Company, it is reported, is asking bids for the construction of a new power plant and boiler house, to cost with other improvements about $50,000.

SUPERIOR, WIS.—At an election held recently the proposal to purchase the local electric light, gas and water plants was carried.

HIBBING, MINN.—Bids will be received by the Water and Light Commission until April 22 for the erection of a new power plant in Alice. The old plant will be dismantled, and as much of the machinery as possible will be used in the new station. Holstead & Sullivan of Duluth are architects. Charles Foster is engineer.

RED WING, MINN.—Plans are being considered for the construction of a municipal electric light plant and new distributing system in Red Wing. The cost is estimated at $350,000. L. P. Wolff, Germania Building, St. Paul, is engineer.

WORTHINGTON, MINN.—Plans are under consideration for the installation of a new switchboard and piping in the municipal electric light plant. Bids, it is understood, will be asked for this spring. The Charles L. Pillsbury Company, Metropolitan Building, Minneapolis, is consulting engineer.

DAVENPORT, IOWA.—A new lighting system is being installed at Vender Park. The old arc-lamp system will be replaced with ornamental lamps maintained by underground wires.

DES MOINES, IOWA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until April 21 for conduit and wiring and lighting fixtures in the old United States court house at Des Moines.

KNOXVILLE, IOWA.—The office building and plant of the Marion County Electric Company was recently destroyed by fire, causing a loss of about $13,000.

KANSAS CITY, MO.—Preliminary steps, it is reported, have been taken by the Kansas City Light & Power Company to petition the Public Utilities Commission for an issue of $6,000,000 in bonds. The company, it is said, will erect a new plant.

MANDAN, N. D.—The City Commissioners are considering lighting all the streets in the paved district and some of the connecting streets, a total of seventy-seven blocks, with electricity. The cost is estimated at $38,000. Black & Griffin of Mandan are engineers.

CARTHAGE, S. D.—An election will be held April 15 to vote on the proposal to issue $18,000 for the installation of a municipal electric light plant in Carthage.

Southern States

BENSON, N. C.—Bids will be received by the Mayor and Board of Commissioners of the town of Benson until April 24 for construction of waterworks, electric light plant and sewerage system. The proposed work will consist of deep well and pump, combined water and electric station, 60-kw. and 100-kw. generating units, boilers, pumps and reservoir and about 5 miles of water-pipe lines, about 4 miles of sewers and sewage-disposal plant. No bids on electric distribution system. Copies of plans may be obtained from Gilbert C. White, engineer, Durham, N. C., upon deposit of $10.

MOULTRIE, GA.—Swift & Company of Chicago, Ill., are contemplating the construction of a power house and two additional stories to its local cold-storage building. The cost of the work is estimated at about $150,000.

CHATTANOOGA, TENN.—The capital stock of the Southern Cities Utilities Company has been increased from $50,000 to $2,500,000.

CHATTANOOGA, TENN. — The power station of the Chattanooga Railway & Light Company on the east brow of Lookout Mountain was recently destroyed by fire, causing a loss of about $50,000.

GLOSTER, MISS.—Bonds to the amount of $11,000 have been voted for the installation of new machinery in the municipal electric and water plants, including oil-burning engines.

CHIDESTER, ARK.—The installation of a light and water plant in Chidester is reported under consideration.

Pacific and Mountain States

SEATTLE, WASH.—Work will begin on extensive additions to the municipal light and power system in the near future, preparatory to receiving and distributing the additional energy to be developed at the Cedar River plant and that is expected to be furnished later on by the development of the Skagit project. The work includes the erection of new lines for street lighting and furnishing electricity for lamps and motors in the business and residence districts, equipping the substation at Ballard and the industrial substation on Spokane, and constructing tie lines connecting the different substations. The ultimate plan is to bring the Cedar River current to the Spokane Street substation instead of the station at Seventh and Yesler Avenues, which will become a distributing station with a lower voltage for the main business section. The Spokane Street substation will also connect with the steam plant on Lake Union at 15,000 volts and on to the Lake Washington Canal, where the Skagit substation will be located, with a transmission voltage of 150,000 from the Skagit plant.

PORTLAND, ORE.—Arrangements are being made by the Pacific Power & Light Company to connect its transmission lines with the lines of the Inter-Mountain Power Company at Lind.

PORTLAND, ORE.—The East Side Mill & Lumber Company of Portland is planning to install a cross-arm factory. About 200 hp. additional will be installed. The company now operates a box factory.

PASADENA, CAL.—The City Commission has voted to accept the proposal of the Department of Public Service of the city of Los Angeles to supply electrical energy to the city of Pasadena for a period of fifteen years. The City Council of Los Angeles has approved the ordinance authorizing the execution of a contract providing for the sale of surplus aqueduct electric power to the city of Pasadena. Under the terms of the contract the Pasadena municipal steam-power plant must be kept in readiness for emergency service.

SAN FRANCISCO, CAL.—Steps have been taken by the Board of Works for the installation of danger signals and lamps on safety stations throughout the city.

SAN FRANCISCO, CAL.—Application has been filed by Horace W. Woolley of San Francisco with the State Water Commission for permission to appropriate 600 cu.ft. per second of water of Kings River in Fresno County, a tributary of the Fresno River, for the development of electricity. The proposed plans provide for the construction of a diversion dam, 50 ft. high, 200 ft. long on top and 180 ft. long at bottom, canal 10½ miles long. The equipment will include impulse waterwheels directly connected to electric generators. About 65,000 hp. will be developed. The cost of the project is estimated at about $6,000,000.

OGDEN, UTAH.—The construction of a municipal electric light plant in Ogden is under consideration.

SALT LAKE CITY, UTAH.—Plans are under consideration for the installation of a lighting system along the highway between Salt Lake City and Ogden. Wesley E. King is chairman of the lighting committee.

FLORENCE, ARIZ.—The Senate has passed the bill providing for the erection of an electric transmission line from Sacaton to the State Prison at Florence and for the installation of electrically operated machinery to replace the present steam engine.

FLAGSTAFF, ARIZ.—Plans are under consideration for a large dam at the mouth of Diamond Creek in the Grand Canyon of the Colorado River by the Grand Canyon Power Development and its affiliated corporation, the Hualpai Syndicate of New York. The project includes the construction of dam, installation of a hydroelectric power plant, erection of transmission lines and substations, to cost about $12,000,000. The proposed plant will provide power to operate the trains on 500 miles of the Atchison, Topeka & Santa Fé railway system in Arizona and also supply electricity to many of the cities, towns and mining camps in that section of the state. James McGirand is chief engineer of the company.

BRECKENRIDGE, COL.—Estimates submitted by engineers for the proposed municipal electric lighting system place the cost at $14,000. A bond issue of $25,000 is recommended.

Canada

FORT WILLIAM, ONT.—An extension of the street-railway system to Mission Park is under consideration by the Public Utilities Commission. The cost is estimated at about $68,235.

GUELPH, ONT.—Plans are being prepared for the installation of two electrically driven units, having a combined capacity of 3,024,000 imperial gallons for twenty-four hours, and a booster pump for fire purposes.

DONNACONA, QUE. — The Donnacona Paper Company is reported to be contemplating a hydroelectric project on the Jaques Cartier River, 27 miles from Quebec. The proposed work will include a dam, flume, power house and installation of electric generating equipment. The company recently purchased 183,360 acres of timber land in this section. G. H. P. Gould, Lyons Falls, N. Y., is president.

MONTREAL, QUE.—Plans are being prepared by I. W. Carmichael, architect and engineer, 29 Hospital Street, for the erection of two new telephone exchanges, to cost about $350,000.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing agent, the Panama Canal, Washington, D. C., until April 19, for furnishing steel, iron railing, iron pipe, boiler tubes, copper tubing and pipe, conduit fittings, fiber rod, receptacles, switches, ammeter and voltmeter. Blanks and information relating to this circular (1269) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

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(Issued March 4, 1919)

1,296,194. ELECTRIC ARC FURNACE; Jens L. La Cour, Christiania, Norway. App. filed Nov. 22, 1915. For equalizing sudden changes of pressure a buffer is mounted directly on furnace.

1,296,250. AUTOMATIC TEMPERATURE REGULATOR; Walter Wyss, Arbon, Switzerland. App. filed March 23, 1918. Plurality of furnaces or other sources of heat placed under temperature control of single apparatus.

1,296,262. BURGLAR ALARM; Fred A. Brunel, Hempstead, N. Y. App. filed May 22, 1917. Opening window sash actuates switch to close signal circuit.

1,296,264. VAPOR RECTIFIER; David E. Carpenter, Wilkinsburg, Pa. App. filed June 9, 1914. By assuring plentiful supply of ions at all portions on vapor path, rectifier is readily started.

1,296,270. FIRE ALARM; William M. Dana and Charles C. Palmer, Minneapolis, Minn. App. filed March 4, 1918. Especially adapted for use with telephone systems.

1,296,276. CIRCUIT CLOSER FOR SIGNALS FOR AUTOMOBILES; Moritz B. Fischer, Chicago, Ill. App. filed Jan. 24, 1918. When slowed down or about to stop, notice is given at rear of vehicle.

1,296,287. PHASE-CONVERTING SYSTEM; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Jan. 23, 1915. For railway polyphase induction motors receiving energy from single-phase source of distribution.

1,296,292. SYSTEM OF ELECTRICAL DISTRIBUTION; John W. Jepson, New York, N. Y. App. filed April 17, 1906. General voltage automatically regulated irrespective of generator speed.

1,296,293. ELECTRICAL SYSTEM OF DISTRIBUTION; John W. Jepson, Buffalo, N. Y. App. filed Nov. 27, 1907. Two regulators provided, one for confining generator output and other for regulating voltage.

1,296,305. INK-FED MARKING DEVICE; Jacob F. Mehren, Chicago, Ill. App. filed July 16, 1918. Supply of ink to marker is continuous and sufficient without being excessive, thereby avoiding waste, smearing and blotting, and unsightly results.

1,296,314. CURRENT LIMITER; Kristian Pettersen, Sarpsborg, Norway. App. filed Jan. 25, 1916. Current consumption at different places controlled by same apparatus.

1,296,323. CONVERTIBLE ELECTRIC APPLIANCE RECEIVING BOX; Joseph Sachs, Hartford, Conn. App. filed July 26, 1916. May receive switch, cut-out, meter-testing instrumentalities, etc.

1,296,350. ELECTRIC WELDING SYSTEM; Emerson S. Zuck, Wilkinsburg, Pa. App. filed Oct. 3, 1913. Means provided for starting welding arc and for switching welding tools to main supply circuit when arc has been established.

1,296,358. WELDING ELECTRODE; Benton W. Bowers, Easton, Pa. App. filed June 27, 1918. Has shield and handle to reduce heating to minimum.

1,296,362. LIGHTNING ARRESTER; Stanley C. Bryant, Chicago, Ill. App. filed May 29, 1917. High-tension oscillating currents or charges flowing along line toward signal-controlling device are diverted and dissipated.

1,296,387. BREAD RAISER; Mary E. Harris, Modesto, Cal. App. filed Aug. 16, 1917. Electrically heating receptacle for dough.

1,296,404. FLASHLIGHT; Harry M. Koretzky, New York, N. Y. App. filed May 10, 1918. Contact maintained between central terminal of battery and central contact of lamp without undue pressure.

1,296,408. STORAGE BATTERY; Orville L. Leach, Providence, R. I. App. filed April 24, 1918. Grid is composed of frame with spaced bars extending between and joining top and bottom of frame.

1,296,420. TIMER BRUSH; Earl L. Miller, Overbrook, Kan. App. filed Nov. 17, 1917. Made of resilient nature and has contact point of hard metal to resist wear.

1,296,438. REMINDER CLOCK; Augustus W. South, Chicago, Ill. App. filed Jan. 6, 1915. Attention automatically shows reminder.

1,296,439. MULTIPLE-TURRET TARGET INDICATOR; Elmer A. Sperry, Brooklyn, N. Y. App. filed Aug. 31, 1914. Turret trained quickly on right target and all danger of interference with adjacent turret obviated.

1,296,440. REPEATER SYSTEM FOR GYRO-COMPASSES; Elmer A. Sperry, Brooklyn, N. Y. App. filed June 21, 1911. For reproducing at a distance the readings of a master compass.

Record of Electrical Patents

Notes on United States Patents

1,296,453. PROCESS OF GALVANOPLASTY; Blasius Bart, Providence, R. I. App. filed March 31, 1916. By means of electrochemical steps copies in all sizes, reproducing every feature and detail of the model, may be obtained.

1,296,487. SYSTEM OF SPEED CONTROL FOR INDUCTION MOTORS; Adolphus M. Dudley, Oakmont, Pa. App. filed Oct. 21, 1916. Motor accelerated in smooth, uniform and economical manner up to, through and above synchronism.

1,296,498. PROCESS OF REPRODUCING ARTICLES IN METAL; Antal Fodor, New York, N. Y. App. filed April 17, 1917. Artistic figures of metal produced in economical fashion.

1,296,504. RADIO TELEGRAPHY AND TELEPHONY; John Hays Hammond, Jr., Gloucester, Mass. App. filed Aug. 24, 1912. Methods for periodically varying amplitude of transmitted electric waves.

1,296,523. PROCESS FOR TREATING ORES; Joseph Irving, Bisbee, Ariz. App. filed Jan. 27, 1917. Effects continuous regeneration of reagents.

1,296,558. PROTECTIVE DEVICE FOR ELECTRIC CIRCUITS; Lloyd N. Robinson, Berkeley, Cal. App. filed Nov. 28, 1916. For alternating-current systems employing long-distance transmission circuits.

1,296,575. APPARATUS FOR CARRYING OUT PROCESSES OF WINNING METALS; Victor M. Weaver, Harrisburg, Pa. App. filed Aug. 22, 1914. Reagents or their constituents collected and, if desired, reused so that continuous process is carried on economically and conveniently.

1,296,587. INSULATOR; William Schaake, Pittsburgh, Pa. App. filed April 5, 1917. Cable-securing means enable clamps to swing into alignment with supported conductor.

(Issued March 11, 1919)

14,610 (reissue). CONTROL SYSTEM; Karl A. Simmon, Edgewood Park, Pa. App. filed Dec. 31, 1918. Minimizes burning of contact members of electric railway motor controller.

1,296,604. SWITCH-OPERATING MECHANISM; Arthur H. Adams, Sparkill, N. Y. App. filed March 31, 1916. Electrically operated clutch mechanisms for coupling selector switch to power shaft.

1,296,613. TELEGRAPH SYSTEM; John H. Bell, East Orange, N. J. App. filed Aug. 1, 1917. For indicating variation of electrical characteristics in circuits of duplex telegraph systems.

1,296,616. ELECTRICAL MEASURING INSTRUMENT; Clarence A. Boddie, Pittsburgh, Pa. App. filed Sept. 21, 1915. Kelvin balance interposed between current winding and circuit of wattmeter.

1,296,617. TELEPHONE SYSTEM; William G. Britten, Fanwood, N. J. App. filed July 29, 1916. Flexible paging or announcing systems.

1,296,620. ALTERNATING-CURRENT MOTOR; James Burke, Erie, Pa. App. filed Feb. 7, 1917. Single-phase commutator type without sparking at brushes.

1,296,634. ELECTROCHEMICAL MOTOR; Georges A. De Guire, Montreal, Quebec, Can. App. filed May 9, 1916. Speed of core's reciprocating motion controlled by bell.

1,296,635. ELECTROMECHANICAL MOTOR; Georges A. De Guire, Montreal, Quebec, Can. App. filed April 30, 1917. Electrically operated mechanical device automatically actuates control switch.

1,296,636. TRIP SWITCH; Georges A. De Guire, Montreal, Quebec, Can. App. filed April 30, 1917. Switch is normally closed by gravity.

1,296,651. METHOD OF SECURING TOGETHER HEAVY STEEL PLATES; James H. Gravell, Brooklyn, N. Y. App. filed July 26, 1918. Combination riveting and spot-welding process.

1,296,677. TELEPHONE-EXCHANGE SYSTEM; Eric R. Lundius, Brooklyn, N. Y. App. filed May 3, 1915. Answering receiver not connected with talking circuit until after ringing current has been disconnected.

1,296,679. TELEPHONE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed Aug. 2, 1917. Ringing current repeated at intervals if not answered.

1,296,680. TELEPHONE EXCHANGE; James L. McQuarrie, Montclair, N. J. App. filed Nov. 26, 1917. Flexible group of step-by-step switches.

1,296,683. TELEPHONE TRANSMITTER; Joseph P. Maxfield, Maplewood, N. J. App. filed Jan. 3, 1916. Microphonic diaphragm.

1,296,687. MEANS FOR SIGNALING FROM CAPTIVE BALLOONS; Harold W. Nichols, Maplewood, N. J. App. filed Feb. 16, 1917. By means of balloon cable.

1,296,693. CALCULATING MACHINE; Arthur Pentecost, East Orange, N. J. App. filed Feb. 28, 1916. Power circuit opened if machine is not operated during certain interval of time.

1,296,698. MANUALLY OPERABLE CONTROLLING DEVICE FOR ELECTRIC MOTORS; Cleveland Redfield, Ogden, Utah. App. filed Aug. 10, 1916. Decrease in inductance may be made approximately proportional to decrease in load demand.

1,296,700. PRIMARY BATTERY; Otto E. Ruhoff, Madison, Wis. App. filed June 9, 1917.

1,296,727. TABULATING DEVICE; John E. Wright, New York, N. Y. App. filed May 14, 1918. Perforated cards passed under series of contacts.

1,296,729. CIRCUIT CONTROLLER; Paul H. Zimmer, Milwaukee, Wis. App. filed Nov. 20, 1916. Movable contacts insure firm engagement with coöperating contacts.

1,296,731. INSULATING SLEEVE; Albert Aichele, Baden, Switzerland. App. filed Oct. 4, 1916. Concave surface stepped instead of a smooth surface.

1,296,740. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed April 22, 1918. Signaling current is effective with a line conductor only at beginning and end of impulse intervals.

1,296,748. TROLLEY-WIRE HANGER; Glenn H. Bolus and William A. Darrah, Mansfield, Ohio. App. filed May 2, 1917. Hanger readily adjusted when installed.

1,296,752. ELECTRIC INDUCTION FURNACE; Oscar Brophy, Philadelphia, Pa. App. filed June 12, 1918. Primary and secondary elements mounted to insure brisk circulation of molten metal.

1,296,774. MAGNETO CUT-OFF SWITCH; Nelson W. Dalton, Buffalo, N. Y. App. filed Nov. 11, 1916. For testing operation of dual magneto systems in aircraft motors.

1,296,780. ELECTRIC WELDING; Frank L. Dyer, Montclair, N. J. App. filed Dec. 20, 1917. For joining thin iron and steel sheets without affecting metal.

1,296,801. ELECTRICAL SWITCH DEVICE; William F. Hessel, New York, N. Y. App. filed Aug. 8, 1917. Used with plurality of extension lights for shipbuilding purposes.

1,296,808. INCLOSED FUSE; George McD. Johns, St. Louis, Mo. App. filed Jan. 2, 1917. Difficult to use fusible-element of wrong size.

1,296,811. SWITCH BOX; Claude A. Keller, Cleveland, Ohio. App. filed March 7, 1916. Easily made without use of screws.

1,296,813. CORE-LOSS TESTER; George A. Kelsall, New York, N. Y. App. filed June 17, 1916. Standard primary coil readily linked to core to be tested.

1,296,829. TROLLEY-WIRE HANGER; James A. McIntosh, Lafayette, Ind. App. filed Feb. 2, 1918. Clenched to trolley wire.

1,296,860. TROLLEY-WIRE HOLDER; Herman Schutte, Wilkinsburg, Pa. App. filed April 25, 1918. Automatically locked when in use.

1,296,862. CLAMPING MECHANISM; Willard T. Sears, Philadelphia, Pa. App. filed Sept. 12, 1916. Operating element rotates clamping device.

1,296,896. ELECTRIC FURNACE AND METHOD OF MELTING METALS AND SMELTING ORES; Parvin Wright and Ivan B. Wright, Seattle, Wash. App. filed Nov. 21, 1917. Magnetizable metals fed magnetically into arc furnace.

1,296,932. MAGNETO TESTER; Daniel C. Dodge, Boone, Iowa. App. filed March 22, 1918. Strength of automobile magneto magnet directly indicated.

1,296,941. BRUSH CONNECTOR FOR ELECTROPLATING GENERATORS; John J. Flynn, Irvington, N. J. App. filed Jan. 29, 1916. Permits use of different voltages.

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1,296,952. ELECTRIC CONDUIT; William Handley, Providence, R. I. App. filed Jan. 13, 1915. Used also as conductor.

1,296,961. BATTERY MUD EXTRACTING DEVICE; Samuel D. Irwin, Floydada, Tex. App. filed July 1, 1918. Mud removed without disassembling of battery.

1,296,963. SPARK COIL; George A. Jacobs, Cleveland, Ohio. App. filed Jan. 31, 1917. Using fine insulated iron wire for secondary winding enables iron to be employed in the magnetic circuit.

1,296,976. ELECTRICALLY CONTROLLED APPARATUS; George I. Leonard, Chicago, Ill. App. filed Jan. 29, 1917. For refrigerating purposes.

1,296,988. METHOD OF OPERATION FOR THE SEPARATION OF LIQUIDS; Charles W. McKibben, Houston, Tex. App. filed Aug. 17, 1918. Series of separating devices connected together in electric circuit.

1,296,999. PANELBOARD CONSTRUCTION; Edwin A. Olley, Syracuse, N. Y. App. filed Aug. 6, 1915. Width made small.

1,297,000. PROCESS OF MAKING DUCTILE BODIES OF REFRACTORY MATERIALS; Peter Orange, New York, N. Y. App. filed Feb. 5, 1917. Produced by volatilization of electrodes in electric arc.

1,297,012. ELECTRIC SWITCH; Joseph Sachs, Hartford, Conn. App. filed Oct. 14, 1915. Access to casing prevented when switching member is live.

1,297,087. SPARK-PLUG TESTER; James W. Burton, Welch, W. Va. App. filed Sept. 30, 1916. Applied to standard spark plug without removing it.

1,297,096. STARTING DIRECT-CURRENT MOTORS; Henry W. Chadbourne and Arthur F. Knight, Schenectady, N. Y. App. filed April 11, 1917. Steps necessary to starting a motor performed in proper sequence.

1,297,100. TELEPHONE-EXCHANGE SYSTEM; Henry Clausen, Mount Vernon, N. Y. App. filed March 18, 1915. Connection of exchange connecting circuit with calling line causes operation of signaling means at exchange.

1,297,102. IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES; Mortimer A. Codd, Lambeth, Eng. App. filed Sept. 7, 1916. Coil, low-tension contact breaker and distributer are one unit.

1,297,109. ELECTRIC BRAKE FOR AUTOS; Charles W. Cunningham, Decatur, Ill. App. filed Aug. 8, 1918. Operated by push-button on steering mechanism.

1,297,120. MOTOR-CONTROL SYSTEM; John Eaton, Schenectady, N. Y. App. filed Feb. 7, 1914. Motor may be quickly stopped and direction of rotation reversed.

1,297,121. MOTOR CONTROL; John Eaton, Schenectady, N. Y. App. filed Nov. 9, 1916. Plurality of mechanically independent electric motors started and stopped simultaneously.

1,297,126. MAGNET CORE; Gustaf W. Elmen Bogota, N. J. App. filed April 2, 1918. Has specific gravity of approximately 7.

1,297,127. MAGNET CORE; Gustaf W. Elmen, Bogota, N. J. App. filed April 2, 1918. See above patent.

1,297,130. SYSTEM OF SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed Dec. 12, 1916. Operates economically on all speeds.

1,297,133. CLAMP, BINDING POST OR THE LIKE; Charles D. Filkins, Schenectady, N. Y. For spiral windings of radio oscillation transformers.

1,297,146. CONTINUOUS-CONTACT REEL; John L. Gleason, Boston, Mass. App. filed Oct. 19, 1917. For portable electrically driven machinery.

1,297,149. ELECTRIC FURNACE; Albert E. Greene, Seattle, Wash. App. filed Oct. 12, 1917. Shell has rotative movement to facilitate extracting portions or all of its contents.

1,297,157. ELECTROLYTIC CELL; John Harris, Lakewood, Ohio. App. filed Sept. 29, 1917. For generation of hydrogen and oxygen from water.

1,297,159. ELECTRIC SEPARATOR; Carl William J. Hedberg, New Britain, Conn. App. filed Feb. 7, 1918. Particles of a mixture sifted by action of electrostatic charges.

1,297,161. TRANSFORMER; Allan B. Hendricks, Jr., Pittsfield, Mass. App. filed May 20, 1914. Shell-type core is uncased.

1,297,174. ELECTRIC SWITCH MECHANISM; Ernest H. Jacobs, Schenectady, N. Y. App. filed April 29, 1915. With relay tripping device.

1,297,179. SEPARABLE PLUG; John J. Kenney, Pittsburgh, Pa. App. filed Aug. 7, 1916. Easily disengaged by pull on cap without injury to plug or cord.

1,297,185. ELECTRIC STORAGE BATTERY; William Knoblock, Philadelphia, Pa. App. filed May 18, 1918. Pillar strap insures perfect contact of electrodes.

1,297,188. SYSTEM FOR AMPLIFYING VARIABLE CURRENTS; Irving Langmuir, Schenectady, N. Y. App. filed Oct. 29, 1913. Means for securing selectivity in detecting signals.

1,297,236. MAGNETIC-CLUTCH-CONTROLLING METHOD AND APPARATUS; Karl E. Peiller, Hartford, Conn. App. filed Dec. 16, 1915. Energy supplied to magnet is varied to adapt its seizing and holding powers to required functions.

1,297,251. TELEPHONE SYSTEM; Homer J. Roberts, Evanston, Ill. App. filed June 3, 1901. Calling subscriber automatically connects his line with idle trunk line leading to manual switchboard.

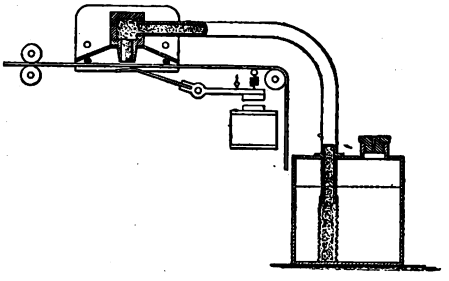
1,297,268. FIRE-ALARM INDICATOR; Fred M. Stacy and William F. Woods, Portsmouth, N. H. App. filed May 18, 1917. Hinged drops successively numbered are released by magnetically operated mechanism.

1,297,281. HEATING DEVICE; Mary Wheeler and Edith M. Bates, Los Angeles, Cal. App. filed June 18, 1918. One of the heating-coil supporting frames is a support for the cooking pans.

1,297,297. CEMENT-MAKING PROCESS; Woolsey McA. Johnson, Hartford, Conn. App. filed Feb. 2, 1915. Combination fuel and electric process.

(Issued March 18, 1919)

1,297,309. MANUFACTURE OF VACUUM-TUBE DEVICES; Harold D. Arnold, East Orange, N. J. App. filed Nov. 18, 1915. Heat applied to exterior of vessel during evacuation.



1,296,305—Ink-Fed Marking Device

1,297,313. APPARATUS FOR DIRECTED WIRELESS TELEGRAPHY AND TELEPHONY; Ettore Bellini, Enghien les Bains, France. App. filed June 19, 1915. Operated without turning antennas.

1,297,326. ELECTRIC AND THERMOSTATIC INDICATOR AND ALARM; Lars J. Dahl and Albert E. Allen, Alpha, Minn. App. filed March 29, 1917. Circuit closed through adjustable contacts.

1,297,348. ELECTRIC SWITCH; George H. Hart, Hartford, Conn. App. filed Oct. 2, 1918. Spindle of rotary snap switch for actuating catch is relieved of driving strain.

1,297,358. TELEPHONE-EXCHANGE SYSTEM; Charles W. Keckler, Newark, N. J. App. filed Jan. 2, 1918. Telephone lines of different characters terminating at central office interconnected by universal link circuit.

1,297,378. APPARATUS FOR DEHYDRATING OIL; Fred W. McNear, Menlo Park, Cal. App. filed Oct. 2, 1916. Separation continuously and completely effected, thus obviating settling tanks for water.

1,297,381. RAIL BOND AND METHOD OF MANUFACTURING IT; George A. Mead, Mansfield, Ohio. App. filed June 2, 1916. Strength of union between welding metal and bond terminal varies greatly.

1,297,382. RAIL BOND; George A. Mead, Mansfield, Ohio. App. filed June 21, 1916. Contains small amount of metal, making it unattractive to thieves.

1,297,383. RAIL BOND; George A. Mead, Mansfield, Ohio. App. filed June 2, 1916. Welded to rail by oxy-acetylene or electric arc.

1,297,387. FUME ABSORBER FOR ELECTRIC LAMPS; William R. Mott, Lakewood, Ohio. App. filed Jan. 27, 1917. Fused boric oxide combines with glass etching fluoride to form hydrofluoboric acid.

1,297,393. PRODUCTION OF CHEMICAL CHANGES BY OSCILLATORY DISCHARGE; Edwin F. Northrup, Princeton, N. J. App. filed July 13, 1917. May be used for either chemical synthesis or chemical dissolution.

1,297,395. APPARATUS FOR MANUFACTURING CHLORATES BY AN ELECTROLYTIC PROCESS; Takeo Oiwa, Toyotama Gun, Tokyo Fu, Japan. App. filed July 23, 1918.

1,297,422. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed March 29, 1917. Generator controlled by fluid under pressure from brake system effects transmission of braking action throughout train.

1,297,432. FILM SOCKET; Herman H. Ashinger, South Bend, Ind. App. filed Feb. 25, 1918. Holding element for film stands away from inner end of socket for accessibility.

1,297,472. RESISTANCE UNIT; Lee P. Hynes, Chicago, Ill. App. filed May 7, 1915. Safe to employ in exposed place.

1,297,487. GALVANIC BATTERY; Charles W. Norton, West Orange, N. J. App. filed Sept. 25, 1916. Necessity of employing bottom insulator within cell container for battery elements is obviated.

1,297,490. TELEPHONE-MOUTHPIECE ATTACHMENT; Howard A. Post, Winfield, Kan. App. filed Feb. 28, 1918. Removable sanitary paper interposed between lips of speaker and mouthpiece.

1,297,511. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed April 17, 1917. Release of brakes prevented so long as emergency magnet valves are open.

1,297,514. ELECTROFLUID PRESSURE BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed Sept. 27, 1917. Braking power varied by increasing or diminishing current flow to brake controlling magnets.

1,297,570. APPARATUS FOR HOT RIVETING; George A. E. Jones, Beverly, Mass. App. filed March 13, 1918. Rivet may be quickly heated by an easily removed electrode.

1,297,608. GUARD FOR ELECTRIC LIGHT CONNECTIONS; Aubrey J. Tidball, Duluth, Minn. App. filed July 20, 1918. Protects flexible cord from wear.

1,297,614. PROCESS FOR JOINING UP ELECTRIC AND OTHER WIRES; Jacob H. van Vlersen, The Hague, Netherlands. App. filed Sept. 11, 1917. Small metal junction tube used for covering junction.

1,297,641. ELECTRIC FURNACE FOR SMELTING ORES; Albert E. Bookwalter, Cœur d' Alene, Idaho. App. filed April 26, 1917. Ores are calcined to melting heat and then fused by electric means.

1,297,653. DRY BATTERY; Charles F. Burgess, Madison, Wis. App. filed May 21, 1917. Flashlight bulb attached to cell.

1,297,654. BATTERY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed May 21, 1917. Considerable reduction in weight of flashlight.

1,297,655. HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed May 21, 1917. Lamp support may be attached to battery end.

1,297,656. BATTERY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed May 21, 1917. Support may be reversed to protect the lamp.

1,297,657. BATTERY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed May 26, 1917. See above patents.

1,297,672. WINDOW LOCK AND ALARM; Isidore Fier, Brooklyn, N. Y. App. filed Oct. 23, 1917. Pressure on window sash operates alarm.

1,297,687. PNEUMATIC SWITCH; William E. Haskell, Brattleboro, Vt. App. filed Jan. 22, 1917. Pneumatic switch closes electric circuit.

1,197,744. RESISTANCE MATERIAL; George T. Southgate, Brooklyn, N. Y. App. filed April 19, 1917. Cuprous sulphide used as resistance material in lightning arrester.

1,297,768. ELECTRIC LIGHTING SYSTEM FOR AUTOMOBILES; John H. Wilton, United States Army. App. filed Feb. 13, 1918. Includes alternate sources of current.

1,297,772. CONCEALED-TERMINAL RECEPTACLE; Harry C. Adam, St. Louis, Mo. App. filed July 27, 1917. Reduces the liability of short circuits during installation.

1,297,774. TELEPHONE ATTACHMENT; Moses T. Allan, Neville, Saskatchewan, Canada. App. filed April 12, 1918. Provides alarm whereby eavesdropping may be detected and identified.

1,297,780. SYSTEM OF DISTRIBUTION; David Basch, Schenectady, N. Y. App. filed May 3, 1917. Circuit breakers used to control feeders on systems of high generator rating.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Coterminous Rates and Costs

A MOVEMENT to obtain lower prices and rates on the ground that certain raw-material costs have been reduced is a perfectly natural outcome of easier quotations. The manufacturer, whether of commodities or of electrical service, must be prepared to meet such demands frankly and to explain why in many cases he cannot immediately grant them. It will pay to take the purchasing public into one's confidence in this respect. In numerous cases the amount of raw material on hand, purchased at higher prices than now prevail, prevents prompt reductions in quotations or increases in discounts. Until a large part of this reserve stock is worked into commodities or into electrical energy, as in the case of coal, and such products are sold, it is manifestly only fair to permit prices to reflect the conditions under which the material was obtained. This applies to the large central station with its coal reserve painfully acquired in 1918 as well as to the producer of more tangible commodities. Progressive central stations will unquestionably share any substantial reductions in fuel cost which they may be fortunate enough to experience in future with their customers when the time is ripe for so doing, and far-sighted electrical manufacturers will be found in the same category in cases where existing labor costs, overhead charges and raw-material prices justify such action.

To everything there is a season, and a time to every purpose under the heavens. Experience shows that increasing rates become unprofitable and low rates yield large returns. Limits there are in both directions, and this the railways have learned to their sorrow. Electric light and power companies can profit greatly from the experience of the railway companies, because history often repeats itself.

Taxes to Meet Cost of Service

A DECISION of the Massachusetts Supreme Court on April 2 declared that if it shall become necessary to levy taxes to meet the full cost of service on the Boston Elevated Railway the action will be constitutional. The fundamental question presented to the court was whether the state has the power under the constitution to take over a public utility and operate it for so low a rate for service as to create a deficit and pay that deficit in the only way possible, out of taxation.

This decision is heartening to advocates of private ownership under public regulation who have feared that in cases where increased rates prove insufficient to meet full service costs utilities will be forced into public ownership in order that the required service may be rendered. The public service rendered by gas and electric utilities generally is as readily demonstrable as that furnished by transportation companies. Experience indicates that progressive increases in rates discourage patronage if carried far beyond the normal planes of current charging for service. If increasing cost of service wipes out the net revenue necessary to furnish a fair return on the legitimate investment, and if higher rates do not suffice to overcome this handicap, taxation must come to the rescue. That such a rescue may be effected without departing from the advantageous policy of private ownership, with its characteristic encouragement of initiative, is a welcome declaration.

Where are the pessimists who visioned loadless stations and bankrupt treasuries with the passing of war-order plants? Sound administration and the square deal are all that are needed to realize a continuity and expansion of service which will be a proud heritage to the industry's leaders who are to come.

Financing Extensions

THE report on financing line extensions which we publish this week was started by the National Electric Light Association committee as a war problem. Its sound principles, however, will stand the industry in good stead since peace brings with it conditions little less disturbed. The costs of labor, and to a less degree of material, are still up and are likely to remain so for a long time to come. This means that the cost of extensions continues to be high and, while the load taken on is likely to be of a more stable character, the initial expenditure must still be faced. In ordinary times, and even now, extensions into fairly homogeneous paying territory are a very simple matter, merely a phase of business-getting like the work of a skilled solicitor.

The real questions of equity arise when there is a call for extension into territory at present unproductive in behalf of a particular person. The customer is practically asking that the company shall carry in his sole behalf an abnormal amount of overhead and maintenance, and there is certainly justice in the contention that somehow he shall share this inevitable charge. The company may, and sometimes does, cheerfully waive its moral rights, particularly when future business is in sight. But in other cases cited in the report it cannot properly do so, and the form in which the customer should share the expenses becomes a matter of importance. In all instances a call for abnormal expense such as is incurred by laying cable in midwinter should be met by a reasonable charge therefor. Sharing the normal expense, however, is a more delicate problem. The two popular methods are to require a guaranteed income and to exact a suitable deposit as an earnest of

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earnings on the extension. The former is akin to paying the freight on purchases above a certain fixed sum, the latter to a stiff return credit on containers, with the difference that in the case before us the two plans can really be used interchangeably. And there is the further distinction that he who returns the container is sure of getting his money back, while even on the showing of the committee the customer who pays a deposit is by no means sure of any return.

Frankly, as between the two plans here considered, we greatly prefer the first, both for simplicity and for moral effect. To guarantee a reasonable business to him who comes far and spends freely to get it is a thing which appeals to the sense of fairness lying at the bottom of all honest business. The deposit scheme looks to the man from Missouri like paying a round lump sum to the fellow who expects to make big profit out of the trade year after year. Of course, the latter plan may work out just as much to the customer's advantage as the former, yet we think that psychologically the guarantee plan is by far the sounder of the two. In the case of companies operating under rigid commission control still other factors enter. Much depends practically on the attitude of the commissions as to expenses that may be capitalized. As the report before us points out, the capitalization of an expenditure such as that for an extension means that the charge is spread over the whole business and the cost is really averaged over the community. This is in line with the general tendency toward demanding uniformity of charges as a matter of public policy. A company might say to a customer asking a long extension for service that on account of the extra expense he must be charged an extra sum per kilowatt-hour. On the theory of individualistic costs this demand would be justified, yet we doubt whether any commission would sponsor it. Between this and the doctrine of general average there are an indefinite number of compromises. Which of them is taken depends, in the last resort, on the attitude of the commissions, and they are as much at sea on the situation as are the operating companies themselves. Certainly work like that done by the N. E. L. A. committee in this carefully considered report will do much toward clarifying the issues.

Barring moderate reductions in the price of low-grade fuel, there is little encouragement for the belief that coal costs will drop sufficiently to justify holding back orders in the coming weeks. Waiting too long for prices to drop may result in the greatest local shortage in the history of that particular section.

Economic Use of Static Condensers

IN OUR last number Prof. Waldo V. Lyon discussed the economic feasibility of bettering the voltage regulation of transmission lines by connecting condensers to them. In this number he turns attention to the economic feasibility of increasing the output of alternators by connecting condensers to them.

To one who has not studied the subject it seems at first sight well-nigh incredible that if a central-station alternator is rated at, say, 1000 kva., or 1000 apparent kw., and if it is operated at this rated output under a low induction power factor, of say 0.5, then it is possible to double the commercial power delivery of the machine by connecting in static condensers at the switchboard to the extent of 866 reactive kw. The output of the alternator under the low power factor was only 500 active kw., and this was accompanied by a useless additional load of $+j866$ reactive kw. Installing condensers to the extent of $-j866$ reactive kw. would compensate and carry on the reactive load without any power loss, if the condensers were dielectrically perfect, leaving the total load on the alternator at 500 active kw. and 100 per cent power factor; so that additional load to the extent of 500 non-reactive or purely active kw. could be added without increasing the heating of the machine. In fact, the heating of the machine would probably be decidedly diminished with 1000 active kw. and no reactive load, because the excitation then required would be likely to fall far short of that necessary to deliver 500 active kw. and 866 inductively reactive kw. at the same rated terminal voltage.

In the case of an active load, or a load of active kilowatts, the power supplied by the alternator and its prime mover is released from the circuit as thermal, mechanical or electrochemical energy, which is supposed to be duly registered on the watt-hour meters for payment. In the case of a reactive load, or a load of reactive kilowatts, the power supplied by the alternator and its prime mover is just as truly power as in the case just considered, but it is not released from the circuit. It is merely occupied in transferring electric and magnetic energy from the alternator to parts of the circuit and back again, being outwardly directed, or positive, during one voltage quarter cycle and inwardly directed, or negative, during the next quarter cycle. The average effect of this in-and-out reactive power is zero, and it leaves the outward stream of active power unchanged in the long run. Nevertheless, the reactive power takes a corresponding reactive component of current to maintain it, and this contributes to heat up and fill up the armature. On a low power factor, an alternator may be heated up to the operating temperature limit largely by the reactive current for maintaining the reactive power of excitation magnetic fields in induction motors. Static condensers provide a bypass for this reactive power, so that they carry the reactive load and the alternator is freed from it.

Although no general rule may be laid down, it would appear that Professor Lyon makes a better economical showing for condensers as auxiliaries to a central-station alternator than as auxiliaries to power-distribution line conductors for diminishing their size. In cases where this is correct an explanation might be looked for in the fact that where condensers are installed merely to help a low-power-factor power-transmission line their cost can only be obtained from the saving in copper wire installation and maintenance. Where, however, condensers are installed to help a low-power-factor alternator, their cost can be obtained from the saving in installation and maintenance of both alternator and prime-mover plant.

An interesting practical question is raised in the article as to where the condensers should be connected to the low-power-factor system—at the power house, on the line or at the low-power-factor motor locations. There are various relative advantages to be considered in this question. At the power house the condensers may be easily inspected and perhaps easily housed. At the motor locations the condensers may be most effective, but they will be more scattered and their oversight may be more difficult.

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Our Electrically Driven Superdreadnought

WE ARE glad to give some details of the equipment and performance of the great battleship New Mexico, the first of the electrically driven class. As our readers well know, electric propulsion for warships has been considered for more than a decade past and was tried in the collier Jupiter with excellent results before its more general adoption. The rationale of the electric drive is extremely simple—it arises from no obsession regarding the mysterious benefits of electricity, but merely from a well-founded desire to take advantage of the light weight and high efficiency of the steam turbine in a field where savings in dead weight and in fuel are all-important. The motor drive, then, is to be reckoned as essentially a speed-reduction gear, reducing the most efficient speed of turbine rotation to the most efficient screw speed. The electrical method has, too, the great advantages of giving a wide range of speeds at small loss of efficiency, and more important still, of giving complete freedom to the designer in the placing of the boiler plant and the turbo-generators. This gain, which will perhaps entirely revolutionize warship design, has not yet been worked out to its legitimate conclusion, and the successor to the New Mexico will have much to show us.

The main driving plant consists of two 13,500-kva. turbo-generators wound two-phase for 35 cycles and either 3000 volts or 4240 volts, as the armature connections may be switched in. Correspondingly, the four propeller motors have pole-shifting connections giving either twenty-four or thirty-six poles. These motors have double rotor windings and pole changing in the primary for the reason that the particular arrangement gave high efficiency at the two important speeds, 21 knots maximum and 15 knots for maximum cruising radius. The winding is actually a double squirrel cage, giving automatically high torque in starting and reversing. One of the very material gains of the system lies in the fact that full power is always available for reversing and the ship can pass from full driving power ahead to full driving power astern in twenty seconds. It is worth noting that in motor and generator design for this purpose it is the joint performance of the pair that is vital, and the result is that neither generators nor motors have exactly the same characteristics as if planned for general use apart, but are complementary to each other, with joint efficiency both in power and weight as the essential feature.

As a matter of fact, the highly successful tests made on the New Mexico tell only a part of the story. The really great gain in the adoption of electric drive is the freedom of placing the driving machinery. In previous battleships the great machinery spaces, always in about the same location from necessity and easy targets for shell or torpedo, have been the danger spots in action. This is grimly proved by the many stout British warships that were sent down by U-boats or gun fire. Now the machinery space can be subdivided far more completely than has before been possible, the units installed where they are far better protected, and above all the several parts of the power equipment scattered where no single explosion can put the whole out of business. We are coming to higher speeds and greater power than ever, so that the relative amount of driving machinery is always on the increase; hence there is the more difficulty in settling upon a safe and efficient design. We feel convinced that the adoption of motor drive, as in the New Mexico and sister ships, is the key to success in future warship design, the more so since our American battleships have to be planned for a big cruising radius as well as the highest practicable speeds and have customarily, through the whole history of our navy, had exceptional battery power given to them as well. We congratulate the navy and the designers on a very notable achievement in our country's behalf.

We are well advanced in a year when there is no government agency looking out for the coal needs of particular sections of the country. Procrastination in buying coal for next winter's service is risky in view of the let-down in production which has been experienced at the mines since the signing of the armistice.

Switch and Bus Structures

WITH the coming of the huge turbo-generator and the super-power station the bus structure has passed from the realm of mechanical design into that of architecture. There are certain practical problems in which, unlike ordinary mathematical operations, the form of the solution depends on the numerical magnitudes of the quantities involved. Such a situation is found in the planning of a modern bus structure, and no better illustration can be found than in the paper by C. D. Gray and M. M. Samuels in the current issue. In the regulation power house of the present day all the units are customarily run in parallel, and if a fault develops in one of them the output, not of that particular unit, but of the whole power station, is involved, so that the current-breaking capacity at each generator must be able practically to handle the whole output of the station without wincing.

It is interesting to note the description here given of some of the extremely heavy-duty circuit breakers which have been evolved to meet the existing demand. A rupturing capacity of some 600,000 kva. implies apparatus built for conditions so extraordinary that it cannot be tested under its working load, and this in turn means that the designer has to play safe; so that it would not be surprising if at a pinch these huge units could do better than their nominal rating. We think the authors do well in this connection to sound a warning note as to attempting too much in the way of compactness, not an uncommon fault in circuit breakers and switchboards generally. Plenty of room may mean security from serious accident, and it furnishes valuable insurance at low cost. The disconnecting switch for circuit breakers of great output is an accessory deserving attention, and the point here made, that the whole set of disconnecting switches should be operated by a single handle, and that handle locked, is altogether pertinent, as is the use of indicator lamps to insure clear circuits before disconnecting switches are operated. Indeed, it might not be a bad idea to have these lamps electrically interlocked with the disconnecting switches so that they could not be cleared for action until free of current.

All such apparatus as that here considered should be built into substantial masonry structures, the present tendency being toward the use of pressed brick. Busbar supports have not only to be strong in themselves but substantially set in the walls of the compartments, since with the enormous currents possible on short circuit the electrodynamic forces rise to astonishing amounts.

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Economic Use of Static Condensers—II

Solution of Problem of Increasing Capacity of a Generating Plant by Using Static Condensers to Correct Power Factor—Determination of Feasibility of Putting Less Generating Equipment in New Plant by Using Condensers

BY WALDO V. LYON
Assistant Professor of Electrical Engineering, Massachusetts Institute of Technology

THE feasibility of improving the voltage regulation of a transmission line by the use of static condensers, as compared with increasing the line copper, was dealt with in the first installment of this paper. Equations were also proposed by means of which to determine whether line losses can be economically reduced by the installation of condensers. In this issue the use of static condensers for increasing the capacity for load of a generating plant whose output is limited by low power factor of the load is considered. The case of a new plant in which it is proposed to provide for static condensers in order to obviate the purchase of excessive generating equipment is also taken up.

INCREASE IN GENERATOR CAPACITY

Consider a station delivering its full-load current at a rather low power factor. If there is a further demand for power, is it economically feasible to add a condenser and supply this additional load without having the generated current exceed its full-load value? In Fig. 5 I_o is the full-load current which the generating station is delivering at a lag angle of θ. The additional current that is demanded is at a lag angle α. When this additional current is I, the condenser must take a current I_c in order that the resultant generated current shall still be its full-load value, I_o. The resulting power-factor angle is diminished to β. We will assume that I_o and I are fixed as long as the condenser is connected to the circuit. If the added load, I, is taken off, the condenser may be left in the circuit, since it will then reduce the generated current and thus cut down the copper losses. The general relations between these currents and power-factor angles are

$$I_o \cos\theta + I\cos\alpha = I_o\cos\beta. \qquad (8)$$

$$I_o \sin\theta + I\sin\alpha - I_c = I_o\sin\beta. \qquad (9)$$

The annual profit that is effected by the use of the condenser is

$$P = pVI\cos\alpha - qVI\cos\alpha - SVI_c - F.$$

p is here the income per watt-year for the additional power, and q is the cost of generating it. There may be a difference in opinion as to whether q should include anything other than the actual annual cost of generating the additional power; *i.e.*, the cost of fuel, water and so forth. The annual cost of the condenser is $SVI_c + F$. Let $p - q = Q$, the net income per watt-year in dollars. The annual profit may then be expressed as

$$P = QVI\cos\alpha - SVI_c - F. \qquad (10)$$

The profit will have its greatest value when

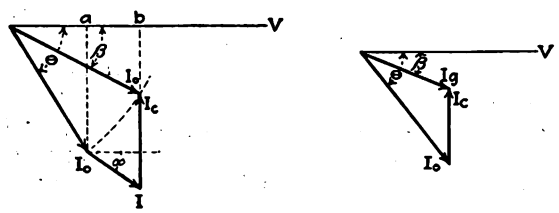
$$\delta P/\delta\beta = O.$$

This condition gives the simple relation that the profit is greatest when the resulting power-factor angle, β, is such that

$$\tan\beta = S\cos\alpha/(Q\cos\alpha - S\sin\alpha). \qquad (11)$$

Notice that this angle, β, depends only upon the power factor of the added load, the net income per watt-year on this load and the "slope cost" of the condenser. If the ratio S/Q is so large that $\beta = \theta$, the addition of a condenser will cause the profit to decrease continually from its initial value, which depends upon the amount of the fixed charge, F. When β equals θ, I_c equals zero, and the profit equation reduces to: $P = -F$. Thus it only pays to add condensers when S/Q is less than $\cos\alpha\sin\theta/\cos(\theta-\alpha)$. If the added load has the same power factor as the initial load, S/Q must be less than $\sin\theta\cos\theta$. If the added load consists wholly of lamps taking current at unity power factor, S/Q must be less than $\tan\theta$. The greatest "slope cost" of the condensers that permits of their use depends upon the net income per watt-year from the additional power sold, the power factor of the original load and the power factor of the added load.

If the value of β from (11) is substituted in the



FIGS. 5 AND 6—VECTOR DIAGRAMS SHOWING RESULTS OF POWER-FACTOR CORRECTION

(5) Possible to add to the load by amount ab.
(6) Reduction in size of generator required from I_o to I_g.

general equations (9) and (10), the values of the added load and the condenser volt-ampere capacity which produce the greatest profit are obtained. The added watt load is

$$VI\cos\alpha = VI_c\left(-\cos\theta + \frac{\cos\alpha - k\sin\alpha}{\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2}}\right),$$

$$k = \frac{S}{Q} \qquad (12)$$

The necessary volt-ampere capacity of the condenser is

$$VI_c = \frac{VI_o}{\cos\alpha}\left(\sin(\theta-\alpha) + \frac{\sin\alpha\cos\alpha - k}{\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2}}\right) \qquad (13)$$

The maximum profit is now obtained by substituting these values of the load and condenser currents in the general equation for the profit. The maximum profit is found to be

$$P_m = \frac{QVI_o}{\cos\alpha}\left(\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2} - \cos\theta\cos\alpha - k\sin(\theta-\alpha)\right) - F \qquad (14)$$

If the fixed cost of the condenser, F, is so large that this value of the greatest profit is zero or negative, the use of a condenser will involve a loss. Thus if the "slope cost" and "fixed cost" of the condenser are equal to or greater than the following critical values, there will be a loss if a condenser is used to correct the power factor.

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$$\text{Critical } S = Q\frac{\cos\alpha\sin\theta}{\cos(\theta-\alpha)} \quad (15)$$

$$\text{Critical } F = \frac{QVI_o}{\cos\alpha}\left(\sqrt{\cos^2\alpha - 2k\sin\alpha\cos\alpha + k^2} - \cos\theta\cos\alpha - k\sin(\theta-\alpha)\right) \quad (16)$$

Notice that the critical value of the "fixed cost" of the condenser depends not only on the net profit on the additional power sold, the "slope cost" of the condenser and the power factors of the initial and added loads, but also upon the volt-ampere capacity of the station. Thus even if the "slope cost" is below its critical value, the "fixed cost" will prohibit the use of a condenser unless the capacity of the station is sufficiently great.

If the use of a condenser in the generating station for increasing its watt output proves to be economical, the question arises whether or not there will be an added saving with the condensers out on the line. If the increased fixed cost, due to housing and attendance or automatic operation, is less than the saving in line copper loss, it will prove advisable to remove the condenser from the generating station to some point out on the line determined by the principles discussed under "Reduction in Copper Loss."

Example 3.—A load of 600 kw. at 0.5 power factor, 13,200 volts, three-phase, is delivered to a circuit. Added load at 0.7 power factor is demanded. Assume that the cost of condensers installed is $18 per kva. and that the charges under items (1) and (2), interest and depreciation, are 12 per cent. Assume that the net income per kilowatt-year for the added load is $10. By (15) the critical value of S is $(0.7 \times 0.866)/0.96 \times \$10 = \$6.25$ per kva. Actual value of S is $0.12 \times \$18 = \$2.16$ per kva.

From (11) the resulting power factor is 0.96.

In equations (12) to (16) inclusive $S/Q = 2.16/10 = 0.216 = k$.

To determine the added load and condenser capacity for maximum profit:

By (12) the added load is

$$\frac{600}{0.5}\left(-0.5 + \frac{0.7 - 0.216\times 0.714}{0.567}\right) = 556 \text{ kw.}$$

By (13) the necessary capacity of condenser is

$$\frac{1200}{0.7}\left(0.249 + \frac{0.7\times 0.71 - 0.216}{0.567}\right) = 1290 \text{ kva.}$$

By (16) the critical value of F is

$$\frac{\$10\times 1200}{0.7}\left(0.567 - 0.5\times 0.7 - 0.216\times 0.249\right) = \$2{,}800.$$

If the annual charges for housing and attendance are $800, there will be a net yearly profit of $2,800 — $800, or $2,000.

At $18 per kva. the first cost of the condensers is $1290 \times \$18 = \$23{,}220$.

If new generating equipment is added at the station to furnish the same load that the condensers allow, the additional equipment must have a capacity of 710 kva. At a first cost equal to that of the condensers this is $33 per kva. But the cost of generating equipment may include the cost of building addition, of increased boiler capacity, switchboards, transformers and line copper and possibly additional charges for attendance. With condensers out on the line all of the copper losses will be about 40 per cent of what they would be if generating equipment were added to supply the added load.

Reduction in Equipment

The last case to consider is that in which a condenser is used to reduce the size of the necessary equipment in a new installation. In order to be conservative we shall disregard the beneficial effect that the condenser will produce in reducing all losses, even if this is the determining factor. The annual cost of the generating and transmission equipment should be analyzed and plotted just as was done for the condenser (see Fig. 1). With the condenser in the generating station the cost for housing and attendance is largely offset by similar charges on the generating apparatus it displaces. If the condenser is placed out on the line, however, the capacity required in line copper and the transformers will be materially reduced. Each of these installations should be investigated and compared. In either case the "slope cost" and "fixed cost" of generating and transmission equipment should include all of that up to the point at which the condenser is installed. Fig. 6 shows the vector diagram which applies to this problem. There is a load demanding a current of I_o at a lag angle of θ. If a condenser taking a current of I_c is installed, the generated current may be reduced to I_g at a lag angle of β. The annual profit is the difference between the cost of generating and transmission equipment corresponding to a current of I_o and the combined cost of similar equipment for a current, I_g, and of a condenser which will take a current I_c. That is:

$$P = S_{go}VI_o + F_{go} - \{S_gVI_g + F_g + S_cVI_c + F_c\} \quad (17)$$

The subscripts g and c show whether the costs refer to the generating and transmission equipment or to the condensers.

The fundamental relation between the currents, from Fig. 6, is

$$I_o\cos\theta = I_g\cos\beta \quad (18)$$

$$I_o\sin\theta - I_c = I_g\sin\beta \quad (19)$$

For a maximum profit $\frac{\delta P}{\delta\beta} = 0$. This gives the simple relation that $\sin\beta = S_c/S_g$ when the profit is greatest. A condenser should not be used if S_c/S_g is equal to or greater than $\sin\theta$. That is, if used for no other purpose than to reduce the necessary capacity of generating equipment the first cost of condensers must be considerably less than the first cost of generating equipment. With turbo-alternators complete at $12 or $13 per kilovolt-ampere and condensers at $16 per kilovolt-ampere, the use of the latter to replace the former is hardly economical.

For the condition of maximum profit the saving in equipment capacity is:

$$VI_o\left(1 - \frac{\cos\theta}{\sqrt{1-a^2}}\right) \text{ volt-amperes, where } S_c/S_g = a \quad (20)$$

The condenser capacity required is:

$$VI_o\left(\sin\theta - \frac{a\cos\theta}{\sqrt{1-a^2}}\right) \text{volt-amperes.} \quad (21)$$

If these values are substituted in the general equation for the profit, its maximum value is found to be

$$P_m = VI_o\left\{S_{go} - S_g\frac{\cos\theta}{\sqrt{1-a^2}} - S_c\left(\sin\theta - \frac{a\cos\theta}{\sqrt{1-a^2}}\right)\right\} + F_o - F_g - F_c \quad (22)$$

The "fixed cost" of the condenser, F_c, must be less than a value which would make the maximum profit equal to zero.

The critical values of the "slope cost" and "fixed cost" of the condenser are in this case

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$$\text{Critical } S_c = S_g \sin\theta \qquad (23)$$

$$\text{Critical } F_c = VI_o\left\{S_{go} - S_g\frac{\cos\theta}{\sqrt{1-a^2}} - S_c\left(\sin\theta - \frac{a\cos\theta}{\sqrt{1-a^2}}\right)\right\} + F_{go} - F_g \qquad (24)$$

The accuracy of these calculations depends entirely upon the accuracy with which the various cost items are determined. This is indeed the crux of the whole problem and should be treated as such.

Example 4.—A new installation requires 500 kw. at 0.4 power factor. Assume that with condensers in the generating station the fixed charges on generating equipment and condensers offset one another; viz., $(F_{go} - F_g - F_c) = 0$ in equation (22). Assume that the first cost of low-speed generators and auxiliary equipment is $21 per kva. and that of condensers is $16 per kva. Assume that the annual charges for interest, depreciation, taxes and insurance are 13 per cent on the generating equipment and 11 per cent on the condensers.

By (23), critical $S_c = \sqrt{1 - 0.4^2}\, S_g = 0.916 \times 0.13 \times \$21 = \$2.50$ per kva.

Actual $S_c = 0.11 \times \$16 = \$1.76$ per kva.

In equations (20) and (24) $S_c/S_g = a - 0.645$.

Saving in generating equipment is by (20)

$$\frac{500}{0.4}\left(1 - \frac{0.4}{\sqrt{1-0.645^2}}\right) = 596 \text{ kva.}$$

Necessary capacity of condenser is by (21):

$$\frac{500}{0.4}\left(0.916 - \frac{0.645 \times 0.4}{\sqrt{1-0.646^2}}\right) = 722 \text{ kva.}$$

The annual profit is:

$$\frac{500}{0.4}\left(2.73\left(1 - \frac{0.04}{\sqrt{1-0.645^2}}\right) - 1.76\left(0.916 - \frac{0.645 \times 0.4}{\sqrt{1-0.645^2}}\right)\right) = \$360.$$

CHART TO FACILITATE THE DESIGN OF LIGHTING SYSTEM

Special Consideration of Each Case Preferable, but Approximate Solution Is Given by the Diagram

NUMEROUS charts, short cuts and graphical methods have been developed to facilitate the selection and layout of lighting units for any given conditions, but their use has so often required the arbitrary assumption of so many important factors that they are of little value. Others are so lacking in supplementary notes regarding their limitations that they are objectionable because they tend to make rule-of-thumb problems out of illumination calculations that ought to involve engineering judgment.

While any chart that may be developed for this purpose would probably have this objection, the accompanying one, included in the Industrial Lighting Code issued by the Industrial Commission of Wisconsin and prepared by Arthur J. Sweet, is deserving of consideration. Some of the instructions which must be followed in using the chart are given in the paragraphs which follow here.

Height of Lamps.—In general it will be found desirable to mount lamps as high as possible. The chief exceptions to this general rule consist of those cases where the ceiling is very high relative to one dimension of the floor area and where horizontal beams, belting or the like form a network at some distance below the ceiling. Save for these exceptions and possibly for some rare conditions of construction (such as use of indirect lighting) the lamps should be mounted as close as possible to the ceiling. Incandescent lamps can generally be mounted directly on the ceiling, thus bringing the light center from 6 in. to 12 in. (15 cm. to 30 cm.) below the ceiling.

There are two chief advantages of mounting lamps as high as possible. First, higher mounting heights permit the use of wider spacings with equally good distribution of the light, such wider spacings in turn resulting in the use of a smaller number of lamps of larger size. This means lower installation and operation costs. A second advantage is that high lamps are less likely to come within the direct field of vision, and hence are less likely to be a source of eye fatigue and eyestrain to the worker.

APPROXIMATE RATIO BETWEEN THE VERTICAL AND THE HORIZONTAL ILLUMINATION

Type of Reflector	Vertical Illumination in Per Cent. of Horizontal Illumination	Correction Factor to Be Applied to Size of Lamp When Chart I Is Used for Vertical Illumination Determination
Deep-bowl prismatic-glass reflector	100	1.0
Shallow-bowl porcelain-enameled metal reflector	70	1.4
Deep-bowl mirrored-glass reflector	60	1.7
Shallow-bowl porcelain-enameled reflector—lamp fitted with shield or cap	55	1.8
Deep-bowl porcelain-enameled metal reflector	50	2.0

Spacing Between Lamps.—The left-hand portion of the chart is employed to determine the proper spacing between lamps when the height of the ceiling can be taken as the approximate height of the lighting unit. Of course, where the lamps are mounted some distance below the ceiling their height above the floor should be considered in using this chart. The method of making a determination is illustrated by the arrows for a particular case in which the ceiling height or the mounting height of the fixtures is 12½ ft. (3.75 m.).

The intersection of the vertical line with the first and last horizontal lines indicates on the bottom scale the closest and widest spacings allowable respectively. The best spacing will be the minimum of these values—in this case 11 ft. (3.4 m.). If the work is of an exacting character, the spacing should approximate the best value; in this case it should not be greater than 13 ft. (4 m.). If the work is not of an exacting character, a wider spacing may be employed, but not greater than the maximum amount which is indicated by the lighting chart.

The exact spacing adopted will generally depend upon the dimensions of the building structure. Thus in the case of the ceiling height assumed, and with bays measuring 22 ft. (6.7 m. by 7.9 m.), lamps would preferably be placed on 11-ft. (3.4-m.) centers in one direction and on 13-ft. (4-m.) centers in the other, thus providing four lamps per bay.

The accompanying curves are based on the illumination intensity 3 ft. (1 m.) above the floor. However,

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the data are sufficiently accurate for a working plane 2½ ft. (0.8 m.) above the floor in a relatively small office interior. These are also sufficiently accurate for lesser distance than 3 ft. (1 m.) from the floor in large interiors.

Size of Lamp.—The right-hand portion of the chart is for determining the size of lamp necessary to produce the specified intensity of illumination. Thus, under the conditions of installation assumed before, with lamps spaced 11 ft. (3.4 m.) apart in one direction and 13 ft. (4 m.) apart in the other, the average spacing between lamps is 12 ft. (3.7 m.). Let it be assumed

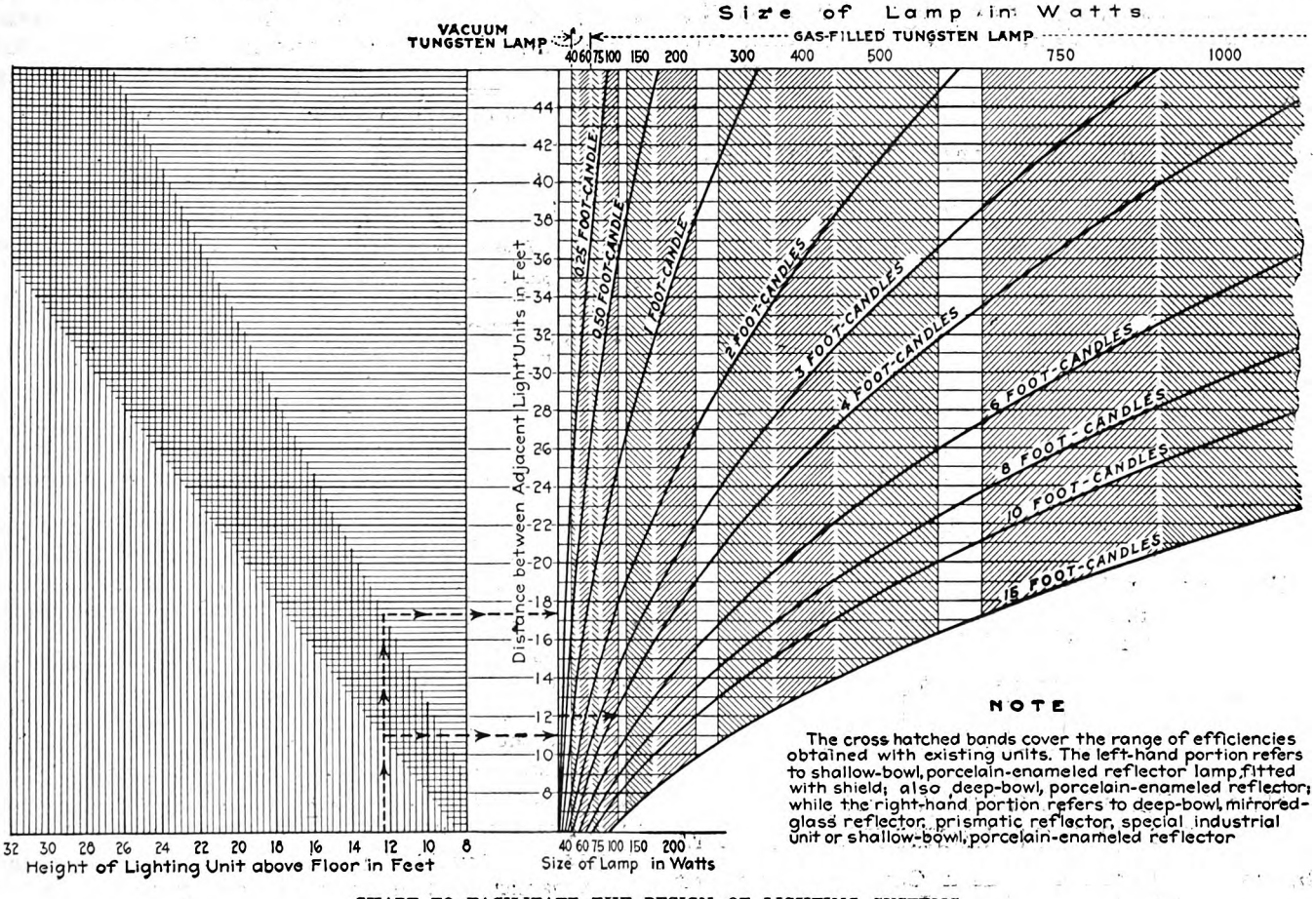

CHART TO FACILITATE THE DESIGN OF LIGHTING SYSTEMS

that the work is of such a character that an illumination of 4 foot-candles (43 lumens per sq.m.) is to be provided. Following the horizontal line representing a 12-ft. separation to its intersection with the curved line representing 4 foot-candles, the cross-hatched band representing a lamp with the rating of 100 watts will be encountered.

Since the intersection falls on the right-hand side of this band, it means that the more efficient types of reflectors will have to be employed if the desired illumination intensity is desired. If the relatively inefficient reflectors are used, the intensity obtained will be less than 4 foot-candles. In other words, the band representing each size of lamp is based on the ordinary efficiencies that obtain, the left-hand side of each band referring to the low-efficiency reflectors and the right-hand side to the high-efficiency units with intermediate grades between.

The charts allow for 30 per cent depreciation in light intensity due to dirt on the reflector or lamp or to deterioration of the filament. If reasonable maintenance which will prevent reduction greater than this cannot be maintained, larger lamps than those indicated in the chart should be used.

It must be clearly realized that the chart determines the size of lamp with reference to horizontal illumination (that is, illumination on a horizontal plane). If the work be chiefly on a horizontal plane, the chart may be directly used to determine the proper size of lamp with reasonable accuracy and exactness. If, however, the work be chiefly in some vertical plane, the problem of proper lamp size becomes much more complicated and can be only roughly determined by any general data. The ratio between the horizontal illumination and vertical illumination depends chiefly on two factors—(a) to what degree the light units are in front of the work, so that the light can illuminate the face of the work, and (b) the type of reflector employed. The first of these factors so depends upon local conditions that no general data or value can be given.

As regards the second factor, the approximate ratios between the vertical and horizontal illuminations are given for the various distinct types of reflectors in the accompanying table. These relations are necessarily approximate since they vary considerably with varying conditions of installations. They vary but slightly, however, in different makes of the same type of reflector.

John A. Hoeveler is illuminating engineer of the Industrial Commission of Wisconsin and was instrumental in the preparation of its lighting code.

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Electric Drive of the U. S. S. New Mexico

Space and Efficiency Are Prime Considerations in Design of Shipboard Drive — Flexibility Provided on New Mexico by Dividing Machinery Into Two Parts, and Ship Makes Seventeen Knots with Half of Machinery Disabled

PROBABLY the most important advantage of electric drive for warships is the flexibility of the driving machinery whereby the ship can cruise, at reduced speed, even when a considerable part of the apparatus has been put out of commission. Vital parts of the propelling machinery, moreover, may be put where the danger of damage is a minimum. The first considerable experience with electric propulsion was derived from the performance of the collier Jupiter, equipped with electric drive by the United States Navy Department. The design of the battleship New Mexico, a 32,000-ton ship, was then undertaken with confidence in electric propulsion, and this confidence has been amply justified by extended tests of that powerful warship.

During the period beginning in 1903, when the first large steam turbo-generator was put into service, the efficiency and weight per kva. of these sets have been improved to such an extent that their use has become possible on shipboard where weight, space and efficiency are the important considerations. The design of electrical machinery for shipboard thus requires attention to these factors as well as to flexibility of control and protection of the apparatus from salt water.

ELECTRICAL DESCRIPTION

The U. S. S. New Mexico is equipped with two main turbo-generator units, each generator designed to de-

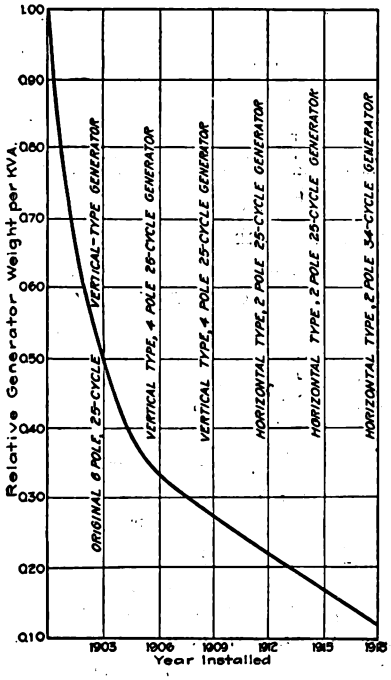

FIG. 1—IMPROVED WEIGHT ECONOMY IN TURBO-GENERATORS

velop 10,500 kw. at 78 per cent power factor and 13,500 kva. at full speed of the ship and to carry a 25 per cent overload (16,850 kva. at 78 per cent power factor) for four hours. The rotors have two poles and a maximum rotative speed of 2100 r.p.m., which corresponds to a frequency of 35 cycles. The stators are wound two-phase with leads brought out from the beginnings and endings of each phase to an eight-pole, double-throw disconnecting switch placed in the main circuit between the generators and the motors. By manipulating this switch two generator connections (Fig. 2) are available—first, diametrical, two-circuit, low-voltage (3000 volts), and, second, square, one-circuit, high-voltage

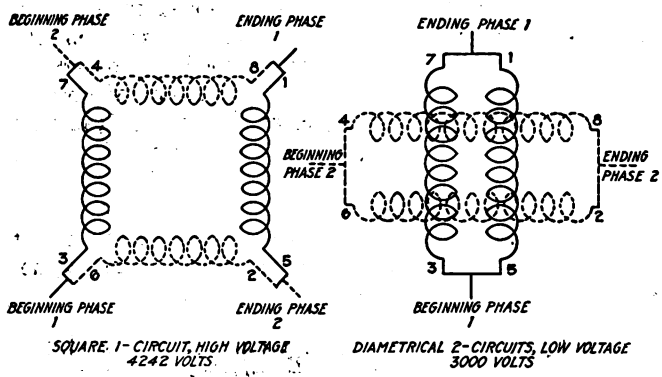

FIG. 2—GENERATOR WINDINGS ARRANGED FOR TWO VOLTAGES

(4240 volts). With a constant flux the voltage will vary directly or inversely as the square root of 2, depending on the connection involved. Suitable interlocks have been installed, making it impossible to operate the two generators in parallel.

All speeds of the ship up to 17 knots inclusive are obtained by the use of one generator having the low-voltage connection, the generator furnishing power for driving the four motors. Above 17 knots two generators having the high-voltage connection are used, each generator furnishing power for driving two motors. The generator efficiency curve shows a uniformly good efficiency throughout a wide range of load. The main turbo-generators are used only for propelling the ship and are in no way connected to the lighting or other auxiliary power circuits. Therefore it is possible under the varying conditions of load to adjust the voltage and current to obtain good efficiency.

The induction motors, directly connected to the ship's propeller shafts, are two-speed motors with connections for twenty-four and thirty-six poles. The speed reduction between the generators and the motors when using the twenty-four-pole motor connection is twelve to one, and with the thirty-six-pole connection, eighteen to one. Hence, the extreme range of generator r.p.m. for the specified operating speeds of the ship, 10 to 21 knots, is approximately 1440 r.p.m. to 2100 r.p.m.

GENERATOR CHARACTERISTICS

The New Mexico generators are conservatively designed. Compared with the maximum rated machines for land practice, the relative armature reaction is considerably lower and the densities in the magnetic section are slightly higher. Test data show that the generators are not working at the peak of the kilowatt curve, but at a safe distance down where there is suf-

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ficient margin in power to take care of the rudder swings and heavy seas. Based on the maximum power factor of the motors, 79 per cent, the generators have a margin in power of 24 per cent.

A very important feature inherent with electrical propulsion is that full power is always available for either direction of propeller rotation. From actual reversal tests, at maximum speed of the ship, the observed excess excitation current required for reversal was approximately 60 per cent above that for the steady running condition. The line current increased to approximately three times the steady running value. That these high values of current are not injurious to the generator is due to the extremely short time required for reversal and the large heat-storage capacity in the generator. The observed time for reversal from maximum speed ahead to full reversing speed astern, with the motors in the thirty-six-pole or low-speed connection, was approximately twenty seconds. To pull the motors into step in the reversed direction of rotation required holding the over-excitation on the generator fields approximately eight seconds, the rest of reversal time being consumed in the release of the interlocks and in the switching operation.

The mechanical design of the generator is similar to that of machines developed for central stations in most respects. One feature that differs from land practice

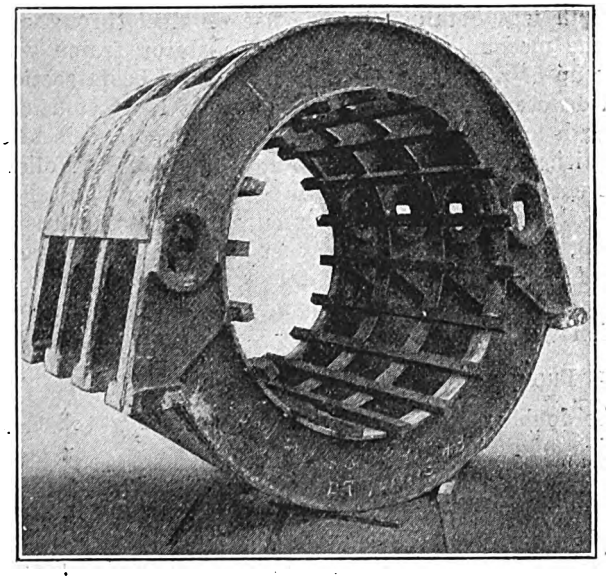

FIG. 3—I-BEAM CONSTRUCTION OF GENERATOR FRAME

is the omission of the turbine and generator base castings. The turbine casing, generator stator frame and bearing standards are bolted directly to a stiff structural steel foundation, which is securely tied in with the ship's structure.

The stator or armature is of a compact design. The stator frame is of the sectionalized I-beam type, which consists of several circular I-section castings, properly spaced and held together at their outer periphery by boiler plates, these plates being hot-riveted to the I-section castings. The I-section castings after being properly spaced and supported are carefully bored out at their inner periphery for the attachment of rectangular steel bars, these bars forming the dovetail ribs for assembling the stator core punchings. The advantage of this frame over the solid cast type is the great saving in weight, it being approximately one-half as heavy. Other advantages are the elimination of dangerous shrinkage strains always present in the solid cast frames, the simplified patterns and castings and the general adaptability for shortening or lengthening and respacing of dovetail ribs to suit the various punching segments.

INSULATION PROBLEM

Stator coils are of the conventional barrel type, but special precautions have been taken in the matter of their insulation. Recognizing the severe conditions that would be imposed on the insulation by the salt-laden ventilating air, waterproofing insulation treatments were applied to the coils, special attention being directed to the connections and to the portions of the coils beyond the stator core. By heat treatment the insulation of the coils is prevented from loosening under the most severe operating conditions. Similar treatment was also accorded the rotor windings.

The turbo-generators are ventilated by two duplicate and separate ventilating systems, one for the starboard generator and the other for the port. The air is taken from out of doors through ducts placed just back of the upper superstructure on the starboard and port sides. The openings in these ducts face aft and are approximately 10 ft. (3 m.) above the main deck floor and are designed to prevent the entrance of rain. Auxiliary blowers of ample capacity draw in the air through these openings and force it down to the bottom of the ship into chambers directly under the generators. These chambers and the air connections to them are made watertight, and the danger of bilge drainage entering with the air into the generator windings is practically eliminated. Fans mounted on each end of the generator rotor take the air from these chambers and force it axially through the various ventilating paths in the machine.

TYPE OF MOTOR SELECTED

Although wound-rotor induction motors with resistance control were used successfully on the Jupiter, induction motors with double rotor windings and pole-changing arrangement in the primary were selected for the New Mexico. For this application the highest possible economy was desired at the two most important speeds—high speed with full power at 21 knots and medium speed at 15 knots where the maximum cruising radius without refueling is of the greatest importance. With these requirements it was evident that for the most economical operation a changeable-pole motor giving a speed ratio of two to three was desirable on each shaft, the four motors at full speed taking power from two generators and when cruising from one generator. By changing the poles on the motor the proper speeds of the screw are obtained with a maximum speed of the generator, thus giving low steam consumption on the turbine in both cases.

Since the motors and generators of the New Mexico were to be especially built to operate together, more liberty in design was allowed. A new type of winding was designed, the coils of which were so grouped that a change in the connection at the motor terminals would give a balanced quarter-phase distribution for either twenty-four or thirty-six poles. This gives a simpler control than if the motor were wound three-phase. In addition, since the four motors receive power from two generators at full speed and one generator at cruising speed, the best combined operation is obtained with a

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decreased voltage on the thirty-six-pole combination. This also works out best for a quarter-phase winding. By connecting the generators in square connection for high speed and parallel connection for low speed the correct ratio of operating voltage is obtained.

The torque requirements derived from actual experiments on the Jupiter, supplemented by tank trials, showed that a resistance inserted in the rotor winding would be required only for a few seconds at a time—that is, during starting or upon reversal—in order to obtain quick possession of the screw and bring it up to speed. With this in mind a double squirrel-cage type of motor was adopted, thus eliminating the rheostat. The outer high-resistance, low-reactance winding takes the place of the rheostat when starting and reversing. The inner low-resistance, high-reactance winding is the running winding when the motor is up to speed. The inductive action between these two cages is such that when the frequency in the rotor is high, as at starting or reversing, the current is choked back in the low-resistance winding, thus forcing a large percentage of the current through the high-resistance and producing adequate torque. As the motor speeds up the rotor frequency drops off and the inductive effect on the inner winding decreases, allowing the current to increase with a corresponding decrease in the outer winding until at slip frequency practically all of the current passes through the low-resistance cage. By this construction the torque advantage of a high-resistance rotor is obtained with the low slip and high efficiency of the low-resistance type of rotor when at full speed.

SHIPBOARD MOTOR DESIGN

The design of motors for use on shipboard differs very materially from those for ordinary commercial use. For the latter the question of size and weight is of minor consideration while for ships it is a vital one. On land a motor is usually operated from a transmission system having a fixed source of supply, and the power-factor of the motor is of great importance. A low-power-factor load requires a larger percentage of the generator and line capacity than does a high one. The best design for the commercial motor of high power factor usually requires a machine with as large a ratio of diameter to length as possible without undue sacrifice in cost and efficiency.

For marine work this standard of design can be greatly modified. First, the power demanded from the motors can be very accurately determined and, except for a slight variation due to depth of the propellers, roughness of the sea and steering, it is constant for any given speed. Second, the motors are supplied with external ventilation instead of being self-ventilated, and the amount of air forced through the motors for cooling can be varied with the load if so desired. These conditions taken together allow of a much smaller motor being used.

As the motors and generators are close together, the effect of the motor characteristics on the transmission system can be ignored and they can be designed directly for each other with special attention given to the combined characteristics of the units. To reduce further the size and weight of the equipment it is obvious that the comparatively low-speed motor end of the unit should be smaller in diameter and longer than is usual and the resulting lower power factor should be taken care of by increased size due to greater excitation necessary on the high-speed generator end.

The motor with a smaller ratio of diameter to length also gives greater efficiency due to the decrease in the fixed rotation losses and a greater percentage of active copper in the slots compared to the inactive copper in the end connections. Fig. 5 shows the small diameter and great length of those motors. The ratio of diameter to length in this case is two to one, whereas in the land type this ratio would be about four and one-half to one.

In addition to reducing the size by designing a lower-power-factor machine and using all the active material at both speeds, a minimum of weight with ample strength was obtained by the use of steel throughout for the mechanical structure. The stator frame was made up of a series of circular rings of I-beam section with dovetail ribs attached. Each ring is of sufficient strength to support its section of punchings and is held in position by being riveted to rigid steel feet. Boiler-plate extending the full length of the frame was rolled to fit the I-beams and was securely riveted to them, making a very rigid and compact structure. The problem of winding, insulating and supporting the stator coils was quite similar to that already discussed in connection with the generators.

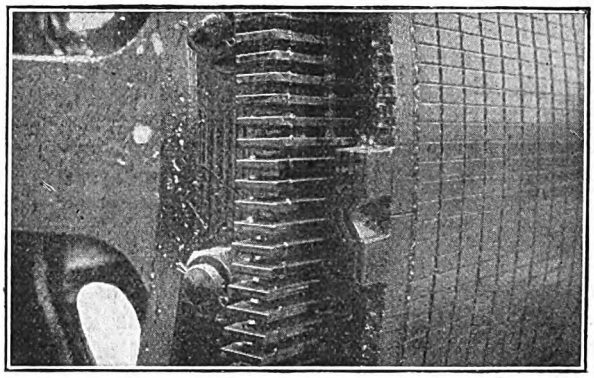

FIG. 4—A PORTION OF THE MOTOR ROTOR CONSTRUCTION, SHOWING EXPANSION JOINTS IN OUTER CAGE END-RING

PROVISION FOR EXPANSION OF END RINGS

The double squirrel-cage secondary winding (Fig. 4) consists of two entirely separate cages, the bars in both cases being driven into close-fitting slots without insulation, allowing the heat generated in these windings to flow freely by conduction into the rotor iron.

The outer cage is of high-resistance metal short-circuited by copper end rings into which the bars are brazed. This ring also is in intimate contact with the rotor punchings. Thus during reversal, when the greatest amount of heat is generated in this winding, the heat storage of the rotor iron is taken advantage of and the temperature of the bars kept down to a very conservative value.

The end ring is of special design made up of short sections connected together by expansion joints of laminated copper, thus allowing expansion due to heating being taken up between sections around the periphery and limiting the possible bending effect on the bars to a few mils instead of the comparatively large value which would exist if the ring were made solid and the diameter allowed to change. The inner cage is of copper. It was not necessary to break up this ring as the inner winding was designed to remain cool under all conditions of running load, the only condition under which the double squirrel-cage design allows full current in this winding.

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The specified requirements for driving the New Mexico propellers called for 26,500 hp. at 161 r.p.m., corresponding to 21 knots ship speed, and 8350 hp. at 112 r.p.m. for cruising at 15 knots.

At speeds from 8 knots to 15 knots the four motors are operated on the thirty-six-pole connection from one generator with its winding connected in parellel, the switching being so arranged that either generator can be used. The variation of speed is obtained by steam control on the turbo-generator.

From 15 knots to 17 knots the motors are thrown over to the twenty-four-pole connection, still using one generator only. Above 17 knots two generators are used connected in two squares. The two motors and generator on the starboard side and the two motors and generator on the port side are connected together and each set is operated as a separate unit.

For reversing, the thirty-six-pole connection only is used. If the motor is running on the thirty-six-pole connection one phase is reversed. If operating on twenty-four poles, the connections are changed over to thirty-six poles and reversed.

The official trials on the driving equipment of the New Mexico were made Dec. 16-18, 1918. Runs were made at various speeds from 7.32 knots to 21.31 knots to establish points for the standardization curve. It dveloped that, owing principally to overloading, which

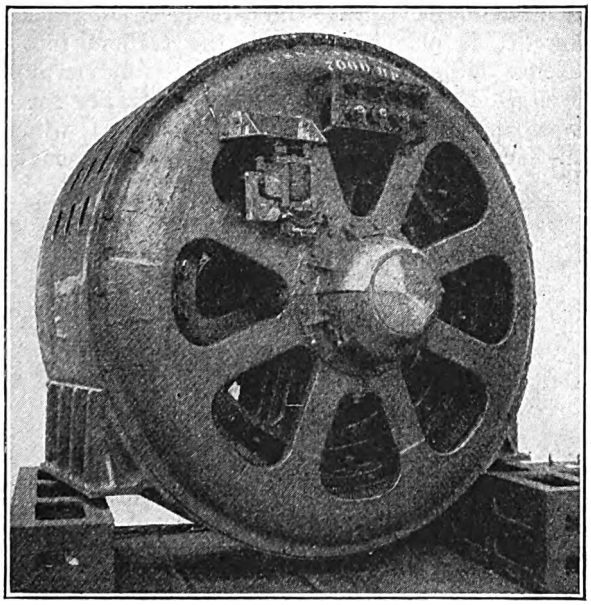

FIG. 5—VIEW OF ONE MOTOR ON THE CALIFORNIA
The New Mexico motor is somewhat longer and has no contactor on the end shield

increased the displacement by more than 1000 tons, the power required to drive was 29,100 hp. at 161 r.p.m. instead of 26,500 hp. at a screw speed of 166.5 r.p.m.

Two runs over the course were very interesting. The two inboard propellers were run from one generator with the motors connected twenty-four poles and with the outboard motors disconnected, allowing the propellers to run free. Another trial was made with the outboard motors driving and the inboard propellers free. In both cases a little more than 15 knots speed was obtained. These two trials showed that to drive the boat at the same speed the inboard propellers required 11 per cent more power than was required by the outboard motors.

Naval experts and designing engineers were enthusiastic over the ease with which maximum load and reversing tests were accomplished by the New Mexico, and three new battleships of the same size, the California, West Virginia and Maryland, are being similarly equipped with electric drive.

Information concerning the generators and motors was given by C. S. Raymond and A. B. Badgley respectively, of the General Electric Company, where the electrical machinery was designed and built.

DISCLOSURES OF RADIO DEVELOPMENT IN WAR TIME

Simultaneous Reception and Transmission of Messages Made Possible and Interference from Other Radio Stations Neutralized

New radio developments in the use of sustained waves and spark transmitters which could not safely be made public during the war were described to the Institute of Radio Engineers, New York, on April 2 by Ernst F. W. Alexanderson of the General Electric Company. Among the salient points brought out in Mr. Alexanderson's paper were the following:

In order to send and receive radio-telegraphic or radio-telephonic messages simultaneously it was first necessary to neutralize the highly intensified transmitted signal so that the local receiving set could always be sensitive to the faint impulses of signals from the distant station. This was accomplished by the use of separate sending and receiving antennas and different wave lengths. The antennas were placed far enough apart so that the selectivity of ordinary receiving instruments could be depended upon for differentiation between the wave lengths of the sending and receiving stations.

This made it possible to give wire telephone subscribers the advantage of combined wire and wireless service. Each pair of sending and receiving stations were interconnected by a wire line and connected to an exchange of a wire telephone system. The telephone subscribers could then be connected to the radio system much as they would be connected to a toll line.

The system of radio-telephony just referred to is not suitable for communication between ships, trains and other places where the sending and receiving equipment should be a unit controlled by the same operator. In this case the two antennas were mounted on the same masts and inductive and capacitive neutralization were tried. The capacitive method was adopted because it was more accurate and simple. The nearby receiving and transmitting antennas were so arranged with their associated apparatus that the receiver and transmitter are in conjugate branches of a Wheatstone bridge. For this reason it is called the "bridge" receiver.

What is called a "barrage" receiver was developed to avoid interference from enemy and other radio stations, especially in transoceanic communications. This receiver is a combination of aperiodic antennas with unidirectional characteristics. With two antennas the phase difference of receiving currents depends on the direction of the incoming signals. Signals from any given direction can be balanced out by phase-shifting devices and a differential coupling to a common receiver.

In the discussion which followed Lester Israel, Lieutenant Lavender, George H. Clark, W. H. Priess, Lieutenant Arps, C. L. Farrand and E. Simon took part. Many of the speakers had successfully operated radio equipment such as Mr. Alexanderson described.

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Electrical Service at Great Seaboard Terminal

Boston Army Supply Base, Costing $28,000,000, Is Equipped for Maximum Efficiency in Handling and Storing Either War or Peace Supplies—Electrical Agencies Include Elevators, Cranes and Industrial Tractors and Trailers

BROUGHT into being by the urgent demands of the war, but designed to furnish service at maximum efficiency even in time of peace, the Boston army supply base represents the last word in marine terminal development and stands to-day a monument of American engineering achievement under emergency conditions. Aside from the general interest which it commands, this terminal deserves attention because of its extensive use of electric power for operating elevators, cranes and industrial tractors and for lighting the vast expanse of working space. Great care was taken in laying out the distribution system to avoid interruptions in service and to enable the lines to be used flexibly. The vital importance of loading ships in the shortest possible time was constantly kept in mind by the designing engineers, who made arrangements for handling the peak load represented by a vessel at each berth loading for convoy service under war conditions.

The base occupies a site about 1.25 miles (2 km.) long, including rail approaches, and has a main working area about 4400 ft. (1350 m.) long and 400 ft. (120 m.) wide. A maximum of ten of the standard vessels of the Emergency Fleet Corporation can be accommodated at its berthing space.

The main storage buildings are arranged for section-

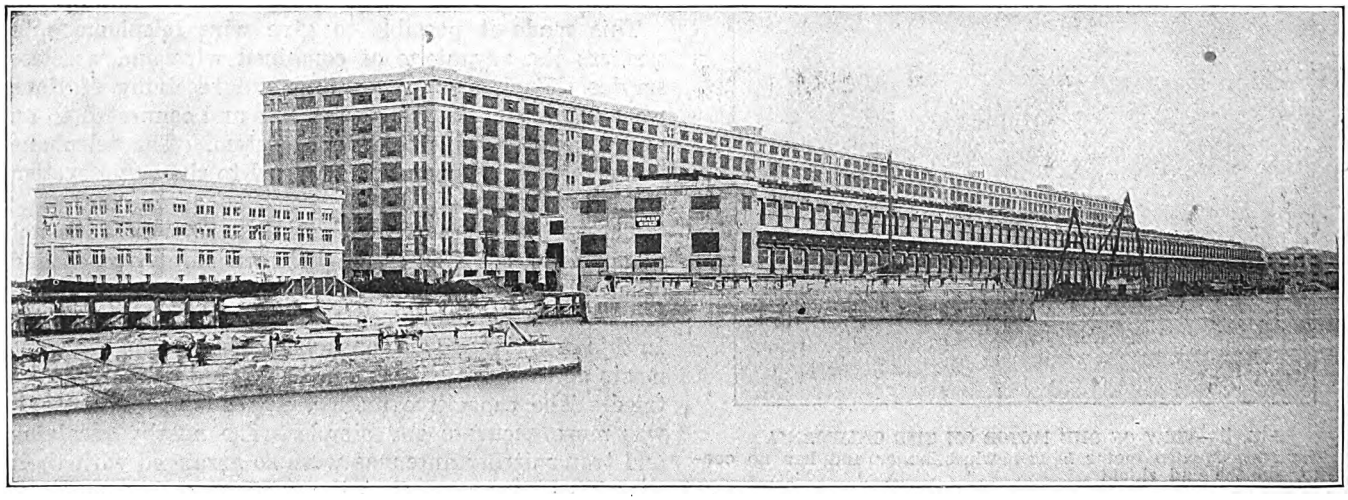

FIG. 1—IMMENSE STOREHOUSE AND WHARF FACILITIES OF ARMY SUPPLY BASE AT BOSTON

alized operation. The principal buildings include a main storehouse, wharf shed, pier sheds, substation, boiler house and administration building. The storehouse is one of the largest reinforced-concrete buildings in the world. It is eight stories high, measuring 115 ft. (35 m.) from first floor to roof, 1638 ft. (500 m.) long and 126 ft. (38 m.) wide, and is divided into six independent sections. Adjacent to it with connecting bridges over the intervening private street is a wharf shed 1638 ft. (500 m.) long, 100 ft. (30 m.) wide and two stories high, the second floor of the wharf shed being on the level of the third floor of the storehouse. The pier shed is composed of two three-story sections, each 924 ft. (280 m.) long by 100 ft. (30 m.) wide. The terminal is equipped with the following freight-handling apparatus: forty industrial storage-battery electric tractors and 600 trailers; forty-six electric freight elevators with motor-operated hatchway doors; six automatic push-button passenger elevators; twenty-four electrically driven winches, and four semi-portal bridge cranes. The approximate cost of the present electrical equipment is $2,500,000, of which the wiring contract represents about $1,000,000.

A railroad yard with accommodations for 730 cars exclusive of ladder and running tracks has been built west of the base. After classification, cars may be taken to the proper section of the storehouse by three tracks on the northerly side of the property, to the pier shed by the same tracks or by two tracks on Terminal Street, to the wharf shed by the latter, and directly to the ship side by tracks on the wharves. Seventy-eight cars can be accommodated on the tracks alongside the storehouse platform. By using gang planks the trailers can be moved into the cars on either track and loaded. It is planned to push the trailers into the storehouse by hand for local distribution by elevator or otherwise. The distance traveled by a trailer for this work will not usually exceed 150 ft. (45 m.), which is the higher limit for hand operation. The battery tractors will probably be used chiefly in handling loaded trailers between the storehouse and wharf shed. The trailers are placed singly or in trains opposite vessel hatchways, to or from which the material will be handled by electric cranes on the wharf shed.

A tractor hauling four trailers will run about 4 miles (6.4 km.) per hour, and preliminary studies indicate that a round trip of a tractor, including the unloading of four trailers, can be made in about five minutes. It is estimated that 200 carloads, or 6000 tons of material, can be unloaded from the cars and placed in the storehouse in ten hours, or 4000 tons unloaded and placed in the pier shed; that 100 carloads or 3000 tons can be unloaded and stored on the first floor of the

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wharf shed in ten hours, and that four wharf-shed cranes will load an 8000-ton vessel in about fifty-five and one-half hours. The tractors were supplied by the Baker R. & L. Company and the cranes by the Wellman-Seaver-Morgan company. All tractors have Edison batteries. Each section of the storehouse will be furnished with two Martin rotary-converter battery-charging sets and panels for tractor service.

The storehouse is equipped with twenty-four Otis electric freight elevators. Each has a capacity of 5 tons, at a lifting speed of 150 ft. (45 m.) per minute, and six A. B. See electric passenger elevators of the same speed and of 3000 lb. (1350 kg.) capacity each. The freight elevators have 17.5 ft. by 9-ft. 4-in. (5.2-m. by 2.8-m.) platforms and are each capable of carrying four loaded trailers on one trip. Entrances are provided at both ends. Each trailer has a capacity of from 1500 lb. to 2000 lb. (680 kg. to 900 kg.), and as each elevator can make twelve round trips per hour, there will be a total carrying capacity of at least 36 tons per elevator per hour.

All four elevators in each section of the storehouse will be operated from a dispatching station on the third floor. On each dispatcher's desk are operating buttons corresponding to each of the floors served by each elevator, enabling the dispatcher to send the elevator to any floor and also to call the elevator from any floor. Stop buttons are provided so that any car can be stopped in transit. Hatchway doors, however, cannot be operated from the dispatchers' desks but are opened automatically when the car reaches the landing.

Lamp-position indicators will show the dispatcher the position of each elevator, with pilot lights showing whether hatchway doors are open or closed. In order that the dispatcher may control the rapid handling of

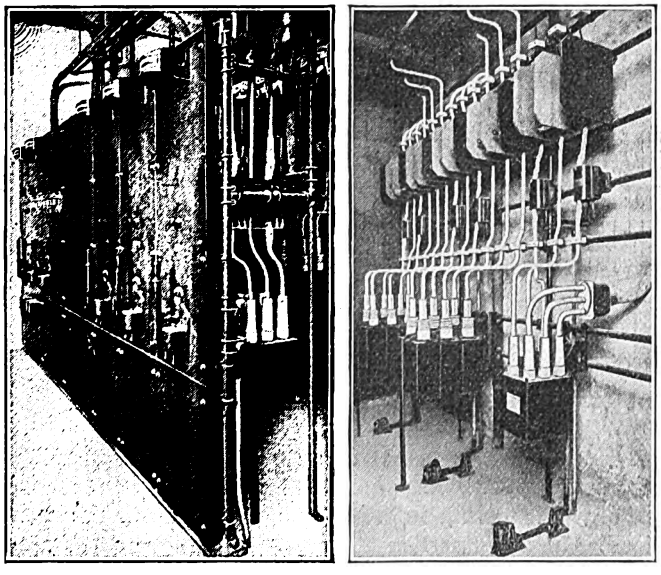

FIG 2—TYPICAL VIEWS SHOWING DISPOSITION OF APPARATUS IN SUBSTATION

freight at the various landings, a telephone system is provided consisting of an instrument on each side of the elevator well on each floor in each car and at the dispatcher's desk. A series of buttons permits the dispatcher to call and talk with any telephone.

Each elevator is equipped with a micro-leveling device, representing an important advance in design, which, after the car has made its initial stop, brings the car to within $\frac{1}{16}$ in. (1.5 mm.) of the floor level and maintains this level independent of the rope stretch during all conditions of loading and unloading. Micro-leveling is accomplished by an auxiliary motor on each machine to operate the elevator during the micro-leveling period.

The doors, which are electrically operated, begin to open as soon as the micro-leveling device comes into

FIG. 3—ELECTRIC TRACTORS FOR TRANSFERRING LOADS FROM STOREHOUSE TO WHARF SHED

play, and by the time the car is level with the landing both doors (one at each end of the car) are opened. About five seconds are required to open the doors. The door-operating devices were manufactured by the Elevator Supplies Company. The equipment consists essentially of a motor-driven machine installed in a penthouse and arranged through a friction clutch to drive a chain connected to a series of sprockets in the elevator hatchway, one sprocket for each door. The doors on each side of the hatchway of any one elevator are operated by one overhead machine. The sprockets are carried on the same shaft as the counterweight sheave for the door and are connected to the sheave by an electric clutch. When the electrical system is out of order the door may be raised and lowered by hand.

An interlocking system is installed which normally will prevent the operation of an elevator unless all its hatchway doors are closed. In each car a switch inclosed in a glass case is provided, so that in case of fire or other emergency the interlock may be disconnected and the elevator operated irrespective of the position of the doors. A limit device is also provided which, through mechanical connection to the doors, opens the motor circuit when both doors are completely opened or closed. The elevator cars are equipped with car switches, and a double-throw switch is provided on the control panel in the car so that either the automatic system or the manual car-control system may be used. The car switches are mounted in a recess in the car inclosure, which also contains an annunciator, a telephone, emergency switches for car doors, a lighting switch and door-operating buttons.

The passenger elevators are provided with both push-button and car-switch control. An interlock is provided which engages with the car door when the car is opposite the landing, so that the opening of either door will open the other door also.

The pier sheds are each equipped with eight freight elevators of 6 tons capacity at 50 ft. (15 m.) per minute and having platforms 9 ft. 4 in. (2.8 m.) wide and 19 ft. 2 in (5.8 m.) long. The eight elevators in the south pier shed are of the Otis type and are similar to the storehouse elevators except that the cars are con-

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trolled by buttons at the landings and not by a dispatcher. The eight elevators in the north shed are of the A. B. See type, being similar to the Otis machines but without the micro-leveling device. In the wharf shed are five electric elevators with a capacity of 6 tons at 50 ft. (15 m.) per minute, supplied by the F. S. Payne Company. These cars are controlled by car switch only. The doors for the elevators in the pier sheds and wharf shed are of the bi-parting, counterbalanced type, supplied by the Peelle Company, and are equipped with electric operating devices manufactured by the Elevator Supplies Company, embodying features similar to those of the storehouse doors.

All the elevator motors are of the three-phase induction type, operating at 220 volts. Those in the storehouse will be designed for two-speed operation, the higher speed being utilized after the elevator has got well under way. All elevator doors are operated by two-speed, three-phase induction motors of special design, furnished by the Elevator Supplies Company. A maximum of 2 hp. will be required for the door operation in any elevator well. The elevator control circuits will be energized by 220-volt. three-phase supply.

Energy for operating the electrical equipment is supplied by the Edison Electric Illuminating Company of Boston through two 13,800-volt underground cables, electrically operated, remote-controlled oil switches and will be protected at the generating station end by overload relays. Provision is made for a third incoming line in the future. Each incoming line is equipped with two oil switches enabling it to be thrown upon either a main or an auxiliary bus. Sectionalizing switches are provided in the buses so that the load upon any incoming line will be kept within predetermined limits and the possibility of interruption limited in case of any local ground or short circuit. Two sets of 2300-volt busbars are installed to insure continuous service and enable the distributing lines to be operated flexibly.

Each rotary converter is to be equipped with two remote-control carbon circuit breakers, and the outgoing direct-current feeders will be provided with type K breakers mounted on the low-tension switchboard panels. Either rotary is large enough to handle the entire direct-current load. The Condit Electrical Manufacturing Company furnished all the oil switches in the army base and about twenty switchboards of various sizes.

Each section of the storehouse is provided with a distributing switchboard. Three such boards are also installed in the wharf shed, two in each pier shed, and one each in the heating plant and administration building. Duplicate alternate-current feeders are run in

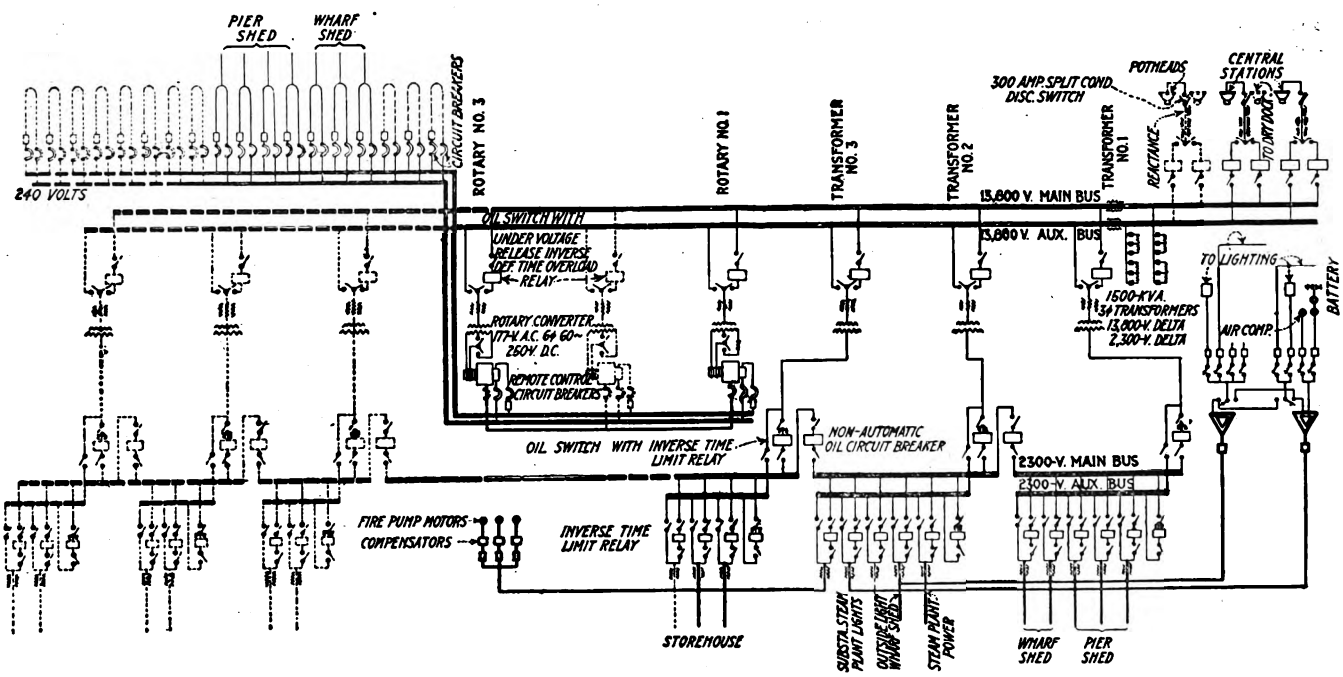

FIG. 4—SINGLE-LINE WIRING DIAGRAM OF SUBSTATION FROM CENTRAL-STATION LINES TO 2300-VOLT FEEDERS

either of which is capable of carrying the present load. In fact, the electrical system in general is duplicated between the source of supply and distributing panels to assure continuous service. At a substation on the army base site the high-voltage supply is stepped down to 2300 volts for distribution to transformers around the terminal, where the electricity is again transformed to 110 volts and 220 volts for power and lighting. Rotary converters provide 240-volt direct-current energy for hoisting and other service for which it is preferable. The substation is designed to handle an initial load of 4500 kva. and an ultimate load of 10,000 kva. The present installation includes three 1500-kva. oil-insulated, self-cooled General Electric transformers and two 500-kw. Westinghouse rotary converters.

The incoming 13,800-volt lines are equipped with F-6 underground ducts and in iron conduit to each distributing switchboard, with full switch protection, either feeder of any pair having sufficient capacity to handle the entire load. In the storehouse the lighting requirements per section totaled about 70 kw. and the power requirements 220 kw. during the war, but in industrial service these will be increased respectively to 300 kw. and 900 kw. To provide for quick changes and uniformity in equipment, there is one 300-kva. transformer for each storehouse section and one for each two sections of the pier sheds, each transformer having six terminals to deliver 220-volt and 110-volt three-phase service for power and lighting. If the load in the storehouse increases later and one lighting and three power transformers are required, the additional transformers of the present type can be added, and the three power transformers will be

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operated in parallel on one set of low-tension buses. Six 300-kva. transformers have been installed in the storehouse, four equipments of this size in the pier sheds and one for a spare unit. Three 150-kw. transformers are provided for the wharf shed. All these transformers were furnished by the Pittsburgh Transformer Company. Smaller transformers are utilized for the boiler house, administration building, etc. As far as possible units employed during construction have been installed.

The permanent outside lighting is furnished by 500-watt and 1000-watt "Novalux" units mounted on poles and on the buildings, and also by 200-watt lamps in steel shades along the edge of the platform on the north side of the storehouse and along the water side of the wharf shed and pier sheds. To control these lamps special feeders are run from a separate panel in the substation; in addition, provision is made for feeding these lights in case of emergency from the local distribution centers. The interior of the storehouse is illuminated in general on the basis of one outlet for each 21-ft. by 21-ft. (6.4-m. by 6.4-m) bay, about 100 watts per outlet being allowed.

During construction a temporary substation was used with a maximum capacity of about 800 kva. This contained a pair of 200-hp. synchronous motors wound for 2300 volts, each motor driven by belting a pair of 60-kw. Edison bi-polar generators, delivering direct current at 120 volts. Each pair of generators was connected in series to provide direct-current 220-volt service. These units were loaned free by the Boston Edison company for the operation of direct-current hoisting motors during the construction period and as a source of direct-current energy for operating permanent equipment of this type in case the rotary converters planned for the final installation should be delayed in reaching the terminal. Energy for construction work was obtained from a 2300-volt underground feeder running direct to the terminal from the Edison generating plant. Local alternating distribution was effected by overhead 2300-volt lines feeding transformers on poles at various points on the site, whence 220-volt, three-phase power service and 110-120-volt lighting service was taken. Electric motors were extensively used in the construction work in the operation of hoists, concrete mixers, crushers, pumps, special machinery for supplying concrete to molds for the production of piles and other material essential in the building work.* The temporary substation was erected with a slate switchboard and oil-switch installation in less than thirty days from the beginning of construction, and during this period there were also erected 100 poles, 75,000 ft. (22,800 m.) of line wire, 1000 outlets for the interior wiring of temporary buildings, thirty motors and twenty transformers, all of which had to be purchased, delivered and installed in this short time.

The site was selected by Major-Gen. George W. Goethals, assistant chief of staff, in charge of storage and traffic, U. S. A., who also determined that the project should be of permanent character and that the main structure should be suitable for commercial use after the war. The storage capacity required and similar features were determined by Col. F. B. Wells, in charge of storage under General Goethals. Construction and disbursement of all funds were under the immediate supervision of Major Charles R. Gow, constructing quartermaster. Preliminary and final designs, field engineering and inspection were by Fay, Spofford & Thorndike, Boston, acting as supervising engineers for the War Department, with Hollis French & Allan Hubbard, Boston, acting as associate engineers for heating and power equipment. The general contractor was the W. F. Kearns Company, Boston, and the sub-contractor for electrical installation was Edwin C. Lewis, Inc., Boston. In general charge of the electrical design and construction for the supervising engineers was Roy R. Burnham, who was chief of electrical design and construction for the Victory destroyer plant at Squantum, Mass., and other important electical work in connection with the recent expansion of the Fore River Shipbuilding Corporation.

* The temporary outside lighting required about 125 1000-watt "Novalux" lamps, floodlamps and smaller incandescents also being used to some extent.

NEW HAMPSHIRE WATER POWER CONSERVATION

Report of State Commission Emphasizes Continued Importance of Fuel Saving, Use of Undeveloped Powers and Co-operative Conservation

Another valuable contribution to the cause of water-power conservation and development has been published in the form of a report of the New Hampshire commission on this subject. Reference has been made in these columns to the reports recently issued in Massachusetts and Maine, and the New Hampshire study adds data of much engineering importance to the information hitherto available in New England relative to stream power and storage facilities and possibilities. The New Hampshire report is signed by George B. Leighton, commissioner, and was prepared in coöperation with the United States Geological Survey, C. H. Pierce of Boston, Mass., being district engineer, with charge of the field work and technical side of the investigation.

The field work shows that there are in New Hampshire about 100 places where storage reservoirs may be constructed at a greater or less expense. Each case, however, needs special study. It was hoped that it might be possible to find within the state a location where a large storage reservoir of several square miles area could be established, but such a place has not been found. There are places where an outlay of $100,000 or more will be justified, particularly at Keene; and again there is the project of increasing the storage capacity of Lake Winnepesaukee, but the majority of storage sites discussed are of moderate capacity, though in the aggregate they will hold a great deal of flood water.

Careful consideration should be given to undeveloped powers, the report states. On the Connecticut there are three important water-power sites from which it is estimated that 345,000,000 hp.-hr. can be secured yearly, and on the Merrimack and its tributaries it is estimated that there are nine undeveloped powers with a total annual output of 145,000,000 hp.-hr. The importance of coöperative conservation is touched upon, and the work of the Androscoggin Reservoir Company in Maine and that of the Wisconsion Valley Improvement Company are commended. It is hoped that the present Legislature will outline a policy of water-power conservation through use and development. It appears that the amount of power at the present power developments which would be saved by fairly complete systems

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of storage would be the equivalent of about 173,000 tons per year in New Hampshire and of about 105,000 tons per year outside the state, a total of 278,000 tons per year, not including the Androscoggin River. At the low coal price of $4 per ton this represents a saving to the people of more than $1,000,000 per year.

The commissioner does not feel that a mutual organization to develop storage facilities would be feasible in New Hampshire except to a limited extent on the headwaters of the Connecticut and Androscoggin Rivers, because only where a few large users of power are found on a stream, as in Maine, is such an organization satisfactory. The storage construction, he believes, should be done either directly or indirectly by the state, through the Public Service Commission. It is recommended that the Public Service Commission be empowered to investigate and prepare a report on each project, whether large or small, ascertaining the probable costs of construction and operation and the probable revenue. The revenue can be saved by entering into long-time contracts with power users on the basis of coal saved and the value of new power developed.

In conference with power companies it is gratifying to learn that they are willing to pay liberally for water power as a substitute for coal. If, for example, it is found that 10,000 tons of coal can be saved in a certain river basin if the flow is more equal, the mills should be willing to pay at least $30,000 per year, or 10 per cent on a cost of $300,000. Each project should be at least self-sustaining, the report maintains. In normal times the state can secure money at less than 5 per cent and the cost of operation may be below 2.5 per cent, so that the total cost may be nearer 8 per cent than 10 per cent.

The estimates in the report are based on 50 per cent increase in pre-war construction costs, plus land damages, flowage rights, etc., at present estimated values. It was assumed that the load factor of each power plant was high enough, so that, taken in connection with the pondage available, no stored water released from the reservoirs during the season when storage was needed would be wasted. It was also assumed that reservoirs would be filled to capacity and completely drawn once each year. Power-plant efficiency was assumed to be 80 per cent and a coal consumption averaging 3 lb. per kilowatt-hour was adopted as more representative of New Hampshire steam-plant operations than the 2-lb. rate often taken.

Modern Bus and Switch Structures

Increase in Size of Generating Units and of the Number Operated in Parallel Has Necessitated Accommodation of New Types of Circuit Breakers and Reliable Support of Buses —Details of Methods of Installation

BY C. D. GRAY AND M. M. SAMUELS
J. G. White Engineering Corporation

DESIGNING of masonry bus structures has become a distinct and prominent branch of power-plant electrical engineering. Although they have undergone a great many changes and improvements since their inception, and particularly within recent years, they have not yet reached any final form and still give the designer and construction man a great deal to consider.

Gradual development, rather than radical changes or inventions, brought about the modern type of bus structure. Engineers realize more and more that safety and continuity of operation of a station depend to a great extent upon the reliability of the bus structure (which may be called the spine of the station) and are willing to devote more time to its design and careful construction. Furthermore, persons financing the building of power plants have also come to realize that a little additional expenditure on a bus structure will prove ultimately to be a good investment.

DEVELOPMENT OF NEW TYPES OF BUS STRUCTURE

Since last writing on this subject* new ideas have had to be injected into the design of bus structures, and entirely new types of structures have been developed. This was due primarily to the increase in the number of large turbo-generator units installed in single stations, and the concentration thereby of large quantities of energy, which necessitated the development of new types of circuit breakers (capable of rupturing enormous short-circuit currents) and the adaptability of the bus structure to such circuit breakers. Whereas only a short time ago a 15,000-kw. turbine was the largest made and offered very little difficulty in switching, 70,000-kw. units are now being installed and have to be taken care of by suitable reliable switching.

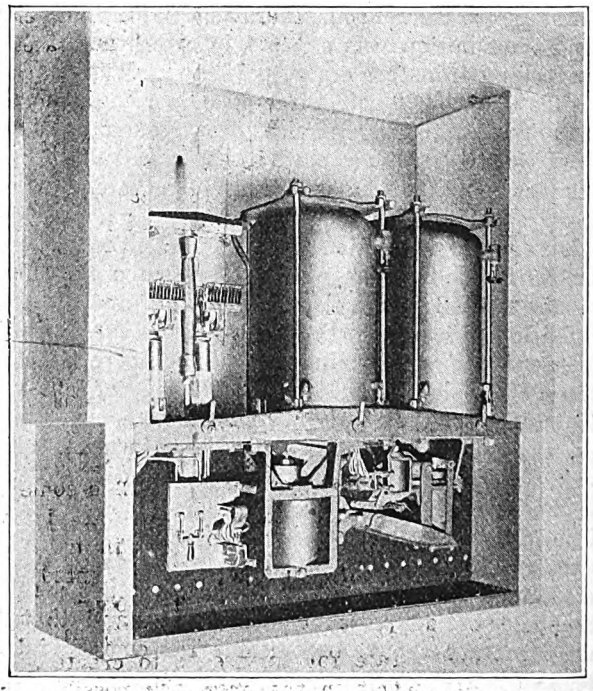

FIG. 1—OIL CIRCUIT BREAKERS RATED AT 2000 AMP., 15,000 VOLTS WITH RUPTURING CAPACITY OF 650,000 KVA.

*See ELECTRICAL WORLD, Jan. 15, 1916.

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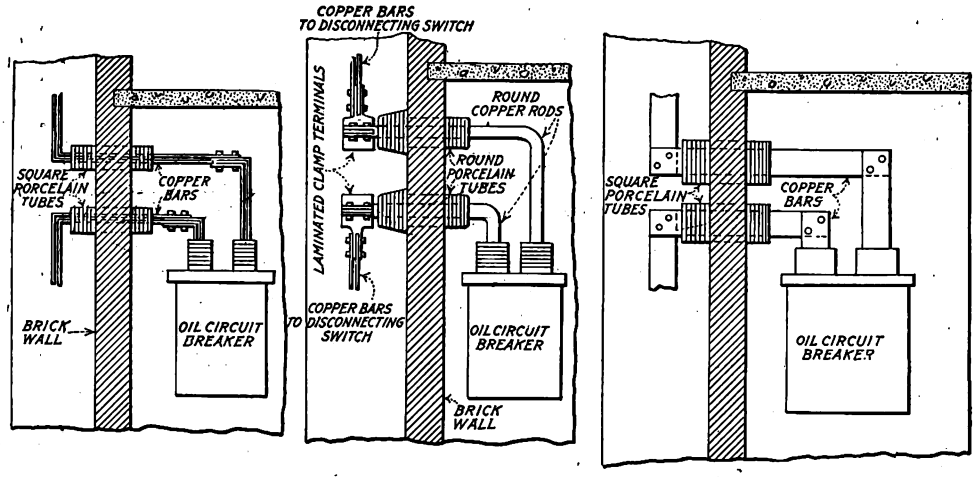
In addition to these difficult switching problems the bus structure designer has to face many demands made upon him by liability insurance companies, which continually and justly require that new safety features be introduced for the protection of life and property.

It is therefore the object of this article to show how some of these problems are being solved and to give a description of some of the most modern types of bus structures and also a brief review of new types of apparatus now being used in modern bus structures.

Determining Required Space.—It often happens that the floor space and height of gallery for accommodating a switch and bus structure are determined on the preliminary assumption of a certain circuit breaker and a certain arrangement of feeders before an actual decision is made on the switching. If the building is then finally designed on the basis of these preliminary assumptions, a great deal of juggling and changing becomes necessary if finally a different type of circuit breaker or a different arrangement of circuits is decided upon, and the result is always a poor switching layout, often unnecessarily complicated.

It must be remembered that different oil circuit breakers require not only different spacings of floor beams but also different heights and widths of galleries, and that whereas some circuit breakers give a good layout with the bus and circuit breaker on the same floor, others will give a much better arrangement if the apparatus is arranged on two or even three galleries. It is therefore a good policy not to make up a final design of the building part accommodating switch and bus structures until the types of all circuit breakers and the arrangement of circuits are finally determined upon. Since the electrical switching is generally housed in a building lean-to, outside of the crane columns, it will be found that the delay caused in the design of this lean-to, which might be caused by the making of a good switching layout, will not hold up the design of the rest of the building, and the inconvenience which may be caused by it will be amply repaid by a good and well-balanced and proportioned layout of the switching arrangement. It would surely cause no delay in the erection, since the difference would only be a matter of a week or two, and sometimes only a day or two. It should never be left out of sight that the building should be designed to suit the apparatus instead of trying to accommodate apparatus to a predetermined building.



FIGS. 3, 4 AND 5—ARRANGEMENTS OF SWITCH TERMINALS THAT FACILITATE CONNECTIONS WITH DISCONNECTING SWITCHES, FUSES, CURRENT TRANSFORMERS, ETC.

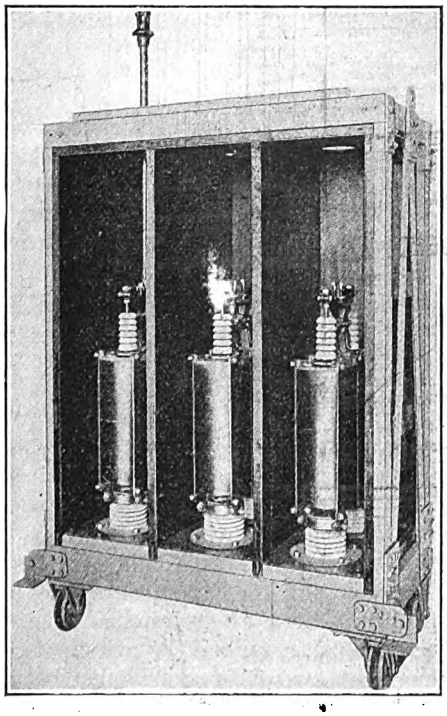


FIG. 2—OIL CIRCUIT BREAKER RATED AT 800 AMP. AND 15,000 VOLTS AND CAPABLE OF RUPTURING 600,000 KVA.

Oil Circuit Breakers.—A great deal of discussion has been taking place recently in various engineering societies as well as in current literature with reference to the rupturing capacities of circuit breakers. The thorough study which manufacturers have made of the subject, as well as the great amount of laboratory research in connection therewith, have developed new types of oil circuit breakers which promise to be a great help in the further combination and concentration of energy that is bound to come in the period of reconstruction and readjustment. Circuit breakers are now made which are guaranteed to rupture the very high short-circuit currents which may occur on modern interconnected systems. For example, the J. G. White Engineering Corporation is now installing a number of 12,000-volt, 2000-amp. circuit breakers, like the one shown in Fig. 1, which are guaranteed to have a rupturing capacity of 625,000 arc kva. and are capable of opening such a short circuit twice in succession at least one-half minute apart and still be immediately reoperative without its being necessary to inspect or clean the contact parts or renew the oil. Furthermore, it is possible to perform this operation without throwing an excessive quantity of oil or damaging any part of the breaker beyond the burning or pitting of arcing contacts. Such breakers must of course be so designed mechanically as to withstand the mechanical stresses that may be imposed upon them during the first few cycles of the short

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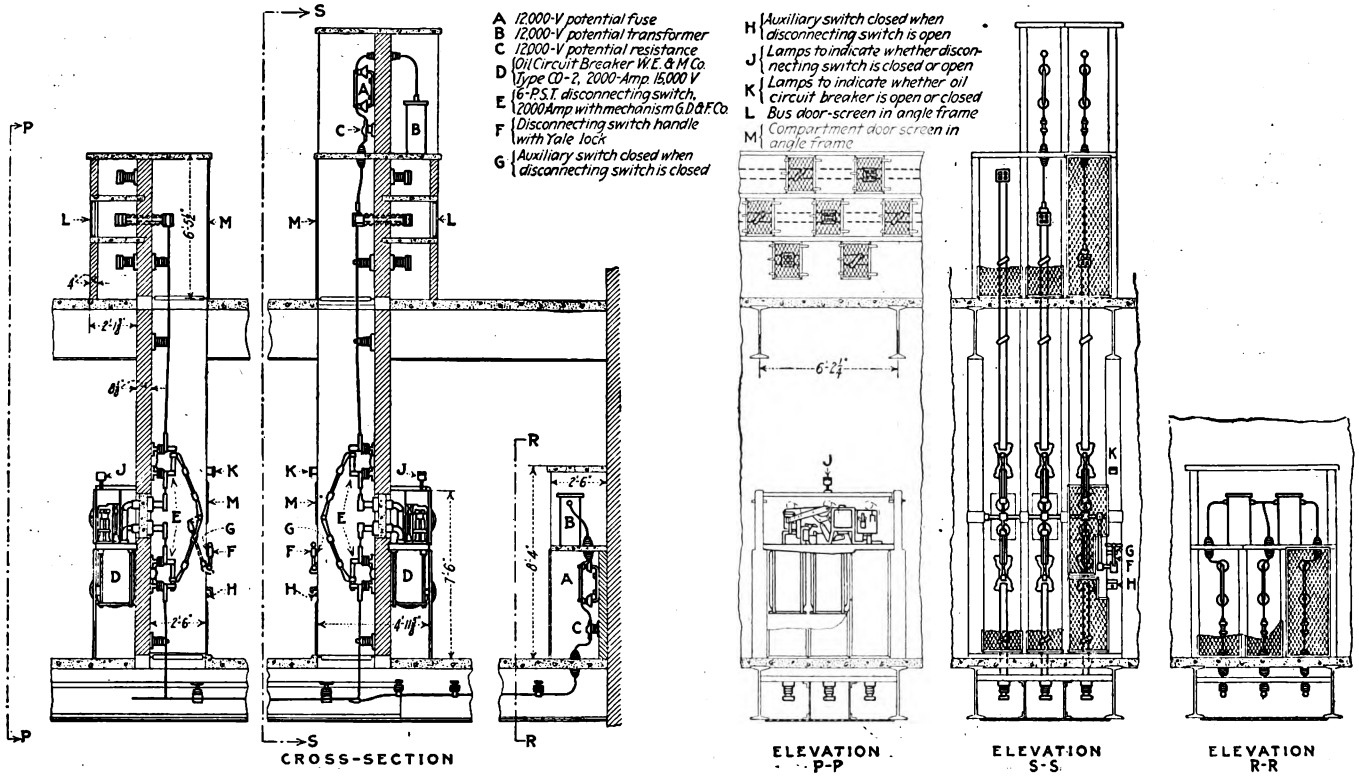
circuit when unsymmetrical currents of high value may exist. The calculated instantaneous short circuit for this particular installation is 580,000 kva. at 12,000-volt operation, so that if the circuit breakers come up to their guarantee there should be no difficulty in taking care of any short circuit which may occur.

There are still a great many misunderstandings with reference to the definition of "rupturing capacity." Until a better definition is developed the proposed definition of the A. I. E. E. should be insisted on, which reads: "By interrupting (breaking or rupturing) capacity is meant the highest r.m.s. current at normal voltage which the device can interrupt under prescribed conditions at stated intervals a specified number of times." Rupturing capacity should therefore be specified in "arc amperes" rather than in "arc kva." It is not sufficient to specify that a circuit breaker has a certain rupturing capacity based on A. I. E. E. rating, since the A. I. E. E. definition leaves three things open which must be defined in each individual case: They are (1) prescribed conditions, (2) stated intervals, and (3) prescribed number of times.

While it is possible to determine the rupturing capacity of a comparatively small circuit breaker by actual tests, this is not the case with circuit breakers which are intended to rupture very heavy short circuits, since a public utility company having such a vast amount of energy available will not permit a short circuit of 1,000,000 kva. or more to be established on its system for the purpose of determining the rupturing capacity of a circuit breaker. For circuit breakers of such enormous capacities the given rupturing capacities are of necessity based on certain assumptions and intelligent guesses. When giving rupturing capacities of large circuit breakers that cannot be actually tested, the assumptions should therefore be specified which were used as a basis for determining the rupturing capacity.

In addition to the rupturing capacity, the mechanical and electrical details of a circuit breaker should be carefully looked into in each case before definitely deciding upon the use of a certain type. The construction of the contacts, the breaking distances, the sizes of the oil vessels, the details of the operating mechanism and other important details of various types of proposed circuit breakers should be compared and well investigated.

In a majority of cases, when oil circuit breakers are used in bus structures, one side of the breaker will be connected to the bus while the other side will be connected to a generator or feeder. In such cases, therefore, the most suitable arrangement of terminals for the oil circuit breaker is obviously to bring these terminals through the rear masonry wall, one above the other, as shown in the bus structures illustrated in this article. The terminals should be arranged in such a way that no difficulty will be experienced in working out the connection bars to disconnecting switches, buses, current transformers or cables. The arrangements shown in Figs. 3 and 4 are the best suited to the purpose in most cases, whereas the arrangement shown in Fig. 5 will only be desired on very special occasions. Standard oil circuit breakers should therefore be designed for the terminal arrangement shown in either Fig. 3 or Fig. 4. In order to avoid the excessive heating of contacts, laminated terminals for bar connections should be insisted on for all circuit breakers of 1000 amp. or over. The recent tendency in circuit-breaker design has been rather too much toward compactness, for the principal reason that a great many such circuit breakers must be installed in existing buildings where only a limited amount of space is available. While compactness has a great many advantages, the question of accessibility should not be lost sight of, and in new power plants of large capacities more liberal spaces should be allowed for switching than has heretofore been the custom.



FIGS. 6 AND 7—LATEST TYPES OF MASONRY BUS STRUCTURE FOR A 12,000-VOLT, 1,000,000-KVA. INSTALLATION HAVING ALL IMPROVEMENTS MENTIONED IN ARTICLE

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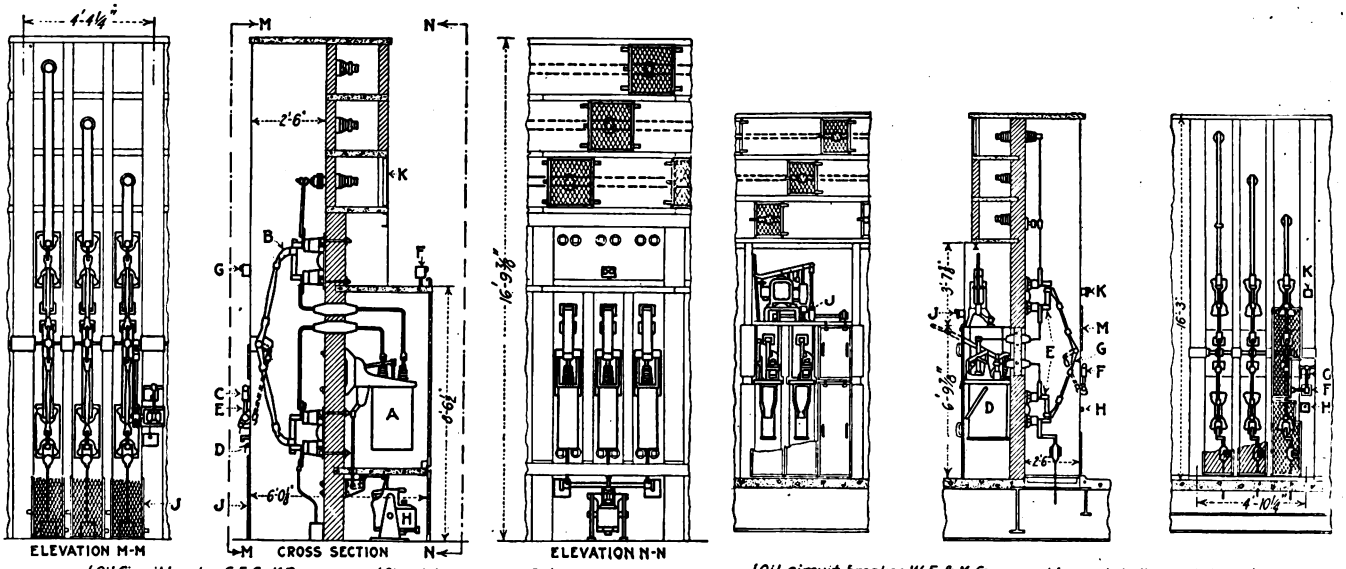
With the increase in sizes of circuit breakers and their mechanisms, the problem of handling, installing and adjusting them is becoming more difficult. Being usually shipped disassembled, it is very difficult to handle the heavy parts of circuit breakers in the switching gallery without the aid of a crane. Therefore the tendency in the design of new circuit breakers should be to develop portable steel frames which will accommodate both the circuit breakers and the operating mechanism and which will also take care of all mechanical stresses. If this is done, the circuit breaker and mechanism can be assembled and adjusted at the factory by experienced men who are very familiar with every part of the apparatus and who would be able to find and remedy misfits or other troubles more quickly than would a construction man in the field, whose experience must be more varied and therefore less specialized. Such an arrangement has just been developed recently and is shown in Fig. 2. It can be shipped assembled and be set in place without any difficulty. The set shown is a triple-pole breaker for 15,000-volt, 500-amp. service and has a rupturing capacity of 18,000 arc amp., or approximately 460,000 arc kva. Removable barriers of asbestos wood are provided between phases instead of the usual brick walls. While masonry division walls are not required between adjacent sets of these structures, such walls can be built much more easily than the usual cells when desired, because the barriers between switch pots and provisions for mounting the switch and mechanism do not have to be made. In an installation containing several such circuit breakers one or two can be kept as reserve and used to replace defective circuit breakers when this is necessary.

Disconnecting Switches.—Even though the disconnecting switch is only an auxiliary to the oil circuit breaker in a majority of cases, serving the purpose of disconnecting an oil circuit breaker from energized parts when it is necessary to inspect or repair it, it is nevertheless a very important part of a bus structure. In the past nearly all disconnecting switches were operated by means of switch hooks. This method of operation is gradually being abandoned for various reasons which have been discussed in detail in the ELECTRICAL WORLD on previous occasions. The modern method is to install a mechanism for operating the three or six disconnecting switches of one circuit by one common handle. Thus the possibility of an operator opening a disconnecting switch accidentally by means of a metallic rod when a switch hook happens to be mislaid is entirely eliminated and a circuit breaker can be cleared very quickly for inspection or repair by one operation of the disconnecting switch handle. This also prevents the opening or closing of one phase of a circuit without performing the same operation on the others. It also obviates the chance of opening two phases of one circuit and one phase of another under stress of excitement. The door of the disconnecting switch compartment can remain closed permanently and need only be disturbed when it is necessary to repair a disconnecting switch, which is not a very frequent occurrence. A Yale or similar lock can be installed on the handle, thus making it impossible for the switch to be opened or closed by an employee who is not authorized to do so. Auxiliary switches can be attached to the handle or other parts of the mechanism for the purpose of operating indicating lamps at the oil circuit breaker, so that an operator inspecting or repairing the apparatus will know definitely that the respective disconnecting switches are open. These auxiliary switches can also be used for operating indicating lamps at transformers, buses or other parts of a circuit remote from the switching to indicate definitely whether or not the apparatus or circuit is energized.

The switches shown in Figs. 6, 7, 8 and 9 are about the latest types of mechanically operated disconnecting switches for compartment use. The insulating members of the mechanism consist of wooden rods, the auxiliary switches are operated directly by the handle, the lock is inserted in the handle, and the various parts of the mechanism are held in the masonry by means of cast-iron inserts, making the arrangement rather com-



FIGS. 8 AND 9—MODERN 12,000-VOLT BUS STRUCTURE FOR STATIONS RATED AT LESS THAN 1,000,000 KV.

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plicated. It requires a very deep compartment, and since the compartment is very narrow, the width being limited by the dimensions of the oil circuit breaker on the opposite side of the wall, it is difficult to install and adjust the disconnecting switches and parts of the mechanism within the compartments. This type of disconnecting switch, even though it offers a great many advantages over the old types, cannot be considered as final.

New types of switches will have to be developed to meet all the requirements of a modern masonry switch structure. A satisfactory disconnecting switch should be very simple, should have very few parts, should not require a very deep compartment, and should have all parts of the mechanism which are not insulated on the outside of the compartments. The mechanism should not in any way interfere with the door, and it should not be necessary to provide any slots in the door to permit parts of the mechanism to pass through. The three or six switches of one unit with their mechanism should be mounted on a common structural steel frame so that they can be assembled and adjusted at the factory. With the heavy short circuits to which modern systems are subjected, the disconnecting switches or their mechanism should be reliably locked so that they will not open under short-circuit conditions. For small circuits of secondary importance hook-operated switches may still be used, but even these should be equipped with locking catches.

Busbar supports, current transformers, masonry material, etc., will be considered in a second installment.

FINANCING EXTENSIONS OF LINE IN WAR AND PEACE

Report of Committee Appointed at 1918 War Convention of N. E. L. A. Deals with Many Possible Conditions

AT THE 1918 war convention of the National Electric Light Association a special committee was appointed to report on the subject of financing extensions of line under war conditions. Its members are E. W. Lloyd, chairman; H. C. Abell, M. R. Bump, Alex Dow and R. S. Hale. Its conclusions were ready about the time the armistice was signed. The report was therefore revised. The committee recognizes that its applicability under peace conditions is obviously "limited to the exceptional cases where the company's custom or policy, or the standing rule of the public utility having authority, does not provide for the making of extensions in the ordinary way and as part of the ordinary investment of the company."

Following are extracts from the report:

When it is decided that an extension is to be made, any portion of cost which cannot properly be capitalized and spread over the rest of the business should be borne directly by the customers for whom the extension is made. The portion to be capitalized may at the option of the company: (1) be borne by the company without further action by the customer; (2) the company may ask the customer to guarantee an income for a term of years, or (3) the company may require that the customer, in addition to paying outright the abnormal portion of the cost, shall deposit an amount equal to the normal portion, on the understanding that each year some portion of the income shall be used first to pay interest on such deposit or on any unreturned balance, and next in order to return the deposit until all of the deposit is returned, provided also that if at the end of some reasonable term of years the deposit is not all returned the transaction shall nevertheless terminate and the unreturned balance be forfeited to the company.

Ordinarily a line extension is merely the healthy growth of a company, since an extension brings in enough income to pay all of the first two following items and usually enough more to pay the third: First, the added expenses (that is, added operating expenses) involved by the new business; second, enough more to pay the fixed charges on the extension; third, the additional income which gives a greater return or profit than would have been obtained if the extension had not been made. This extra profit can then be used for the benefit either of the stockholders or of the earlier customers, or both. When an extension will give sufficient income to take care of these three items, it is obviously to the advantage of the stockholders and of previous customers that the extension should be made.

The cost of the extension may be high for various reasons. The reason that has been troublesome recently was the high cost of labor and material and also money during war times. This war-time condition was only a difference in degree and not any difference in principle from conditions that occur in peace times. Shall these differences in cost be borne by the particular customers in the different streets, making a different price in each street for the future supply of electricity, or shall the costs be spread over the whole business and averaged so that the cost of electricity shall not vary from street to street but only with the kind and quantity of service?

The answer is pretty clear as to the principle that when abnormal costs are incurred solely for the benefit of a particular customer or set of customers, the rest of the customers should not always be called on to pay the abnormal costs. However, the problem of deciding what is the normal cost and what is abnormal is not so easy. The public cannot be called on to decide the detailed figures for each case, but the public in America has very generally appointed commissions which issue rules and regulations of service and frequently decide what expenditures for special extensions should be made, what balance should be paid for by the public utility, and which portion the company may capitalize. When an expenditure is capitalized, then it is spread over the whole business. If, on the other hand, the commission will not allow it to be capitalized, then it obviously should be borne by the customers benefited.

The committee also takes up the question of abnormally low income as one that may cause equal injury to the other customers. The income may be so low that it does not provide for operating expenses and return on the new investment, and then in the long run the rest of the business will have to make up the difference if the customers on the new extension do not either provided enough extra income or a part of the cost.

In order to protect the company properly, the most practical scheme is for the customer to deposit with the company the cost of the extension, or rather the normal portion of the costs. The abnormal portion of the cost should be paid by the customer outright without hope of return. If the income proves too low, the customer never gets his money back and may not get even full interest. This is not unfair, since in these cases the extension, even if it has cost the company no capital expense beyond the deposit, may have increased the company's operating expense for patrolling, etc., and in any case has given no profit to the company.

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STATION & OPERATING PRACTICE

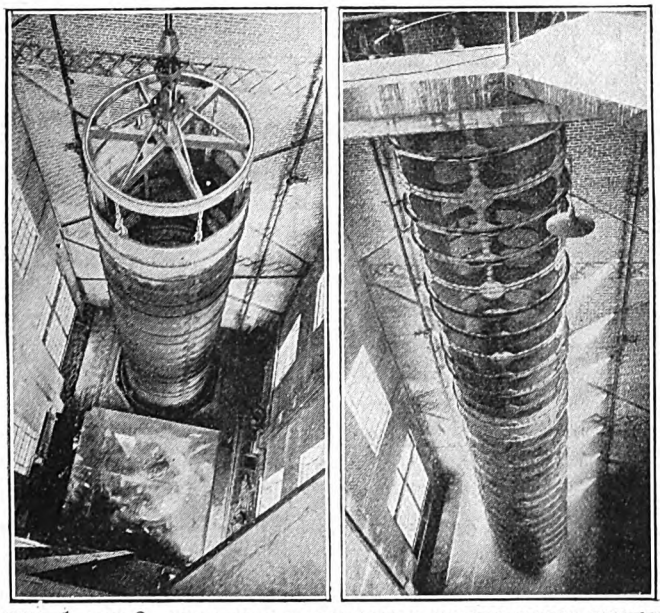
A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

WATER INTAKE SCREENS ARE EASILY AND QUICKLY CLEANED

Leaves Must Be Removed as Often as Once an Hour at Times, but Screens Are So Effective that Condensers Keep Clean for Three Weeks

Each fall the Ohio River, which drains a watershed on which there are a great many forests, is filled with an enormous amount of leaves. As condensing water for the Louisville (Ky.) Gas & Electric Company is taken from this river, some means had to be devised to strain the water to avoid cleaning the condenser too frequently. Furthermore, provision had to be made to clean the screens, for otherwise the intake would be completely closed because of the severe conditions imposed.

This problem has been successfully solved by the use of three concentric cylindrical screens 60 ft. (18 m.) high, any one of which may be hoisted independently of the others. During the worst period these screens are hoisted each hour and cleaned by water jets striking the screen tangentially and causing it to revolve. A platform rolled under the screen covers the screen well and catches the leaves and water as they are washed off. This refuse drops through a grating and flows out to the river together with the discharge water from the condensers.



FIGS. 1 AND 2—PLATFORM ROLLED OVER SCREEN WELL; WATER SPRAY ROTATES AND CLEANS SCREEN

During the year these screens have been in use they have strained as much as 75,000 gal. (28,000 l.) of water per minute. At low water they are immersed for a depth of 20 ft. (6 m.), but they are fully immersed at times when the river is at its height. When the river is low and clean the screens are not cleaned more than once in three weeks, but during times when the river is full of leaves the screens are cleaned as often as once every hour. This operation can be accomplished in twelve minutes. These screens are very effective, for even when the river is turbid the condensers are cleaned only once every three weeks.

On account of the cylindrical shape of the screens no difficulty is encountered in raising them like that present with flat screens when the difference in pressure on two sides is great. The inside screen measures 8 ft. 8 in. (2.6 m.) in diameter, the middle one 11 ft. 4 in. (3.4 m.) and the outer one 14 ft. (4.3 m.).

The screen house and intake tunnels were designed and erected by H. M. Byllesby & Company, Chicago, but the arrangement of screens is covered in a patent owned by Donald McDonald, vice-president and general manager of the Louisville (Ky.) Gas & Electric Company.

INFLUENCE OF HIGH ASH ON BOILER CAPACITY

Capacity Reduced Because Sufficient Coal Cannot Be Burned on the Grates to Do the Necessary Work When High Ash Is Present

The increase in the ash content of coal seriously reduces the capacity of steam boilers because the excessive quantity of coal required to deliver a horsepower with poor coal makes it impossible to consume sufficient coal on the grate to deliver the necessary boiler horsepower. Central stations find that, whereas their boiler houses two or three years ago were of sufficient size to handle all ordinary increase in power demands, now, because of the poorer quality of coal, it is difficult to provide the steam necessary to carry the station load. Until two years past it was considered good practice to operate central-station boilers at 200 per cent to 250 per cent of their rated capacity during peak periods. In the same stations it is now difficult to operate the boilers at more than 150 per cent to 160 per cent of their rating, and sometimes even at that. It is therefore necessary for these stations to place more boilers on the line, and in many cases they have been compelled to purchase more boiler units at unusually high prices.

The effect upon industrial plants is similar to that experienced by the central stations but in a different degree. Industrial plants do not usually operate their boilers at the high ratings experienced in central-station practice, but neither do they as a rule carry so large a percentage of spare boiler equipment. Therefore they find it necessary to operate their entire boiler equipment or curtail production, and their boilers are kept in service for longer periods than is good practice. It is impossible to take the boilers out of service long enough to free them properly from scale and to repair baffles and brickwork in the furnaces properly. The consequence is that the boiler efficiency is seriously re-

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duced until they are in such poor condition that they must be shut down for cleaning at the expense of production. With reasonably clean coal this situation would not exist. Another solution is modification of the grate to handle the lower-grade fuel.

This information was taken from a report of the engineering committee of the National Research Council of the National Coal Association prepared by the J. G. White Engineering Corporation of New York.

TELEPHONE LINES EQUIPPED TO OVERCOME INTERFERENCE

Power Company Eliminates Disturbing Effect of Its 60,000-Volt Power Line by Using Shield Between Transformer Windings

After several years' experience the Seattle municipal lighting department has developed a satisfactory means of protecting telephones from inductive interference on the city's 40-mile transmission line. The telephone wires are strung 15 ft. (4.5 m.) below the power wires, which consist of a 60,000-volt star-connected circuit with grounded neutral. Transpositions had been put in the power line, but conditions occasionally arose under which considerable interference occurred. Effort has therefore been made so to arrange the telephone circuits that interference will be eliminated under normal operation and protection afforded for such unbalanced conditions on the power circuit as may arise.

The plan which has succeeded after the failure of several other attempts has been to install on all telephone services a special closed-core transformer of a design worked out by J. D. Ross, superintendent of lighting, and built in the city's shops. In this transformer a heavy brass sheath separates primary and secondary coils. The edges of the sheath are overlapped but insulated to prevent its becoming a secondary of one turn. The sheath is grounded, as is also the secondary of the transformer. This design is the same as that used on small power transformers which step down from 60,000 volts to 125 volts and 250 volts for the accommodation of patrolmen along the right-of-way.

The idea for this transformer developed when it was found that an operator could get a heavy shock through the transformer acting as a condenser even if it did not puncture. To prevent this the sheath was added and made of a considerable thickness. With this arrangement no static impulse can pass to the telephone, and the operator is protected in case a high-tension conductor should break and fall over the telephone line. No insulated stool is used for high-tension telephone operators.

It was found difficult to design a transformer that could be used for both ringing and talking, particularly when the induction from power lines is severe. Based on the principle that the greater the ratio of talking current to induced current, the better the conditions for telephone operation, an attempt was made to get a very loud-speaking telephone and a powerful ringer. A telephone manufactured in Seattle was found in which two contacts are used, one on each side of the diaphragm. The two paths of the current being wound differentially in th repeating coil, a constant current is not obstructed but is shifted from one wire to the other with the vibrations of the diaphragm, thus permitting the use of high currents.

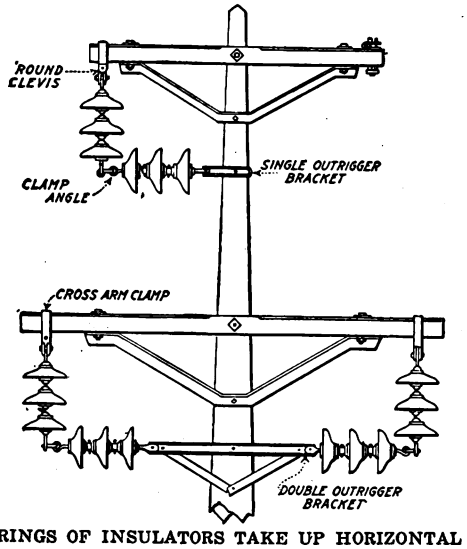
The transmitter at the power house is at the present time being successfully operated from the current of one of the 125-volt exciters through a variable resistance which allows a larger current to be maintained when the telephone lines are disturbed. In this way there can be maintained a much larger talking current in proportion to the induced current from the power wires. If the talking is too loud in the receiver, a variable-capacity reactor or resistor between the telephone lines can be used to reduce the volume. This reduces the talking current and the interfering currents in a virtually proportional degree. So far excellent results are reported.

On account of the number of telephones on the line, a stronger ringer was necessary, and this requirement has been met by W. V. Sylvester, one of the men of the department, who tried gearing together two ordinary magnetos connected in series. These are operated from one crank in the usual way and with no extra inconvenience.

CONDUCTOR SUPPORT FOR LINE CURVES AND ANGLES

Post Insulators Made Up of Disks Take Horizontal Strain and Keep Conductor in Position on Curves and Small Angles of High-Tension Lines

Instead of using dead-end construction or three strings* of star-arranged suspension insulators to keep conductors at the proper distance from cross-arms and poles on curves and small angles of 33,000-volt to 66,000-volt lines, the Minneapolis (Minn.) General Electric Company has developed the method shown herewith, using only two strings of insulators to each conductor. The disks are clamped together and the string attached to the 1-in. (2.5-cm.) channel-iron bracket. The single outrigger used on the upper conductor is bent to fit around the pole, whereas the double outrigger used for the two lower conductors is a straight piece of channel iron fastened to the pole at its center and held in position by two flat braces. To keep it from twisting, two flat braces are also attached to the opposite side of the pole.



RIGID STRINGS OF INSULATORS TAKE UP HORIZONTAL STRAIN

This arrangement permits using lighter and shorter cross-arms than would be required otherwise and uses no more insulators than are employed in dead-ending.

*The three-string method was described in the ELECTRICAL WORLD for July 13, 1918, page 64.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

A COLLECTION METHOD FOR ISOLATED COMMUNITIES

Meter Reader Now Makes Out Bills and Collects Amount Due Company Besides Making Small Repairs Where Required

BY P. M. CORDELL
Superintendent Meter Department, Choctaw Power & Light Company, McAlester, Okla.

Operating companies serving small towns and communities from their transmission lines are often at a loss as to the best procedure to follow in handling the consumers' accounts in the smaller and often isolated places. While with a company operating in Texas and serving a large number of towns and cities, it came to the writer's notice that a great deal of dissatisfaction was caused by the methods of collecting the accounts in places of thirty or forty or fewer customers.

The meter reader would go out from the district office and read the meters. Then bills would be made out and mailed to the customer from the district office, which is usually in the largest town of each district served. The practice was to arrange with the local bank to make the collections and forward them to the district office. This service was usually rendered the company gratuitously by the local bank, though in some instances there was a small charge made. This, however, was not satisfactory, because no effort was made to collect any delinquent amount that might be due the company, the collection agent merely collecting whatever amount the customer chose to pay.

There is no mail delivery in some of the smaller communities, hence the customer would have to go to the post office for his bill, and from there to the bank to pay it. Some of the customers expressed dissatisfaction with this manner of paying their monthly light bills, so it was decided to make a change. The man who reads the meters now makes out the bills, collects the money and gives a receipt at the time he calls to read the meter. It has been the writer's privilege to put this plan into operation in a small town in eastern Oklahoma very recently.

Previously the collections had been handled by the local bank, which was paid a small sum to handle this business. For various reasons, several of which have been stated, this plan was not satisfactory, and as the town served is seldom visited by any of the company employees and has a transient population, it was found that changes caused by one consumer moving out of and another moving into a house served were not properly cared for. This trouble has now been obviated.

Before making the change a letter was mailed to each customer explaining the new plan, and he was told that the meter reader would be in his town on a certain day each month to read the meter and collect the money for that month's bill. The meterman gets the bills from the bookkeeping department, all made out with the exception of the current month meter reading and kilowatt-hours consumed. The meter reader makes out the bill upon making the reading and collects the amount due less the discount. This plan has proved a success in the several towns where it has been tried. The consumer can now take advantage of the prompt-payment discount, and this alone has pleased the customers very much. It permits the company's representative to come into close contact with the customer and goes a long way toward establishing the cordial relation so much desired by the lighting company. Much can be done to make this relation more secure, as it requires only a few minutes of the meterman's time to fix a socket or mend a broken iron cord. No charge is made for these trivial repairs, as the good will established thereby is worth more in the long run than the revenue that might be had. The postage and stationery and office work saved by this plan more than pay for the slight additional time it requires to make out the bill at the time of reading the meter. Without an exception, the customers have expressed satisfaction at having their light bills handled in this way. The customer soon learns to expect the monthly visit of the meterman and has the money ready to pay him.

DEVELOPMENTS IN ELECTRIC TRUCKS AT HARTFORD, CONN.

Gross Revenue from Ninety-two Trucks, Averaging Around $3,000 per Month, Shows a Very Substantial Improvement

With the close of hostilities a greatly improved outlook is now a striking feature of the electric road-truck market. Even in cities like Hartford, Conn., where the central station has enthusiastically pushed electric truck business for years, there is a better feeling about this class of service. The Hartford Electric Light Company maintained an extensive system of electric transportation all through the darkest days of the war, but the scarcity of labor and materials, combined with high

TABLE I—GROWTH OF ELECTRIC VEHICLE SERVICE AT HARTFORD, CONN.

	No. of Trucks in Use	Mileage for Month Named	Mileage to Date
June, 1910	3	272	272
December, 1910	5	3,196	15,573
June, 1911	6	2,915	31,396
December, 1911	14	8,639	82,317
June, 1912	18	11,757	138,925
December, 1912	30	15,207	218,894
June, 1913	32	24,873	347,636
December, 1913	46	32,751	574,900
June, 1914	50	38,614	727,345
December, 1914	58	40,787	978,526
June, 1915	64	47,615	1,232,967
December, 1916	84	48,044	2,040,900
June, 1917	88	53,197	2,312,071
December, 1917	82	28,182	2,601,704
June, 1918	92	35,903	2,802,373
December, 1918	91	26,642	3,012,757
January, 1919	92	27,179	3,039,936

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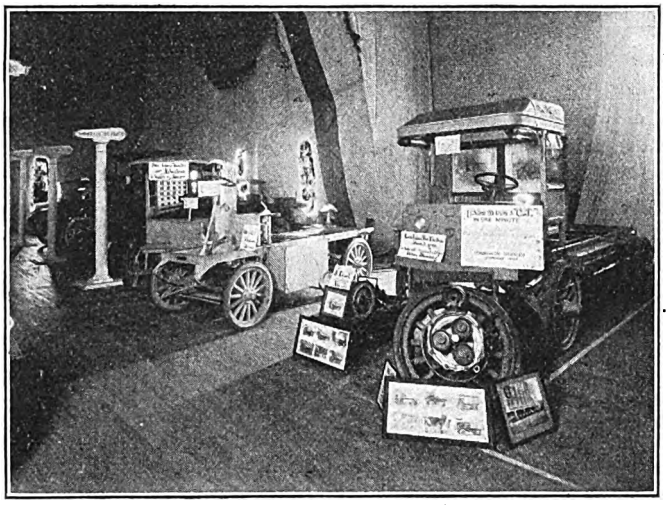
prices for both, greatly reduced the number of machines on the streets as the war approached its climax. It is significant, however, that when the company asked all the users of its battery service system if they would like to have their money back on their equipment, every customer refused to consider such an offer. To the extent that drivers could be obtained or afforded at the unprecedented wages of $20 to $25 per week, the users of truck service continued in large measure to operate



ELECTRIC TRUCK EXHIBITION STAGED BY LIGHTING COMPANY

their equipments. Soon after the signing of the armistice the outlook began to improve, and the company is now supplying service to ninety-two trucks on the battery-mileage plan, the gross revenue averaging about $3,000 per month.

At the recent automobile show in Hartford a striking display of trucks was made in space supplied by the Hartford company free of charge to manufacturers and dealers. Five different trucks, manufactured by four different firms, each with a different type of drive, were shown and much interest was aroused.

The growth of central-station electric vehicle service at Hartford since June, 1910, when it was started, is shown in the accompanying Table I.

More than 3,000,000 miles of truck service have been furnished by the battery-service system at Hartford, and the total revenue received from this service from June, 1912, to January, 1919, was $176,547. The principal items covered in this revenue were gross battery expense and energy charges. A large part of the charging is done at night, so that the additional investment

TABLE II—SERVICE RECORD AND SIZE OF TRUCKS

No. of Trucks	Capacity, Lb.	Total Mileage Since Service Began	Total Car-Months
10	750	469,007	822
19	1,000	1,021,741	1,566
38	2,000	1,213,879	2,081
13	4,000	221,106	445
10	7,000	77,747	162
1	10,000	6,657	19

required in generating, transmission and distributing equipment to handle this business is practically negligible. To December, 1918, the average mileage per truck in service was 586 per month, without deductions for any cause. The total truck-months of service rendered was 5101, or over 400 years' experience in battery service, speaking mathematically.

The service record and sizes of trucks in operation in December, 1918, are shown in Table II.

TO POLULARIZE A COMPLETE JOB OF ELECTRIC SERVICE

Middle Western Company Will Devote Effort to Selling the Idea that the Home Should Have Sufficient Outlets, Switches, etc.

In its coming campaigns the Public Service Company of Northern Illinois will make an effort to induce each home owner who signs a contract for the equipment of his premises to have it made a complete job. He will be urged to specify the numerous auxiliary outlets for the use of lamps and appliances. One of the pieces of literature which are going out on this point reads as follows:

"When facts are known quality is desired. If the public knew no more about the automobile refinements than it does about electrical conveniences, automobiles would be sold minus lamps, starters, tops, wind shields and tools and would be equipped with undersized tires and one-cylinder engines. They would run, but that's all.

"Most house-wiring jobs give light and that's all. The public is buying electrical work on a price basis and is securing only half-completed jobs because it does not know any better.

"It is our work to show the public the advantages of oversized wiring, especially feeders, plenty of flush receptacles, switches, additional and emergency lighting outlets, and to have the people know about all electrical devices for the home. They should learn that there is a difference between electrical jobs."

UTILITY CO-OPERATES IN RENTING WIRED HOUSES

File in Hartford Company's Offices of Such Vacant Properties Consulted by 1049 Persons in First Twenty Days in March

The Hartford (Conn.) Electric Light Company inserted an advertisement about an inch long, Feb. 15, in a local daily stating that a list of wired houses and apartments available for rental had been placed on file at the company's offices for the convenience of the public. This was on a Saturday night, and the following Monday thirty-eight persons called upon the company in response to its invitation. The service was so much appreciated that a bulletin board about 30 in. by 40 in. in dimensions has been hung in the contract department, with vacant rentals listed by wards, and in the first twenty working days of March 1049 persons consulted the list. A large map showing the ward limits has also been hung in the department. Meters are allowed to remain for three months in vacated places, and the service the company has rendered has resulted in an increased demand for wired residences, many friends having been made by the company.

Some of the persons who benefited have written letters of thanks for the company's coöperation, and the local real estate men appear to be in hearty sympathy with the company's policy. The local electrical contractors are using the demand for wired apartments in interesting property owners in wiring, and house-wiring work was also considerably accelerated during March by the fact that a new wiring code extending the limits of the fire district took effect April 1. The rental service was suggested by George H. Allen, head of the contract department.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Large Motors for Reversing Mills.—The general features of two large reversing-mill motors having a peak power of 19,000 hp. and a speed variation of 60 to 140 r.p.m. are given in this article. The motor is of three-armature design and is said to possess advantages over the two-armature machines as follows: (1) As the diameter of the armatures is smaller than would be necessary in the case of a double-armature machine of the same power, the inertia is reduced and the operation of the mill is improved, owing to the more rapid acceleration obtained. (2) The distance between the centers is shorter and the weight on the bearings is less than in the case of a two-armature machine. (3) The total weight of the motor is divided into less weighty parts, thus facilitating handling. (4) This type of machine fulfills the requirements of standardization of parts, as by employing one, two or three of the separate units comprising the whole motor either 6500, 13,000 or 19,000 hp. is available.—London *Electrician*, March 14, 1919.

Use of Mica Insulation for Alternating-Current Generators.—H. D. STEPHENS.—The writer deals with mica for use in high-voltage, high-power alternators where the temperature is high and corona may exist. The futility of using paper or cloth insulations for such conditions is pointed out, and photographs are shown indicating the deterioration of such insulations under high temperature and corona conditions.—*Electrical Journal*, March, 1919.

Determination of the Efficiency of the Turbo-Alternator.—S. F. BARCLAY and S. P. SMITH.—Modern turbo-alternators invariably have forced ventilation, and practically all the losses except the bearing losses are carried off by the cooling air. Thus the most obvious method of finding the losses under load is to ascertain with regard to time the heat energy that is being carried away by the ventilating air. If the volume of the air flowing through the machine in unit time and the average increase of temperature that the air undergoes in absorbing the losses in the machine are known, then the total losses under load can be calculated. This method is referred to as the "air-heating" method. An alternative method (the "calibrated air-temperature" method) is to ascertain the increase in temperature of the cooling air caused by a loss of known magnitude in the alternator and from the observed temperature rise of the air under load to deduce the total losses. In the determination of the losses in the alternator from the cooling air the bearing losses are not included. These losses may be determined with fair accuracy by measuring the volume and temperature rise of the lubricating oil and by making a suitable allowance for the heat dissipated in other ways. These constitute only a small percentage of the total losses. The author discusses various methods of measuring the air velocity and the average temperature. For the measurement of air velocity the following methods are suggested: (1) the Pitot tube; (2) the Venturi tube; (3) electrical methods, and (4) the anemometer. Under electrical methods a scheme is suggested similar to that used with the gas meter, based on the law that an electrically heated wire in a current of air cools at a rate that is dependent on the velocity of the air current. It is said that a hot-wire velocity indicator operating on this principle has recently been devised by Prof. J. T. MacGregor-Morris. With the air-heating method the great advantage is that a driving motor is not required; also, when, on account of transportation difficulties, the stator has to be assembled on the site, in addition to measuring the total losses on load, the method could be employed to measure the separate losses with ease and accuracy. The "calibrated air-temperature" method has the one advantage compared with the "air-heating" method that the air volume does not have to be measured, but on the other hand it has certain disadvantages. For example, the efficiency cannot be determined solely by tests on site, and without the alternator a check test in the case of dispute cannot be made. The following table gives a comparison of results obtained by four different methods.

	Methods Based on Cooling Air		Methods Based on "Summation of Losses"	
Machine Number	"Air-Heating" Method	"Calibrated Air-Temperature" Method	A.I.E.E. Method	Stray Loss Ignored
5,862	352	362	336	211
7,001	327	338	315	255
7,541	46	47	52.5	42.8

—London *Electrician*, Feb. 28, 1919.

Lamps and Lighting

Industrial Illumination; Theory and Practice.—GEORGE K. MCDOUGALL.—A brief review of the elementary laws of light and suggestions for better lighting in factory, office and warehouse.—*Electrical News*, March 1, 1919.

Electricity in Household Service; Lighting.—E. J. EDWARDS.—Since the beginning of the electric lighting business about 1890, the cost of electric lighting has decreased about 85 per cent. This decrease has been due to improvements in the efficiency of incandescent lamps, to the decrease in their cost and to decreases in the cost of electrical energy, and it may be said that at the present time electric lighting is inexpensive, convenient and safe. The author takes up in detail the illumination of the rooms in households, showing the important considerations in each case and illustrating recommendations with photographs.—*General Electric Review*, March, 1919.

Apparatus for the Determination of the Spherical Candlepower of a Source of Light.—J. SAHULKA.—A device for the measurement of spherical candlepower is described which is somewhat similar in appearance to the Matthews photometer developed in America. It is said, however, that the mirrors are replaced with plaster-of-paris plates, which have the advantages that

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it is only necessary that the light which reaches the photometer shall be proportional to the light intensity of the lamp and that the plates do not require to be adjusted to suit the distance of the lamp from the photometer.—London *Electrician*, Feb. 28, 1919.

Generation, Transmission and Distribution

Three-Phase Four-Wire Distribution.—GEORGE E. WAGNER.—In comparing the weight of copper required for the usual systems of distribution and assuming the weight of copper necessary for a single-phase circuit as 100 per cent, it is shown that the percentage of copper required for the various systems for the same load is as follows: Single-phase system, 100; two-phase four-wire system, 100; two-phase three-wire system, 73; three-phase three-wire system, 75; three-phase four-wire system 33. The advantages and limitations of the three-phase four-wire system are thus summarized: (1) The amount of copper required for transmitting the same load over the same distance is very much less than is necessary for any of the other systems. (2) The change to the four-wire system does not cause a change in voltage of the stepdown transformers, thereby permitting the use of the same transformers. (3) The four-wire system can be used for supplying current for light, heat and power purposes from one circuit, thereby overcoming the necessity of parallel circuits. This produces an additional saving in copper. In order to protect all parts of the circuit against excessive voltage to ground and to protect single-phase lighting transformers against excessive voltage, the neutral wire of a three-phase four-wire circuit should be grounded not only at the station but at a sufficient number of points along the line. (5) The neutral point of three-phase transformer banks should be isolated. (6) When the neutral point of a three-phase transformer bank is connected with the neutral wire of the circuit, the delta-connected secondaries tend to equalize the phase voltages. This should therefore not be done except on transformers of large capacity for a special purpose. (7) If a single-phase load is supplied from one phase of the delta-connected secondaries of a three-phase bank of transformers, the transformer on that phase will supply about one-half of the single-phase current and the other two transformers will supply the rest, whether the primary neutral point is connected to the neutral wire or not.—*Electric Journal*, March, 1919

Saving Steam in Industrial Heating Systems.—The discussion of the possible economies in steam-heating systems for factories are summarized as follows: (1) Avoid producing more exhaust steam than can be used at all times of the year, day and night. (2) If non-condensing units which will conform to rule 1 cannot be utilized for the power requirements, then operate non-condensing units only for such time, periods and load as will just balance the heating demand and have a unit or units of the most economical type to carry the rest of the purely power load. The same effect may sometimes be obtained by use of a bleeder type of steam turbine. Sometimes the most economical units for power only may be oil or gas engines. (3) Never use live steam for a purpose to which exhaust steam can be applied. (4) If a plant contains non-condensing units only, maximum efficiency is obtained when the production of exhaust is equal to or less than the heating demand, but never when an excess of exhaust is produced. When less exhaust is made than the quantity wanted, it is proper to draw live steam from the boilers to supply the deficiency. It is said that the value of exhaust steam compared to that of the hot returns is often misunderstood, so that very large losses in heat and fuel continue without correction. Where exhaust steam is substituted for live steam the saving will be approximately eight times that of returning an equal weight of hot drips.—*Technical Paper No. 221, Bureau of Mines.*

Extending the Life of Wood Poles.—CHARLES R. HARTE.—The seasoning of wood is a much more complicatd process than the mere drying out of contained water. Chemical changes occur in the contents and in the walls of the cells which have a marked effect upon the characteristics of the wood, but the amount of water content in the wood is the simplest and most universal test of seasoning. Many methods are in use for prolonging the life of the various woods. The author describes these and discusses their relative advantages, pointing out how different preservatives keep out and destroy the destructive germs. Photographs are shown which illustrate methods of reinforcing wood poles with concrete, removing dead wood and attaching iron-reinforced latticework in place. The N. E. L. A. and Western Union specifications for preservatives are reproduced. —*Electric Railway Journal*, March 22, 1919.

The Larger Undeveloped Water Powers of Tennessee. —JOHN A. SWITZER.—A review of a bulletin with this title was published in the ELECTRICAL WORLD of March 22, page 587. Unfortunately the name of the author was given as J. A. Fletcher. It should have been John A. Switzer.

Traction

Railroad Electrification Facts and Factors.—A. J. MANSON.—That the kind of current and supply voltage determine the power-collecting method used is discussed in full, together with diagrams showing methods of mounting and protecting third-rails.—*Railway Electrical Engineer*, March, 1919.

Rail Plateways.—Attention is called to the system of rail plateways advocated and described by G. Noble Fell some time ago. Plateways are not intended to compete with existing railways. They are to become feeders and to constitute a means of bringing traffic to the main railways. The rails are standard-gage and are designed to carry locomotives up to 25 tons weight. Estimates on the cost of this means of handling tributary traffic are set down.—*Electric Railway and Tramway Journal*, Jan. 10, 1919.

Effect of Tramways on Central Stations.—N. SCHULZ. —The financial results of the supply of energy for traction purposes and the effect produced on the profits of the undertaking are dealt with, the article being based on the results of the years 1912 and 1913 and forming a sequel to articles previously published by the author on the same subject.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elecktrot. Zeits.*, Oct. 10, 1918.)

Electric Battery Locomotives.—Excellent results are being obtained from the use of electric battery locomotives on freight sidings and other places where shunting and miscellaneous haulage are carried on. An illustration of one of the many electric battery locomotives made by the Brush Company for the Ministry of Munitions of England is shown. These battery locomotives are said to be ideal for factory purposes.—*Electric Vehicle*, December, 1918.

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Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ALUMINUM, SOLDERS FOR.

The use, serviceability, method of application and composition of solders for aluminum have been investigated in the light of special tests made at the Bureau of Standards on commercial and other compositions of solders and also as a result of general experience with them. All soldered joints are subject to rapid corrosion and disintegration and are not recommended except where protection from corrosion is provided. Suitable compositions for solders are obtained by the use of tin with the addition of zinc, or both zinc and aluminum, within wide percentage limits.—*Bureau of Standards, Washington.*

ANEMOMETER, HOT WIRE, DROP-OF-POTENTIAL TYPE.

In this instrument the average velocity or flow of a gas is measured over a length of from 1 mm. to 3 mm. Two small 0.002-in. (0.05-mm.) platinum wires are attached about 2 mm. apart near the middle of the 0.007-in. (0.18-mm.) platinum heating wire. In calibrating and using it the current is measured that is required to maintain a certain potential drop—say 60 millivolts—between the two potential leads. A good portable potentiometer is sufficient for measuring the potential drop, while the current can be measured quite satisfactorily by use of a good ammeter of proper range.—*T. S. Taylor, Westinghouse Research Laboratories, East Pittsburgh, Pa.*

BEARINGS, SPRING-THRUST.

On larger bearings it is very difficult to establish and to maintain bearing surfaces fitting the journal within the limits of the thickness of the oil film. If this be not done, the metals will touch and the friction will greatly increase. In the new bearings the surfaces are made of thin flexible members supported in such a way that they can yield if overloaded over any small area. The usual support is by helical springs. The idea is to provide a bearing surface which is so yielding, flexible and elastic that it may conform to the rotating surface without creating at any point a unit pressure sufficient to destroy the oil film.—*H. G. Reist, Schenectady, N. Y.*

CONDUCTORS, AERIAL, WIND PRESSURE ON.

In connection with the preparation of the Electrical Safety Code, experiments have been made upon the shielding effect of several conductors with different directions of the wind. A tunnel was used in which the air velocity was controlled at will and the lateral pressure upon the conductors accurately determined. It has been found that the shielding effect of one conductor upon the other depends essentially upon the angle between the direction of the wind and the plane of the conductors. The shielding effect fell off rapidly as this angle was increased. No definite results could be accomplished in the open air.—*M. G. Lloyd, Bureau of Standards, Washington.*

IGNITION DEVICES, CALORIMETRIC STUDY OF SPARK.

Temperature curves were obtained which varied with the kind of thermometer used and with its position in the calorimeter. The pressure curves varied with the size and length of the pressure tubes. However, the same conditions were maintained in all the tests, and if the type of calorimeter used proves to be of practical value, it is proposed to work up specifications so that comparative results could be obtained anywhere by using common cheap supplies. It is interesting to note that the magneto giving the highest temperature curve does not necessarily give the highest pressure and vice versa. There seems to be some work to be done here.—*F. W. Springer, University of Minnesota, Minneapolis.*

ILLUMINATION, THE MEASUREMENT OF REFLECTION AND TRANSMISSION FACTORS.

A method has been developed for measuring the reflection and transmission of various light-diffusing media. The illuminating surface is a hemisphere of translucent glass inside a white-lined box. The material to be investigated is placed on a diametral plate and its brightness determined at definite angles by means of a photometer. This method is based on the principle involved in the Nutting absolute reflectometer, namely, two definite planes, one of which is opaque and receives all its illumination from the other. The relative brightness of the two planes measured with a comparison photometer is the absolute mean reflecting power of the opaque surface. Data have been obtained on ribbed and frosted glass. Numerous methods for investigating the optical properties of partly diffusing media were reviewed by the 1915 committee on glare in the *Transactions* of the Illuminating Engineering Society, pages 353-378, July, 1915.—*M. Luckiesh, Nela Park, Cleveland, Ohio.*

INDUCTANCE COILS, ELECTRICAL OSCILLATIONS IN.

Inductance coils may be treated from the standpoint of the theory of distributed inductance and capacity. Expressions have been derived for the reactance of a coil at any frequency and for the natural oscillations of a circuit of coil and condenser. It has also been shown that, in so far as the frequency of oscillation is concerned, an inductance coil with distributed characteristics is equivalent to a pure inductance of constant value with a constant capacity across its terminals. Excepting for skin effect, this pure inductance would be the same as the low-frequency inductance of the coil. This explains the fact which has been frequently observed experimentally, in particular for single-layer solenoids.—*John M. Miller, Bureau of Standards, Washington, D. C.*

MACHINERY, ELECTRICAL, SEPARATION OF LOSSES.

The machine under test is run idle as a motor at a constant speed, with various voltages impressed across the armature, the watts input to the armature being measured. In the case of a direct-current machine the excitation and the voltage are changed simultaneously so as to maintain constant speed. With a synchronous machine it is desirable to maintain approximately unity power factor. With induction machines the method is the usual idle running saturation current, the voltage being varied and the frequency kept constant. Volts are plotted as abscissas and the power input to the armature as ordinates. Assuming the curve to be a general parabolic one, the exponent of the parabola is computed and the curve extrapolated to the axis of ordinates; that is, to the voltage zero. The point so obtained on the axis of ordinates gives the value of the friction and windage loss. The remainder represents the core loss. The method will be described in detail in the A. I. E. E. *Proceedings.*—*C. J. Fechheimer, Pittsburgh, Pa.*

Apparatus Available

CONDENSERS, PRECISION.

The Bureau of Standards has constructed ten 0.01-mfd. air condensers, making a total of 0.1 mfd. These condensers were constructed for permanence and are not portable. They are mounted together on one table in such a way that any one or all may be connected to a given terminal. The condensers and all leads running from the condenser are carefully shielded so that the capacity is a definite quantity. In the construction of the condensers a minimum amount of insulating material was used, and this was so placed that it would not be in a strong electrostatic field. As a result, the condensers show no appreciable absorption and hence have the same capacity at all frequencies. The distance between the plates is 2 mm., this large distance being chosen in order that slight variations in plate distances shall produce the minimum effect on the capacity of the condenser. The condensers have been very satisfactory in service, the principal trouble arising from the ract that brass plates have not been thoroughly annealed.—*Bureau of Standards, Washington, D. C.*

Suggestions for Research

INSULATORS, LEAKAGE RESISTANCE.

Some measurements on surface resistivity of various materials have been published by the Bureau of Standards, in 1915, especially at 90 per cent air humidity. Among the materials that have the highest surface resistivity in damp air are paraffin, resin and sulphur, while glass and porcelain are among the lowest. L. New has recently shown experimentally the great advantage of insulators provided with a paraffin creepage surface (*Bulletin de la Societe Internationale des Electriciens*, Vol. 8, p. 83). The subject deserves serious attention on the part of insulator designers, especially with voltages at which the surface creepage and not the dielectric strength may be the determining factor.—*Editorial Suggestion.*

PERMEABILITY AT LOW DENSITIES.

Very little information is available concerning the permeability of iron and of its alloys in the region of minimum permeability occurring at very low densities. Iron has a low permeability of the order of 100 at exceedingly low densities, and this permeability is nearly constant throughout a certain range. Within this range the hysteresis effect is exceedingly small or negligible. When an iron core is used with a coil and when magnetic densities are within the range considered, the iron-core magnet has the advantages of an air-core magnet, namely, constant inductance and zero core loss, but has an enormously greater inductance. Further data concerning iron and alloys within this range would be of considerable value in special cases.—*R. W. Atkinson, Perth Amboy, N. J.*

SYNCHRONOUS MACHINES, TRANSIENT REACTANCE.

I should like to see some one investigate fully the influence of saturation on the transient reactance of, say, a turbo-alternator. We calculate the reactance of the winding and obtain results which are fairly accurate for normal values of current in the stator. But does this value hold with an excessively large current, such as obtained at the instant of short circuit? Owing to the saturation caused by the excessively large leakage fluxes, does not the winding behave as if it were located in a core of high reluctance? So far as I have been able to check this up, I believe this effect is present in 25-cycle generators, which are normally worked at fairly high tooth and core densities.—*R. B. Williamson, Milwaukee, Wis.*

TELEPHONE LINES, CAPACITY OF.

When a section of a telephone line with the arrangement of wires under consideration is not available for capacity tests, measurements can readily be made by the use of a satisfactory model. The capacities per unit length remain the same if all the dimensions of width and height are reduced in the same proportion. Furthermore, the conductivity or the permittivity of the medium may be increased. One suggestion would be to place the model in a tank of electrolyte with the vertical dimension corresponding to distances along the line. Some preliminary work of this sort was published by Dr. A. E. Kennelly many years ago, but considerable further study would be required to get the method into a form sufficiently accurate for our work, in which, in studying unbalances, we are interested in the small differences of relatively large capacities.—*H. S. Osborne, American Telephone & Telegraph Company, New York.*

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

LIST OF EXHIBITORS AT THE ATLANTIC CITY CONVENTION

Partial List Announced by Exhibition Committee of N. E. L. A.—Arrangements for Necessary Additional Space

An incomplete list of names of exhibitors at the exhibition to be held in connection with the National Electric Light Association convention during the week of May 19, at Atlantic City, has been made public by the exhibition committee.

While this is a partial list, it takes up the entire original allotment of space so that it has been necessary for the exhibition committee to arrange for additional space, which it has done to the extent of about 3500 sq.ft.

"From the number of applications coming in constantly we feel sure that this will not be sufficient to take care of the newcomers who desire to exhibit," says H. G. McConnaughy, secretary of the exhibition committee.

Following is the list made public by the committee:

Allis-Chalmers Manufacturing Company, Milwaukee.
American Conduit Manufacturing Company, Pittsburgh.
American Electrical Heater Company, Detroit.
American Ironing Machine Company, New York.
Albert & J. M. Anderson Manufacturing Company, Boston.
Baker R. & L. Company, Cleveland.
Borne-Scrymser Company, New York.
Central Electric Company, Chicago.
Commercial Truck Company of America, Philadelphia.
George Cutter Company, South Bend.
Delta-Star Electric Company, Chicago.
Detroit Stove Works, Detroit.
Edison Electric Appliance Company, Chicago.
Edison Storage Battery Company, Orange, N. J.
Electric Service Supplies Company, Philadelphia.
Electric Storage Battery Company, Philadelphia.
Electric Vacuum Cleaner Company, Cleveland.
Electrical Record, New York.
Electrical Review Publishing Company, Inc., Chicago.
Electrical Testing Laboratories, New York.
ELECTRICAL WORLD, New York.
Elliott-Fisher Company, Harrisburg, Pa.
Eureka Vacuum Cleaner Company, Detroit.
Federal Sign System (Electric), Chicago.
General Electric Company, Schenectady.
G & W Electric Specialty Company, Chicago.
Hoover Suction Sweeper Company, New Berlin, Ohio.
Hubbard & Company, Pittsburgh.
Hurley Machine Company, Chicago.
Independent Lamp & Wire Company, New York.
International Time Recording Company, New York.
Jeffery-Dewitt Insulator Company, Huntington, W. Va.
H. W. Johns-Manville Company, New York.
Landers, Frary & Clark, New Britain, Conn.
Leeds & Northrup, Philadelphia.
McGraw-Hill Company, Inc., New York.
Metropolitan Engineering Company, Brooklyn, N. Y.
Moloney Electric Company, St. Louis.
Naugle Pole & Tie Company, Chicago.
Norris Iron Works, Long Island City.
Ohio Brass Company, Mansfield, Ohio.
Packard Electric Company, Warren, Ohio.
Palmer Electric & Manufacturing Co., South Boston.
Philadelphia Electric Company, Philadelphia.
Philadelphia Electrical & Manufacturing Co., Philadelphia.
Pittsburgh Transformer Company, Pittsburgh.
Railway & Industrial Engineering Company, Pittsburgh.
Rathbone Sard Electric Company, Albany, N. Y.
Remmert Manufacturing Company, Belleville, Ill.
Rumsey Electric Company, Philadelphia.
Sangamo Electric Company, Springfield, Ill.
Simplex Electric Heating Company, Cambridge, Mass.
Square D Company, Detroit.
Tabulating Machine Company, New York.
Wagner Electric Manufacturing Company, St. Louis.
Walker Vehicle Company, Chicago.
Ward Motor Vehicle Company, Mount Vernon, N. Y.
Western Electric Company, New York.
Westinghouse Electric & Mfg. Co., East Pittsburgh.
C. H. Wheeler & Company, Philadelphia.

Additional names and also details of the new plan will be made public is soon as arrangements are completed.

LAMP COMMITTEE EXHIBIT AT ATLANTIC CITY CONVENTION

Frank W. Smith Says that the Presentation of "the New Spirit of Lighting" Will Be a Revelation of Opportunities

Frank W. Smith, chairman of the lamp committee of the National Electric Light Association, is taking steps to attract general attention to the exhibit of "the new spirit of lighting" which is to be a feature of the convention at Atlantic City during the week beginning May 19. He believes that this exhibit will be of great educational value and will stimulate progress and development. It is desired to encourage the largest possible attendance at the exhibit and careful study of the lessons which the lighting displays will carry. Details of the proposed exhibit were published in last week's issue of the ELECTRICAL WORLD.

"The exhibit is made possible," said Mr. Smith to a representative of the ELECTRICAL WORLD, "by the splendid coöperation of the lamp manufacturers, who will bear the principal burden of the preparation and conduct of the exhibit. The lighting sales bureau of the Commercial Section is actively coöperating with the lamp committee and with the manufacturers in securing the best results.

"The plan to hold the exhibits is one that was under consideration for the 1917 convention but was abandoned under the stress of war conditions. In part it will represent what has been learned during the war period. The entire exhibit will be, we think, a new revelation to many people of the opportunities in the adaptation of lighting to many fields of usefulness.

"It is confidently felt that a great development in lighting will be seen in the post-war period in this

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country. Public interest has been stimulated in the question of adequate lighting. The industrial benefits of proper lighting are better appreciated than ever before. There is more readiness on the part of users to listen to the message which the central-station illuminating engineer bears. We want to be sure that central-station managers and salesmen are thoroughly alive to the opportunities before them. The lighting exhibit will emphasize the importance of the subject in a new way. It will be instructive and practical.

"An effort will also be made to tie the exhibit in with part of the program of the lighting sales bureau of the Commercial Section. But the exhibit itself is to be so comprehensive that we hope that it will appeal to every delegate at the convention."

Mr. Smith said that the lamp committee will regard the exhibit in part as illustrating the committee's report, which will be made before the convention in the usual form. Questionnaires for some of the data have been sent to member companies, and it is stated that up to this time nearly 50 per cent of replies have been received. This will enable the committee to bring up to date the information concerning the lamp practice of member companies reported in 1917. It will be fully illustrated by charts, curves, etc., in that part of the exhibit devoted to "company lamp practice."

To simplify the questionnaire the committee compiled its inquiries so that the companies might indicate their practice on the different points by simply placing a mark after the particular statement which shows their policy. The questions deal with the policy as to giving free renewals on merchandising, allowance for claims on account of defective lamps, wattage limits of lamps supplied free, identification of consumer or lamps to obtain free renewals, method of deliveries, approximate percentage of lamps used by customers which are obtained by the company, methods used in advising consumers in regard to proper use of lamps to obtain best illumination, and statement of length of period in which practices described have been in effect.

LISTEN! PRIZE CONTEST FOR N. E. L. A. CONVENTION

Victory Liberty Bonds to Be Given by Exhibition Committee for Best Articles on Exhibit of Manufacturers at Atlantic City

Lay down the pliers, take up the pen, sit on the beach and write what you think about the electrical manufacturer. Thus the exhibition committee of the National Electric Light Association announces a prize contest in connection with the Atlantic City convention of the National Electric Light Association. Prizes will be awarded for articles giving the impressions of delegates on the exhibition as a whole. The following rules will govern:

(1) Every contestant must be a Class "B" member of the N. E. L. A.

(2) All Class "B" members except those engaged in publicity and advertising are eligible to compete.

(3) Every contestant must have manuscript in the hands of the judges by June 1, manuscripts not to exceed 2000 words and to bear the name, address and occupation of the contestant.

A board of judges selected by the president of the National Electric Light Association will decide on the best three stories and will award first, second and third prizes, as follows: First prize, $150 in Victory Liberty bonds; second prize, $100 in Victory Liberty bonds; third prize, $50 in Victory Liberty bonds.

Prize-winning stories will receive early publication in the National Electric Light Association *Bulletin* and electrical trade papers.

In announcing the contest the committee calls attention to the fact that the real good that comes from an exhibition is mutual. It adds:

"The manufacturer, by his investment in space, apparatus and time, brings something and adds something to the convention itself and offers an opportunity to the central-station man to get "up-to-the-minute" information on appliances, methods and apparatus that improve his business or department. Conventions, like colleges, offer but a part of their educational advantages in the classroom. There is a world of knowledge to be learned on the campus—and the exhibition hall is a part of the convention campus. It is appreciated that the best possible advice to be obtained for future exhibits will come from the man who is closest to the use of the materials or appliances exhibited, and that an exhibition is good or poor to the extent that it helps central-station operation, maintenance, construction and selling."

ENTERTAINMENT AT THE ATLANTIC CITY CONVENTION

Tentative Outline for the National Electric Light Association Meeting — Wireless and Aeronautical Exhibits of Great Interest

T. I. Jones, chairman of the entertainment committee, has issued the following tentative program for the Atlantic City convention of the National Electric Light Association:

Monday, May 19

9 a.m.—Opening of exhibition, Million-Dollar Pier.

9:30 p.m.—Reception, followed by dancing, Million-Dollar Pier.

Tuesday, May 20

12:30-1:30 p.m. and 5-6 p.m.—Wireless telephone communication between land and flying aëroplanes; aëronautical exhibition, showing machine control and feats in flying, end of Million-Dollar Pier.

4 p.m.—Cards for the ladies—"auction bridge" and "five hundred" for prizes—Million-Dollar Pier.

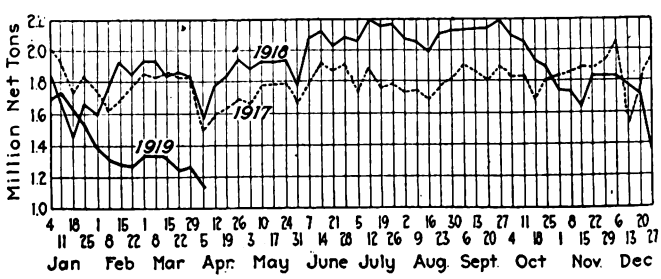
Wednesday, May 21

12:30-1:30 p.m. and 5-6 p.m.—Second wireless telephone communication; aëronautical exhibition.

4 p.m.—Ladies' tea and musicale, string orchestra, instrumental and vocal solists, Million-Dollar Pier.

9 p.m.—Carnival and ball, including illumination spectacle; special music, Million-Dollar Pier.

Decline in Bituminous Coal Production



Production of bituminous coal is still declining sharply.

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Program for the N. E. L. A. Convention

Tentative Program for the Meeting to Be Held at Atlantic City During the Week Beginning May 19 Shows a Wide Range of Constructive Topics for Discussion and Action

FOLLOWING is the tentative program adopted for the forty-second annual convention of the National Electric Light Association, to be held at Atlantic City, N. J., on May 19 to May 22, 1919:

First General and Executive Session

Tuesday, May 20, 10 A.M.

1. Welcome to the city by Mayor Harry Bacharach.
2. Address of the president, W. F. Wells, Brooklyn Edison Company, Inc.
3. Appointment of committee on president's address.
4. Announcements.
5. Report of the acting secretary, S. A. Sewall, New York.
6. Report of insurance expert, W. H. Blood, Boston, Stone & Webster.
7. Report of rate research committee; Alex Dow, chairman, Detroit Edison Company.
8. Progress report of special joint committee on determination of power factor in polyphase unbalanced circuits; R. J. McClelland, chairman, New York, Electric Bond & Share Company.
9. Paper, "The Electric Truck in Modern Transportation," E. E. LaSchum, New York, general superintendent American Railways Express Company.

Second General and Executive Session; the Public Policy Session

Tuesday, May 20, 9 P.M.

1. Paper, "Sale of Securities to Customers and Resident Citizens," W. H. Hodge, Chicago, H. M. Byllesby & Company.
2. Report of public policy committee; W. W. Freeman, chairman, Cincinnati, Union Gas & Electric Company.
3. Report of National Committee on Gas and Electric Service; J. W. Lieb, chairman, New York City, New York Edison Company.
4. Address, "The Trend of Socialism," F. G. R. Gordon, Haverhill, Mass.

Third General and Executive Session

Wednesday, May 21, 10 A.M.

1. Report of the treasurer, Frank W. Smith, New York City, United Electric Light & Power Company.
2. Election of nominating committee.
3. Report of membership committee; Walter Neumuller, chairman, New York City, New York Edison Company.
4. Report of committee on company sections; F. A. Birch, chairman, Philadelphia Electric Company.
5. Report of committee on constitution and by-laws; William C. L. Eglin, chairman, Philadelphia Electric Company.
6. Appointment of committee on memorials.
7. Appointment of committee on resolutions.
8. Address, "Regional Power Systems," Dr. George Otis Smith, Washington, Geological Survey, Department of the Interior.

Fourth General and Executive Session

Thursday, May 22, 10 A.M.

1. Report of committee on safety rules and accident prevention; William C. L. Eglin, chairman, Philadelphia Electric Company.
2. Report of lamp committee; Frank W. Smith, chairman, New York City, United Electric Light & Power Company.
3. Paper, "The Importance of Electrochemistry," Prof. Joseph W. Richards, Lehigh University, secretary of American Electrochemical Society.
4. Report of committee on form of annual report to commissions; W. J. Meyers, chairman, New York City, United Electric Light & Power Company.
5. Report of committee on Billings and Doherty prizes; A. S. Loizeaux, chairman, Baltimore Consolidated Gas, Electric Light & Power Company.
6. Report of committee on president's address.
7. Report of committee on constitutional amendments.
8. Report of committee on memorials.
9. Report of committee on resolutions.
10. Report of national nominating committee.
11. Election and installation of officers.

Tentative Program, Company Sections

Wednesday, May 21, 6:30 P.M.

Company sections' dinner.

Tentative Program, Accounting Section

Tuesday, May 20, 2 P.M.—First Accounting Session

1. Chairman's address, Paul R. Jones, New York, Henry L. Doherty & Company.
2. Election of nominating committee.
3. Report of committee on cost accounting and statistics; A. D. Spencer, chairman, Detroit Edison Company.
4. Report of committee on commission accounting rulings; H. E. Addenbrooke, chairman, Chicago, Commonwealth Edison Company.
5. Report of committee on accounting education; H. B. Lohmeyer, chairman, Consolidated Gas, Electric Light & Power Company of Baltimore.

Wednesday, May 21, 2 P.M.—Second Accounting Session

1. (a) Report of committee on operating records; C. A. White, chairman, Edison Electric Illuminating Company of Boston.
   (b) Address, "Experience with Government Transportation," H. B. Lohmeyer, Consolidated Gas, Electric Light & Power Company of Baltimore.
2. Report of committee on purchasing and storeroom accounting; W. F. Stevens, chairman, Edison Electric Illuminating Company of Boston.
3. Report of committee on accounting service to member companies and the monthly bulletin; Frederick Smith, chairman, New York Edison Company.
4. Report of committee on customers' records and billing methods; H. C. Schlegel, chairman, New York Edison Company.
5. Address, "The Importance an Efficient Accounting Department Is to a Business," Col. H. A. Gidney, Boston, Charles H. Tenney & Company.
6. Report of nominating committee on section officers.
7. Election of section officers.
8. Adjournment.

Tentative Program, Commercial Section

Tuesday, May 20, 2 P.M.—First Commercial Session

1. Chairman's address, Charles J. Russell, Philadelphia Electric Company.
2. Report of committee on finance; John G. Learned, Chicago, Public Service Company of Northern Illinois.

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3. Appointment of nominating committee.
4. Report of committee on commercial service and relations with customers; R. F. Bonsall, Consolidated Gas, Electric Light & Power Company of Baltimore.
5. Report of committee on wiring; R. S. Hale, Edison Electric Illuminating Company of Boston.
6. Report of committee on education of salesmen; Fred R. Jenkins, Chicago, Commonwealth Edison Company.
7. Report of committee on electric salesmen's handbook; R. H. Tillman, Consolidated Gas, Electric Light & Power Company of Baltimore.

Wednesday, May 21, 2 P.M.—Second Commercial Session—Lighting Sales Bureau

1. Chairman's address, C. L. Law, New York Edison Company.
2. Report of committee on commercial aspects of lamp equipment; O. R. Hogue, Chicago, Commonwealth Edison Company.
3. Report of committee on commercial aspects of street and highway lighting; C. G. Durfee, Rochester, Rochester Railway & Light Company.
4. Report of committee on residence lighting; C. W. Johnson, Jackson, Hodenpyl, Hardy & Company.
5. Report of committee on outdoor lighting; H. H. Magdsick, Cleveland, National Lamp Works.
6. Report of committee on electrical advertising; E. A. Mills, New York Edison Company.
7. Report of committee on store lighting; A. L. Powell, Harrison, General Electric Company.
8. Report of committee on lighting of public buildings; G. Bertram Regar, Philadelphia Electric Company.

Wednesday, May 21, 2 P.M.—Third Commercial Session—Power Sales Bureau

1. Discussion, "Effect of the War on Isolated Plant Costs"; discussion led by I. Lundgaard, Rochester Railway & Light Company.
2. Discussion, digest 1917 report of electrical heating bureau, "Electric Heating of Non-Ferrous Metals"; C. F. Hirshfield, Detroit Edison Company.
3. Paper, "Electric Furnaces." (a) Non-ferrous metals; discussion led by N. T. Wilcox, Keokuk, Mississippi River Power Company. (b) Steel; discussion led by Morse DellPlain, Hammond, Northern Indiana Gas & Electric Company.
4. Paper, "Power Factor in Customers' Installations"; discussion led by R. H. Knowlton, Philadelphia, United Gas Improvement Company.

Wednesday, May 21, 3:45 P.M.—Fourth Commercial Session—Electric Range Committee

1. Discussion, commercial information and recommendations; discussion led by J. F. Killeen, Chicago, Edison Electric Appliance Company.
2. Discussion, technical features of the electric range business; discussion led by Hartwell Jalonick, Dallas, Texas Power & Light Company.
3. Discussion, water heating by electricity.

Wednesday, May 21, 6:30 P.M.—Power Sales Bureau Dinner

1. Discussion, electric welding; discussion led by F. E. Richards, Newark, Public Service Electric Company.
2. Paper, "Electric Industrial Trucks and Tractors and Their Relation to the Central-Station Load"; E. J. Bartlett, Cleveland, Baker R and L Company.

Thursday, May 22, 2:30 P.M.—Fifth Commercial Session

1. Report of committee on publications; F. D. Pembleton, Newark, Public Service Electric Company.
2. Report of committee on coördinate advertising and sales campaigns; Henry Harris, Pittsburgh-Duquesne Light Company.
3. Report of committee on merchandising; E. R. Davenport, Providence, Narrangansett Electric Lighting Company.
4. Report of nominating committee.
5. Election of section officers.
6. Demonstration, industrial lighting equipment; William A. Durgin, Chicago, Commonwealth Edison Company.
7. Adjournment.

TENTATIVE PROGRAM, ELECTRIC VEHICLE SECTION

Tuesday, May 20, 2 P.M.—First Electric Vehicle Session

1. Chairman's address; E. S. Mansfield, Boston, Edison Electric Illuminating Company.
2. Report of secretary.
3. Report of treasurer.
4. Report of committee on federal and municipal transportation; James H. McGraw, chairman, New York, McGraw-Hill Publishing Company.
5. Report of committee on garage and rates; C. H. Miles, chairman, Edison Electric Illuminating Company of Boston.
6. Report of committee on legislation; G. A. Freeman, chairman, Chicago. Walker Vehicle Company.
7. Report of committee on manufacturers and central-station coöperation; George B. Foster, chairman, Chicago, Commonwealth Edison Company.
8. Report of committee on standardization; E. R. Whitney, chairman, Philadelphia, Commercial Truck Company of America.
9. Report of operating records committee (Accounting Section); C. A. White, chairman, Edison Electric Illuminating Company of Boston.
10. Report of transportation engineering committee; F. M. Feiker, chairman, New York City, ELECTRICAL WORLD.
11. Appointment of nominating committee.
12. Paper, "The Present and Future Status of the Electric Vehicle"; Rodney K. Merrick, Philadelphia, Commercial Truck Company.
13. Paper, "The Electric Vehicle from a Salesman's Standpoint"; J. B. M. Cordoza, New York, Walker Vehicle Company.

Wednesday, May 21, 2 P.M.—Second Electric Vehicle Session

1. Paper, "A Message from Electric Vehicle Users"; George B. Foster, Chicago, Commonwealth Edison Company.
2. Report of nominating committee.
3. Election of officers.
4. Paper, "The Proper Application of the Electric Vehicle"; F. F. Sampson, New York, Exide Battery Depots.
5. Paper, "Electric Industrial Trucks and Tractors and Their Relations to the Central-Station Load"; E. J. Bartlett, Cleveland, Baker R. & L. Company.
6. Questionnaire containing various subjects for discussion.
7. Adjournment.

TENTATIVE PROGRAM, TECHNICAL AND HYDROELECTRIC SECTION

Tuesday, May 20, 2 P.M.—First Technical Session

1. Chairman's address, R. J. McClelland, New York City, Electric Bond & Share Company.
2. Appointment of nominating committee.
3. Report of committee on prime movers; N. A. Carle, chairman, Newark, Public Service Electric Company.

Tuesday, May 20, 2:30 P.M.—Second Technical Session

1. Report of committee on underground construction and electrolysis; E. B. Meyer, chairman, Newark, Public Service Electric Company.
2. Report of committee on overhead lines and inductive interference; A. E. Silver, chairman, New York City, Electric Bond & Share Company.

Wednesday, May 21, 2 P.M.—Third Technical Session

1. Report of committee on electrical apparatus; R. F. Schuchardt, chairman, Chicago, Commonwealth Edison Company.
2. Report of committee on meters; F. V. Magalhaes, chairman, New York Edison Company.
3. Report of nominating committee.
4. Election of officers.
5. Adjournment.

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"ELECTRIFY YOUR HOME" CAMPAIGN DOING WELL

Edward N. Hurley Writes Society for Electrical Development on Necessity for Electrical Industry to Do Its Part Toward Prosperity

"Electrify your home," the national house-wiring campaign launched by the Society for Electrical Development, is well under way in 400 cities throughout the country. Many letters approving the campaign to energize electrical activities have been received by the society from prominent men in the industrial and official world.

Edward N. Hurley, chairman of the United States Shipping Board, in a letter to J. M. Wakeman, general manager of the society, makes an interesting survey of the post-war problems of readjustment. Mr. Hurley says:

While we have many great problems brought about by the violent changes from peace to war and from war to peace, yet these are in process of readjustment, and from my point of view the certain way to resume business is to resume. If people make up their minds business is going to be good, it will be good. It is going to be good anyway, but that is the short cut.

In order to go over a grade you must take a run for it, whether you are in an automobile or a locomotive. And all that the electrical or any other of our industries has to do to go over the top is for salesmen to go out and make sales. There is an abundance of money to care for the result.

I am keenly interested in the success of the electrical industry and am glad to know that the Society for Electrical Development is again endeavoring to arouse the electrical industry to the necessity of doing its part toward hastening prosperity.

The world wants American electrical products. We now have the ships ready for carrying these products to the markets of the world. Please pay close heed to this: In the future the leaders of the electrical industry, as well as the leaders in other of our industries, must not only think nationally, they must think internationally. For in foreign markets we have the greatest opportunity ever presented to any nation. Moreover, we now have the ships for carrying the enormous volume of manufactures and products which this nation is capable of supplying.

OHIO WORKS TO IMPROVE INDUSTRIAL LIGHTING

Campaign of Illumination Committee of Ohio Electric Light Association Includes Meetings at Columbus, Toledo and Akron

The illumination committee of the Ohio Electric Light Association held three meetings last week—at Columbus on April 9, at Toledo on April 10 and at Akron on April 11. These followed the conclusion reached by the committee several months ago that the time was ripe for an active campaign in behalf of improved industrial lighting. Among the considerations that led them to this conclusion were the growing evidence as to the increased production resulting from the use of high lighting intensities, the approaching completion of the factory lighting code of the Industrial Commission of Ohio and the general demand for higher efficiency in manufacturing methods, resulting from war conditions.

Among the various lines of attack that were decided upon by the committee were the series of special meetings mentioned and a sort of correspondence course for the benefit of the member companies.

The three meetings held last week were at points most accessible to the lighting men of the association. With the exception of one address by a local central-station man, the program was the same at all the meetings and was designed both to impress upon the lighting men the importance of the work which they were undertaking and to supplement, by lectures and demonstrations, the correspondence work. The morning sessions were closed conferences at which the work to be done was talked over by the members of the committee and the lighting men. The afternoon meetings were open to all persons interested and were attended by electrical contractors, industrial managers and others besides the central-station men. The programs were divided about equally between the commercial and the more technical aspects of the work.

Coöperation was the subject of an address by George W. Hill, who was sent from New York by the Society for Electrical Development to assist the committee in its undertaking. The need for the central stations and the electrical contractors to work together cordially was the special theme of Mr. Hill's plea. Short talks along similar lines, based largely upon their own experience, were given in their respective cities by W. A. Walls of the Columbus Railway, Power & Light Company, W. E. Richards of the Toledo Railways & Light Company and D. MacNaughton, formerly of the Northern Ohio Traction & Light Company. "Illumination Design," illustrated with lantern slides and demonstrated with various types of factory-lighting units, was the subject of a lecture by H. H. Madgsick of the engineering department, National Lamp Works of the General Electric Company. The program was closed with a short talk on the measurement of illumination by the chairman of the committee. This was accompanied

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by a demonstration of several types of illumination-measuring instruments.

It is believed that these meetings have done much to create and extend interest in industrial lighting. Up to date about sixty companies have selected their representation for this work.

In the conduct of the correspondence course for the member companies each company was invited to appoint a member of its sales-engineering staff as the "lighting man" of their organization. To these lighting men the committee is sending a series of communications known as "policy letters." These letters are designed to give the men the latest information concerning developments in industrial illumination, methods of presenting these to factory managers and other suggestions which should assist them in conducting the campaign for improved lighting in their various communities.

It soon became evident that, owing both to the limited attention which it has been practicable to give to lighting problems in recent years and to the rapid developments of the lighting art during this period, very few of the companies had men on their staffs who possessed the technical information needed to qualify them for this work. On this account the department of electrical engineering of the Ohio State University was persuaded, in coöperation with the committee, to publish a series of technical letters on industrial illumination, to be used in conjunction with the policy letters mentioned above.

These "technical letters" are of a practical character. They begin with the elementary principles of the subject and treat it from every point of view needed by the man who has charge of the design and maintenance of such illumination. They are unique in that instead of endeavoring to include all of the required information they depend largely upon references to the technical trade literature, of which there is such an abundant and well-written supply in the lighting field. In contributing this material the manufacturers of lamps and accessories have coöperated most cordially. In the interest of improved illumination this series of technical letters is being offered to any one interested, at $2 each.

The members of the Ohio Electric Lighting Association illumination committee who have this work in charge are G. S. Merrill, engineering department National Lamp Works of the General Electric Company, Cleveland, Ohio; E. H. Beil, Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, and F. C. Caldwell, chairman, Ohio State University, Columbus, Ohio.

TELEPHONE STRIKE HITS FIVE NEW ENGLAND STATES

Demands for Increased Pay and Dissatisfaction with Proposed Method of Settlement Lead to Break in Service

A strike of more than 6000 operators of the New England Telephone & Telegraph and Providence Telephone companies began at 7 o'clock on Tuesday morning of this week, tying up service in practically all of New England except Connecticut and directly affecting nearly 750,000 subscribers. Demands for increased pay, coupled with dissatisfaction regarding the method of adjustment proposed by the Postmaster-General and the telephone companies, are involved in the walkout.

The operators seek a wage scale ranging from $10 per week on assignment to duty to $22 at the end of four years' service, with supervisors' pay ranging from $23.50 to $25. The previous scale, which expired Dec. 31, 1918, included the following rates: Training period, usually three weeks, $6 per week; student period, usually seven weeks, $7; end of three months, $7.50, with increases to a maximum of $16 for seven years and over. Junior supervisors received $10 to $17 and supervisors from $17 to $19.

The operators claimed that their inability to deal with the company officials as under private management has led to fruitless efforts to obtain a decision from the Post Office Department through a period of several months, and the companies maintained that the procedure advised by the Postmaster-General should be followed in settling the dispute, namely, to submit the schedule first to the companies, then to the operating board in New York, then to the wire control board in Washington and lastly to the Postmaster-General, on whose recommendation the entire scale to be adopted depends.

An enormous amount of extra business was thrown upon the telegraph companies as a result of the strike. With the exception of a few very small places the tie-up was practically complete on Tuesday, and it was virtually impossible at the time of writing to estimate the loss sustained by business interests or to appreciate the amount of personal suffering resulting from the walkout. Vigorous efforts were made by the public authorities and by powerful business organizations to prevent the strike, but all attempts at postponement were futile. On Tuesday attempts were made by the companies to provide a measure of emergency service for hospitals, public utilities and the government, but little beyond interior communication was available.

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LIGHTING LEGISLATION DISCUSSED IN NEW YORK

Outline of Principles of Several State Codes Given Before Joint Meeting of Electrical and Illuminating Engineers

Safeguarding of the life, limbs and vision of industrial workers and increasing the earning power of both the workers and the industrial plants were stated to be the main functions of industrial lighting codes, by G. H. Stickney of the Edison Lamp Works of the General Electric Company, in a paper presented before a joint meeting of the American Institute of Electrical Engineers and the Illuminating Engineering Society on April 11 in New York. Industrial lighting codes based on the Illuminating Engineering Society's rules are now in force in Pennsylvania, New Jersey, New York, Wisconsin and Oregon, and in several other states similar codes have been drawn up and are under consideration for adoption. In spite of the recent general improvement in industrial lighting practice, the increasing need of ample assurance in this matter is evident from the present tendencies of manufacturers, among which may be mentioned the following: The grouping of larger numbers of employees, the extension of all-night processes, increasing use of dangerous machinery, intricacy of processes, and specialization of workers who have to sustain close visual application. It has been the experience of labor commissions that at least 90 per cent of the manufacturers cordially desire to comply with their regulations. The principal difficulty so far encountered in applying the code has been to make clear to the layman just what is required and just how it can be obtained. It has, therefore, been found expedient to publish supplementary educational sections.

The principal lighting specifications common to all states which have adopted the code are intensity, glare limits and distribution. In drawing the specifications it has been constantly recognized that they must be kept simple and practicable so that conformance may be determined without recourse to lighting experts or bulky and expensive instruments. On the other hand, it is desirable to make the specification as definite as possible, minimizing the part left to the individual judgment and thus avoiding controversy and prejudice. In all codes which have so far been enacted the intensity is specified in foot-candles. While at first some difficulty was experienced in explaining these values and providing for their measurement, the development of a simple and inexpensive foot-candle meter, described elsewhere in this issue, has facilitated the application of the specifications.

The establishment of proper limits for glare is probably more important than the matter of intensity. It seems to be general that more employees suffer from glare than from insufficient light. Distribution of light, emergency lighting and switching of controlling and enforcement were also discussed by Mr. Stickney. In dealing with lighting codes he made an attempt to emphasize the principles involved rather than the details. Change in details may be expected, but any considerable change in principles seems unlikely. No one is more conscious of the limitations of the code in its present form than the illuminating engineers who have been active in its development. Mr. Stickney pointed out that manufacturers were glad to have codes adopted because of the economies of standardization.

Discussion

Prof. C. E. Clewell, University of Pennsylvania, observed that codes are new and different from the regulations usually supplied to state inspectors and that inspectors should be posted on fundamentals. The three main points, he thought, were that enforcement calls for education, that inspectors should have simple devices to check their opinions and that the human element in the inspector's judgment should be eliminated by supplementing the code and gathering inspectors together to give them instructions. Professor Clewell spoke about the Museum of Safety in New Jersey, which contains various kinds of lighting systems, enabling manufacturers and inspectors to see what sort of installations are desirable.

The educational value of these codes should be emphasized to a much larger degree than the legal value, according to Dr. E. B. Rosa of the Bureau of Standards. There should be educational information for preparers of codes, engineers, employers and employees. He also thought that the codes should be put on trial before they are adopted.

C. B. Aul of the Westinghouse Electric & Manufacturing Company criticised the method of having different codes for each state, because, he said, it is a disadvantage to manufacturers and others trying to obtain standard requirements. He said the intensities outlined in the majority of the codes are too low, and that the effect of dirty lamps is not emphasized as it should be. Some method should be obtained to insure distribution of light on the work. It is ridiculous to have duplicate emergency circuits in operation all of the time because sufficient assurance is given by means of an auxiliary circuit which is switched off by a relay when the regular lights are disconnected by some accidental means.

Dr. M. G. Lloyd of the Bureau of Standards told about the safety work of the bureau and said that the requirements for lighting were included in building construction specifications of the N. E. S. C. He also said that federal lighting standards closely followed the Illuminating Engineering Society standard code and told of some of the general rules and other requirements made by the government. The recent Oregon law, according to Dr. Lloyd, does not include definite quantity values but gives the commission power to fix general intensity and conditions of glare, distribution and emergency lighting.

Ward Harrison of the National Lamp Works of the General Electric Company said that the most difficult thing to measure in illumination was glare and that engineers had been working for some time on a glareometer for telling when the correct lighting was provided.

John H. Vogt, chemical engineer of the New York Industrial Commission, said that up to March 1, 1919, 3290 orders for changes in lighting had been given and that 1569 compliances had been secured. He remarked that there does not seem to be any particular difficulty in getting manufacturers to change their systems.

Other engineers discussing the paper were W. T. Blackwell, Benjamin Manufacturing Company; E. D. Perrot of Bollinger & Perrot, and Norman Macbeth of the Artificial Daylighting Company.

Mr. Stickney said, in closing the discussion, that the code tells what is to be maintained in lighting intensity and not (except in the supplement) how it is to be maintained.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

N. E. L. A., Philadelphia Electric Company Section.—On April 15 the engineering branch meeting of this section of the National Electric Light Association was addressed by W. T. Watson, whose subject was "Transportation."

Massachusetts Electrical Contractors' Association.—On March 26 a Connecticut Valley Branch of the Massachusetts Electrical Contractors' Association was formed, with Frank Haskell and Ernest Bishop, both of Holyoke, Mass., as chairman and secretary-treasurer, respectively.

N. E. L. A. and A. I. E. E., Portland Sections.—J. W. Sadler, Great Northern Concrete Shipbuilding Company, addressed the Portland Sections of the American Institute of Electrical Engineers and the National Electric Light Association at their joint meeting of April 7 on the subject of "Concrete Ships."

Tri-State Water and Light Association.—The next convention of the Tri-State Water and Light Association of the Carolinas and Georgia will be held at Greenwood, S. C., on June 17, 18 and 19. W. F. Stieglitz, secretary-treasurer and convention manager, says that programs for the meetings will be available on June 1.

A. I. E. E., Erie Section, and Engineering Society of Northwestern Pennsylvania.—On May 13 Vladimir Karapetoff, professor of electrical engineering at Cornell University, will address the Erie Section of the American Institute of Electrical Engineers and the Engineering Society of Northwestern Pennsylvania on "Electro-acoustic Shock Signaling." Professor Karapetoff has been investigating this subject for industrial concerns and will demonstrate his lecture with working models, signaling codes and numerous lantern slides.

O. E. L. A., New-Business Coöperations Committee.—The industrial power and heating section, new-business coöperations committee of the Ohio Electric Light Association, is to hold a meeting in Columbus, Ohio, on April 23. At the morning session R. T. Kaighin, Cleveland Electric Illuminating Company, is to speak on "Recent Developments of Industrial Heating," and the discussion is to be divided into three sections, "Brass Furnaces," "Low-Temperature Heating," and "Heat-Treating and Melting of Steel." In the afternoon C. J. Crippen, of Youngstown, Ohio, is to have for his subject "Application of Electric Welders and Proper Remuneration for Their Current Consumption."

Jovian League of Kansas City, Mo.—The Jovians celebrated "Mazda Day" on April 3 with a luncheon at the Muehlemach. Boyd F. Gurley, managing editor of the Kansas City *Post*, talked about "Light," and a moving picture was shown, depicting the manufacture of Mazda lamps from the time the ore was mined for the metal and the glass until the finished lamp was produced.

Western Canada Electrical Convention.—Manufacturers, jobbers, dealers, central-station men, contractors and others interested in the electrical industry are to participate in a convention to be held under the auspices of the British Columbia Association of Electrical Contractors and Dealers in Vancouver on May 26 and 27. W. L. Goodwin and Samuel A. Chase are to be among the speakers.

A. A. E., New York Chapter.—The New York Chapter of the American Association of Engineers held a special meeting on the evening of March 28 in New York City. The meeting was addressed by C. E. Drayer, national secretary of the association, his topic being the object of the organization, its sphere of influence and the results already achieved by it. On April 23, at the Engineering Societies Building, Dr. George W. Kirchwey, director of the United States Employment Service, will give an address on "Solving the Unemployment Problem."

American Institute of Electrical Engineers

Rochester Section.—Samuel W. Miller gave a lecture on "The Heat Treatment of Steel" at a recent meeting of the section.

Toronto Section.—"Some Overload Limitations of Current Transformers" will be the subject of W. B. Buchanan, Hydroelectric Laboratories, who is to speak at the April 25 meeting of this section.

Washington Section.—Walter D'Arcy Ryan, head of the illuminating laboratories, General Electric Company, gave a talk on "Illumination" at the meeting held on April 8. The talk was illustrated by over 250 lantern slides and covered ancient and modern lighting, decorative street lighting and the illuminating of the Panama-Pacific Exposition.

Indianapolis-Lafayette Section.—The meeting of this section held on March 4 was a joint one with the Telephone Plant School at Purdue University. Six lectures were given. V. N. Gregg discussed "Systems of Handling and Recording Trouble," Frank X. Staub had for his subject "Maintenance of Central Office Equipment," F. N. Hodgson spoke on "Maintenance of the Outside Plant," H. O. Garman gave a talk on "The Engineering Department of the Public Service Commission," C. A. Breese lectured on "Recent Developments in Central Office Equipment," and H. W. Munsell's subject was "Some Experience in Cutting Over a Large Manual to Automatic Plant."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Rate Increases at Stockton.—The Railroad Commission of California has authorized increased rates of charge for both gas and electric service supplied by the Western States Gas & Electric Company, Stockton division. The decision grants increases over surcharges allowed for the duration of the war and establishes the new rates on a permanent basis without surcharge features. This is the third rate increase allowed this company since the start of the war.

Lower Industrial Rates in California.—In a supplemental order issued by the Railroad Commission the Sierra & San Francisco Power Company is authorized to make a reduction in its charges for electric energy served to large industrial consumers. The order substitutes for the surcharge of 3 mills a kilowatt-hour authorized by the commission in a previous decision a graduated scale reading as follows: "Where annual consumption of energy for power purposes is less than 1,000,000 kw.-hr. a year, 3 mills a kilowatt-hour; where the consumption is greater than 1,000,000 kw.-hr. and less than 2,000,000 kw.-hr., 2½ mills; where the consumption is greater than 2,000,000 kw.-hr., 2 mills." The new schedule is provided by the commission in order to give large users of power the benefit of their wholesale consumption.

Improvement in Service.—Authority to increase its present rates for electrical energy by surcharge that will mean an average increase of 20 per cent has been granted the Coast Valley Gas & Electric Company by the Railroad Commission, but the order also carries with it instructions to the company to improve its service. Lack of diligence in this work, says the commission, will bring further action on the part of the board. These improvements will require the expenditure of $25,000 new capital and will consist of the following betterments: Overhauling of steam plant at Monterey, line and transformer improvements at Monterey, rebuilding of Salinas substation and installation of modern switching apparatus, installation of feeder voltage regulators at Monterey and Salinas, and increased substation attendance.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Pan-American Conference. — At a meeting at the Pan-American Building of the governing board of the Pan-American Union, Washington, it was unanimously voted to hold, under the auspices of the union, an informal Pan-American commercial conference in the Pan-American Building during the last week of May or the first week of June of this year. A special committee, consisting of Ygnacio Bonillas, Ambassador of Mexico; Santos A. Dominici, Minister of Venezuela, and Rafael H. Elizalde, Minister of Ecuador, assisted by Director-General John Barrett and Assistant Director Francisco J. Yanes, has been studying the plan and has reported favorably upon it to the full meeting of the board, presided over by Acting Secretary of State Frank L. Polk. The board in turn authorized the Director General to announce the plans for the conference and extend invitations on behalf of the governing board to the commercial and financial experts of the United States government departments, to the consular, commercial and financial representatives of the Latin-American governments in the United States, to the United States Chamber of Commerce, to the National Foreign Trade Council, and to such other responsible commercial and financial organizations, firms and individuals as are interested in the better development of Pan-American trade.

Municipal Ownership Defeated at Alliance, Ohio.—Municipal ownership of an electric plant at Alliance, Ohio, was defeated at an election on April 8, when a proposed four-hundred-thousand-dollar bond issue received a little more than one-third of the votes necessary for passage. The advocates of the issue were headed by the Mayor, and the opposition centered about a citizens' committee, assisted by Glenn Marston. In addition to the activities of the citizens' committee, the employees of the company, both men and women, organized a campaign of their own under the direction of H. G. Bonner, general manager. The ordinance submitting the bond issue to a vote of the people was unanimously passed by the City Council, but two days before the election the councilmen issued a statement advising against voting the bonds on the ground that the time was inopportune and the issue too small to build a complete plant. This statement was signed by every councilman except one, who was too ill to be seen. The statement was issued by the citizens' committee. The company conducted an aggressive publicity campaign during the weeks before the election, showing that the issue had been submitted without securing adequate information as to cost of plant and probable rates to be charged. Motion pictures were used to a considerable extent, a series of animated cartoons being shown.

Increased Operating Costs.—In asking the Public Utilities Commission to revoke its order of July 13, 1917, reducing rates, the Potomac Electric Power Company of Washington, D. C., through William F. Ham, president, shows its increased operating costs. In part Mr. Ham says: "The most important item is coal. When the order previously referred to was entered the commission, among other things, assumed $3.61½ a ton as the price of coal. The average price paid for coal at the Benning plant during the year 1918 was $4.89 per ton and the present price is $5.35 per ton. Also, coal is now of inferior quality to that used prior to the war, greatly adding to the cost of operation and maintenance. The cost of generating energy at the Benning plant is now running approximately 100 per cent higher than at the time the commission's order was issued. Other maintenance costs have also been tremendously increased. Since the beginning of the European war rates of electric light and power companies have very generally increased by authority of regulatory bodies, while this company is only petitioning for the restoration of rates which existed in the period prior to the war."

Oil Price Soars to Great Heights.—The tremendous advance in the price of oil during 1917 is shown in the annual report of the California Railroad Commission. In the chapter dealing with the problems of the public utilities of the state the commission says: "This year (1917-18) has witnessed tremendous increases in the cost of fuel oil. The cost has more than doubled. Formerly the average price varied from 65 cents to 80 cents a barrel, delivered at the companies' plants. Now (1918) the records of the commission show that fuel oil costs $1.62 a barrel in Oakland, $1.86 in Chico, $1.87 in Colusa, $1.65 in Fresno, $1.68 in San Rafael, $1.77 in Marysville, $1.97 in Oroville, $1.68 in Napa, $2.27 in Nevada City, $1.62 in San Francisco, $1.79 in Santa Rosa, $1.762 in San José, $1.77 in Woodland, $1.79 in Vallejo, $1.646 in Santa Cruz, $1.856 in Hollister, $1.60 in Los Angeles, $1.60 in San Diego, $1.55 in Martinez, $1.85 in Yreka, $2.40 in Ukiah, $1.60½ in Stockton, $1.90 in Madera, $2.80 in Needles, $2.52 in El Centro and $1.91 in Modesto." It is estimated that because of lack of rain and snow in the mountains last winter more than 2,000,000 barrels of oil were used by the hydroelectric power companies to produce power, the oil being consumed at their steam plants, which in time of normal rain conditions are held inactive.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Negligence in Leaving Wire Loose.—In action for damages because of the electrocution of plaintiff's husband by contact with a coil of defendant's wire, evidence was held to sustain charges of defendant's negligence in leaving coil without deadheading or grounding a wire and in leaving the wire loose between poles, since it might sag and come in contact with high-voltage wires. (Coverly v. United Water, Gas & Electric Company; 178 P. 393).

Removal of Meters.—A gas company which has installed a gas meter in the cellar of a householder cannot forcibly remove it, against the protest of the householder, without proof that the contract under which the meter was installed gave the company the right to enter the premises and remove the meter, according to the Supreme Court of New Jersey (105 A. 723). A gas meter being in the defendant's possession, the presumption is that it is rightfully so until something is shown which justifies the forcible removal of the meter. The possession may be defended. If the possession of a meter from a householder on whose premises it has been installed by the gas company cannot be regained peaceably, resort should be had to a legal remedy; possession cannot legally be regained by force. The remedy lies in the courts, and the householder is acting within his legal rights in preventing the forcible removal of the meter.

Evidence on Appeal from Commission.—Under Burns' Annual Statutes, 1914, Sec. 10,052, providing that court may hear evidence "different" from and "additional" to that heard by commission, it was proper for the circuit court, on appeal from an order of the Public Service Commission fixing telephone rates, to admit evidence of operating expenses at a time subsequent to the decision of the commission, the Supreme Court of Indiana held (122 N. E. 328). On appeal from order of commission fixing telephone rates, testimony of an expert accountant as to whether cost of operating telephones within the last few years had increased, taking the telephone station as a unit was admissible. Where, on appeal from decision of commission, the circuit court adjudged that decision upon issues tried before commission was wrong, it properly ordered that amount paid by plaintiff into state treasury as expenses of the commission, pursuant to order of commission under the statute cited above, should be repaid to the plaintiff.

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A. T. Early, who has been district manager of the Greenville district for the Southern Illinois Light & Power Company, has been transferred to the Collinsville district.

Henry Bostwick, manager of the San Francisco district of the Pacific Gas & Electric Company, has been elected president of the San Francisco Electrical Development League.

James B. Dugan of Kenton has resigned as chief inspector of the Ohio Public Utilities Commission to become general manager of the Lima district of the Ohio Electric Railway Company.

Glen L. Corey has been appointed district manager for the Pacific Power & Light Company at Seaside, Ore., succeeding A. L. Strickland. Mr. Corey was formerly a solicitor for the company.

A. C. Hopkins has resigned as local superintendent at Belfast, Me., of the Penobscot Bay Electric Company, a subsidiary of the Central Maine Power Company, to enter business for himself. Mr. Hopkins has been in the electric light and power business in Maine and New Brunswick for the past thirty years.

J. S. Pevear of the Birmingham (Ala.) Railway, Light & Power Company has been appointed general manager of the operating department of the American Cities Company. Headquarters of the department are being moved from New York to Birmingham. The American Cities Company, a subsidiary of the United Gas & Electric Corporation, operates utilities in Birmingham, New Orleans, Memphis, Little Rock and other cities.

Philip K. Condict, who has until recently been in government service, has been elected vice-president of the International Western Electric Company, Inc. In the early summer of 1917 Mr. Condict gave up his work as foreign sales manager for the company to take charge of the New York office of the War Trade Board, after a short stay with the Department of Commerce. In December, 1917, he received a commission as major in the Quartermaster's Corps, U. S. A., serving in that capacity until July, 1918. He was then detailed to the Signal Corps with the same rank and served in France until January.

Dr. Frank B. Jewett, chief engineer of the Western Electric Company and late lieutenant-colonel in the Signal Corps, U. S. A., was presented with the distinguished service medal at Washington, on April 5, "for exceptionally meritorious and conspicuous service in connection with the development of the radio-telephone and the development and production of other technical apparatus for the army." Dr. Jewett shortly after the United States entered the war received a commission as major in the Signal Officers' Reserve Corps. His promotion to the rank of lieutenant-colonel followed in the early part of 1918.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Ira Cushing, chairman of the Boston Section of the American Institute of Electrical Engineers, is an ardent worker on behalf of coöperation among engineers of diverse specialties and an active influence in the upbuilding of professional society interconnections in New England. He was born in Brookline, Mass., in 1875 and received the degree of M.E. from Brown University in 1899. Mr. Cushing entered the electrical field in 1901 via the testing department of the General Electric Company in Schenectady, N. Y. After eighteen months' service he was assigned to the department of switchboard design, where he acquired a broad experience in connection with plant layouts and system engineering. In 1906 Mr. Cushing was transferred to the engineering department of the company's Boston office, where he has been identified with switchboard and other consulting work, and during the past two years the technical library of the office has been in his charge. He became secretary of the Boston Section in 1914.

IRA CUSHING

W. J. Canada, who toward the end of 1917 severed his connection with the Bureau of Standards, with which he had been associated for more than four years, to enter the work of the American International Shipbuilding Corporation at Philadelphia, has left this work to join the engineering department of Stone & Webster at New York City. Prior to his association with the Bureau of Standards in Washington, where he was chiefly engaged in the compilation of the National Safety Code, as assistant to Dr. E. B. Rosa, Mr. Canada was for some time electrical engineer with the insurance interests in the Rocky Mountain section of the country.

J. F. Derge, for the past six years superintendent of lighting plant sales of the Utah Power & Light Company, Salt Lake City, has been promoted to be sales superintendent in charge of all sales work. Prior to going to Utah Mr. Derge was manager of the commercial department of the Missoula (Mont.) Light & Water Company.

Thomas W. Peters, who for the last twelve years has been commercial agent of the Columbus (Ga.) Electric Company, has resigned to become associated with the Chero-Cola Company of Columbus. Mr. Peters was one of the founders of the Southeastern Section of the National Electric Light Association, of which he was the first president and later secretary.

J. G. Holtzclaw has been appointed to succeed T. J. Hanlon, Jr., as manager of the Pensacola (Fla.) Electric Company. Mr. Holtzclaw is a native of Georgia and a graduate of the electrical engineering department of the Georgia School of Technology, class of 1907. He has been general superintendent of the local company for the last three years and has been connected with the company in various capacities for eight years. His experience with the Stone & Webster interests embraced three years with the Savannah Electric Company before going to Pensacola as manager of the Pensacola property.

Obituary

Frank Carter Childs, president of the Nightingale & Childs Company, Boston, dealers in asbestos material, died recently at Lexington, Mass. He was educated at the Massachusetts Institute of Technology and was well known in the power-plant field.

Alexander Cochrane, identified for many years with the development of the telephone through his service on the directorate of the American Telephone & Telegraph and allied companies since their organization, died suddenly in his home in Boston on April 10 at the age of seventy-nine years.

Edwin J. Mullen, former general manager of the Philadelphia office of the General Electric Company, died at his home in Germantown, Pa., on April 5. Mr. Mullen was born Nov. 4, 1838, and had been prominently identified with the electrical industry for thirty-five years. He was general manager of the Thomson-Houston Company when the merger resulting in the present General Electric Company took place. He retired from active work as head of the Philadelphia office Jan. 1, 1916, but during his retirement had acted in an advisory capacity and was in the office almost daily.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

EASTERN SECOND-HAND MARKET SHOWS INCREASED ACTIVITY

Reputable Business Dealing Puts Market on Sound Basis—Stocks Ample—Prices About 75 per Cent of New

Among the dealers in second-hand apparatus established in and near New York City are found both those whose trade is mostly local and those who do a country-wide business. Inquiries among the former show that there is considerable business at the present time in small numbers of rather small-capacity motors, both direct-current and alternating-current types.

The preponderance of direct current still holding on Manhattan Island leads to more business in equipment with characteristics for that service, but the alternating-current service is gaining ground, and in sections outside of the borough of Manhattan there is considerable sale for alternating-current apparatus.

The size of the units is in general rather small, usually for additional equipment to small operators or where a small business is being started. The number of instances of installations of such a character where second-hand equipment is being used is large.

Outside of New York City there seems to be considerable call for used equipment, many times running into large sizes of motors. It is found that manufacturers who have been unable to fill orders from stock have called on used-equipment dealers to supply the required apparatus.

This brings to attention the class of work turned out by reputable dealers in used apparatus. So many dealers are securing business on the basis of service they see to it that every article of equipment is thoroughly repaired and tested, commutators turned down and bearings replaced if necessary, the machine painted in its original color before it leaves the shop, and a guarantee given against mechanical and electrical defects for one year. In such cases the machines have virtually been rebuilt.

Prices of this machinery, which at times during the war were equal to or above the prices of new equipment, have come down to the neighborhood of 60 to 75 per cent of new machinery prices. Stocks gathered during the latter part of the past year by dealers were so large that the decline in business which was evident the first of this year found them generally overstocked. Recently, however, resumption of business has begun to move these stocks, but not to the point where there is any great amount of buying for restocking.

The anticipated flooding of the second-hand market with electrical equipment from factories which had ceased their war work has not materialized. The government in some cases is turning back to contractors as part payment motors which that contractor still may use, and in other cases is keeping motors for use in some of its own work. And there are many instances where dealers will not bid on lots offered by contractors and the government on account of their already large stocks. Prices around $5 per horsepower are being offered for some lots of motors. Many of the pieces of apparatus have never been uncrated. There is, however, much apparatus that has been severely damaged by acid fumes, chemicals and overload.

There has been reported a satisfactory market for steam generating sets in practically every section of the country but the New York section. This equipment ranges from boilers to distribution panels.

With electrical equipment repaired, if necessary, tested and given the same guarantee as is given by the manufacturer, with prices now in the neighborhood of 25 per cent less than new, there is a very active field for second-hand dealers. There is in general sufficient central-station power available to supply normal commercial needs. More confidence is being placed in second-hand material as a result of reputable business methods on the part of so many of the dealers.

Although there has not been as much used material thrown back on the market as was at one time anticipated, there has recently been released a quantity of boilers in the East and Middle West. These comprise 130 boilers, aggregating approximately 57,000 boiler-hp. One hundred of the boilers have been in service less than four years.

STANDARD PACKAGES FOR ELECTRICAL HEATING DEVICES

A Movement Put on Foot Some Months Ago Appears to Be Gaining Considerable Headway with Appliance Manufacturers

Several years ago electrical jobbers began to study the cost of handling orders for single irons, single toasters, single percolators and other devices of this character in connection with their general studies of the evils of the small-order business. These studies brought out that a very large percentage of the appliance orders amounted to less than $10 and were expensive for the jobber to handle on that account. Accordingly, some method of reducing the expense of handling this business was thought to be necessary.

This search for a method led to the adoption of the standard-package idea as one which might bring a solution. When this stage in the development was reached the jobbers put the proposition up to the manufacturers. Already one manufacturing company has begun to pack certain items in standard packages. The following table will show the trend of developments in that line:

Devices:	Number for Standard Package
6-lb. flat-irons	12
Toasters	12
Toaster stoves	6
Round table stoves	6
Curling irons	4
Warming pads	4
Headlight heaters	3
Small immersion heaters	4
All other appliances	6
Combination package	6

These are the standard-package quantities adopted by this particular manufacturer. This manufacturer has also gone further and has called three standard packages a standard quantity. In order to give the dealer who orders in quantity the advantage of this plan a discount schedule has also been arranged so that there is about 10 per cent difference between the price which the dealer pays for a single flat-iron and the price he pays for it if he buys it in a standard package. There is a further differential of 10 per cent between the standard package and the standard quantity. Distributers who are operating under this plan state that it is working out very well, but they express a belief that it will work out much better when other manufacturers shall have put their distribution on a standard-package basis.

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The tendency seems to be for other manufacturers to get into this scheme of distribution at an early date. The whole proposition is regarded by them as a problem in education. It will first be necessary to fix a standard package which will be satisfactory to the majority of manufacturers. All manufacturers are not in accord with those quantities adopted by the manufacturer above referred to. The discussion is over the dozen and decimal plans of packing. When this stage has been passed certain of the manufacturers believe that it will be wise first to adopt a standard-package method of selling and educate the dealers to buy in standard packages without making any price concessions. This, they argue, will give the smaller dealer an opportunity to learn about the system before it is thrust upon him. After this educational campaign, lasting over a few months, has been completed, then it is probable that a discount plan will be arranged which will give the large buyer the advantage of making quantity purchases.

METAL MARKET CONDITIONS

Copper and Lead Both Decline in Price—Market Very Dull

There has been another turn in the copper and lead markets. Prime Lake has declined ½ cent, to 15.50 cents; electrolytic has dropped ⅛ cent, to 15.37½ cents, and casting copper is off 0.3 cent, to 15 cents a pound. Buying has dropped off appreciably, even where some dealers are shading prices more than the ⅛ cent quoted by the larger interests.

The London spot market is nearly £3 lower than a week ago, and British commercial interests have almost withdrawn from the market. British stocks of copper apparently are being absorbed, as the amount in the hands of that government on April 1 was 2671 tons less than on March 1. Previous months had shown an increase.

Lead is down ½ cent, to 5 cents a pound, but the reduction has proved no stimulation to buying. Advices from Washington state that the disposition of surplus government stocks of lead is being made at local market prices at points where the surpluses are being held. As this amounts to only 7000 tons, it is not expected that its sale in small lots will have any appreciable effect on the market.

Tin and spelter sales have been noticeable by their absence. Conditions of the steel market have not materially changed during the last few days, and there is little buying.

The scrap-metal market reflects the new metal market in regard to its quiet state, but heavy lead is the only scrap suffering a material drop. There is no buying anyway. Aluminum scraps seem to enjoy the only movement, but the supply is short.

NEW YORK METAL MARKET PRICES

	April 8	April 15
Copper:	£ s d	£ s d
London, standard spot	79 0 0	76 10 0
	Cents per Pound	Cents per Pound
Prime Lake	16.00	15.50
Electrolytic	15.50	15 37½
Casting	15.30	15.00
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.25	5.00
Antimony	6.80	6.75
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.52½	6.50
Tin	Govt. price 72.50	Govt. price 7.25
Aluminum, 98 to 99 per cent.	30.00	30.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 13.75	13.50 to 13.75
Brass, heavy	7.50 to 8.00	7.50 to 8.00
Brass, light	6.50 to 7.00	6.50 to 7.00
Lead, heavy	4.25 to 4.50	4.00 to 4.25
Zinc, old scrap	4.25 to 4.75	4.25 to 4.75

THE WEEK
IN TRADE

SALES of wiring material and socket devices are going along well. Stocks are still being kept down by jobbers, but are being built up by manufacturers.

Building is increasing, particularly in the Middle West. A large amount is being held up until something definite comes out of the steel price situation.

Prices are still receding here and there, some apparatus prices falling this week.

NEW YORK

Conditions among jobbers point to a better state of business than in the previous months of the year. There are increasing demands for wiring devices, and these seem to be to a large extent for residential purposes. Apparatus which can be applied to already existing circuits is showing its continued strong market. Business in general is such that jobbers show their optimism over what the coming months have in store for them. Although buying for stocks, as it is normally considered, is light, jobbers are keeping their stocks abreast of conditions as they expect them in the near future. With the rather quick deliveries which manufacturers can in general make, the jobbers feel that it is not so necessary to carry the amount of stock previously required.

As to labor shortages and surpluses, reports received by the United States Employment Service from sixty-six cities record an increase in surplus labor from thirty-eight cities for the week ended April 5. There is a shortage in nine and an equality in nineteen cities. These figures take in the representative employers of the cities enumerated and merely show the trend of the labor situation in those localities.

SCHEDULE MATERIAL.—Jobbers report an increase in sales. The consumption seems to be for the most part for residential work.

DRY CELLS.—The increasing commercial uses for which dry cells of the large type and for flashlights have been adapted are keeping a steady market for this product.

TRANSFORMERS.—Power transformers of 200 kva. rating and above have been reported off another 10 per cent as of the first week in April. The former reduction was the middle of February. There is a fair movement of this material in the South and Southwest.

CEDAR POLES.—An increased activity has been noted this past week due to several carload shipments to the Middle West. This is in conjunction with pole-line material for power work previously reported.

ELECTRIC FURNACES.—There is some activity in this material and a great deal pending the resumption of the output of steel products.

SEWING-MACHINE MOTORS.—There is considerable activity among garment manufacturers. Conditions of drive are being changed, and motors for both individual and group drive, the latter especially low-speed motors, are finding a strong market.

LAMP CORD.—Large orders continue to come in, particularly from lighting fixture and apparatus manufacturers. This also is producing a good market for sockets and attachment material.

CONDUIT.—Orders for pipe are gradually opening up, but a considerable call is noticeable for flexible metallic conduit.

LIGHTNING ARRESTERS.—The market continues strong for both power and railway-type arresters.

WIRE.—Bases quoted by manufacturers of rubber-covered wire have not changed this past week. Seven producers

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quote 20 cents. Lamp cord is quoted on an 18-cent base and weatherproof on 19 cents.

MOTORS.—The demand is improving for motors of a smaller size for industrial work, along with their control equipment and switchboards.

BOSTON

Sales are being maintained in good volume, with highly diversified business. Contractors are getting more active and house-wiring campaigns have been started at Providence, R. I., and Manchester, N. H. At Quincy, Mass., 234 houses are to be completed within about three months for shipyard workers. The Quincy central station expects to spend $40,000 this year on extensions, and the Boston Edison company has somewhat relaxed the restrictions it has hitherto maintained on electric-range services. General building is below normal still.

Jobbers' stocks are still fairly large. One large Boston house reports increased sales and volume of material handled for the first quarter of 1919 compared with a year ago. Price reductions have been announced on irons and radiators and single-phase motors. Deliveries are improving and few are now quoted in excess of seven weeks for usual jobbing material. Collections are somewhat improved this week. A shortage is reported in certain makes of vacuum cleaners and in armored conductor. The strike that began on Tuesday morning of telephone operators and allied electrical workers all over New England was the most threatening feature of the labor situation at the time of writing.

WIRE.—Bare and weatherproof wire have stiffened a little in price this week, the base quotations being respectively 18½ cents and 20 cents. Rubber-covered wire is steady at 22 cents base. An increasing demand is noted, and deliveries are in good shape. Many repair jobs are being handled by the contracting houses. The supply of armored flexible conductor is somewhat under normal.

MOTORS.—The demand for small motors appears well sustained. A 10 per cent reduction in Century single-phase motors was announced last Saturday. Polyphase motors hold firm in price. A good deal of factory-drive betterment work is under way, and the New England Power Company is making a campaign to raise the power factor in many industrial installations on its lines through the readaptation of motors to loads.

CONDUIT.—Prices rule about as last week. The supply is coming into New England pretty much as needed, deliveries being excellent. Should building operations take a sudden boom through the belief that present costs of labor and material will be long sustained, it is likely that the supply of conduit would soon be exhausted and that strenuous work would be necessary to maintain present delivery rates.

FANS.—Jobbers are ready to supply the trade in case of a demand for fans, but as yet retail buying is at a minimum. Many dealers are carrying fans from their 1918 stocks. It is probable that in some central-station circles fans will be sold this year on the installment plan to stimulate business which might otherwise be retarded by upward price tendencies.

WIRING MATERIAL.—Stocks are in good shape to meet eventualities, as the diplomats sometimes term an attack in force. Present purchases are for repair work and for new construction on a moderate scale only, or for public or semi-public structures in the main.

WASHING MACHINES.—The demand is remarkably well sustained, and stocks are being refilled at a rate which insures exceedingly prompt deliveries.

VACUUM CLEANERS.—Trade is very brisk and prices are firm. A decided shortage is reported this week in two prominent lines. A fine spring business is now being handled.

PORTABLE LAMPS.—Despite daylight saving, trade is fairly good. The return of service men to the colleges has developed considerable business in study lamps which under normal conditions would have been handled in the fall. One Boston house is making a hit by utilizing army helmets in indirect-lighting fixtures. Floor lamps continue to be popular.

ELECTRIC RANGES.—The outlook is improving. Last week the Boston Edison company sold six ranges, and a prominent dealer is reported to have sold two carloads. Easier conditions are being accorded to range service installations in some cases.

CHICAGO

The beginning of the long-heralded spring construction program is now definitely in sight. Not only does this apply to the construction of buildings and public works within the city of Chicago, but it also applies to central-station construction work throughout the Middle Western territory. In Chicago's best building year, 1916, the average weekly total of building permits was $1,585,000. The average over a five-year period before the war taken for the first three months of the year was $1,183,000 per week. After running along at a low figure for the early part of the year, the total of weekly building permits recently reached a peak of $1,450,000 and attained another peak this week which totaled $2,509,000.

Jobbers report that business is coming along in good shape and that line extensions from 1 mile to 30 miles long are affording numerous inquiries.

COPPER WIRE.—The market strengthened just a trifle this week on account of the large number of inquiries for wire to supply line-extension demands. The base on weather-proof and rubber-covered copper wire is between 19 and 20 cents.

CONDUIT SPECIALTIES.—Business in this line is beginning to pick up with the opening of building construction. There have been no reductions in prices, but this was not a deterring influence on buying since prices in this line were not raised to unreasonable figures when the advances were made.

DOMESTIC APPLIANCES.—There has been no general decrease in prices of electrical appliances, and manufacturers have informed jobbers that no decrease need be expected for some time to come. The American Electric Heater Company has begun to distribute its appliances in standard packages and standard quantities, making a differential of about 10 per cent between the price of one item and the standard package and another differential of 10 per cent between a standard package and a standard quantity. Six electric irons will constitute a standard package and thirty will constitute a standard quantity.

IRON WIRE.—The prices of iron wire and steel-stranded wire are off somewhat. The price of steel strand has decreased 10 per cent, while the price of iron wire has decreased about 5 per cent.

LIGHTING FIXTURES.—Manufacturers of lighting fixtures claim that the farm-lighting plant sales are the biggest factors in building up the demand for fixtures in the present market.

REFRIGERATING MACHINES.—One manufacturer in Chicago proceeding with this type of equipment for domestic use is closing contracts for distributing his machines along lines used by automobile companies. He is granting exclusive contracts to distributers in certain territories, giving them authority to appoint sub-agents.

WIRELESS TELEGRAPH.—Within thirty days one manufacturer expects to have wireless-telegraph sets on the market. He expects to distribute these through the electrical trade.

ATLANTA

The percentage of textile machinery idle through the increase of mill orders and the adjustment of labor controversies is diminishing—but encouraging indications such as this are modified by the reduced activities at iron and steel establishments. Briefly summarizing the electrical field, it may be said that wholesale and jobbing trade has been well maintained and buying seems to be more confi-

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dent, retail trade has enlarged slightly and ordinary collections are good. The million-dollar development of the Blue Ridge Power Company, Tuxedo, N. C., is progressing rapidly and 44,000-volt transmission lines will be constructed to Tryon and Saluda, N. C.; Spartanburg, Inman, Campobello and Landrum, S. C.

CABLE.—The heavier sizes from 500,000 circ. mil. to 2,000,000 circ. mil. went back to a 20-cent base after the sag in prices of last week. A brisk movement is noted and orders are increasing. Slow-burning weatherproof is especially active. A number of large industrial establishments that have caught up on orders are taking this opportunity to rehabilitate certain departments badly in need of maintainance. Factory shipments are promised for thirty days.

RANGES.—Selling activity on the part of distributers appears to be lagging temporarily, and transactions have fallen off accordingly. While a fair volume of business is being done, it is not up to the standard set for this period of the year. Deliveries are much improved.

INSULATORS.—There has been no price change in the past fifteen days. Glass insulators are in greater demand than for some time, the business coming from small central stations and industrial extensions. The call for the porcelain type has shown signs of revival, and spotty requirements point to the fact that activity is increasing; but nothing big is expected for a little time at least, as the greater portion of orders sustaining this item come from large developments and maintenance projects which are being delayed. Factory shipments are good.

POLES.—Producers and distributers report an increasing demand. This week's business is especially active. An analysis of orders received fails to show that any one branch of the industry is more active than another. A healthy condition exists and future prospects look bright. Sales for the first quarter of 1919 are well ahead of the same period in 1918. The large Western stocks are being slowly distributed, and deliveries from local stocks are excellent. The looked-for drop in prices has not appeared.

HARDWARE.—The call has quickened considerably in sympathy with the increased movement in poles; but the volume of transactions dropped to such a low level following the armistice that a substantial demand will have to exist before this item will reach anywhere near the point that may be called good. Prices are gradually dropping, a slight decline being registered this week. The average shipments have been reduced to two weeks.

LAMP CORD.—The advent of warm weather this week increased the local call for considerable quantities of lamp cord, anticipating the rush of fan-motor requirements. Local stocks are ample. Prices are steady.

FANS.—Outside of a small flurry during the early part of this week, no perceptible movement is noted locally. The southernmost sections, however, are now entering a period of semi-summer temperature, and central stocks have been called upon to fill these requirements. Shipments from Eastern points are much improved over the same period of last season, and stocks are being well maintained. Fan stocks in general are well distributed this year, and dealers and jobbers have the stage set to take care of a larger business than ever before handled.

SEATTLE—PORTLAND

Both jobbers and dealers in Seattle report business during the past week on a par with activities of several weeks past. From all appearances shipyard owners intend to know their ground regarding cancellation of old contracts. receipt of new contracts and policy of government in respect to foreign contracts before purchasing in excess of actual demands. Heavy equipment, such as motors, transformers, generators and the like, is not moving.

Inquiries from out-of-town central stations are pouring in regarding prices for equipment for proposed improvements and extensions, but orders have not materialized. An authoritative source in Seattle states that if inquiries on hand developed into orders and if central stations which have plans prepared for extensions and additions would proceed, Northwest jobbers would be swamped with new business.

Jobbers' sales to out-of-town dealers during the past week showed a slight increase over the past three weeks, although the increase is not considered indicative of immediate future increases. Some of the smaller towns in northern, central and southwestern Washington report an exceptional increase in amount of residence construction. The larger cities, particularly Tacoma and Seattle, are also having slight increases in the number of building permits, although actual spring building has not started. Eastern Washington territory reports a heavy demand for pumping machinery for irrigation purposes. New tracts of land are being brought under water and new plants installed to replace those which have outlived their usefulness. Mines in the Spokane and Cœur d'Alene districts are showing increasing activity. This is especially true of smaller producers and new concerns. Sales of mining equipment, including motors both large and small in considerable volume, are noted. Labor conditions in the Pacific Northwest are considerably improved, although the scarcity of farm labor is still causing anxiety.

In Portland business conditions remain unchanged as compared with last week. Many plans are being prepared, but there have been no steps to date toward putting them into execution.

Farm-lighting plant sales during the past week showed a slight increase in sales, comparatively well divided over territory served by the Spokane, Wallawalla, Seattle and Portland districts. House-wiring device sales during latter part of the week increased noticeably. Jobbers have a good supply of wire, lighting fixtures, bells, etc., on hand. Prices remain steady.

SAN FRANCISCO

Practically ideal weather conditions for farmers, orchardists and vineyardists have obtained this season. The rice industry is increasing enormously, new mills being built to take the valley crops and new wharves to handle overseas shipments. The United States government has decided to increase by at least 50 per cent the capacity of the Mare Island Navy Yard because of the intention to keep half of the battleship fleet in the Pacific Ocean. New docks, new ways and new equipment for scraping and painting will be installed and the personnel of the yard considerably increased. The respective building permits for the month of March were: San Francisco, $910,000; Los Angeles, $1,122,000; Oakland, $495,000. Interior cities are running about two-thirds of their 1918 showing for the same month.

Collections are fair, with an increased tendency to extend longer terms of payment, due to the preponderance of large devices, requiring term payments, in the dealers' purchases.

MOTORS.—Business for this year, though brisk, cannot compare with that of last year, because of the greater amount of rain this season, nor are there so many new industrial plants to be equipped. Motors this season are sold through education and sales effort rather than a demand on the customer's initiative.

WASHING MACHINES.—The most popular electrical device at the present time is the washing machine, of which all sizes and varieties are cropping up to take advantage of this condition. Prices are still steady.

LAMPS.—Demands are lower than for last year, when the government industrial business was in full swing. Stocks are good and well distributed. The especial feature of this season is the remarkably keen competition for dealers' accounts.

RUBBER-COVERED WIRE.—Large circular-mil cable has again decreased, taking a 2½ per cent fall. Stocks are good and demand small.

MARINE MATERIAL.—A new schedule of prices laying especial stress upon quantities is reported. The United States business for emergency fleet ships has naturally decreased, but the activity of local commercial bodies for export trade is boosting the business of local manufacturers.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	20%
Coil to 1000 ft	25%
No. 12 Solid	
Less than coil	20%
Coil to 1000 ft	25%

Twin-Conductor

No. 14 Solid	
Less than coil	20%
Coil to 1000 ft	25%
No. 12 Solid	
Less than coil	20%
Coil to 1000 ft	25%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
1	50	13.00
1¼	50	21.00
1½	50	26.00
2	25-50	35.00
2½	25-50	45.00
	25-50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¾	.06	1¼	.33
¾	.09	1½	.40
⅞	.12	1¾	.47
⅞	.15	2	.55
¼	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00	$18 00	$16 00
¼-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00-26.50
¼-in.—	65.00	32.00-32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS
RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1 80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb	7% to 12.1%	9% to 14.1%
2500 to 5000 lb	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.18
Coil to 1000 ft	25.94

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%-35%	20%-33%
$10.00 to $50.00 list	36%-47%	31%-43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%-32%	10%-27%
$10.00 to $50.00 list	30%-40%	20%-35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $17.00
1/5 to std. pkg	12.00 to 14.00

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00-$24.15
1/5 to std. pkg	17.85- 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg	$16.00	$22.00
1/5 to std. pkg	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000
Less than 1/5 std. pkg.	$13.00-$18.40	$32.00-$36.80
1/5 to std. pkg	11.50- 16.00	27.20- 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39
No. 18, full spools	.37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15-$14.50	$10.50-$12.65	$10.50-$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00-$20.00	$13.00-$15.00	$11.50-$13.00
12	17.50- 21.63	17.55- 21.63	17.55- 18.54
10	24.05- 28.91	24.05- 28.91	21.16- 24.78
8	33.35- 39.34	33.35- 33.72	29.35- 33.72
6	52.95- 61.74	46.60- 52.92	46.60- 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$24.00
25 to 50 lb	24.00
50 to 100 lb	23.00

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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NEW APPARATUS & APPLIANCES

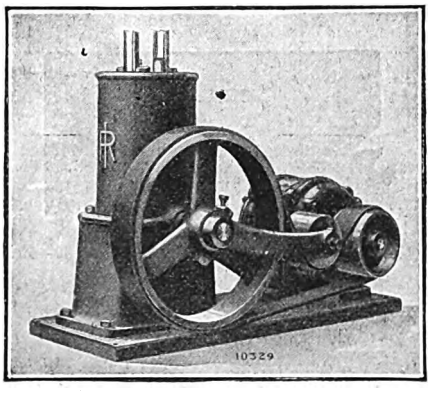
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Converting Helmet Into Lighting Fixture

Military helmets which the soldiers bring home may be made both ornamental and utilitarian by converting them into indirect lighting fixtures for illuminating small rooms through the use of fittings procurable from the National X-ray Reflector Company, 233 West Jackson Boulevard, Chicago. This equipment, which includes a canopy complete with an insulating joint and a fiber ring, three suspending chains finished in the color of the helmet, an interior lining for the helmet, and a small X-ray reflector for 100-watt or 150-watt lamps, is known as No. 3921-D.

Small Single-Acting Air Compressors

In designing its type "Imperial Fourteen" small air compressors it was the desire of the Ingersoll-Rand Company, 11 Broadway, New York City, to obtain good efficiency of operation with the close secondary consideration of general ruggedness and simplicity. Features of their construction are the drop-forged crank shaft, the die-cast renewable bearings and the automatic splash lubrication system. There are four sizes of these compressors with ratings of from 3 cu.ft. to 45 cu.ft. (0.08 cu.m. to 1.8 cu.m.) per minute at pressures to 100 lb. per square inch (7 kg. per sq.cm.). However, they can be used for pressure requirements up to 200 lb. per square inch (14 kg. per sq.cm.) if the driving power is slightly



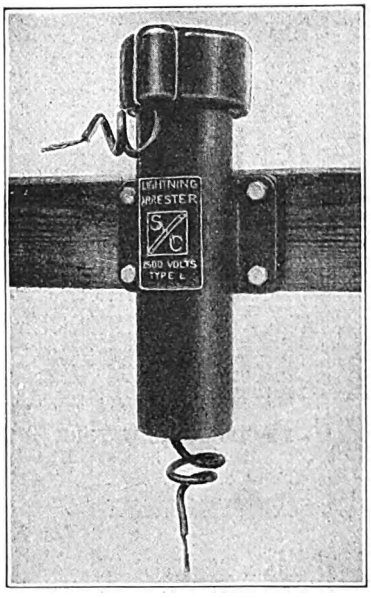
ADDITIONAL BASE FOR MOTOR MOUNTING

increased. The units can be furnished complete with individual motor mounted upon a hardwood base plate or prepared to be driven from line shafting.

The smallest size of these compressors is built with a ribbed cylinder for air cooling where service is intermittent and with a water-cooled cylinder of the reservoir type for continuous operation

Multi-Chamber Lightning Arrester

For service on 2500-volt distribution systems Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, have developed a multi-chamber lightning arrester, which consists of a number of discharge gaps connected in series with a resistance and mounted in a porcelain tube closed at both ends excepting for a ventilating hole at the lower end. The mounting bracket of this arrester, which is known as type



HAS FIVE SERIES GAPS IN SEPARATE CHAMBERS

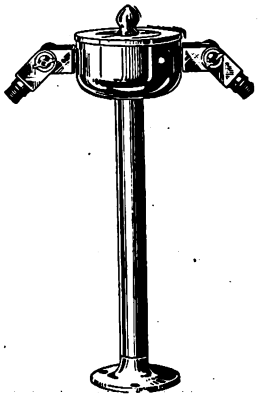
"L," is an integral part of the main housing and may be secured to either cross-arm or wall.

The operating element of the arrester comprises five series gaps, each gap mounted in a separate cylindrical chamber. These cylindrical chambers are open only at one end, and the discharge gap in each chamber is placed near the closed end.

When a discharge passes through the arrester the heated air back of each gap in the closed ends of the respective chambers blows the arc out toward the open end of the chamber. This blow-out action is said to be very effective in extinguishing the arc and in rupturing the dynamic current that tends to follow the high-voltage discharge. The insulating blocks are assembled so that the path between adjacent gaps is a maximum.

Adjustable Lamp Clusters for Portable Lamps

The adjustable lamp cluster just developed by the Peerless Light Company, Halsted, Adams and Green



ESPECIALLY SERVICEABLE WITH FLOOR-STAND PORTABLE LAMPS

Streets, Chicago, fits not only one or two particular shades but can, the maker points out, be used with any type or shape of portable lamp shade. It is also claimed that because of the swivel adjustment incorporated in the clusters the sockets can be adjusted to obtain the utmost efficiency from the lamp bulbs under all conditions. These clusters are made with the "E-Z" wire stem, which makes for ease in assembly and wiring.

Safety Steel-Inclosed Switches

Ability to withstand hard usage is one of the chief claims made for the safety switch—one which can be placed in any position—being marketed by the Leonard Electric Manufacturing Company of Cleveland, Ohio. The door of the cabinet cannot be opened without tripping the switch, therefore making it impossible to re-fuse a live switch. In addition, the switch cannot be partly closed and left in that position, because of an arrangement which causes the switch to "fly" open when it is not fully closed. This prevents insufficient contact and subsequent heating of the switch parts and eliminates arcing at the contacts on opening the circuit. The lever and toggle principle is embodied in the handle, and an easy pull will close the switch, while a slight blow suffices to open it.

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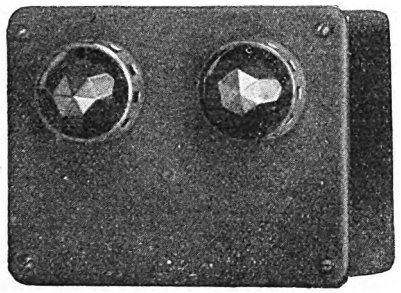
Signal Box with Non-Interchangeable Lenses

Where exposed colored bulbs are used for pilot lamps in switching installations they are easily damaged, and in renewing them an operator may accidentally place a green bulb in the socket intended for a red one and thereby defeat the purpose of the indicating signals, which is to tell whether the respective disconnecting switches are



RED AND GREEN LENSES WHICH CANNOT BE INTERCHANGED ARE USED

open or closed and to protect the operator when inspecting or repairing the circuit breaker. To remove such disadvantages the Lewis & Roth Corporation of Philadelphia has brought out a signal box for switch structures in which white bulbs are installed behind red and green lenses and a barrier placed between the bulbs prevents one lamp from illuminating both lenses. The two lenses are set in the hinged cover of the box in such a way that interchanging them is impossible. In order to identify the circuits a name plate may be affixed to the front of the box.

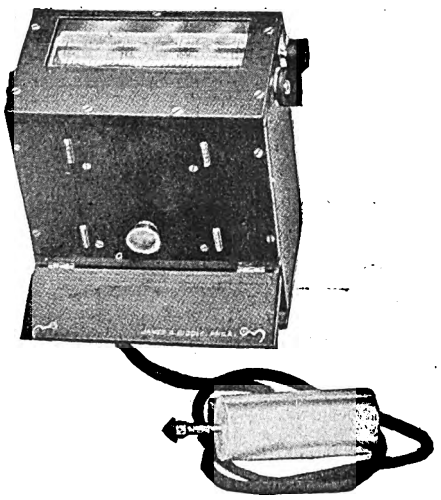
Combination Electric Waffle Baker, Griddle and Toaster

A recent addition to the line of cooking apparatus made by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City, is a combined electric griddle, toaster and waffle baker. It is constructed throughout of heavy wrought steel bound and braced with polished steel trimmings mounted on an angle-iron frame with an undershelf. The griddle top is 27 in. (68 cm.) long and 16 in. (40 cm.) wide, made of polished steel, is heated by the same units that heat the waffle irons, and can be used separately or in connection with any of the other two operations.

The toasting or baking compartment is 23 in. (58 cm.) wide and 13 in. (33 cm.) deep inside. Heat is supplied by both top and bottom units, separately controlled by three heat switches. Bread is toasted on both sides at the same time, saving considerable time over other methods. Three waffle irons, each holding two cakes, rest on an angle-iron frame which can be removed when the fixture is used for toasting, three bread-toasting frames being furnished for this purpose. A removable drip pan is also supplied for cleaning, etc. This cooking device operates on 110-220 volts, has a total connected load of 6 kw. and weighs 200 lb. (90.7 kg.).

Multiple-Scale Speed Indicator

Designed to measure the entire range of commercial speeds up to about 12,000 r.p.m. with as high a degree of accuracy as the Frahm vibrating-reed tachometer, the Frahm "electro-tachometer" or revolution indicator has recently been developed by James G. Biddle, 1211 Arch Street, Philadelphia. It is said that this high degree of accuracy is maintained for practically an indefinite period and is well defined throughout the different ranges. The instrument possesses considerable advantages over the ordinary-type tachometers with speed indicators, which so frequently need inspection and calibration and the indications of which are always open to doubt, the maker states. A characteristic feature of this



UNIDIRECTIONAL IMPULSES UTILIZED

instrument which recommends its use as a universal speed-testing instrument, particularly in testing several electric motors or generators, is that the whole set can be observed at the same time. Speeding up or slowing down the machine is shown instantaneously by this device as well as any irregular behavior, thus enabling the attentive observer to form a good idea of the character and working of the machine.

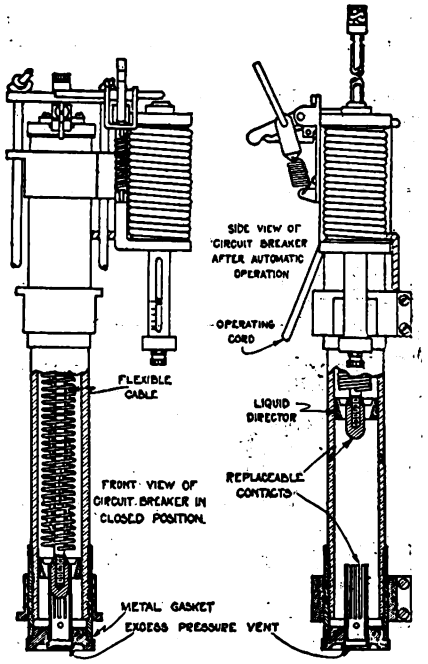
The electro-tachometer, so called to distinguish it from the regular vibrating-reed tachometer as well as from the centrifugal type, consists of a set of reeds excited in the same way as the frequency meter by means of electromagnets whose action is assisted by a permanent magnet. Instead of alternating current, however, unidirectional impulses are utilized. A multiple-scale arrangement is provided for, which permits one to read five single scales, for instance 2000 to 5000, 1000 to 2500, 500 to 1250, 250 to 625, 200 to 500. Similar scales down to 100 and up to 12,000 can be obtained without difficulty.

High-Voltage Automatic Circuit Breaker

A small, compact, high-voltage circuit breaker with contacts operating in a non-inflammable liquid similar in some respects to carbon-tetrachloride has been developed by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago. The switch element itself for 33,000 volts is only 36 in. (91 cm.) high by 4 in. (10 cm.) wide by 4 in. deep without the mounting when in the open position. With the mounting it measures 82 in. (208 cm.) high by 24 in. (60 cm.) deep by 8 in. (20 cm.) wide. The switch consists of a moving contact mounted on the end of a spring-actuated operating rod and a stationary contact mounted in the base of the breaker. The current is conveyed to the moving contact through flexible copper connections so that the current carried through the spring is negligible.

Mounted on the end of the operating rod and next to the moving contact is a liquid director—a funnel-shaped arrangement—that forces a powerful stream of the liquid into the moving contact as it recedes through the liquid when opening. Immediately under the stationary contact is an excess-pressure vent which opens when the pressure in the main tube becomes abnormally high due to the rupturing of very heavy short circuits. This vent, as well as the two main contacts, is easily replaced.

The operating rod which carries the moving contact extends out through the top of the circuit breaker and is provided with a cross-bar to which the



NON-INFLAMMABLE LIQUID ALSO ACTS AS A FIRE EXTINGUISHER

operating mechanism is attached. Mounted on top of the circuit breaker is a series relay which provides the automatic overload feature of the device.

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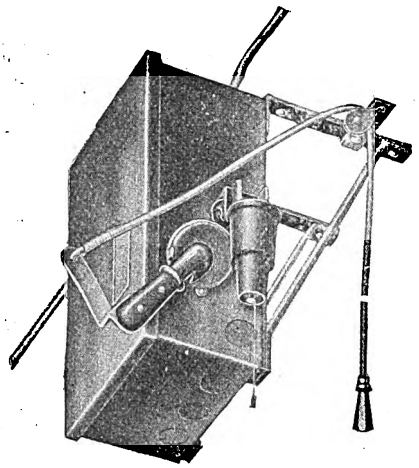
Ceiling Mounting for Motor-Starting Switches

Where the motor-starting switches with undervoltage release coils made by the Trumbull Electric Manufacturing Company, Plainville, Conn., are to be installed high above the operators'



SWITCH EASILY OPERATED FROM THE FLOOR

heads they can be obtained with ceiling brackets and with operating cords. One of the cords works over a pulley so that the switch mechanism can be easily operated from the floor. Another cord connects with the undervoltage release coil and is pulled to throw the switch into the "off" position.

Completely Inclosed Washer and Wringer

That all its working parts, exclusive of the wringer, are inclosed in a white enamel and nickel cabinet with a table-lid top is the feature of an electric clothes washer announced by the Bluebird Appliance Company of St. Louis, Mo. The washing mechanism, which is said to be simple and strong, operates a polished copper rocking cradle. A large adjustable power-driven swinging wringer is mounted on the washer.

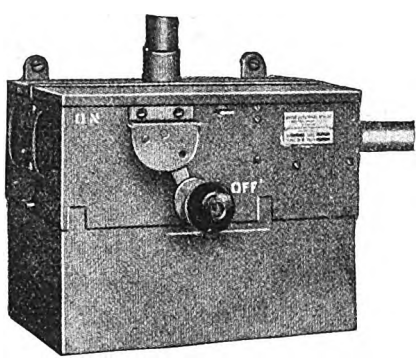
Repair Outfit for Storage Batteries

Removing cell plates from storage batteries without injury to the batteries can be done with ease and quickness through the use of a repair outfit recently developed by the Hauck Manufacturing Company, 101 Eleventh Street, Brooklyn, N. Y., which softens the sealing compound by means of steam. The apparatus consists of a steam generator with six jets, three of which are controlled by a valve. The valve is closed for three-cell batteries and opened when all six jets are used. Sufficient steam can be obtained in from two to three minutes. The steam generator is fitted with a safety pop valve which blows off at pressures of 10 lb. per square inch (700 g. per sq.cm.). However, the manufacturer claims pressure is never needed above 3 lb. per sq.ft. (200 g. per sq.cm.). The process of softening the battery's sealing compound is very simple, the vent caps being removed, the jets inserted on each cell and steam forced directly into the cells. Within four or five minutes the plates are removed. Grease and other impurities can be steamed and cleaned off the batteries at the same time.

The outfit is operated by kerosene, although when desired gas burners can be furnished. A 1-gal. (3.7-l.) capacity kettle to melt wax for resealing, a 35-lb. (15-kg.) capacity melting pot for reclaiming lead and a mold to make lead sticks are furnished with the apparatus.

Fused Oil Switches Having Automatic Attachments

For a number of uses, particularly as entrance switches, oil disconnecting switches and for the control and protection of small induction motors and lighting and power circuits, type N-2 oil switches are now being manufactured by the Condit Electrical Manufacturing Company of South Boston, Mass. They are suitable for use with alternating-current motors where the starting current does not exceed 100 amp. at 220 volts or less, or 60



FUSE CHAMBER AND OIL TANK MAY BE LOCKED INDEPENDENTLY OF EACH OTHER

amp. at 440 or 550 volts; also for use as service switches, oil disconnecting switches and similar applications, where the current does not exceed 60 amp. at pressures of 600 volts or less. These switches are made in two, three and four poles, single-throw type, in non-automatic form, with and without fuse clips. Under-voltage or shunt-trip attachments are furnished with either form.

All live parts and mechanism of the switches are entirely inclosed. The switch may be locked in open position, and the fuse chamber may be closed independently of the oil tank and vice versa. Fuses are dead when the switch is open, while the position of switch contacts is plainly indicated. The circuit is opened under oil and a high factor in insulation is present. Inclosed fuses afford overload and shunt-circuit protection. On reduction or loss of voltage the undervoltage attachment automatically disconnects the circuit, and with the shunt-trip attachment the circuit is allowed to be opened from a remote point.

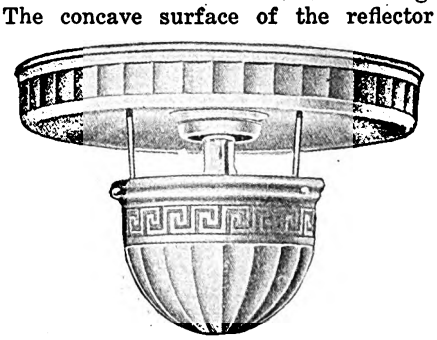
Electric Frying Kettles

For frying food quickly the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City, has developed electric kettles. They are made of heavy polished cold-rolled steel and are insulated on the bottom. A three-heat switch for 110 volts or an off-and-on switch for 220 volts is furnished with kettles and is intended for mounting on a side wall. The kettles are equipped with a wire drainer basket and holder. Four sizes of the kettles may be obtained, the smallest having dimensions of 14 in. by 7 in. (35 cm. by 18 cm.) and the largest 24 in. by 10 cm. (61 cm. by 25 cm.). The minimum and maximum wattages of the smallest of the four kettles are 562 and 2250, while those of the largest are 1125 and 4500.

Lighting Fixtures for Gas-Filled Lamps

For illuminating stores, offices or public buildings "Lightolier" No. 3802 has been brought out by the Lightolier Company of 569 Broadway, New York City. It is adapted for gas-filled lamps up to and including 200 watts and is said to give a maximum of properly toned light. Both the reflector and the bowl are of translucent glass embossed in Grecian design. This unit is intended for rooms with low ceilings or where it is desirable to have the light source at a considerable distance from the working place. Fittings are supplied for attaching the fixture directly to the ceiling. The over-all length of the fixture is 36 in. (91 cm.), the reflector is 16 in. (40 cm.) in diameter and 2½ in. (6 cm.) deep, while the diffusing bowl has a 6-in. (15-cm.) diameter and is 9 in. (22 cm.) deep.

This company has also developed design No. 3653, which is identical with the fixture described above except that a canopy and chains replace the fittings for direct attachment to the ceiling. The concave surface of the reflector



FURNISHED BOTH IN CHAIN TYPE AND FOR DIRECT CEILING ATTACHMENT

has been designed to direct the light down to the plane of usefulness but permits sufficient light to filter through and break up unsightly ceiling shadows.

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Commerical Lighting Fixture for Stores and Offices

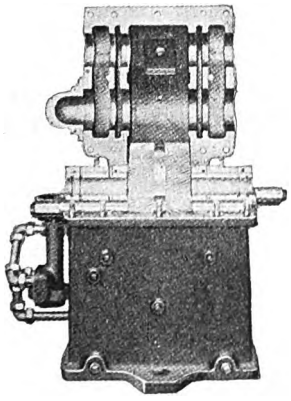
The combination of an artistic design with good efficiency is the main feature of a commercial lighting unit recently placed on the market by the

WELL-VENTILATED, BUG-PROOF AND DUST-PROOF

General Gas Light Company, 50 West Broadway, New York City. This well-ventilated and bug-proof fixture, known as the "Humphrey Radio 30," has a self-centering spring globe holder with a porcelain enameled dome. When the metal parts of the fixture are finished in antique brass a green porcelain enameled dome is supplied, and when they are finished in nickel a white porcelain dome is furnished. The length of the unit is 38 in. (91 cm.) from the top of the canopy to the bottom of the globe.

Strongly Constructed Speed Reduction Gears

Although intended primarily for use with Terry turbines, the reduction gears illustrated, made by the Terry Steam Turbine Company of Hartford, Conn., are available alone whenever desired. A well-ribbed, double-walled, boxlike structure, extending the full



COVERING REMOVED SHOWING GEARS

depth of the case, forms a rigid support for each pair of bearings of these gears. The space between the walls acts as a water jacket for cooling the oil, and the ribs between the walls serve as both stiffening members and water baffles. The central part of the case, directly under the gears, forms an oil reservoir which contains sufficient oil to supply not only the gears but also the turbine. This construction of the case also insures accurately maintained alignment of the gears.

The bearings are of ample size, insuring safe pressures and rubbing speeds, and are split horizontally to permit replacement without removing the couplings. The lining used is of high-grade tin-base babbitt on both gear and pinion. Interchangeability of the bearings makes it possible, in case of excessive wear, to replace them easily and quickly and restore the original alignment.

In spite of the cool operation of the gears, a water-cooling system forms part of the standard equipment. The gears may be furnished for either direction of rotation, the only change being location of the oil-spray piping above or below the contact point.

Portable Meter for Illumination Intensities

One of the most difficult problems in obtaining correct illumination in industrial plants is occasioned by the lack

MEASURES ILLUMINATION IN FOOT-CANDLES WHEN PLACED ON DESK OR WALL

of an instrument for telling whether or not adequate lighting is provided. The inspectors who visit the plants are not usually electrical engineers and therefore cannot enforce rules if they cannot tell what is needed. Moreover, contractors installing equipment do not usually know whether the correct intensity exists in the industrial plant. Recently, however, a light, compact and easily operated foot-candle meter has been developed which is being distributed by the "Mazda" interests—that is, the Edison and National Lamp Works of the General Electric Company, at Harrison, N. J., and Cleveland, Ohio, respectively, and the Westinghouse Lamp Works, 165 Broadway, New York. The instrument, which was designed by Dr. Clayton H. Sharp, Electrical Testing Laboratories, consists mainly of a screen, lamp bulb and flashlight cell, voltmeter and rheostat, all contained in a leather case.

The lamp bulb is arranged at one end of the compartment illustrated here, having a screen which consists of a clear-glass plate, a sheet of thin paper and opaque paper, with a series of holes on one side, the opposite side sloping toward the bulb.

When the correct voltage is applied to the lamp, as indicated by the mark on the voltmeter, the intensity of the light being measured is indicated at the point on the scale where the spots are invisible in comparison with the screen background.

NOTES ON RECENT APPLIANCES

Induction Motors

A line of induction motors is being manufactured by the Electric Machinery Company, Minneapolis, Minn.

Soldering Iron

A special garage repair soldering iron with three tips is being made by the Dover Manufacturing Company, Dover, Ohio.

Motor-Driven Oven

The Crandall-Pettee Company, Beach and Hudson Streets, New York City, is making a motor-operated gas oven of the reel type for bakeries.

Dish-Washing Machine

The Couch Dean Corporation of Hartford, Conn., has improved its model CD-3 "Autosan" motor-driven dishwasher for restaurants and hotels.

Key and Keyless Porcelain Sockets

Additions to the line of sockets made by the Connecticut Electric & Manufacturing Company, Bridgeport, Conn., are key and keyless porcelain types having 600-watt, 250-volt mechanisms.

Portable Electric Heater

A portable electric heater having a rating of 660 watts and built for use on both 110-volt and 220-volt circuits is now being made by the Despatch Manufacturing Company of Minneapolis.

Electrically Operated Dishwashers

Electrically operated dishwashers with capacities of from 3000 to 15,000 dishes per hour and suitable for hotels and restaurants are being sold by F. G. Street & Company, 60 Broadway, New York City.

Mixing and Beating Machine

To mix dough, whip cream and beat batter and eggs and to perform other culinary operations the "Reliance Mixobeater" has been developed by the American Mixing & Beating Machine Company, 72 Liberty Street, Brooklyn, N. Y.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Norway (No. 28,970) desires to purchase and secure an agency for the sale of electric touring cars (without tops), Edison batteries preferred.

A man in Belgium (No. 28,930) desires to secure an agency for the sale of all kinds of electrical supplies and material. Correspondence may be in English.

A man in Italy (No. 28,928) wishes to secure an agency for the sale of electrical materials and machinery. Payment guaranteed through bank deposit. Correspondence should be in Italian.

A merchant in France (No. 28,918) desires to purchase and secure an agency for the sale of all sorts of electrical appliances and apparatus, such as motors, heaters, lighting fixtures and tools. Terms of payment, cash against documents. Correspondence should be in Frecnh.

A man in Italy (No. 28,897) desires to receive an exclusive agency for the sale of electrical machinery, magnetic sheet steel, batteries, frequency meters, phasometers, current meters, instruments of precision, electric apparatus for mines, for chemical industries and for electric railways; also insulating material, mica paper, varnish, fiber and cable insulators, medical applications, marine installations, magnetos, telephone apparatus and telephone switchboards. Correspondence may be in English.

Westinghouse Changes

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces through the *Westinghouse Electric News* these changes in its personnel:

R. L. WILSON has been appointed general superintendent of the electrical work. Mr. Wilson studied mechanical engineering at the University of Iowa and at Rose Polytechnic Institute and electrical engineering at Johns Hopkins University. After an apprenticeship of one year with the General Electric Company he became associated with the Westinghouse company as draftsman, later as engineer, then erection engineer, superintendent of construction, and at the time of his promotion he was superintendent of the railway department and assistant general superintendent of the electric works.

GEORGE H. COX, former manager of the supply division, Boston office, has been appointed district manager of that office. S. St. J. Morgan, manager of the Boston office, has become president of the Lamson & Hubbard Company, Boston and Canada, retail and wholesale fur dealers.

B. H. CHATTO, of the small-motor section, engineering department, has been appointed to a position in the industrial department where his duties will be in connection with power and light plants for agricultural districts.

F. A. BERG has been promoted to be manager of the condenser section of the power department.

CAPT. N. H. CALLARD, who has been discharged from government service is appointed to the railway sales department in the capacity of commercial engineer.

E. O. GALYON has been discharged from the service and is transferred to the company's St. Louis service department as superintendent of the electrical division.

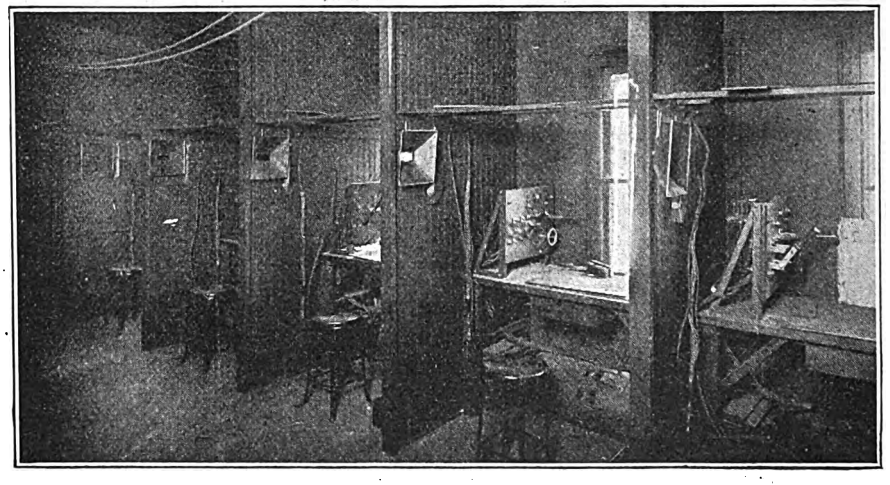
W. KEITH McAFEE has been transferred to the service department as railway engineer.

F. D. KENNEDY is appointed superintendent of the railway department of the works.

C. D. LAMADE has taken up his duties as superintendent of ratings and inspections at the Krantz Manufacturing Company's plant at Brooklyn, N. Y. Mr. Lamade has been in the inspection department since 1905, and before going to the Krantz plant he was in charge of inspection work in sections E, O & P and at Trafford City.

ELECTRICAL GOODS NEEDED IN SWEDEN.—Sweden's needs, especially in view of the growth of new war industries and the increased purchasing power of the people, should be studied, says the British Consul General at Gothenburg. Electric lamps, fuses, switches, etc., also electric motors were almost exclusively imported from Germany before the war. The electrical industry, which was strongly established in Sweden, has taken the opportunity afforded by the limitation of German production to extend its borders. The extension of industrial activity has greatly increased the demand for mechanical and electrical appliances of all kinds. Thus electrical power is being increasingly supplied to all industrial concerns, and will eventually be extended to many of the railways. All sources of water power in Sweden have recently passed into the control of the state, and such power will in future be fully utilized. This has created a great demand for electric fittings and appliances of all kinds.

LINCOLN ELECTRIC CONTINUES WELDING SCHOOL.—The Lincoln Electric Company, Cleveland, Ohio, is continuing as a permanent peace-time institution the school in electric welding established by the Emergency Fleet Corporation. No tuition fee is charged, and the course is open to all who wish to take it. An instructor is provided, and a small lecture room and twelve welding booths are completely equipped. The purpose is to train employees of purchasers in the use of the apparatus and also to provide expert welders for manufacturers who may need their services.



BOOTHS IN LINCOLN ELECTRIC WELDING SCHOOL

NEW POSITION OF NORWAY IN LAMP MARKET.—Attention has recently been called in the Norwegian press to the change in the lamp position in Norway since the establishment of the first factory for manufacturing lamps in that country. It is only two years since the A-S Norsk Elektrisk Lampefabrick started business at Drammen, but the rapid increase in the demands made upon the firm has necessitated new buildings and extensions. These are now completed, and the previous output of 4600 lamps per day will be largely increased. Previous to the war most electric lamps were imported to Norway from Germany. The present position seems to indicate that Norway will soon supply her own needs and enter the field of exporters.

THE RAILWAY & POWER EQUIPMENT COMPANY, Woolworth Building, New York City, reports that it is planning increased scope of operation. With this in mind it has been incorporated in Delaware with a capital stock of $5,000,000, $3,000,000 common, $2,000,000 7 per cent cumulative preferred. In addition to the interests of Charles F. Johnson, who has been carrying on the business for about twenty years, it has taken in other interests. Its new work is planned to include engineering and equipment work in any way connected with power, railroads, industrial establishments and contracting in all parts of the world. The company announces export inquiries for electric power and lighting machinery for Japan, derricks and electrical machinery for China, electric motors for Bombay, India.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago, announces the discontinuance of its office at Wichita, Kan. F. V. Sargent has been appointed district manager of sales in the Boston territory, succeeding F. S. Eggleston, with headquarters at 182 High Street, Boston.

THE VULCAN STEEL PRODUCTS COMPANY, INC., and the Vulcan Trading Corporation, general exporters and importers, are occupying new general offices at 136 Liberty Street, New York City.

LANDERS, FRARY & CLARK, New Britain, Conn., manufacturers of the "Universal" line of electric heating goods, it is reported, will build a four-story factory building, 60 ft. by 162 ft., at Plainville, Conn.

B. H. AHLERS, formerly sales manager of the circuit-breaker division of the Condit Electrical Manufacturing Company, has since March 1 taken up sales work with the insulated-wire division of the Marlin-Rockwell Corporation, New Haven, Conn.

THE ARCHIABLE ELECTRIC COMPANY, 138 West Third Street, Cincinnati, incorporated February, 1919, is now operating with George W. Archiable as president and manager and W. E. Retsch as secretary and treasurer.

THE CHICAGO INSULATED WIRE & MANUFACTURING COMPANY, Sycamore, Ill., suffered loss by fire in the neighborhood of $150,000. Several buildings and some stock were damaged. The plant was one of the largest in the Central West for the manufacture of insulated copper wire.

THE CONSOLIDATED BELTING COMPANY is now located in the plant formerly occupied by the Biddle Motor Car Company at Germantown and Sedgley Avenues, Philadelphia, where it has greatly increased facilities. The former location of the company was Chester, Pa.

CAPT. A. L. MULLERGREN, Construction Division, U. S. A., has received his discharge from the service and has returned to his duties as secretary and treasurer of the Benham Engineering Company, consulting engineers, Oklahoma City, Okla. Captain Mullergren was officer in charge of steam heating and assistant to the constructing quartermaster at Camp Funston, Kan.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, announces that Charles W. Unbehaun, formerly New York City and general Eastern salesman for the Bailey-Drake Company, Chicago, has joined its organization in the capacity of branch manager. Mr. Unbehaun will cover Eastern New York and the state of Connecticut with portable electric drills, electric air compressors and electric valve grinders.

IRVING SAMUELS has established offices in the Hunsicker Building, Allentown, Pa., as an electrical and mechanical sales engineer and manufacturers' agent. Mr. Samuels is a graduate of Lehigh University and served as efficiency engineer for the Lehigh Valley Transit Company, Allentown, Pa., in 1913; became engineer in charge of distribution for the Lehigh Valley Light & Power Company, also in Allentown, in 1914, and in July, 1918, resigned to accept a position as electrical engineer for the Air Nitrates Corporation in New York City in connection with the design and construction of the government nitrate plants at Toledo and Cincinnati, Ohio, and at Muscle Shoals, Ala. While with the Lehigh Valley

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Light & Power Company, Mr. Samuels served as chairman of the local section of the National Electric Light Association and also was chairman of the company's safety committee.

THE HOWE SPECIALTY COMPANY, Cleveland, Ohio, has let contracts for a factory building to cost $70,000.

THE RECIPROCATING ELECTRIC TOOL COMPANY, Louisville, Ky., has increased its capital from $10,000 to $100,000.

THE MITCHELL-RAND MANUFACTURING COMPANY, 99 John Street, New York City, has removed to larger quarters at 18 Vesey Street.

THE ALLIED ENGINEERING COMPANY, INC., has removed from 546 Fifth Avenue to larger quarters at 1400 Broadway, New York City.

THE KING MANUFACTURING COMPANY, St. Joseph, Mo., is successor to the King Foundry Company, manufacturer of street-lighting equipment.

THE INDEPENDENT LAMP & WIRE COMPANY, York, Pa., manufacturer of wire products, will build a one-story addition at a cost of $6,500.

THE MECHANICAL APPLIANCE COMPANY, motor manufacturer, announces that its Chicago office after May 1 will be in Room 545, Webster Building, 327 South La Salle Street.

THE DELTA ELECTRIC COMPANY, Marion, Ind., has plans for a large addition to its plant for the manufacture of dry-cell batteries. The factory will have a capacity of 15,000 batteries daily.

JOHN N. WATSON, accountant, has become associated with Colonel Rogers Birnie, A. S. M. E., and Major Wilford J. Hawkins, A. S. M. E., consulting engineers and accountants, 511 Fifth Avenue, New York.

WILLIAM GARTNER, manager of the New York salesroom of the Bell Electric Motor Company, 30 Church Street, New York City, has returned to civil duties. He has just been discharged from the service in which he acted as electrician at Texas aviation field.

THE PRECISION INSTRUMENT COMPANY, Detroit, Mich., announces the addition of William L. DeBaufre to its corps of engineers. Mr. DeBaufre was formerly in the same department with the navy at Annapolis, which position he resigned to become associated with the Precision Instrument Company.

THE EFFICIENT SERVICE COMPANY, 1966 Broadway, New York City, is representative for New York State for A. F. Daum, Pittsburgh, Pa., manufacturer of renewable fuses and Eastern representative of the Automatic Electrical Devices Company, Cincinnati, Ohio, manufacturer of battery-charging and control apparatus.

CAPT. A. C. NELL, construction division, United States Army, who has been in charge of the purchase of power and mechanical equipment in the construction division, has been released from service and appointed Chicago district manager for the Lea-Courtenay Company and the Schutte & Koerting Company, with offices at 1466 Conway Building. Mr. Nell was formerly with the Allis-Chalmers Manufacturing Company.

L. K. COMSTOCK & COMPANY, New York City, constructing engineers, announce the establishment of a new department known as the electrical equipment department under the direction of W. J. Moore. This department will engage in the sale of complete industrial and power equipments. It has been organized for the purpose of offering a more inclusive and continuous service to clients in connection with the purchase and installation of equipment required for new plants, extensions and maintenance.

THE STANDARD REFRACTORIES COMPANY, Claysburg, Pa., manufacturer of silica brick and other refractories, recently issued $500,000 ten-year 6 per cent first mortgage bonds for the purpose of refunding a small bond issue now outstanding, also for permanently funding additions made to the plant during the war period, to purchase a ganister property which the company is now operating and to add to the plant a complete machine shop and warehouse. It is not the intention of proceeding at once, however, with the building of the new machine shop and warehouse, but this will likely be done later this year.

Trade Publications

FARM-LIGHTING PLANT.—The L. A. Young Industries, Inc., Detroit, Mich., has got out a folder about its "Lay" farm-lighting plant.

WASHING MACHINES. — The Globe Manufacturing Company, Perry, Iowa, has issued a colored window poster showing nine illustrations of its machines.

ELECTRIC TRUCKS.—"E. S. E." electric trucks are the subject of a folder recently issued by the West Motor Company, Twentieth Street and Avenue B, New York City.

FUSES.—The Bussman Manufacturing Company of St. Louis has issued a booklet telling about its renewable and non-renewable cartridge fuses, fuse plugs, fuse links and fuse wire.

CIGAR LIGHTER.—In a recently issued mailing card the Electric Sales Corporation, 1812 Ninth Avenue South, Seattle, Wash., gives some of the advantages of its electric cigar lighter.

RENEWABLE FUSES.—The National ferrule and knife-blade-type renewable fuses are listed in a folder prepared by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago.

FUSES.—The D & W Fuse Company, Providence, R. I., describes its cartridge-type renewable fuses in catalog No. 16 and its knife-blade-type renewable fuses, with jacketed fuse link, in a supplement to the above catalog.

TOOL GRINDERS.—New bench and floor type electric tool grinders are covered in a leaflet being distributed by the Janette Manufacturing Company, Singer Building, New York City, and 617 West Jackson Boulevard, Chicago.

GLASS REFLECTORS.—The Gleason-Tiebout Glass Company, 99 Commercial Street, Brooklyn, N. Y., is issuing a new series of bulletins. Bulletins 1 and 2 of the series are about blown-glass reflectors and English line reflectors.

OIL MOTOR STARTERS.—Type G-1 oil motor starters with maximums of 100 amp. and 600 volts are fully described in illustrated bulletin No. 436, being described by the Condit Electrical Manufacturing Company, South Boston, Mass.

COMBINATION WASHER AND DRYER.—The Marlow Manufacturing Company, 2152 Superior Avenue, Cleveland, Ohio, describes its new electric clothes washer and dryer for combination or separate use in a leaflet of recent issuance.

BATTERY-CHARGING RHEOSTATS.—Bulletin No. 27 has been prepared by the Electric Products Company of Cleveland, Ohio, to supersede bulletin No. 26 and to cover its battery-charging rheostats for trucks, tractors and locomotives.

WATER-BOTTLE HEATER AND CURLING IRON.—The Christian Heater Sales Company, 532 Grand River Avenue, Detroit, has got out an illustrated leaflet describing its combination electric curling iron and hot-water-bottle heater.

POWER-FACTOR SURVEYS.—In a recent issue of the "Esterline Graphic," published by the Esterline Company of Indianapolis, Ind., the subject of power-factor surveys with relations to the instruments made by this company is taken up.

LIGHTING FIXTURE.—"More Light on Your Profits" is the title of an attractive mailing folder being distributed by the Miller Saw-Trimmer Company, Point Building, Pittsburgh, Pa., to tell about its "Anyangl," adjustable industrial lighting fixture.

THERMOCOUPLE PYROMETERS. — Causes of and methods of prevention of errors in pyrometer equipment are brought out and discussed in bulletin No. 867-B, issued by the Leeds & Northrup Company of 4901 Stenton Avenue, Philadelphia, entitled "Checking Thermocouple Pyrometers." It discusses the importance of maintaining standards and of checking in pyrometry and points out sources of error and the remedies for troubles in thermocouples, millivoltmeters, cold junctions and potentiometers.

FLASHLIGHT DISPLAY AND STOCK CABINET.—The "Niagara-Lite sales winner" is described in a leaflet prepared by A. Hall Berry, 71 Murray Street, New York City.

DIRECT - CURRENT GENERATING SETS.—Catalog No. 103 of Engberg's Electric and Mechanical Works, St. Joseph, Mich., will shortly be available. It is thirty-two pages long and describes in detail the improved direct-current generating sets made by this company in 1-kw. to 50-kw. sizes.

STEAM-JET AIR PUMPS.—Preliminary Bulletin No. 113, illustrating and describing the Wheeler steam-jet air pump, is now being distributed by the Wheeler Condenser & Engineering Company, Carteret, N. J. This pump, which is applicable to jet condensers as well as to surface condensers, features two or more steam jets working in series with a condenser between the jets. The bulletin explains operating principles, describes the inter-condenser and shows an operating test curve. It includes a cross-section drawing and shows how to connect double machines or triple machines to surface condensers.

New Incorporations

THE SMITHLAND (KY.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $8,000 by H. Wilson, G. L. Crawford, M. L. Poell and others.

THE ELECTRICAL CONSTRUCTION COMPANY of Charlotte, N. C., has been incorporated with a capital stock of $100,000 by G. S. Harrison, G. R. Trotter and C. E. Barber, all of Charlotte.

THE RURAL RETREAT (VA.) POWER COMPANY has been incorporated with a capital stock of $25,000 to supply electricity in Rural Retreat. J. S. Etter is president, and C. W. Davis is secretary.

THE ELECTRIC VACUUM CLEANER COMPANY of New York, N. Y., has been incorporated by J. Sherwin, G. E. Patterson and A. K. Baylor, 120 Broadway. The company is capitalized at $50,000.

THE DEVON ELECTRIC COMPANY of Pittsburgh, Pa., has been incorporated by W. I. Bickford and associates. The company is capitalized at $50,000 and proposes to manufacture electrical specialties.

THE BATTERY & ELECTRIC SERVICE COMPANY of New York, N. Y., has been incorporated with a capital stock of $25,000 by C. Alexander Lion. The company proposes to manufacture electric storage batteries.

THE HASKELL ELECTRIC COMPANY of Holyoke, Mass., has been incorporated by Frank E. Haskell, F. Haskell and R. L. Davenport. The company is capitalized at $30,000 and proposes to manufacture electrical supplies.

THE UNITED STATES ELECTRIC MANUFACTURING CORPORATION of New York, N. Y., has been chartered with a capital stock of $50,000 by J. J. Lazroe, A. Caming and G. Frankel, 666 West 162d Street, New York City.

THE LIBERTY STORAGE BATTERY COMPANY of Wilmington, Del., has been incorporated with a capital stock of $502,000 to manufacture electric storage batteries. The incorporators are C. Heilig and E. V. Fulton of Wilmington.

THE RENFREW (ONT.) ELECTRIC PRODUCTS, LTD., has been incorporated by Stephen H. Murphy, John A. Jamieson, Thomas A. Low and others. The company is capitalized at $500,000 and proposes to take over the property and business of the Renfrew Electric Manufacturing Company.

THE A. M. CASTLE ENGINEERING COMPANY of Toronto, Ont., has been incorporated by Walter G. Hammond, 24 King Street, West; Jacob H. Greenberg, John D. Bradford and others. The company is capitalized at $275,000 and proposes to manufacture gas and steam engines, electric generators and other machinery.

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New England States

CLAREMONT, N. H.—The Claremont Power Company is contemplating the installation of a new electric generating unit with auxiliary equipment.

SPRINGFIELD, VT.—Plans are under consideration by the Springfield Brass Company for the installation of a new electrically operated furnace at its foundry for brass casting work. Energy for operating the company's works is supplied by the Colonial Light & Power Company of Cavendish.

CAMBRIDGE, MASS.—Plans are being prepared by the New England Telephone & Telegraph Company for an addition to its exchange building on Inman Street.

WARREN, MASS.—A boiler house and new pumping plant will be erected in connection with the new addition to the plant of the Warren Steam Pump Company.

WORCESTER, MASS.—The Worcester Pressed Steel Company is contemplating the erection of an addition to its rolling mill, 90 ft. by 150 ft., to be equipped with electrically operated machinery.

Middle Atlantic States

BINGHAMTON, N. Y.—The Nineteen Hundred Washer Company is planning to equip all the departments of its works for electrical operation. Electricity will be furnished by the Binghamton Light, Heat & Power Company.

BUFFALO, N. Y.—The finance committee of the Board of Supervisors, it is understood, is considering the installation of lighting, heating and ventilating plants in connection with the proposed county home and hospital.

BUFFALO, N. Y.—Extensive alterations and improvements to the municipal pumping station, including the installation of new equipment, are under consideration by the City Council. A bond issue of $136,000, it is said, will be authorized for the work.

BUFFALO, N. Y.—Application has been made to the City Council by Acting Chief M. W. Koester, Great Lakes Communication Service, for permission to erect two steel radio towers, about 200 ft. high, at the foot of Michigan Avenue, in connection with the establishment of a new government radio station for Great Lakes communication.

LONG ISLAND CITY, N. Y.—Loft, Inc., has awarded general contract to John H. Carl for a factory addition, 155 ft. by 200 ft., five stories, on Vernon Avenue, between Dayton and Hamilton Streets. A large garage will be erected in connection with the project. The cost of the buildings is estimated at about $500,000. The company manufactures candy and operates a chain of confectionery stores. Tenney & Ohmes are engineers.

LONG ISLAND CITY, N. Y.—Considerable electric equipment, including motors, light and power wiring, and auxiliary electrical apparatus with pumping apparatus for fire service, will be required in connection with the new manufacturing plant to be erected by the American Chicle Company, 19 West Forty-fourth Street, New York, to be located on Nott Avenue, Long Island City. The cost of the building is estimated at over $1,000,000.

NEWARK, N. Y.—Bids will be received by Mrs. Sarah F. S. Armstrong, president of board of trustees, State Custodial Asylum for Feeble-Minded Women, Newark, N. Y., until May 8 for construction, including heating, sanitary and electrical work for cottage for inmates, at the State Custodial Asylum for Feeble-Minded. Drawings and specifications and blank forms of proposals may be consulted at the above asylum, at the New York office of the Department of Architecture, Room 1715, Tribune Building, and at the Department of Architecture, Capitol, Albany. L. F. Pilcher, Capitol, Albany, is state architect.

NEW YORK, N. Y.—The United Electric Light & Power Company has begun work on the erection of a new transformer station at 201st Street and the Harlem River. The building will cost about $16,000.

NEW YORK, N. Y.—The Wappler Electric Manufacturing Company, 173 East Eighty-seventh Street, is considering the construction of a plant on Harris Avenue, Long Island City, where it proposes to locate its main plant. The company manufactures X-ray equipment, etc.

NEW YORK, N. Y.—Auerbach & Sons, candy manufacturers, have awarded general contract to Marc Eidlitz & Son for the erection of an eleven-story addition, 100 ft. by 200 ft., to their plant at Eleventh Avenue and Forty-sixth Street, to cost about $500,000. Tenney & Ohmes are engineers.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEWARK, N. J.—The Town Council of Hillside is considering extension to the street-lighting system.

NEWARK, N. J.—Preparations are being made by the Lowenstein Radio Company, 50 Spring Street, for alterations and improvements to its plant.

NEWARK, N. J.—Plans have been filed by the Spitdorf Electrical Company, 98 Warren Street, for alterations and improvements in a section of its plant.

NEWARK, N. J.—Bids will be received until April 21 by George C. Bergen, purchasing agent, for furnishing a supply of incandescent lamps for the several county institutions during the coming year.

PEMBERTON, N. J.—The Browns (N. J.) Electric Light Company, recently organized, is contemplating extending its system to Pemberton. A franchise has been granted the company by the Board of Freeholders to erect electric transmission lines along the county road.

COATESVILLE, PA.—Notice has been filed by the Chester Valley Electric Company with the Public Service Commission of an issue of $82,000 in bonds. Part of the proceeds, it is understood, will be used for extensions to its system.

SCRANTON, PA.—The Carleton Coal Company is planning to rebuild its coal breaker at Minooka, which was recently destroyed by fire, causing a loss of about $50,000. The plant was driven by electricity.

WILMINGTON, DEL.—The power plant of the Wilmington & Philadelphia Traction Company was recently damaged by fire, causing a loss of about $10,000.

BALTIMORE, MD.—Samuel T. Williams, 223 North Calvert Street, Baltimore, would like to receive prices on power-plant equipment, including a 250-kw. to 300-kw. generator and engine, directly connected, 250 volts, direct current; directly connected compound engine, and also condenser and air pump, boiler pressure 100 lb., switchboard, instruments, etc.

MILLVILLE, W. VA.—Contract has been awarded by the Northern Virgina Power Company to the Consolidated Engineering Company, Calvert Building, Baltimore, Md., for the erection of an addition to its local electric plant.

MOUNDSVILLE, W. VA.—Plans are under consideration by the C. McKinley Company for the installation of electrically operated machinery to replace steam-driven equipment in connection with the rebuilding of its coal tipple recently destroyed by fire.

HARRISONBURG, VA.—Contract has been awarded by the city of Harrisonburg to Betts & Boice to construct a concrete dam at the municipal hydroelectric plant. The cost is estimated at about $40,000. N. Wilson Davis of Harrisonburg is engineer in charge.

RURAL RETREAT, VA.—The Rural Retreat Power Company, recently organized with a capital stock of $25,000, proposes to supply electricity in Rural Retreat. The company will purchase energy from the Appalachian Power Company of Bluefield, W. Va. J. S. Etter is president.

North Central States

DETROIT, MICH.—The construction of an electric railway from Flint to Davison and Potter's Lake, with continuation to Elba, Lapeer and Imlay, is reported to be under consideration by the Detroit United Railway.

DETROIT, MICH.—Contract has been awarded by the Stecker Electric & Machine Company, 34 Bates Street, for the construction of a factory building, to cost about $135,000, to W. S. Pocock & Company, Hammond Building.

HOWELL, MICH.—The Detroit Edison Company has purchased a site in Howell on which it proposes to erect a distributing station, to cost about $25,000. The company recently purchased the municipal electric plant.

MARQUETTE, MICH.—The Commissioners have authorized bids to be called for the construction of a new municipal electric light plant. It is proposed to send blank forms for bids to a number of contractors. The new plant will be located about one-quarter of a mile below the present plant. Charles Retallic is manager of the municipal electric plant.

TUSCOLA, MICH.—An election will soon be called to submit to the voters the proposal to grant a franchise to the Frauhenmuth Light & Power Company to install an electric lighting system in Tuscola.

CLEVELAND, OHIO.—Plans are under consideration by the Aluminum Castings Company, 2800 Howard Avenue, Cleveland, for the erection of a power house on Harvard Avenue and East Twenty-eighth Street, to cost about $50,000. The G. S. Rider Company, Century Building, is architect.

WASHINGTON, IND.—The City Council has petitioned the Public Service Commission for authority to issue $20,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant.

LIMA, OHIO.—The Lima Electric Railway & Light Company, it is reported is contemplating the construction of a large power plant in Lima. The company is controlled by the Ohio Electric Railway Company of Springfield.

MOUNT UNION, OHIO.—The installation of a municipal electric light plant in Mount Union is under consideration.

WOOSTER, OHIO.—Bids are being asked by H. H. Miller, service director, for lighting the streets of the city. The construction of a municipal electric light plant in Wooster is under consideration.

GHENT, KY.—The Ghent Electric Light Company, recently organized with a capital stock of $5,000, has been granted a franchise to install an electric lighting system.

SMITHLAND, KY.—Contract has been awarded by the Smithland Light & Power Company to the Home Electric & Supply Company of Paducah, at $8,000.

ATTICA, IND.—The Indiana Public Service Commission has granted the Attica Electric Light Company permission to issue $10,000 in bonds to complete its new electric plant.

COLFAX, IND.—The Colfax Electric Company, recently organized, is planning to supply electricity in Colfax. George Davis is interested in the company.

LINN GROVE, IND.—The Commissioners of Wells County have granted the Linn Grove Light & Power Company a franchise to erect an electric transmission line from Riverside to Craigvile, to supply electricity in the latter town and to residents along the line.

LOGANSPORT, IND.—Plans are under consideration by the city officials for the installation of ornamental lamps from College Hill to Spencer Park.

MARION, IND.—The Delta Eletric Company is planning to erect a large addition to its Marion plant for the manufacture of dry cell batteries.

MONMOUTH (R. F. D. from Decatur) IND.—A company is being organized, to be known as the Monmouth Light & Power Company, to furnish electricity for lamps and motors in Monmouth.

SHELBYVILLE, IND.—A company is being organized to utilize the water power of Flat Rock River at St. Paul. The engineers recommend the construction of a dam 280 ft. long across the top and 35 ft. high.

UNIONDALE, IND.—The Commissioners of Wells County have authorized the Union Township Electric Company to erect an electric transmission line from Uniondale to Prospect to enable it to secure energy from the Fort Wayne & Northern Indiana Traction Company.

WINAMAC, IND.—The Winona Telephone Company is contemplating improvements to its system, to cost about $12,500. W. E. Daniels of Knox, Ind., is secretary.

BLOOMINGTON, ILL.—The construction of a power plant is under consideration by the Illinois Tractor Company.

BLOOMINGTON, ILL.—The Union Gas & Electric Company is contemplating improvements to its system, to cost about $50,000. The proposed work will include a boiler house, equipped with three new boilers, and a new exhauster house, to replace the one now in use.

CHICAGO, ILL.—Plans are being prepared for the erection of an addition to the plant of the Pullman Couch Company at Thirty-eighth Street and Ashland Street, to cost, with equipment, about $250,000.

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DEER CREEK, ILL.—The Deer Creek Power & Light Company, recently organized, is planning to erect an electric transmission line from Deer Creek to Cruger. Joseph A. Danforth, Samuel Belsley and others are interested.

EAST PEORIA, ILL.—Plans have been prepared by the Conover-McHenry Elevator Company of Peoria for the construction of a grain elevator in East Peoria, to cost about $250,000. E. B. Conover of the E. B. Conover Grain Company, 322 South Washington Street, Peoria, and others are interested.

HILLSDALE, ILL.—The Rock River Valley Light & Power Company has petitioned the Public Utilities Commission for permission to issue $20,000 in capital stock, and also for a certificate of convenience and necessity to construct and operate an electric light and power plant in Hillsdale, Barstow and Joplin, Ill.

NEW BERLIN, ILL.—The Central Illinois Public Service Company of Mattoon has petitioned the Public Utilities Commission for permission to erect a high-tension transmission line to New Berlin to supply electricity for lamps and motors in the town.

MANITOWOC, WIS.—Plans are being prepared by Lockwood, Green & Company, industrial engineers, 38 South Dearborn Street, Chicago, Ill., for an additional plant for the Aluminum Goods Manufacturing Company at Manitowoc, including a five-story building, 160 ft. by 280 ft., to cost about $600,000.

MANITOWOC, WIS.—Kelsey, Brewer & Company of Grand Rapids, Mich., are planning to establish an electrically operated coal dock in Manitowoc, at a cost of between $150,000 and $200,000, for handling the fuel supply of their properties in this territory. The company owns and controls a number of hydroelectric and steam generating plants in Wisconsin and eastern Minnesota. Gaylord C. Cummings is in charge of the work.

THREE RIVERS, WIS.—Plans are being completed by Lockwood, Green & Company, 38 South Dearborn Street, Chicago, Ill., for the erection of three new buildings at the plant of the Aluminum Goods Manufacturing Company, one three-story, 60 ft. by 320 ft., to cost $250,000; one four-story, 60 ft. by 300 ft., $250,000, and one three-story, 44 ft. by 137 ft., $40,000.

KELLY LAKE, MINN.—The Town Board has decided to install electric lamps on the principal thoroughfares in the town.

ST. PAUL, MINN.—The St. Paul Union Depot Company has temporarily abandoned plans for the installation of a $250,000 power and heating plant, auxiliary to the new union station. The proposed plant will not be built for at least two years. The depot company is negotiating with the Northern States Power Company for heat, light and power for the new head house which will be ready for occupancy late this summer.

ATLANTIC, IOWA.—General contract has been awarded to David G. Fisher & Company, engineers, 206 East Fourth Street, Davenport, for an addition to the municipal electric power plant. The output of the plant will be increased by 500 kw. The cost is estimated at $30,000.

DUBUQUE, IOWA.—Extensions to the ornamental lighting system are under consideration.

OTTUMWA, IOWA.—At an election held April 1 the proposal to construct and operate a municipal electric light plant in Ottumwa was carried.

CARROLLTON, MO.—The Water, Light & Transit Company is considering the installation of centrifugal pumps and other equipment at its waterworks plant. E. E. Harper of Kansas City, Mo., is engineer.

ST. JOSEPH, MO.—Swift & Company are planning to erect an addition to their boiler room, to be equipped with two 500-hp. boilers with chain-grate stokers and two boiler-feed pumps, to cost complete about $90,000.

ST. LOUIS, MO.—The Valier-Spies Milling Company is contemplating the construction of a grain elevator, to cost about $1,000,000.

SIKESTON, MO.—At an election to be held June 2 the proposal to issue $75,000 in bonds to establish a municipal electric light plant will be submitted to the voters.

LINCOLN, NEB.—Bids will be received by the city of Lincoln until April 25 for a four-cycle Diesel engine directly connected to approximately 300-kw., three-phase, 60-cycle, 4400-volt alternator, switchboard, etc. Theodore H. Berg is clerk.

OMAHA, NEB.—The Overland Tire & Rubber Company, W. O. W. Building, has awarded general contract to the Vaughn Construction Company for the construction of power house, to cost about $8,000.

OSWEGO, KAN.—Bonds to the amount of $50,000 have been voted for the installation of a municipal electric light plant in Oswego.

Southern States

LA GRANGE, GA.—Bids will be received by the town of Southwest La Grange until May 1 for construction of approximately 11 miles of sewers, disposal plant, 4 miles of water mains, storage reservoir, 2 miles of electric transmission line, one 500,000-gal. filter and one 500-gal.-per-minute horizontal centrifugal pump, directly connected to motor, and for furnishing all material. Specifications may be procured and plans seen at the office of G. H. Sargent, city engineer, La Grange. A deposit of $10 will be required for each set of plans.

BUSHNELL, FLA.—Bonds to the amount of $10,000 have been sold by the city, the proceeds to be used to establish a municipal electric light plant.

LEESBURG, FLA.—Bonds to the amount of $35,000 have been voted for the construction or purchase of an electric lighting system.

PIERCE, FLA.—Contract has been awarded by the American Agriculture Chemical Company to G. A. Miller of Tampa, Fla., for the construction of a steam turbine power plant.

SEBRING, FLA.—The Sebring Light & Water Company is contemplating improvements to its electric light plant.

CHATTANOOGA TENN.—The Chattanooga Railway & Light Company is planning to rebuild its passenger and power station at the head of Lookout Mountain incline and also to restore the electrically driven hoist and car.

NASHVILLE, TENN.—Bonds to the amount of $60,000 have been voted for the installation of a boiler in the electric light plant.

GLOSTER, MISS.—Bids will be received by the Mayor and Board of Aldermen of the town of Gloster until April 28 for furnishing and installing an oil engine and motor-driven pump and oil-storage tank. Specifications, form of proposal, plans, etc., may be seen at office of the Mayor in Gloster, or may be obtained upon application to Xavier A. Kramer, consulting engineer, Magnolia, Miss.

ROLLING FORK, MISS.—The installation of an electric light plant is under consideration by the City Council.

BATESVILLE, ARK.—H. V. Hoyt is contemplating the installation of electric generating equipment in his grain elevator to supply electricity for lamps and motors in the village of Batesville.

DE WITT, ARK.—The Arkansas Light & Power Company of Pine Bluff has been granted a franchise to supply electricity and water in De Witt.

NEWARK, ARK.—H. V. Hoyt of Newark is contemplating the installation of an electric generator in connection with his grist mill to supply electricity for the city.

PARAGOULD, ARK.—The City Council is considering the construction of a municipal electric light plant, to cost about $100,000.

PINE BLUFF, ARK.—The Arkansas Light & Power Company has been granted a franchise to supply electricity for lamps and motors in the town of De Witt, 20 miles distant. The company now has a transmission line running to a point 8 miles from Gillette, which will be extended 12½ miles further to De Witt. H. C. Couch is president of the company.

DE RIDDER, LA.—At an election to be held April 22 the proposal to issue $90,000 in bonds for the installation of an electric light plant and pumping station will be submitted to the voters. Xavier Kramer of Magnolia, Miss., is engineer.

DUNCAN, OKLA.—Contract for equipment for power plant has been awarded to the N. S. Sherman Machine & Iron Works of Oklahoma City, Okla., at $33,000. The Benham Engineering Company, Colcord Building, Oklahoma City, has charge of the engineering work.

NEWKIRK, OKLA.—Bids, it is reported, will be received by the city of Newkirk about May 20 for rebuilding the electric light and waterworks systems, including the installation of two 40-hp. motors and three 165-hp. oil engines. H. G. Olmstead is city engineer.

FORT WORTH, TEX.—A bond issue for $50,000 to provide funds for extensions to the municipal electric light system is under consideration by the City Council.

FORT WORTH, TEX.—An election will soon be held to vote on the proposal to issue $50,000 in bonds for extensions to the municipal electric lighting system.

SAN ANGELO, TEX.—Bonds to the amount of $500,000 have been voted to construct an electric light and power plant and waterworks in San Angelo or the purchase of the plant of the Interstate Electric Corporation.

STAMFORD, TEX.—Plans are being prepared for improvements to the waterworks system, to cost about $400,000. The work will include construction of concrete dam and installation of turbine engines.

Pacific and Mountain States

SEATTLE, WASH.—Bids will be received by the Commissioners of Kings County until May 5 for the installation of electrical exhaust blower in the basement of the County and City Building.

BRAWLEY, CAL.—The installation of a municipal electric light plant in Brawley is under consideration by the City Trustees.

LOS ANGELES, CAL.—A permit has been granted to the Clune Production Company for the erection of a dark stage and power plant.

SAN FRANCISCO, CAL.—Surveys are being made for a dam site on Pitt River above Copper City in connection with the proposed hydroelectric development by the Pitt River Power Company. The plans provide for two power developments to cost about $17,500,000. The first dam will be located near Sheep Rocks, 4 miles from Copper City, and the second dam is to be 12 miles up the river near the mouth of Totem Creek.

SALT LAKE CITY, UTAH.—Improvements to the waterworks supply lines, power plants, etc., to cost about $1,000,000, are contemplated by the City Council.

DILLON, MONT.—Plans are under consideration for the installation of a new street-lighting system and paving the streets. The cost of the entire work is estimated at about $80,000.

MISSOULA, MONT.—Engineers have been engaged by the Missoula Light & Water Company for the purpose of perfecting plans for sluicegates at the company's dam near Bonner, the cost of which is estimated at more than $60,000.

GALLUP, N. M.—The Gallup Electric Light & Power Company, recently incorporated, will take over the electric light and power plant, owned by Gregory and associates. The plant, it is understood, will be enlarged and the service improved.

Canada

SQUAMISH, B. C.—Contract has been awarded by the provincial government of British Columbia for the construction of a hydroelectric plant at Squamish to Robertson & Partners, Metropolitan Building, Vancouver, B. C., to cost about $72,000. The plant will supply electricity for the railway shops and other industries in Squamish.

BANCROFT, ONT.—The Canada Marble Company, 18 Toronto Street, Toronto, is planning to develop its quarries at Bancroft. The cost of machinery and equipment is estimated at about $500,000.

CORNWALL, ONT.—Work has begun on the construction of the proposed new substation to be erected by the Hydro-Electric Power Commission of Ontario.

FORT WILLIAM, ONT.—The Black & Muirhead Elevator was recently destroyed by fire. The building and machinery were valued at nearly $200,000.

GUELPH, ONT.—Plans are being prepared for the erection of four buildings, to cost about $200,000, for the Ontario Agricultural College. F. R. Heakis, Parliament Buildings, Toronto, is architect.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 1 for furnishing copper wire and cable, brass tubing and electrical supplies, etc., under circular 1270.

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Record of Electrical Patents

Notes on United States Patents

(Issued March 18, 1919)

1,297,781. LIGHTING FIXTURE; George M. Beardslee, Chicago, Ill. App. filed Aug. 28, 1917. Relation between the lamp and the shade or bowl may be adjusted.

1,297,822. DIMMING DEVICE; Otis R. Ford, Pittsburgh, Pa. App. filed May 4, 1914. Variable-resistance tube attached to automobile steering post.

1,297,857. EMERGENCY POWER EQUIPMENT FOR ALTERNATING-CURRENT SYSTEMS; Harry M. Jacobs, Schenectady, N. Y. App. filed Sept. 17, 1915. Auxiliary motor-generator set for emergency signal energy.

1,297,858. ELECTROMAGNETIC COIL; Kenneth S. Johnson, Jersey City, N. J. App. filed Dec. 10, 1917. Suppresses low frequency but permits transmission of high-frequency currents.

1,297,879. ELECTRICAL CONTROLLING DEVICE; Charles F. Lorenz, Cleveland, Ohio. App. filed April 12, 1917. Illumination intensity may be simply and easily controlled either at lamp socket or at a remote point.

1,297,903. COMMUTATOR TERMINAL AND METHOD OF MOUNTING SAME; Henry H. Phillips, Niagara Falls, N. Y. App. filed April 17, 1914. Means for attaching a commutator terminal to commutator segment.

1,297,905. TELEPHONE TRANSMITTER; Arthur P. Pinkler, Ridgefield, N. J. App. filed May 10, 1916. Microphonic.

1,297,912. DEAD-FACE SWITCHBOARD; Albert N. Rogers, Irwin, Pa. App. filed April 17, 1914. Switches mounted on rear of board.

1,297,918. PRIMARY BATTERY; Charles B. Schoenmehl and Martin L. Martus, Waterbury, Conn. App. filed Feb. 9, 1917. Prevents disintegrated material from short-circuiting battery.

1,297,919. ELECTROMAGNET; Edward Schwartz, New York, N. Y. App. filed Aug. 31, 1918. Adjustable for electric buzzers.

1,297,929. DIFFERENTIALLY CONNECTED EXPLORING COILS; John B. Taylor, Schenectady, N. Y. App. filed Sept. 28, 1915. Coils some distance apart produce sound when near fault.

1,297,931. ELECTRIC FUSE; Francis I. Thiebaut, San Francisco, Cal. App. filed April 13, 1918. Glass body with detachable end caps.

1,297,935. PROTECTION OF PARALLEL FEEDERS; Oliver C. Traver, Schenectady, N. Y. App. filed March 3, 1917. Feeder at fault individually opened.

1,297,936. PROTECTION OF PARALLEL FEEDERS; Oliver C. Traver, Schenectady, N. Y. App. filed March 3, 1917. See above patent.

1,297,938. COOKING UTENSIL; Dana P. Varner, Baltimore, Md. App. filed Aug. 30, 1918. Sounds alarm when contents reach certain point.

1,297,945. AUTOMATICALLY EXTINGUISHING ELECTRIC LIGHTING SYSTEM; John R. Warden and Howard C. Warden, Jr., Paducah, Ky. App. filed July 23, 1917. Operated by thermatic and mercury-tube circuit breakers.

1,297,953. SYSTEM OF TRANSMISSION; Max A. Whiting, Schenectady, N. Y. App. filed June 13, 1917. Prevents unstable conditions in induction motors for driving hoists.

1,297,965. ELECTRIC RIVETING APPARATUS; Neil MacNeale, Cincinnati, Ohio. App. filed Aug. 25, 1916. Electrode and a riveting die are applied successively.

1,297,966. ELECTRIC RIVETING APPARATUS; Neil MacNeale, Cincinnati, Ohio. App. filed Sept. 26, 1916. See above patent.

1,297,979. MAGNETICALLY CONTROLLED SWITCH; Herman L. Van Valkenburg, Milwaukee, Wis. App. filed April 7, 1916. Used in connection with motor starter.

(Issued March 25, 1919)

1,297,989. REGULATOR FOR MOTOR-GENERATOR SYSTEMS; John A. Bairns, Detroit, Mich App. filed July 24, 1915. For automobiles.

1,297,996. SWITCH FOR ELECTRIC CIRCUITS; Carl Bramming, Chicago, Ill. App. filed Oct. 16, 1917. Automobile use.

1,298,000. TIME-INDICATING SYSTEM; James W. Bryce, Bloomfield, N. J. App. filed Sept. 7, 1917.

1,298,032. ELECTRICALLY CONTROLLED ELEVATOR; Floyd C. Furlow, Montclair, N. J. App. filed April 22, 1915. Small direct-current generator driven by elevator supplies energy to storage battery.

1,298,107. ELECTRICAL SYSTEM; Karl A. Simmon, Edgewood Park, Pa. App. filed March 4, 1916. Supplied from line circuits of relatively high and variable potentials and delivers currents of low and constant potential.

1,298,148. ELECTRODE OF SECONDARY BATTERIES; Edward F. Ablitt, London, Eng. App. filed Oct. 31, 1918. Can be rolled up into spiral forms with separators between them.

1,298,155. MACHINE FOR POINTING METALLIC ARTICLES BY ELECTROLYTIC ACTION; Marcus O. Anthony, Englewood, N. J. App. filed Aug. 4, 1916.

1,298,175. AUTOMATIC HEAT ALARM; Paolo Cardone, Brooklyn, N. Y. App. filed Feb. 23, 1918.

1,298,179. INCANDESCENT ELECTRIC LAMP; Jacob H. Coggins, Talladega, Ala. App. filed Jan. 22, 1917. Multi-filament.

1,298,217. INTERCOMMUNICATING SET; George M. Jenkins, Paris, France. App. filed Nov. 3, 1917. Strapped to head of pilot and observer in an aëroplane.

1,298,225. MAIL BOX FOR RURAL DISTRICTS; Alexander F. Krieger, St. Joseph, Mich. App. filed Sept. 25, 1915. Wheels of mailman's vehicle open cover of box to permit ready insertion or removal of mail.

1,298,237. TELEPHONE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed Nov. 21, 1917.

1,298,293. TELEPHONE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Oct. 29, 1917.

1,298,297. INSULATED WIRE; William E. Cook, New York, N. Y. App. filed April 24, 1917. Outside braid dispensed with, covering for wire being held in place partly by an adhesive.

1,298,299. ELECTRIC INCANDESCENT LAMP; John H. Dale, New York, N. Y. App. filed Jan. 20, 1915. Heat insulator placed between wall of lamp and metallic base.

1,298,301. WATER-HEATING SYSTEM; Virgil E. David, Omaha, Neb. App. filed April 1, 1918. Heater operates water-controlling means.

1,298,321. TERMINAL BANK; Oscar F. Forsberg, Yonkers, N. Y. App. filed March 29, 1916.

1,298,322. LOCK-ACTUATED CIRCUIT BREAKER FOR IGNITION SYSTEMS OF EXPLOSIVE ENGINES; Otto Forthmiller, Minneapolis, Minn. App. filed April 5, 1918.

1,298,330. CONTACT BANK; Charles L. Goodrum, New York, N. Y. App. filed June 19, 1917. Conductors readily inserted, removed or adjusted.

1,298,339. TELEPHONE SYSTEM; Harvey L. Harris, Elyria, Ohio. App. filed April 26, 1915. Responding party cannot connect his receiver to conductors that are connected to source of ringing current during ringing period.

1,298,354. SWITCHING SOCKET; George C. Knauff, Chicago, Ill. App. filed Jan. 17, 1917. Circuit made or broken without relative movement of the two terminal carriers.

1,298,365. TELEPHONE-EXCHANGE SYSTEM; James L. McQuarrie, Montclair, N. J. App. filed Oct. 20, 1917.

1,298,375. ELECTROMAGNETIC POWER-TRANSMITTING APPARATUS; Alfons H. Neuland, San Francisco, Cal. App. filed Aug. 8, 1914. Driven member may rotate at different angular velocity from that of driving member.

1,298,376. ELECTROMAGNETIC TRANSMISSION; Alfons H. Neuland, New York, N. Y. App. filed Jan. 18, 1916. Capable of exerting greater pull than applied torque.

1,298,384. ILLUMINATOR FOR WRITING ELEMENTS; Byron L. S. Perrin, Ottawa, Ontario, Can. App. filed July 18, 1916. Lamp illuminated by replacing cap upon rear end of fountain pen.

1,298,396. CONDENSER; Albert Pruessman, Berwyn, Ill. App. filed Dec. 18, 1916. Multiple-unit type.

1,298,400. MACHINE-OPERATING MECHANISM; Lynus C. Reynolds, Washington, D. C. App. filed July 6, 1918.

1,298,414. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed July 15, 1915. Telephone line released immediately after conversation is terminated.

1,298,420. AUTOMATIC SIGNAL; Harvey E. Tharp, Smith Center, Kan. App. filed Sept. 14, 1917. When pneumatic tire becomes deflated to a certain degree a signal is actuated.

1,298,421. ZIGZAG CARBON ELECTRIC RESISTOR; John Thomson, New York, N. Y. App. filed April 16, 1918. Carbon element rendered immune to oxidization.

1,298,433. ELECTRICAL SYSTEM OF POWER TRANSMISSION AND REGENERATIVE BRAKING; Clinton J. Axtell, Schenectady, N. Y. App. filed Feb. 4, 1918. Variations in speed upon braking torque produced are compensated.

1,298,440. AUTOMATIC TRANSMITTER; George R. Benjamin, Jersey City, N. J. App. filed April 26, 1915. Perforated tape controls closing and breaking of plurality of contacts.

1,298,441. TELEPHONE SYSTEM; Sidney A. Beyland, North Ridgeville, Ohio. App. filed June 23, 1915. Ringing controlling means released for further use after ringing connections have been completed.

1,298,442. ELECTRICAL SYSTEM FOR MOTOR VEHICLES; Joseph Bijur, New York, N. Y. App. filed July 7, 1914. Constant-current regulation.

1,298,443. TRANSFORMING DEVICE; Theodore Bodde, Lynn, Mass. App. filed April 13, 1916. Constant current obtained from constant-potential sources without employing devices having moving parts.

1,298,457. VARIABLE RESISTANCE; Theodore W. Case, Scipio, N. Y. App. filed Feb. 9, 1917.

1,298,462. ELECTRIC RAILWAY CONTROL SYSTEM; Charles B. Connely, Scotia, N. Y. App. filed Nov. 10, 1915. Switches automatically respond to a change in voltage.

1,298,464. ELECTRIC SWITCH; John L. Creveling, New York, N. Y. App. filed Dec. 29, 1911. Automatic, for generator supplying storage batteries.

1,298,465. GENERATOR; William W. Dean, Stamford, Conn. App. filed April 25, 1917. Tripolar core-structure type has flux-generating element producing flux reversals.

1,298,490. ELECTRICAL OSCILLATION GENERATOR; Leonard F. Fuller, San Francisco, Cal. App. filed July 12, 1916. Arc generator has large power output in proportion to size.

1,298,505. AUTOMOBILE RADIATOR; Mortimer C. Hollister, Elgin, Ill. App. filed June 19, 1917. Heater for protecting radiator against freezing.

1,298,513. TREATING LIQUOR FROM REDUCING PROCESSES OF NITRATED COAL-TAR DERIVATIVES; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 26, 1918.

1,298,534. IGNITION DYNAMO; Charles T. Mason, Sumter, S. C. App. filed April 19, 1916. Condenser attached directly to circuit by metal terminals.

1,298,562. ADJUSTABLE SUSPENSION DEVICE; Timothy B. Powers, New York, N. Y. App. filed Dec. 13, 1917. For hanging electric lamp.

1,298,569. APPARATUS FOR EXHAUSTING INCANDESCENT LAMPS; Robert Le Rossignol, Berlin, Germany. App. filed Jan. 30, 1917. Large number of lamps exhausted and sealed at same time.

1,298,588. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed Nov. 12, 1914. Line-circuit and other apparatus automatically released at end of call.

1,298,589. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed June 19, 1915. Single set of controlling mechanism for substation signals at each operator's position.

1,298,590. ELECTRIC ARC WELDING; Andrew Smith, San Mateo, Cal. App. filed Aug. 17, 1914. Weld produced by series of utomatically controlled steps.

1,298,603. WELDING CONTROLLER; Edwin B. H. Tower, Jr., Milwaukee, Wis. App. filed March 11, 1915. Circuit is always in condition for safe operation.

1,298,608. FUSE BOX; Albert A. Wells and Harry B. Fife, Detroit, Mich. App. filed Aug. 29, 1917. Cover containing fuses opened and drawn down and away from box to permit renewal of fuses safely.

1,298,609. SHEATHED-WIRE TERMINAL; Arthur M. Wentworth, Pittsfield, Mass. App. filed Sept. 25, 1918. Separate elements fit snugly over ends of core wire.

1,298,613. WIRELESS SIGNALING SYSTEM; William C. White, Schenectady, N. Y. App. filed April 23, 1915. Either receiving apparatus or transmitting apparatus automatically connected to antenna.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 — New York, Saturday, April 26, 1919 — *Number* 17

Need of Publicity

PUBLICITY is a very potent force for good provided it is wholesomely and properly applied and withal at an appropriate time. In industrial and in corporate life just as in the workaday world

> There is a tide in the affairs of men
> Which, taken at the flood, leads on to fortune;
> Omitted, all the voyage of their life
> Is bound in shallows and in miseries.
> On such a full sea are we now afloat,
> And we must take the current when it serves
> Or lose our ventures.

But no amount of publicty will avail anything nor can any argument or excuse atone for inferiority of service or merchandise, or for pledges broken or obligations slighted, or for costs which are excessive. The cause must be just and worthy if publicity is to be of any service to it at all.

Now, there is much about the electric utility business, and particularly about the manifold uses of electricity, that the public does not know and on which it must have enlightenment if maximum use of electricity with mutual advantage is to result. There is not a widespread public knowledge of the fact that the same wonderful, flexible power which can propel the most ponderous train swiftly across the steepest mountain grade can also be used to manipulate the finest needle or the most delicate instrument. The consciousness that electricity has contributed incalculably to modern civilization and that its application will solve many of our most pressing industrial and domestic problems is not entirely developed. Likewise, the general public fails to realize the difficulties under which service is rendered and the injustice of a legally stipulated and almost immovable price. Only when these questions are brought home intimately can a sympathetic hearing be obtained.

Of what immense value would enlightened public opinion have been to the street railways of the country in their adversity if they had given information regarding their affairs to the public in the last decade! Their function is to carry passengers, but they have also borne other semi-public burdens, such as paving, removal of snow, etc. There can, however, be no upright opinion without knowledge, and this the railway companies were too late in imparting. Is it not owing to the publicity campaigns of the telephone systems, as well as to their good service under corporate control, that the present policy of government ownership and control by contrast appear so obnoxious? And is there not a lesson here for the electric utilities? Indeed, the National Electric Light Association can well afford to see to it that the problems of the electric utilities are so spread before the public that he who runs may read, and that the possibilities inherent in the application of electricity are set forth so that the housewife, merchant, manufacturer, and the nation as a whole, will instinctively turn to electricity for relief. While it is most fortunate that electricity is its own best advertiser, it is also most unfortunate that neither the public nor the industrial world has an adequate comprehension of the full possibilities of its application. Here is work to which the National Electric Light Association can well apply itself.

But this is only one phase of the problem, and, important as it is, there are other problems within the public utility field itself awaiting solution which involve the central station and other branches of the industry on which the National Electric Light Association can also concentrate its energies and resources in the public interest. These have to do with the questions of standardization of service and equipment, uniformity in commission regulations and rulings, ordinances and franchises, valuation, rates and the utilization of natural resources. As the authority in such matters, the National Electric Light Association has an obligation to acquaint the public with the facts. There can be no doubt about the need of more general knowledge and the desirability of undertaking the work of imparting it at once. The need is plain, and we believe that the mere statement of it will quicken action toward the desired end.

Results count for more than costs. Delegates to the National Electric Light Association convention at Atlantic City, beginning on May 19, will learn what post-war problems mean in a good many localities. The expense will yield a return that by comparison will make the return allowed by commissions look seasick.

The Victory Loan

SOME of those who went into the war have paid the full cost. No more is asked, can be asked, of them. They have given with willing heart that freedom might live. The name and fame of America's part in the war are inseparable from their sacrifice. Many others did all that they could do in different ways that were vitally necessary, but they were not called on to offer their lives in danger on the battlefield. It is a great obligation which we face toward these who took the risks at the front. This obligation is brought to mind by the poster printed by the publisher of the ELECTRICAL WORLD and distributed with this issue. Heroes who fought and died, heroes who fought and lived, did their part to put the victory into "Victory Liberty Loan." They did not lend, they gave. It is up to the rest of us to lend the money so that Uncle Sam can pay the bills. The hardest work of the war is done, the road is clearer ahead, the fifth loan will finish the job.

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Distribution in Industrial Plants

THE most frequent trouble with electrical industrial installations is that they just grow without a properly coherent plan of operations. A few motors go in, then a few more, and by the time the work is complete it is tangled and as a whole inefficient. F. L. Leurey exhibits to our readers an excellent example of quite the other thing—the evolution of a well planned and executed equipment with an eye to results in the larger aspect and to ordered simplicity and economy. The equipment considered is that of a big sugar refinery with about 400 motors devoted to a wide variety of purposes and aggregating some 6000 hp. The total load factor is, however, somewhat favorable, since the plant runs twenty-four hours per day and only locally displays unusual load changes.

The power plant here is for 480-volt, three-phase distribution, in three units, with fourteen feeder circuits. The distribution was almost necessarily in conduits, and the feeder system was laid out on the basis of three 500,000-circ.mil cables per conduit. Uniformity of loading was secured by adroit routing of these main feeders. To continue the orderly progress of affairs standard steel switchboards were designed for the subdistribution with standard conduits and fittings, so that, however crowded with machinery the space may be, the boards are safe and easy to handle. To give opportunity for the necessary changes in machinery the whole working space was gridironed with sub-feeders to serve as always available sources of power. The standard subfeeder is of three No. 1 wires and is generally run beneath the floor slab so that the control may be reached by a short riser. Like the switchboards and feeders, the starting equipment is standardized in a few simple forms. Altogether, a study of this particular industrial equipment reveals a singularly orderly and effective development of an apparently intricate system from simple elements simply combined.

Was the war worth the price? Are the boys who come back worth bothering over? You don't hear pessimistic remarks on the real issue. We may sidestep on the minor questions, but on the great big issue of the war won for the sake of a decent world the vote is about unanimous. And the true meaning of it is starting new life in every industry.

Dean Cooley's Vision of the Engineer

THREE things stand forth in the views of Dean Cooley of Michigan on the field of the American engineer. These, it will be seen from the article printed elsewhere, are his potential service as a link between labor and capital, his qualifications to enter public life, and the desirability of broadening and humanizing his college education. The growing discussion of the subject by technical men and others leads, indeed, pretty generally to this tripartite conclusion. It is an attractive vision. First, we have the American engineer in the shop, inspiring and instructing the workmen under him, understanding them, their needs and their ambitions, and proving the ideal mediator between them and their employers. In taking such a part the engineer, rather than the capitalist, becomes the veritable captain of industry, and this is as it should be. Second, we have the American engineer in the legislative halls and the executive chair—perhaps even in the White House, and it must not be forgotten that if only one engineer has ever risen to be the President, he was the first and greatest. In public office, as has often been contended, the engineer's analytical mind, reasoned processes and gift of foresight should enable him to serve his community and the nation with distinction and success. Third, we have the American engineer as an element in the cultural forces of the country—not afraid to make an occasional excursion into the realms of literature, art or music, not ignorant of the classics of his mother tongue nor yet obliged to sit mute and uncomprehending in international councils where the proceedings are not in English—taking his place, with unstarved imagination, among other men of catholic development.

Only the occasional man, of course, can combine in himself the attributes of the practical worker, the technician, the statesman and the all-around scholar. Him we call great. But all engineers, graduates and students alike, can strive for fuller accomplishment both in their trade and in their citizenship, and in avoiding the whirlpool of scattered energy can steer clear also of the rock of specialization too narrow and intense.

New England telephone workers were wrong in resorting to strike, because striking is inadmissible in a public utility. The government authorities, however, were wrong in relying altogether on public condemnation of the strike. They failed to get public support because their service is fautly and they were poorly advised in refusing to correct just causes of grievance on the part of employees.

Some Uses of Spot Welding

ELECTRIC welding as a substitute for riveting has been gradually coming into use for some years, and the rush work done during the war in shipbuilding and similar classes of metal working has demonstrated the usefulness of the new process. G. A. Hughes and R. H. Pool in a very recent issue gave a clear and simple account of the several types of spot welding which have come into use for various work which earlier depended entirely upon riveting. Both arc welding and resistance welding are successfully applied in this way. In the former process it is usual to punch one of the sheets to be joined, as if for rivets, lap it on a plain sheet, and then bring the arc welder to work at the hole, welding in a solid plug to serve as a rivet. It is a quick and comparatively cheap process, not yet fully standardized and lacking some information as to the permissible size of spots and strength of the complete weld, yet very promising of good economic results. Spot welding with the resistance process brings somewhat heavy pressure at the point of contact with the electrodes and actually melts the work together at this particular point. The contact electrodes are of copper, and one of the outstanding difficulties of the process is the limitation to the pressure which can be applied to these relatively soft electrodes in forming a weld. Inasmuch as the strength of the weld depends on the final squeeze when metals are being melted together and the necessary force of this bears some relation to the thickness of plate, there is a limitation on thickness thus imposed. Just what the value of this limit may be remains undetermined. Work up to a thickness of ¾ inch (19 mm.) has been handled by the authors with special machines, but the resistance process is much easier on the thinner plates.

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There seems little doubt that electric spot welding is likely to be used to a very large extent to supplant ordinary riveting for many purposes. The important thing is to make a neat and tight joint, and this can be made quickly and cheaply by the welding process with sufficient strength for, certainly, the majority of purposes. It is likely that in the long run in such work as shipbuilding arc welding, resistance welding and riveting will all be used freely, each where the particular circumstances of the work give it the advantage. Welding as compared with riveting is quick, cheap and noiseless, and it is sure, we think, to find steadily increasing application. It is one of the interesting instances in which an old plan worked out in considerable detail a good twenty years ago has invaded under new economic conditions a wide field in which its early progress was but slow.

Charges that money might have been more efficiently expended by the government in the conduct of the war form a poor excuse for indifference toward the Victory Liberty Loan. With all her blunders and wastefulness, America came through gloriously, and shall we leave it to others to set the seal of financial indorsement upon our common achievement?

A Striking Case of Interconnection

THE union of neighboring transmission systems into a coherent network, pooling steam and hydraulic plants for common usage, is now so frequent as hardly to call for comment. Now and then, however, operating conditions arise which involve unusual features of practice well worthy of attention. Such an instance is found in the California scheme of interconnection described in our columns this week by L. J. Moore. The case concerned is the physical union of three important plants, those of the Southern California Edison Company, the San Joaquin Light & Power Corporation and the Mount Whitney Power & Electric Company. The first named has a group of hydraulic and steam plants in the Los Angeles territory and three big water plants far across the mountains, one on Kern River and two others on Big Creek; the second group consists of nine hydroelectric plants in the central California region with a couple of reserve steam stations, while the third operates water plants on the Kaweah and Tule Rivers and also a 5000-kw. steam reserve. An unusual feature of the situation is that the Edison plant operates at 50 cycles, the others at 60 cycles. There is one considerable reservoir on the San Joaquin system and another reinforcing the Big Creek plants. As all the generating stations concerned are on the same or closely similar watersheds, the need of storage or steam is imperative.

The first step toward mutual interconnection was taken two years ago to help out the Mount Whitney Company. A long 30,000-volt link was built, and one of the Kern River generating sets was speeded up to 60 cycles and cut in on the Mount Whitney connection. A little later the transmission was raised to 60,000 volts and tied in en route with the San Joaquin system. Thus as many of the four machines in the Edison Kern River plant No. 1 as are needed are raised to 60 cycles and put on the joint line. Finally, a few months ago a 5000-kw. frequency changer was tied in to transfer moderate loads without speeding up or slowing the generators and to facilitate the adjustment of power factor and voltage. The interconnection seems to work out admirably in practice, especially since the diversity factor is a rather favorable one, and what is more, it is possible to furnish power at times of short water from the most economical of the available steam plants. The Mount Whitney steam reserve is the least desirable on the score of cost of production, and at present it pays to replace its output from the Redondo or Long Beach steam plants or even from the distant Bakersfield station, which burns oil and natural gas. It is found that in changing the frequency by varying generator speeds there is some variation in prime-mover efficiency rather favorable to the lower periodicity, but this method of interchange involves no particular difficulties and the whole scheme of interconnection works out advantageously. The case is a rather extreme one, for the distances involved are long and the separate systems extensive, yet the interchange is a source of substantial saving and great convenience at times of scant water.

The stability shown by the central-station industry during the past five months is a basis for indestructible optimism as we look toward the future of electrical service. Could any better test have been devised of the adaptability of the industry to meet changing conditions?

The Electrification of an Army Base

THE army supply base at Boston, designed as a terminal and shipping point for general supply service, is a remarkable example of organization for rapid and efficient service in which electricity plays a peculiarly important part. The base, which is directly on the water front, has a working area of somewhat more than 40 acres (16 hectares) and pier facilities for accommodating simultaneously ten of the standard vessels of the Emergency Fleet Corporation. The main storehouse, of reinforced concrete, eight stories high, has about 35 acres (14 hectares) of floor space and is connected with an immense two-story wharf shed of which the upper story is on the level of the third floor of the storehouse.

To facilitate quick and efficient service it was determined to equip the whole terminal electrically for freight handling and general use. To this end the buildings are fitted with forty-six electric freight elevators, six automatic passenger elevators, twenty-four electric winches and four cranes. Besides the outfit for the buildings there are forty small storage-battery tractors and 600 trailers. It is reckoned that 200 carloads can be unloaded in ten hours, while the wharf shed cranes can load an 8000-ton vessel in less than sixty hours' working time. The freight elevator equipment consists of four 5-ton units in each of the six independent sections into which the storehouse is divided.

The plant is operated by a substation initially of 4500-kva. rating fed by duplicate 13,800-volt cables from the Edison station. The general distribution is at 2300 volts stepped down to 110 or 220 for the motor and lighting service. During the building of the plant an 800-kva. temporary substation was installed to furnish power during the construction period. This station, it is interesting to note, was put up complete in less than thirty days from the start, together with about 14 miles (23 km.) of line wire with the necessary poles, 1000 outlets for interior wiring of temporary structures, thirty motors and twenty transformers—a rush job of highly efficient character.

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Synchronous Motor Characteristics—I

The Heyland Diagram for the Induction Motor Is Applied to Synchronous Motors with Squirrel-Cage Windings in Order to Investigate Starting and Pull-in Torques—Brass and Copper Compared for Rotor Bars

BY THEO. SCHOU
Consulting Electrical Engineer, Electric Machinery Company

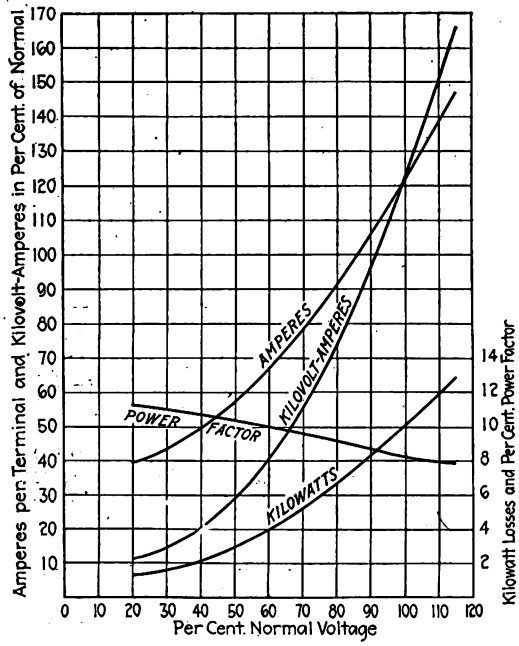
THE polyphase synchronous motor starts, and behaves during the starting period, like an ordinary induction motor. An induction motor, however, even at no load, can never reach synchronous speed, whereas a synchronous motor of the defined pole construction will draw itself into synchronous speed, and even carry considerable load, before the field excitation is applied. In the first of two articles it is the purpose of the author to show how the Heyland diagram may be used to investigate the starting characteristics of synchronous motors and to apply the method to a comparison between motors with copper and brass squirrel-cage windings in regard to starting performance. In the second paper a compound squirrel-cage winding will be discussed, showing an excellent device for obtaining good starting torque as well as high pull-in torque.

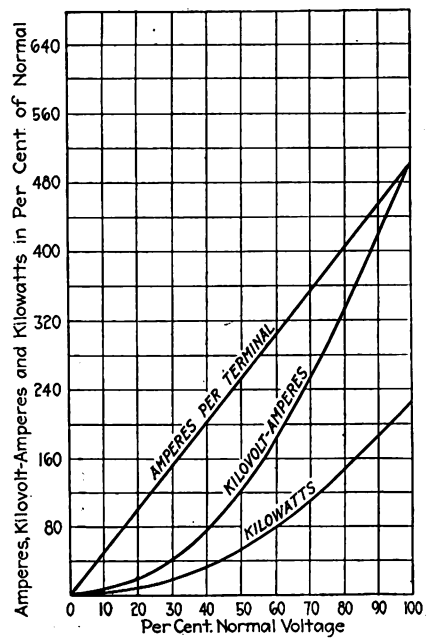
The fact that the synchronous motor may be brought into step with the line without field excitation is mainly due to the defined pole construction, which offers paths of varying reluctance to the alternating flux, depending upon the position of the field poles with reference to the alternating flux path. If the magnetic circuit of the field poles is in line with the alternating-current flux path, then the reluctance evidently is a minimum. At any other position of the field poles with reference to the alternating flux the reluctance will increase, and it will become a maximum when the alternating flux path is in line with the center line between poles or goes through the interpolar space.

The alternating flux strength, however, depends upon the alternating ampere turns per pole, and as the turns remain constant, the armature current drawn from the line will vary in value as the reluctance varies. As the motor approaches synchronous speed the flux path will take and maintain the path of minimum reluctance and the motor will be in step and drawing a steady current.

The force with which the motor is kept in step without field excitation, or the load the motor will carry under this condition of operation before falling out of step, may be from 25 to 50 per cent of its normal load, varying with the design.

The starting characteristics and design features in connection with the same may most conveniently be discussed by applying the plain Heyland circle diagram. The complete construction of this diagram requires knowledge only as to the resistance of the armature winding and kva. input and power factor at normal voltage, (1) when motor is running idle at zero per cent slip, and (2) when standing still or with locked rotor at 100 per cent slip. The construction is similar to an induction motor diagram, but proportions are somewhat different. Although this construction is well known, a brief outline is deemed advisable.





FIGS. 1 AND 2—RUNNING AND LOCKED SATURATION TESTS OF 100-HP. SYNCHRONOUS MOTOR
100 hp., 2200 volts, 106 amp., three-phase, 60 cycles, 600 r.p.m.

Working from the test results, the kva. input and power factor of the motor when running at zero per cent slip, normal voltage, is obtained from the running saturation test (Fig. 1). The kva. input and power factor of the motor when standing still or "running at 100 per cent slip" is obtained from the locked saturation test (Fig 2). Amperes and kilowatt losses are taken at lower voltage so as not to draw a prohibitively large current, and the curves are extended to normal voltage by calculation, as the amperes increase directly in proportion to the applied voltage and the kilowatt losses with the square of the applied voltage.

Now, referring to the circle diagram, Fig. 3, it should first be noted that this diagram is a general one and does not necessarily correspond with the values as obtained from Fig. 1 and Fig. 2; furthermore, it combines two diagrams in one, showing the effect of using bars of copper and bars of brass in the squirrel-cage winding. As everything else has remained the same, the maximum torque, although remaining the same in both cases, will occur at different slips. For construction of the diagram it will be found practical and more conveni-

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ent for discussion to use kva. instead of current vectors and also to plot the kva. vectors in per cent of normal, instead of using actual values. For the sake of convenience, a power-factor circle is drawn in in the diagram (Fig. 3). The magnetizing kva. found either by calculation or from the running saturation test, is laid off according to magnitude and power factor, and is represented by the vector *O-R*. This magnetizing kva., as per diagram, is approximately 132 per cent of the normal kva at 8.5 per cent power factor; its

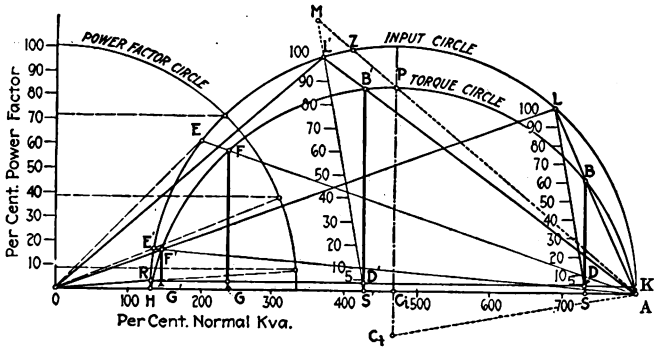

FIG. 3—INDUCTION MOTOR DIAGRAM APPLIED TO SYNCHRONOUS MOTOR

wattless component is *O-H* and its watt component *H-R*. We have now located one point *R* on the kva. input circle, which corresponds to no load, zero per cent slip.

Another point, *L*, is obtained by laying off according to magnitude and power factor the kva. at standstill (100 per cent slip), found either by calculation or from the locked saturation test. Vector *O-L* represents kva. drawn from line, with rotor equipped with copper bars in the squirrel-cage winding, at standstill and with normal voltage applied. Referring to diagram, it is laid off as 730 per cent of normal kva. at 34.5 per cent power factor. The input circle is then drawn through *R* and *L*.

The torque circle is found as follows: When the motor is standing still, or locked, with voltage applied at its terminals, no work apparently is done, although torque is exerted. The output of the motor in this case is transformed into heat, and in the diagram vector *L-A* represents the stator and rotor copper losses. Now, since the starting torque is proportional to the rotor losses, we can find the torque by deducting the stator I^2R loss, which is known when the current and resistance per phase are known.

In the diagram vector *L-B* represents the stator I^2R loss, and vector *B-K* the rotor I^2R loss. The torque circle, therefore, must pass through the point *B*. It also must pass through the points *H* and *A*, where the torque is zero. The center C_t of the torque circle is at the point where the vertical line C_t-*P* is intersected by the perpendicular bisector of the line joining points *H* and *B*. If a line is drawn through the point *L* at right angle to *A*-C_t, we obtain the slip line *L-S*, which if divided into 100 equal parts, as shown, will give the operating characteristics of the synchronous motor, running as induction motor, at any slip from zero to 100 per cent. The starting torque of the synchronous motor equipped with copper bars in the squirrel-cage winding can now be found directly from the diagram in terms of per cent normal kilowatt rating by scaling the vertical or kilowatt component of the vector *A-B*. The starting torque proper is represented by the vector *B-D*, which in this case is approximately 146 per cent of normal.

In reading off the torque at any other slip the torque will be the vertical distance from the torque circle to the line *R-K* drawn through point *R* parallel to the base line *O-A*.

Equipped with brass bars in the squirrel-cage winding, the kva. input of the motor at standstill is represented by the vector *O-L'*, and as everything except the rotor resistance has remained the same, the point *L'* will be located on the input circle as found for motor equipped with copper bars in the squirrel-cage winding. Vector *L'-B'* represents for this condition the armature I^2R loss, vector *B'-A* the rotor I^2R loss, and vector *B'-D'* the starting torque. Scaled from the diagram, the starting kva. of the motor equipped with brass bars in the squirrel-cage winding is approximately 487 per cent of normal, the power factor 66 per cent and the starting torque 266 per cent of normal. As no current is flowing in the squirrel-cage winding at zero per cent slip, the magnetizing current, or the kva. input at no load, remains the same and is independent of the material of the squirrel-cage winding.

In discussing the magnetizing current or the kva. input at no load, it should be noted that this is far larger than should be expected from induction-motor practice. The power factor is also much lower. This is due to the fact that the air gap of a synchronous motor is, and must be, much larger than that of the corresponding induction motor.

As pointed out by the writer in the ELECTRICAL WORLD of April 6, 1918, in his article on "Improving Synchronous Motor-Starting Features," the air gap of synchronous motors is limited from electrical, that of the induction motors from mechanical, reasons. In Fig. 4 the approximate values of air gap and magnetizing current are plotted for a 100-hp., 60-cycle synchronous and induction motor at different speeds. The curves are self-explanatory and bring out clearly the statement made above. The power factor of a synchronous motor when running as an induction motor is very low, owing

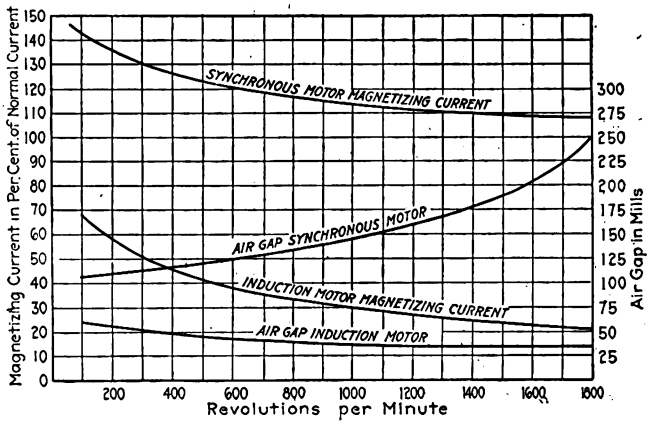

FIG. 4—AIR-GAP REQUIREMENTS FOR SYNCHRONOUS AND INDUCTION MOTORS

to the large wattless component of the magnetizing kva. (See Fig. 1.)

If test data, such as no-load and short-circuit saturation tests, are available, the magnetizing current of a synchronous motor may be found as follows: Neglecting the saturation of the magnetic circuit, a synchronous motor running at any voltage, at synchronous speed and without field excitation, will draw a current from line approximately equal to the short-circuit current when run as a generator with field excitation corre-

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sponding to above-mentioned voltage on open circuit. (A detailed explanation of this will be found in the ELECTRICAL WORLD of Feb. 19, 1916, embodied in an article by the writer entitled "The Excitation of Synchronous Machines.") Referring to Fig. 5 and applying the above rule, we obtain a magnetizing current for this motor when running at normal voltage equal to 125 per cent of normal current. The running saturation test of this motor is reproduced in Fig. 1 and from this the actual magnetizing current is found to be 123 per cent of normal current, which checks very closely with the value obtained from the above-mentioned method.

COMPARISON OF COPPER AND BRASS FOR ROTOR BARS

With good starting characteristics we obtain high torque with low kva. input. A glance at the diagram (Fig. 3) shows that in order to achieve this we must keep the magnetizing current and the armature I^2R loss low and the rotor resistance high. As pointed out before, the magnetizing current or the motor kva. input at no load is limited from electrical reasons. The armature I^2R loss is also more or less limited both from electrical and economical reasons. The rotor I^2R loss, however, may be varied at will over a wide range. It is most important to consider in this respect that with synchronous motors we are not limited by running characteristics as would be the case with induction motors. With synchronous motors the squirrel-cage winding is used only during the starting period and not under running conditions. The slip and lagging power factor inherent with induction motors are, of course, eliminated in synchronous motors.

Referring to Fig. 3, we note that with copper bars in the squirrel-cage winding the maximum torque is

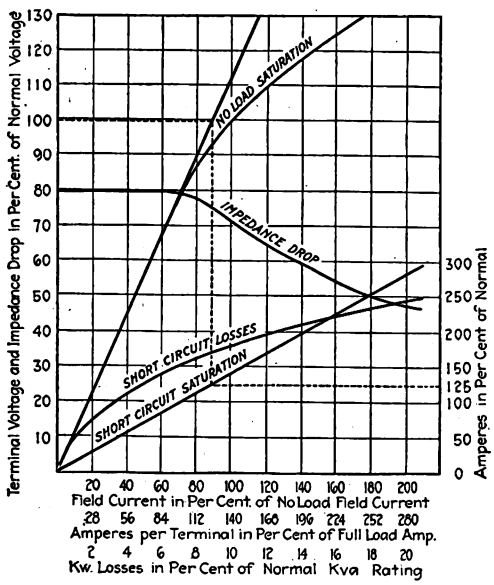

FIG. 5—METHOD OF DERIVING MAGNETIZING CURRENT; REFERS TO MOTOR DESCRIBED IN FIGS. 1 AND 2

exerted at 27 per cent slip. The maximum torque, the kva. input and the slip at which maximum torque occurs are found from the diagram by drawing a line through the point A and the point P, which represents the crest value of the torque circle. The slip is found by the intersection of this line with the slip line. The kva. input is found by drawing the line O-Z, which represents the kva. vector.

In case of brass bars in the squirrel-cage winding it is found that the maximum torque occurs at a slip of more than 100 per cent or at a negative slip of 25 per cent. (This slip, —25, is found by the intersection of the line A-P with the slip line L'-S', or at point M.) It is obvious, therefore, that a certain critical rotor resistance exists where maximum torque will be exerted at standstill or at 100 per cent slip. This critical re-

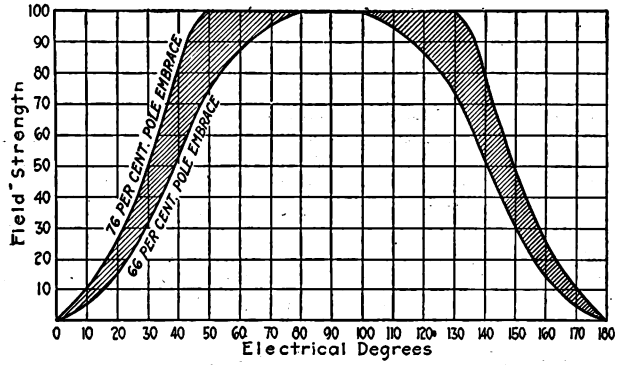

FIG. 6—FIELD FORMS OF SYNCHRONOUS MOTORS WITH 76 AND 66 PER CENT POLE EMBRACE. FIG. 6 REFERS TO MOTOR DESCRIBED IN FIGS. 1 AND 2

sistance of the rotor winding has for any motor design a definite value which approximately may be found by the equation:

$$R_c = \sqrt{R_s^2 + (X_s^2 + X_r^2)}$$

Where:

R_c = critical rotor resistance in ohms per phase, reduced to equivalent primary resistance.

R_s = stator resistance in ohms per phase.

X_s = stator reactance in ohms per phase.

X_r = rotor reactance in ohms per phase, reduced to equivalent primary reactance.

If we now would investigate the kva. input, torque and power factor at 10 per cent slip of the rotor equipped with copper and brass bars in the squirrel-cage winding, we find from diagram:

Rotor Bars	Per Cent. Kva.	Per Cent. Normal Torque	Per Cent. Power Factor	Per Cent. Slip
Copper	286	180	71.5	10
Brass	147	43	38.5	10

We see from this that we can vary the starting characteristics very materially by merely changing the material of the squirrel-cage winding.

AMERICA threw the world into a daring maze of possibilities by its entrance into this war upon lines more idealistic than any other national venture in history. And in doing this we challenged the world to a contest for supremacy, not upon the field of battle, but in the much larger field of intellectual, moral and social leadership. Whether we can make good before the world depends upon our willingness and our ability to see the problems that we must meet and our will to meet them forehandedly. For clearly our right to world leadership in the new day is not to be measured by the number of men who have gone to France or the things they have done, but by the use we now and from this time forward make of the freedom we have secured for ourselves and others.—*Secretary of the Interior Franklin K. Lane.*

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Modern Bus and Switch Structures—II

Increase in Size of Generating Units and of the Number Operated in Parallel Has Necessitated Accommodation of New Types of Circuit Breakers and Reliable Support of Buses —Masonry, Material, Compartment Doors and General Arrangement

BY C. D. GRAY AND M. M. SAMUELS
J. G. White Engineering Corporation

In last week's issue the authors pointed out that, owing to the coming of huge turbo-generators and the operation of these units as well as plants in parallel, more careful consideration of bus and switch structure design is required than formerly. Switches of larger rating have to be accommodated, space must not be cramped, stresses produced by short circuits must be withstood without damage, and disconnecting switches should be preferably operated by a single handle. This installment of the article will be devoted to the consideration of supporting busbars, providing space for current and voltage transformers, compartment material and doors, signals, grounding, conduit and general arrangement.

WHEREAS in small busbar installations it is only necessary to consider the insulating value of the supports, the majority on the market being of ample mechanical strength to withstand the short-circuit stresses of a comparatively small installation, it is important to investigate closely the tensile strength and cantilever strength of a busbar support which is intended to withstand the mechanical stresses caused by a short circuit of 500,000 kva. or over. The distance between phases and the spacings of busbar supports on each individual run of bars will be determined to a great extent by the mechanical strength of the available insulators. The method of determining short-circuit currents and mechanical stresses caused by them was thoroughly discussed by I. W. Gross in a paper presented at the one hundred and third meeting of the American Institute of Electrical Engineers, New York, on Jan. 8, 1915, and very little has been added on this subject in the engineering literature since the publication of that paper. Porcelain factories have of late been making a thorough study of the mechanical qualities of porcelain, and particularly of the mechanical strength of joints between porcelain and metal, with the result that busbar supports of sufficient mechanical strength can now be

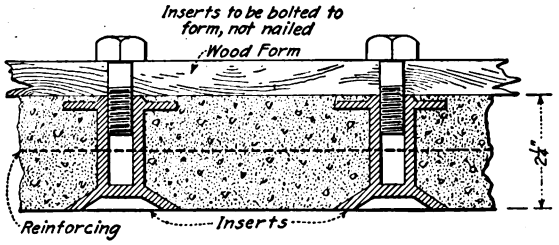

FIG. 10—METHOD OF INSTALLING CAST-IRON INSERTS IN CONCRETE SLAB FOR MOUNTING BUSBAR SUPPORTS

obtained at a reasonable cost. However, even with the good designs of bus supports which are now available, it is important to test every individual insulator after the various clamps have been mounted on it not only for flashover but also for mechanical strength before installing it. But even if an insulator withstands mechanical test in the laboratory, there is no guarantee that it will stand up under actual short circuit, since the time element of a short circuit, and therefore the exact nature of the impulse which may be caused by it, is a quantity which cannot be predetermined. Short-circuit conditions will have to undergo a considerable amount of additional research before the nature of an impulse can be predetermined with a reasonable amount of accuracy, and in the meantime it is advisable to be very conservative in the selection of busbar supports for heavy duty.

In this connection it may be mentioned that the back-connected busbar supports used in the structures shown in Figs. 6, 7, 9 and 15* not only give a very simple and

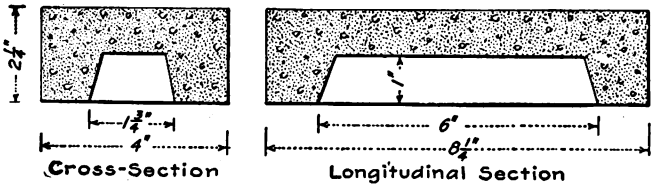

FIG. 11—CONCRETE BRICK FOR BUS STRUCTURES

accessible bus arrangement but also add a great deal of mechanical strength to the bus system. This type of bus support consists of a strong porcelain bushing which may be either cemented or clamped in the brick wall. A solid copper rod runs through the full length of the bushings and is clamped on each end. To the end of the rod which projects into the bus compartment or shelf is attached a suitable clamp of proper carrying capacity and contact surface for holding the busbar. The other end of the rod is equipped either with a similar clamp in the case of high current or merely with contact nuts in the case of low current for accommodating the connection to the disconnecting switch or other apparatus. Where busbar supports are attached to a concrete slab it is not advisable to set bolts in the slab for this purpose, since with such an arrangegement it would be necessary to lift the whole bus whenever it was wished to remove an insulator having a base cemented to it. It is much preferable to set metal inserts in the slab as shown in Fig. 10. With this arrangement it is possible to remove the bolts and slide the insulator out from underneath the bus without disturbing the bus itself. Whenever possible the base as well as the top fitting should be clamped, not cemented, to the porcelain.

Current Transformers and Potential Transformers.—In the preliminary design of a bus structure and of space requirements for it the current and potential transformers are often left out of consideration, and great difficulty is experienced later in trying to find necessary space and a good wiring arrangement for them. Since usually no more space is allowed for a bus structure than is absolutely necessary, this condition will result in crowding of other apparatus and the installation of auxiliary compartments in unusual places and will in general lead to awkward-looking structures. It is therefore very essential to consider all the current and

*Figs. 6, 7 and 9 in last issue.

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potential transformers when making the first design of the structure.

Masonry Material.—All who have had considerable experience in the design, erection and maintenance of bus structures now generally agree that reinforced concrete is not the proper material for bus-structure walls, and that brick is much more suitable for the purpose. The discussion about "brick versus concrete" may now be considered as having been generally decided in favor of brick. The best obtainable pressed brick should be used for the purpose, and only experienced labor should be employed, since a small additional expenditure on good material and labor will be only a small proportion of the total cost of the structure. Whenever it is necessary to set small bolts or cast-iron inserts near the end of a brick wall, it is advisable to set these bolts or inserts in small concrete blocks which can be made up to conform to the brick dimensions and which can then be set into the brick compartments. Thus the necessity of cutting and chipping many bricks can be avoided without affecting the good appearance of a brick structure. However, this suggestion does not refer to main bolts for mounting the circuit breaker, the mechanism or other important parts, and the briquette idea should not be overdone.

Whenever it is difficult to obtain the proper quality of pressed brick, cement brick can be recommended. Various forms of cement brick have been used on many occasions with excellent results. One of the forms was described in the ELECTRICAL WORLD of Nov. 23, 1918, by E. B. Meyer. Another form of cement brick, which was used by the J. G. White Engineering Corporation in a recent installation, is shown in Fig. 11.

For horizontal shelves or barriers white sandstone slabs have been used with very good results. Wherever sandstone is not available reinforced concrete slabs are generally used, as described in a previous article.† Natural soapstone or some of the artificial stones are also used.

No doubt sandstone will be tried out in the near future for bus-structure walls, since with the methods now in use at the quarries for sawing sandstone there does not seem to be any particular reason against the construction of a whole bus and switch structure from sandstone, provided the cost is not excessive. This depends largely on the freight cost.

Compartment Doors.—The doors of the compartments containing the oil circuit breaker proper must be arranged for suspension, so that they can swing out in case of an accumulation of gases in the compartment. Such doors have been made traditionally of asbestos wood and in some cases of wire glass. But there is no objection whatever to making them of light steel plate with small angle or channel frames.

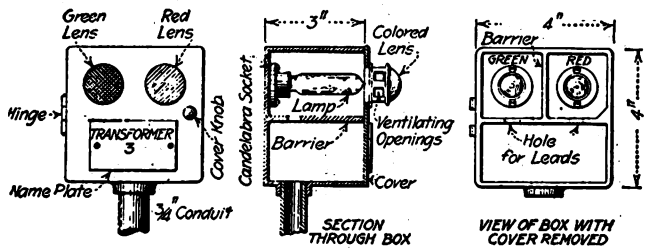
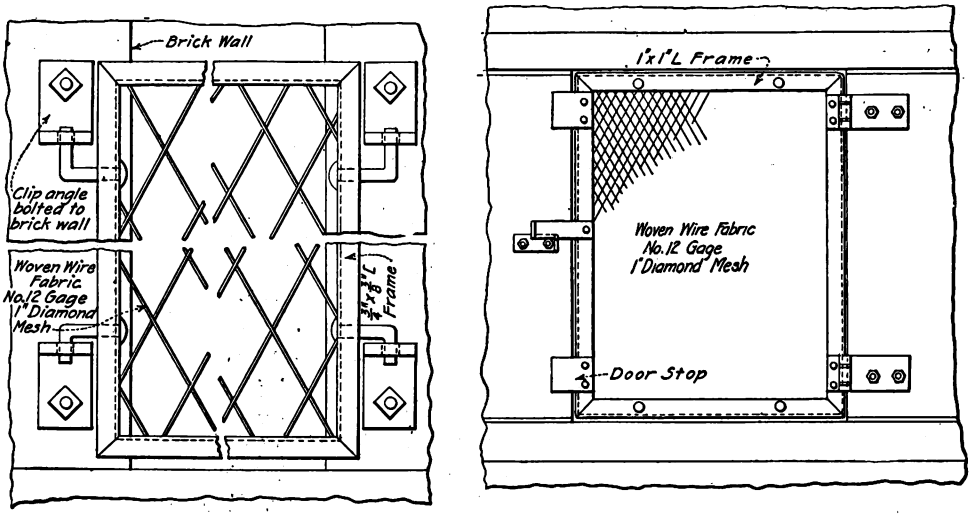


FIG. 14—SIGNAL BOX WITH RED AND GREEN LENSES THAT CANNOT BE INTERCHANGED WHEN REPLACING LAMPS

The opening in the bus compartments opposite insulators should not be left open but should be covered to avoid accidents. The cover should be transparent to allow for the inspection of insulators and should be perforated to allow for ventilation. A small hinged door, made up of wire mesh with an angle-iron frame (Fig. 13), will no doubt give satisfaction. For the disconnecting-switch compartments or other compartments not containing oil vessels it is neither necessary nor advisable to install solid asbestos or metal doors, since wire-mesh doors are sufficient for protection and have the additional advantage of facilitating inspection and of giving ventilation. The rear compartments of a structure are generally very high, thus making it necessary to arrange the door in sections, and great care should be taken to design them in such a way that the upper section will not accidentally fall off and injure the operator when he is removing the lower door. Fig. 12 shows a simple construction of a wire-mesh door the mounting of which is so arranged that the lower section when being removed cannot touch the upper section.



FIGS. 12 AND 13—TWO TYPES OF WIRE-MESH COMPARTMENT DOORS

The first is for rear compartments and is arranged so that the upper part will not fall out of place while lower hinge is being disengaged. The second door is for compartments opening opposite insulators.

Signals.—At each oil circuit breaker there should be a red and green lamp to indicate whether the respective disconnecting switches are open or closed, to protect an operator when inspecting or repairing the breaker, and at each set of disconnecting switches there should be a red and green lamp to indicate whether the respective oil circuit breaker is open or closed, to prevent the opening of a disconnecting switch under load. A suitable box for such signals, with red and green lenses, is shown in Fig. 14. This box is so arranged that the possibility of interchanging red and green lenses when replacing lamps is avoided.

†See ELECTRICAL WORLD, Jan. 15, 1916.

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Grounding.—All uninsulated metal parts of apparatus should be thoroughly grounded. It is advisable to install a ground busbar on the oil circuit breaker side as well as on the disconnecting-switch side and to make all ground connections to it. At each oil circuit breaker there should be a suitable fitting on the ground bus

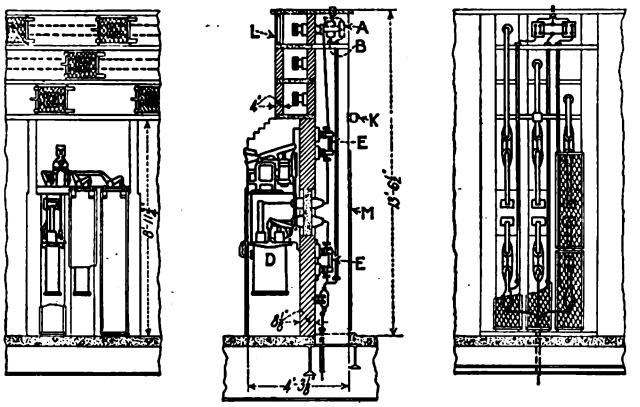

FIG. 15—MODERN 2300-VOLT BUS STRUCTURE

for the purpose of quickly grounding a circuit breaker when repairing or inspecting it.

Conduits.—Great care should be taken in the preliminary design of a bus structure, as well as in the floor construction under it, to allow for the necessary conduits for oil-circuit-breaker control, instrument transformer secondaries and signal wiring. Conduits should be exposed, instead of being concealed in walls, to allow for changes in wiring and interchanging of circuits after installation. For this reason all junction boxes should be of very liberal dimensions and should be easily accessible.

General Arrangement.—After discussing in detail the various features of masonry bus structure, very little is left to be said about the general arrangement. As mentioned above, the back-connected bus support gives the simplest and best arrangement for buses and connections, and there will not be many cases where this arrangement cannot be used. For carrying capacities of 2000 amp. or over it would not be advisable to use a solid round copper rod through the wall. In such cases a similar arrangement can be made by using a square porcelain tube through the wall and cementing the proper number of flat copper bars in the tube, mounting the bus on one end of these bars and the connection to oil circuit breaker on the other end.

Various views of a very modern heavy-duty bus and switch structure for 12,000-volt, three-phase, and about 100,000-kva. generating capacity are shown in Figs. 6 and 7. Each circuit of this installation is equipped with two sets of oil circuit breakers, each connected to a separate bus. The disconnecting switches on both sides of the oil circuit breaker are operated by one common handle, and all the other improvements suggested above are incorporated in this structure. The generator-potential transformers are installed in compartments along the wall on the oil circuit breaker floor, whereas the bus-potential transformers are placed in compartments above the bus. This arrangement makes all the wiring direct and simple. A floor is installed between the oil circuit breakers and the bus, which should be done in all cases of very heavy duty, so that circuit-breaker explosions under extremely heavy short circuit should not affect the buses. Current transformers are not shown in these bus structures, since in this particular installation it was necessary to install the current transformer near the apparatus. However, it is obvious that no difficulty would be experienced in accommodating them in the structure.

Two 12,000-volt bus structures for small-capacity installations were shown in Figs. 8 and 9. It will be noted that no floor exists between the circuit breakers and the buses, since this is not considered necessary for small capacity. These structures also have all the improvements described above and are about as simple as bus structures could be made and at the same time be thoroughly reliable. It is obvious that, in spite of all the advantages which a bus structure of the type offers over the older types, its cost will not be higher, and in most cases will be lower, than that of the older type.

A 2300-volt bus structure for small capacity machines is shown in Fig. 1[illegible]. The disconnecting switches in this structure have no mechanism and must be operated by a switch hook, therefore the signals at the oil circuit breakers had to be omitted. In all other respects, however, this structure follows along the lines of improvement suggested above. The potential transformers are mounted in compartments near the top of the structure, and for generator circuits it is necessary to bring the primary leads down to the generator side of the oil circuit breaker, which is at the bottom of the structure. This can be done in iron conduit, since the magnetic field caused by the primary current of a potential transformer would not cause much heating.

Lighting.—Care should be taken to illuminate all apparatus and other parts of the bus structure thoroughly.

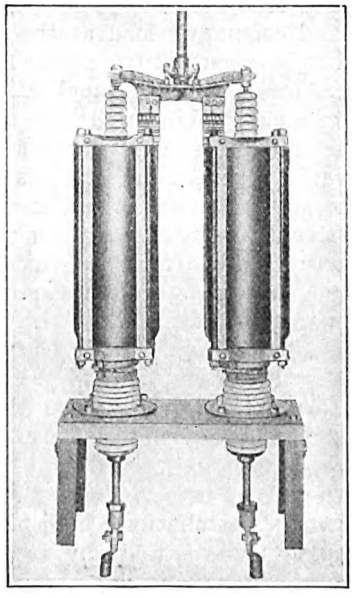

FIG. 16—SWITCH RATED AT 800 AMP. AND 15,000 VOLTS CAPABLE OF RUPTURING 600,000 KVA.

This should be done by carefully selecting and placing the lighting fixtures in a way to give good illumination without causing any glare. In addition, an ample number of receptacles for attaching portable lamps should be installed on both sides of the structure.

All bus structures described were designed and installed by the J. G. White Engineering Corporation.

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POWER-FACTOR IMPROVEMENT IN NEW ENGLAND STATIONS

Recent Work in This Direction Outlined at Meeting of Boston Section of American Institute of Electrical Engineers

OUTLINES of work done in New England in power-factor improvement were given at a meeting of the Boston Section of the American Institute of Electrical Engineers by A. E. Pope, assistant general manager New England Power Company, L. R. Hicks of C. H. Tenney & Company, R. E. Argersinger of Stone & Webster, Boston, and others.

Mr. Pope stated that in 1916 the voltage conditions at some of the New England company's substations required remedying. These conditions were largely due to low power factor, and the use of condensers at once suggested itself. An investigation showed that condensers were justified for use during heavy load periods only, and two 7500-kva. machines were installed at Pawtucket, R. I., and Greendale, Mass., respectively, where the power-factor conditions were most undesirable. The results in improved regulation and in effect on system losses have been most satisfactory.

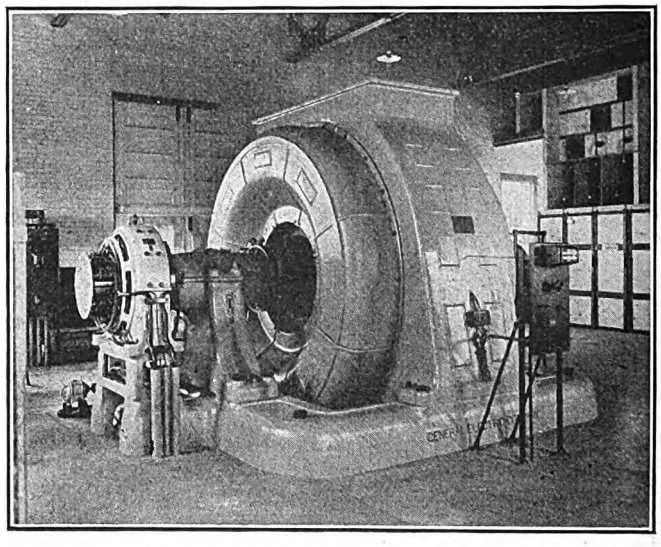
During the past year the company's power factor has again become low, owing to largely increased load, additional substations, etc., and a more exhaustive study of the conditions is being made. Readings have been taken on each customer's installation, with the exception of some of the smaller ones, and a classification of results shows in round numbers about 10,000 kw. between 60 and 70 per cent power factor, about 23,000 kw. between 70 and 80 per cent, about 6000 kw. between 80 and 90 per cent, and about 10,000 kw. between 90 and 100 per cent. Additional load is also carried where the company is tied in with other systems.

From the above study the composite power factor of the New England company's load at the points of delivery is found to be about 82 per cent. A further analysis of system losses with the application of proper power factors to each, combined with the above, gives a resultant power factor of about 72 per cent at the buses of the various generating stations. The actual readings at the stations with no condensers operating are about 2 per cent higher than this calculated result. There appears to be little question that the reactive effect of the lines and transformers should properly be corrected at the substations, and in this connection a third condenser of 7500-kva. rating has been ordered for installation at Fitchburg, Mass. With these three units in operation the power factor at the generating stations will become practically equal to that at the points of delivery.

The next step will be to better the conditions existing at the customers' installations, both present and future. The company believes that any properly motored mill should operate at an average power factor of 80 per cent or better, and future New England Power contracts will carry a power-factor clause based on 80 per cent minimum and impose penalties for lower power factor of probably 5 per cent between 70 and 80 per cent power factor, 15 per cent between 60 and 70 per cent, 25 per cent between 50 and 60 per cent and 50 per cent below 50 per cent. The company is taking up with its present customers, particularly those having the lower power factors, a study of their mill conditions with a view to locating any cases of over-motoring. This is a large undertaking, but it is hoped that the results will justify the effort. In one mill where such a study has been made the motors were rearranged to such good advantage that the power factor has been increased from below 80 per cent to 88 per cent and six spare motors have been rendered available.

No attempt is being made at this time to persuade customers to install condensers of their own. With the possible exception of the larger customers it is felt that if this proves desirable, it can perhaps be done more economically in the substations in large-capacity condensers than at the individual customers' plants. It is hoped by the above methods to raise the customers' composite power factor to between 85 and 90 per cent, which appears sufficient under present conditions. Mr. Pope said:

A general study of condensers and their effect on system regulation is at first discouraging. Most of us have been educated in the idea that condensers can be economically used to correct power factor up to 90 per cent but no higher. This is true when the object is only to save capacity in generators, transformers, etc., but it is quickly found that in their effect on regulation the great benefit is obtained above 90 per cent. To reach this means an excessive use of condensers, and a comparison of losses in various condensers versus line losses at low power factor tends on the average system to place the economic limit to which we can afford to correct by condensers at between 80 and 85 per cent.



SYNCHRONOUS CONDENSER RATED AT 7500 KVA. INSTALLED AT WORCESTER, MASS.

Further analysis is more encouraging, however, and tends to show that this figure is reasonable. For instance, if the total regulation in a system from the generating bus to the substation bus is 25 per cent under full-load conditions at 80 per cent power factor, it will be found that at least 10 or 12 per cent of this exists under minimum load conditions, due to the much lower power factor at such time caused by the increased effect of the transformer core losses. In other words, this much of the regulation is constant and can easily be taken care of by the ratio of transformation. In almost any hydroelectric system another 6 to 8 per cent can be taken care of at the generating stations, which leaves a net regulation at the substation bus of from 5 to 8 per cent. This is really what we are interested in. An increase in the power factor of from 80 to 90 per cent will improve the regulation to the extent of at least 5 or 6 per cent, which practically eliminates the effective regulation at the substation bus. In other words, condenser action must be considered, not in relation to the entire regulation involved, but only to that

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portion of the entire regulation which cannot be corrected by other and more economical methods.

The author stated that he considers this question of most vital importance to central stations and particularly to transmission systems. The tendency of mills to over-motor is one which must be fought at every turn, and in this the manufacturers, who are in many cases the mill engineers, must help. The present design of synchronous motors makes them more applicable than in the past, and here again the manufacturers should use their influence, not only in the sale of the present sizes, but in the further development of smaller units.

J. A. Walton, Boston Edison Company, stated that a power factor of at least 80 per cent is sought on all new installations and that a rate taking the power factor into account has been established for all customers having 50 kw. demand or more, the customer being penalized for all power factors under 80 per cent. In an installation with 200 kw. load and using say 300,000 kw.-hr. yearly, this would mean a rate of 2.5 cents per kilowatt-hour for 80 per cent power factor and 2.7 cents if the power factor was 70 per cent. In the later substations synchronous motor-generator sets or rotary converters are being used widely. During the day the power factor at the L Street generating station in South Boston ranges from 80 to 85 per cent, and on the peak it is raised to from 90 to 95 per cent. No static condensers are in use so far on the Boston system.

Mr. Hicks pointed out that a 4000-kw. synchronous condenser has been installed through an agreement between the Bristol & Plainville Tramway Company and the Connecticut Power Company for power-factor improvement. The former power factor was 60 to 65 per cent, and it was estimated that from 2000 kw. to 2500 kw. would raise this to 85 per cent. Wattless component integrators are used, and the tramway company pays for correction up to 85 per cent, the power company paying for any correction in excess of this. In one month's service the tramway company purchased 1,250,000 kw.-hr. from the power company and 40,000 kw.-hr. was required in operating the synchronous condenser. Ordinarily this machine is run from early forenoon to about 5 p. m., or from fifty to sixty hours per week, under control of the power company's load dispatcher. In the case of an industrial plant at Bristol the installation of a synchronous condenser will obviate the duplication of distribution lines serving a brass mill, and at Montpelier, Vt., and Oswego, N. Y., the use of such equipment on Tenney properties has saved fuel by making it unnecessary to run extra steam-plant equipment. R. E. Argersinger cited the saving of $2,800 per year by the use of a static condenser costing $7,500 on the lines of the Abington & Rockland company in Massachusetts. Before the condenser was installed the average load on the line was 650 kw.; afterward it was feasible to handle 950 kw.

Flexible Distribution for Industrial Plants

System of Busbars Meets Changing Demands for Power—Safety and Low Operating Costs Also Secured by the Employment of Busbar Feeders of Uniform Size

BY L. F. LEUREY
Consulting Engineer, San Francisco

IN INDUSTRIAL power installations of large size and of diversified demands important advantages can be secured by a well-proportioned design of main feeders and sub-feeders of a uniform size. The important results to be obtained are these: First, flexibility is assured in meeting the necessary growth of the system and in accommodating the shifting of motors incidental to improvements in the industrial process. Second, by reducing to a minimum the variety and sizes of materials required installation costs are reduced and a better purchasing leverage is secured. Third, by reducing the number of fuse locations and by simplification of arrangement a minimum of upkeep cost and a reduction in interruptions is secured.

To illustrate how this method of distribution can be applied a specific example will be referred to—the plant of the California & Hawaiian Sugar Refining Company, Crockett, Cal.—and the determining reasons for adopting this method will be outlined.

From the viewpoint of the refinery management three things were of primary importance—first, that the design meet all present requirements of the Pacific Board of Fire Underwriters and the Industrial Safety Commission of California; second, that the trend of modern precautions against fire and personal risk be taken into account; third, that the design must be capable of meeting extension of plant capacity and flexible enough to accommodate the frequent shifting of loads incidental to improvements in sugar refining.

The connected load at this refinery consists of approximately 400 motors, ranging in size from 1 hp. to 200 hp. and aggregating a total of 6000 hp. These motors drive a very wide range of machinery, including many types of conveyors and pumps, reels and screens,

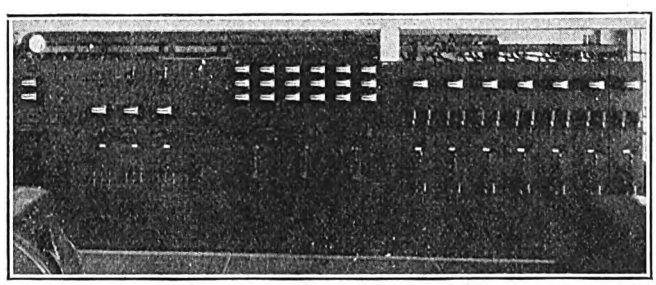

FIG. 1 — PORTION OF MAIN SWITCHBOARD WITH EXCITER AND GENERATOR PANELS AT LEFT AND SEVEN FEEDER PANELS AT RIGHT; BUSBARS ARE OVERHEAD

centrifugals and machine tools. Owing, however, to the fact that a definite tonnage of bulk product is traveling through this refinery each hour of the twenty-four the total load is very uniform, and it is only at local points that any unusual demands exist.

Main Switchboard.—The source of power at this refinery consists of non-condensing turbo-generators operating at 480 volts, three-phase, 60 cycles, the exhaust steam being used in the sugar-refining process. The

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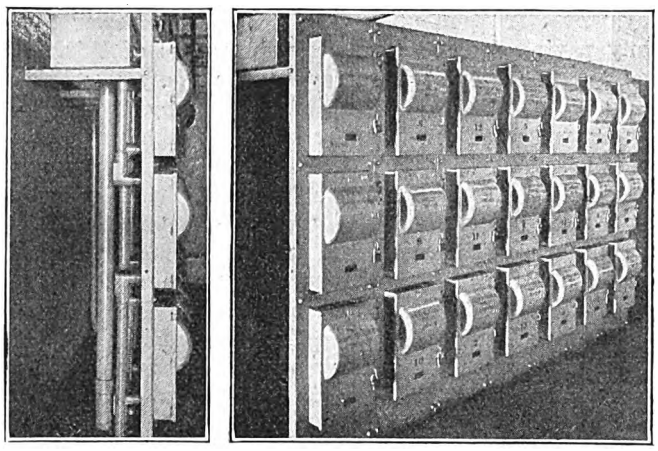
main switchboard is of conventional design, consisting of three electrically operated generator oil switches of 3000-amp. capacity and of fourteen remote-control manually operated feeder oil switches rated at 500 amp. each. Seven of these feeders are on each end of the bus with generator connections in the center. On account of heavy currents carried, the copper bars of each



FIGS. 2 AND 3—SIDE AND FRONT VIEW OF SEVEN-PANEL IRONCLAD DISTRIBUTION BOARD

This board controls twenty 30-hp. motors and one group of small motors. The supply circuits enter the bus compartment at the top and to the rear of the board through 3-in. conduits, while smaller conduits inclose the connections between the switches and busbars.

phase in the main bus are arranged in a hollow square and are transposed at three places in the length of the bus.

Main-Feeder System.—In determining the size of the main feeders the following considerations were involved:

First, the feeder must be of large carrying capacity to minimize the number of feeders and oil-switch controls, but not so large as to be uneconomical because of skin effect.

Second, the size must not be so great as to make an unwieldy and over-costly conduit system. Owing to the fact that sugar refineries are necessarily densely packed with machinery, shafting and pipes, a conduit system was essential, even if its many other advantages had been overlooked. This very space congestion which forced a conduit design increased the cost of installation.

Third, high electrical labor cost was another important factor in considering a compromise between a minimum number of conductors and a unit conductor not too expensive to install.

With these considerations in mind, it was decided to adopt three 500,000-circ.mil cables and 3-in. (7.6-cm.) conduit as the envelope. The feeders were all kept at this uniform size, as it was the aim and intent of the design so to arrange and route these feeders that all would have approximately the same value of average load. The great diversity of loads and many motor units made this comparatively easy of accomplishment without any forced application of the principle involved.

These main conduits begin in the power house with a porcelain-lined bushing near the feeder terminals of the 500-amp. oil switches, from which point they drop beneath the floor line and there are ganged in a single conduit rack to the first point of divergence. At this point a sheet-steel junction box, approximately 24 in. by 24 in. (60 cm. by 60 cm.), is installed, and the feeders are separated in sub-groups leading to various sections of the refinery. Wherever possible these main feeders are routed along the main passageways of the buildings and ganged under single supports at all possible points. Wherever the length of the runs makes it impossible to use standard sweep elbows a sheet-steel junction box of heavy construction is installed. In order to carry out continuity of the metallic bond on these conduits the external lock-nuts which clamp these conduits to the junction boxes were welded by the oxy-acetylene process to both the conduit and junction box. The power-station ends of all of these main conduits are connected solidly to a large copper ground plate buried in the moist earth below the buildings. Auxiliary grounds are also made to the permanent water-pipe systems.

The main feeders serve two typical groups of loads. In one case the loads consist of several motors of from 75 hp. to 150 hp. capacity controlled from a single group cabinet, at which cabinet the starting compensator for these motors is installed. In the other case these main feeders are run to sheet-steel distribution switchboards for the control of a large number of smaller motors. In all cases this second type of feed is extended sufficiently to take on a load which will work the feeder to an economical limit, and, as far as possible, the feeders are so routed as to embrace within their scope loads of certain definite sections of the refinery.

Sub-Distribution Switchboards.—In planning the location of the sub-distribution switchboards the size and extent of the area to be served by sub-feeders was kept in mind, and the characteristics of machinery on

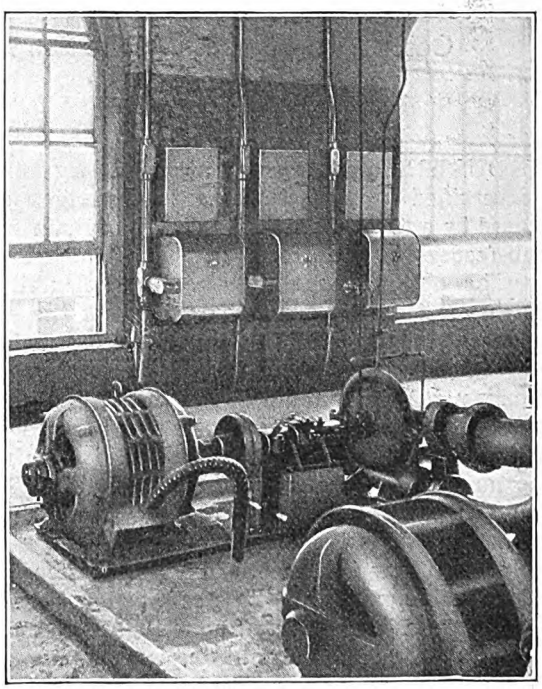


FIG. 4—IRONCLAD SWITCHES AND CONTROL FOR MOTORS WITH ALL WIRING PROTECTED

the various floors were so studied that these boards were placed as near as possible to the load centers with a view to minimizing the length of sub-feeder conduits. The position of these boards was naturally governed by a compromise between extending the main feeders and extending the sub-feeders.

These boards consist of units of No. 12 gage sheet

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steel, 18 in. wide by 84 in. high (46 cm. by 213 cm.), mounted on 2-in. by 2-in. (5-cm. by 5-cm.) angle-iron supports. Each panel carries three 100-amp., three-pole, 500-volt alternating-current externally operated switch units. Near the top and at rear of the panel is a sheet-steel bus compartment approximately 10 in. by 15 in. (25 cm. by 37 cm.) in section, made of code-thickness metal. Different numbers of these panel units are grouped together to form the switchboards, the bus compartments being made of sufficient length to cover the backs of all panels installed. Each compartment is designed with a view to a single-panel extension so that panels can be added from time to time as desired. The bus material is supported on cleat insulators and consists of the same material as is used in the main feeder. All taps from switch units to bus compartment and from switch units to sub-feeders are in conduit and enter the switch unit from the rear, being held to the switch by means of lock-nuts and bushings. The taps from the upper lugs of the switch to the bus are made with standard N. E. C. wire; for convenience all taps from the three units on one panel are connected to the bus at a single point.

In practice these steel switchboards have certain excellent advantages, one of which is that they consist of only three standard materials easily obtained in any market, namely, externally operated ironclad knife switches, sheet-metal panels and angle-iron framework. The material for connecting them consists of standard conduit and fittings, which are always available, and the bus connections and buses are ordinary National Electric Code wire and cable. One other very important advantage, especially in congested industrial installa-

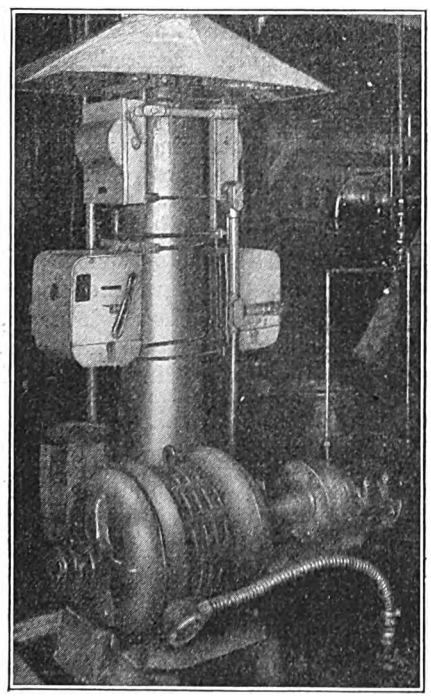

FIG. 5—IRONCLAD SWITCHES AND MOTOR CONTROL MOUNTED ON POST CLOSE TO MOTORS

tions, is the absolute safety from personal contact, which not only insures the safety of workmen but also prevents interruptions to service. The latter advantage in turn produces the complementary feature that in very crowded conditions where machinery space is highly valuable these boards can be placed within 2 ft. (60 cm.) of the wall and in the most congested quarters without danger from accidental contact or disturbance of service. At the plant of the California & Hawaiian Sugar Refining Company every branch switch in service on these switchboards is kept locked, and it is a common procedure to send a painter unattended to one of these switchboards and allow him to paint it in

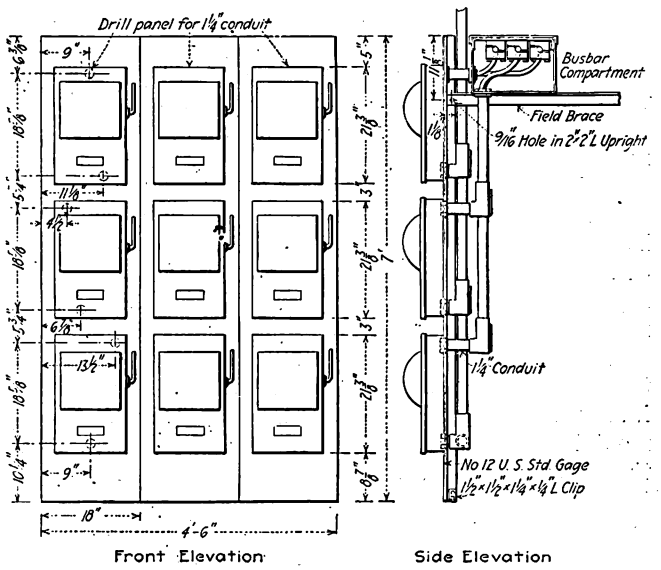

FIG. 6—DETAILS OF IRONCLAD INDUSTRIAL SWITCHBOARD

place, front and rear, without any possibility of injury to the man or disturbance to the service.

The panels, as designed, are exceptionally flexible. In one case in this refinery, by the use of one spare panel, a complete switchboard has been moved to make room for important machinery without any interruption to the service. It has developed in practice at this plant that each branch feeder on these boards will control single motors rated from 30 hp. to 40 hp., two motors of 20 hp. capacity, or as many as three to ten motors of smaller capacity. Since the average controlled horsepower per circuit is about 50 hp., each 18-in. (46-cm.) panel unit, with its section of bus, controls a total of 150 hp. The cost installed per panel of five-panel to seven-panel boards of this type averaged under war conditions $120, or 80 cents per horsepower controlled.

Where the distribution involves only the control of two or three large motors of from 75 hp. to 150 hp., another type of control panel, a sheet-steel compartment, is used. This contains a quick-break disconnecting switch, current transformers, starting fuses and an overload relay with an ammeter mounted externally above the door. The framework that supports this cabinet is also designed to carry the starting compensator. On account of the necessity of having current transformers and of using an older type of auto-starters on hand, it was impracticable to use externally operated disconnecting switches for this work.

Sub-Feeders.—In studying the question of sub-feeders for this refinery, the characteristics both of the load and of the industrial processes were kept in mind. Most of the buildings served were of from five to nine stories in height and all of relatively compact floor space. This arrangement favored sub-feeders of moderate size, because they would not involve any great length in run from the sub-distribution switchboards before accumulating the necessary amount of load. The basic plan kept in mind in running all of these feeders was that, in order to meet the many changes both in motor

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horsepower and in the necessary rearranging of machinery, it would be necessary to gridiron, so to speak, the whole area with sources of power.

A uniform feeder consisting of three No. 1 wires inclosed in 1½-in. (3.7-cm.) conduit was selected, which size of wire permits operating the 100-amp. switch units on the distribution switchboards at full rating. These feeders are run in some cases to individual motors of 40-hp. capacity, but in most cases they are extended with full wire and conduit size to scattered motors of smaller size. In most cases these feeders are run beneath the floor slab from which the motors are controlled, and only a short riser full-size wire and not fused is necessary to reach the control equipment. Full advantage is taken of the variation demand factor of these small motors, so that the copper is always working at high efficiency, but, as a rule, with a sufficient reserve over the fuse capacity to take on reasonable increments of load. Wherever possible two or more of these sub-feeders are ganged under one run and open into common tapping boxes, so that an excellent arrangement is obtained for transference of load from one of these sub-feeders to another when desired. In running these feeders through the floor where future loads were expected or possibilities of loads might occur due to shifting of equipment, tapping boxes were installed at

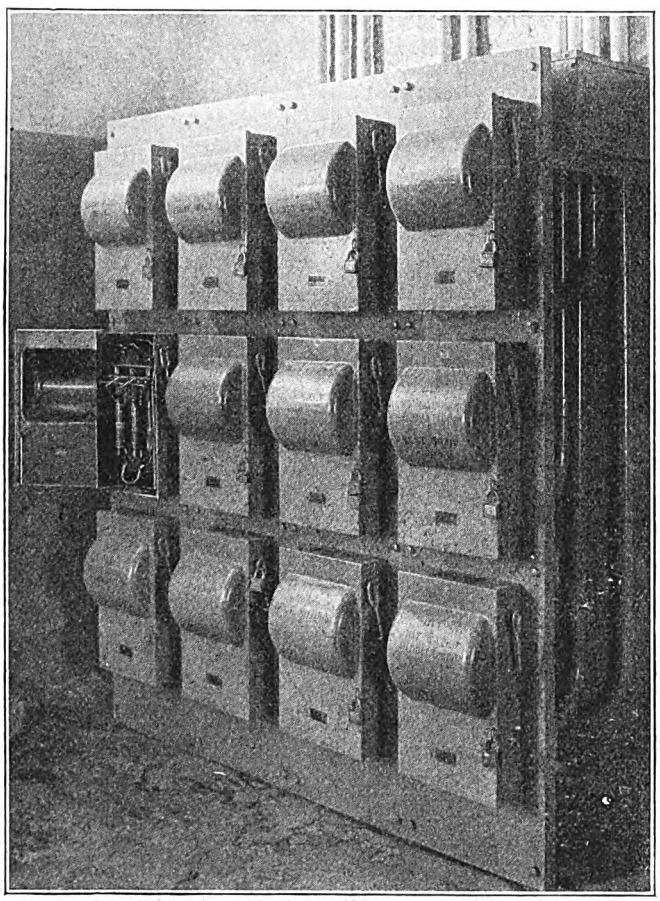

FIG. 7—TYPE OF SWITCHBOARD THAT MAY BE PAINTED OR WORKED AROUND WITHOUT ANY HAZARD

intervals in the line. All of the taps in these boxes are unfused and the conductors are continued in full-size wire to the control equipment to be connected.

While this system may seem expensive, the high cost is only apparent, because in the conventional method of running from a central distribution switchboard to all individual motors, the wire and conduit both are proportioned to the starting capacities of the motors, and their individual efficiency is very low.

Starting Equipment.—The starting equipment for all motors of 5 hp. and less consists of P-10 oil switches with no-voltage release and time-element fuse-plug protection. For motors over 5 hp. type "A" auto-starters are used, in which the no-voltage release and the over-

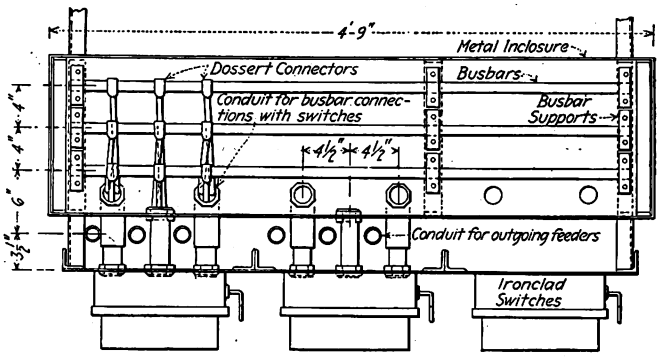

FIG. 8—SECTION THROUGH BUSBAR COMPARTMENT

load relay are inclosed within the housing of the starter. In the installations with which auto-starters are used they are preceded by externally operated disconnecting switches fused for the starting current of the motor, the disconnecting switch and auto-starter being interconnected with full-size wire to the sub-feeder. The outgoing side of the compensator is connected with required code-size wire to the motor controlled, the whole installation being ironclad throughout. The use of bottom-fused ironclad disconnectng switches, fused for the starting current of the motor, complied with the requirements of the Underwriters as well as the orders of the California State Industrial Accident Commission, which requires that all fuses having a potential of 300 volts or more to ground must be preceded by isolating switches.

Both the units for controlling motors under 5 hp. and the units consisting of compensator and disconnecting switch for motors over 5 hp. are arranged on standard racks wherever possible, so that the whole unit can be moved with the motor when required. The installation of disconnecting switches preceding the motors having compensators, aside from meeting requirements of the code and safety commissions, has the additional advantage of permitting examination of the starting-compensator contacts with a minimum interruption of service.

Wherever conditions permitted the starting equipment was installed so that it was either within view of the motor to be started or within view of some visible unit in the train of gear being driven. All starting equipment, sub-feeder conduit and distribution switchboard are thoroughly grounded throughout.

Conclusion.—In planning and executing this entire work it was always kept in mind that the electrical arrangements were not complete in themselves but were only one part in a complete industrial train of equipment. Certain definite requirements of the fire and safety codes naturally decided many features of the installation, but in many other features the requirements of operation were the governing factors.

That the flexibility aimed at has been secured is amply proved by one year's operation. In spite of many and important shifts in load centers due to rearrangement of equipment, additions, etc., it has not been found necessary to modify one feature of the permanent work.

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THE ENGINEER THE IDEAL LINK BETWEEN CAPITAL AND LABOR

Dean Cooley Thinks This One of the Technical Man's Important Functions—More Liberal Education Is an Imperative Need

IN AN article published recently by the *Evening Sun* of New York Dr. Mortimer E. Cooley, dean of the Colleges of Engineering and Architecture of the University of Michigan, makes a plea for a wider field of usefulness for the engineer, urging that the nature of his work affords him an excellent opportunity to become a link between the forces of labor and capital and that he should also take a more prominent part in public affairs. Dr. Cooley emphasizes the need for the education of engineers along less highly specialized and broader cultural lines. He begins by saying:

In the present-day maelstrom of social and industrial unrest which, according to the press of America and Europe, is menacing the civilized world, many curative measures have been suggested. The most powerful agent, however, is the workingman himself. I believe that the highest type of constructive "workingman" is the professional engineer, who is the connecting link between capital and labor.

Our entire material world, so far as social structure is concerned, can be very justly credited to the engineer, or to professional men intimately allied with the engineer. Our great buildings, our transit lines, our industrial plants, our national and international communications by wire, wireless, mail and steamship, and the distribution of our wares, all owe their origin and comparative perfection to the engineer.

And yet there is one phase of the engineering profession which is little understood—even by men of the calling—which is of even broader value to the nation than that of material advancement. This is the relation of the engineer, in the different branches of his science, to the worker—the hewer of wood, the forger of iron, the carver of stone—who typifies the constructive half of our civilization known as "labor" and his equal and important intimacy with the other, the provisioning and directing half, usually termed "capital."

If we are to solve the tense problems which have arisen through the last few years of bloodshed, misery and spreading dissatisfaction with certain of our living conditions, no saner, surer mediator can be found between the classes than the man who proves to both "upper" and "lower" strata his sincerity, working ability and right to adequate reward—the engineer.

To even the simplest of the labor forces the engineer, many times working with them, unshaven, unshorn, wearing muddy overalls, speaking in the patois of the workers while wielding his magic pen and pencil with the wizardry of the laboratory and the classroom, represents a higher force than the wage earner—power which justly deserves infinitely greater reward.

The engineer is to the workingman who materializes his blueprints and obeys his personal directions the symbol of science, of intellect, of education and of that "teamwork" which is the keynote of modern achievement. In his task and his ability he is one of the most powerful rebuttals of Bolshevism and industrial unrest.

To the employer and the capitalist whose profits depend upon his accuracy and energy the engineer is the governing factor of business success in production. His creative vision, growing from his scientific training and brought to fruition by the virility of his practical executive ability, is the foundation of modern achievement in a thousand ways.

THE ENGINEER IN PUBLIC LIFE

Turning to the question of citizenship and civic service, Dean Cooley continues:

There is even a greater field of achievement for the engineer, one in which his past works have given him unique power and justification. This is in the line of unselfishness—creative, scientific participation in citizenship. America's towns, cities, states and the nation itself all need more expert aid and advice in the multifold problems of government and growth. The engineer should devote more of his abilities to the general good, and the public should more persistently seek his aid.

In short, the engineer should enter public life, giving his talents and technical skill for the good of his neighbors. Local engineering societies in the various towns and cities should coöperate with their neighbors and with municipal authorities not only in technical problems but in social and industrial as well, because of their unusual knowledge of and acquaintance with people of all classes. Their ability as mediators of labor problems, their scientific knowledge of the details of public matters, should be given without charge for the general good.

As to state and national problems, we need more engineering skill in the direction of executive matters. Lawyers seem to predominate in nearly all lines of general public life; yet there are questions of international importance in every branch of government work which need administration by scientifically trained minds.

The lack of engineering experts is due as much to the unwillingness of the engineer to enter political life as to the public's failure to urge him to do so. Engineers do not like politics; yet politics—in government—are necessary to every phase of modern society and industry. How many engineers are there in Congress, in Cabinet positions—even in public service commissions? In labor boards and boards of trade?

THE EDUCATIONAL NECESSITIES

To fill great positions in national and municipal life the engineer must receive a broader, more human and less specialized training than he is getting to-day in the university courses. Dean Cooley says:

Vision, background, knowledge of life and the "humanities" suffer at the expense of an almost selfish concentration on laboratory methods. We must break down the walls which we are building around the new generation of young men in our colleges—walls so high that they cannot see over. We must so teach that the boys who are going to become engineers will not remain "privates" or "non-coms," but can be field officers and line officers of the highest ranks, qualified to command and campaign from the hilltops, looking far ahead and with historic perspective.

We should develop in America a new kind of engineer by lengthening study courses, by broadening interests and by instruction in the wider-range subjects which deal with all sides of modern life. Our international leadership in industry, commerce and political idealism demands superior training for the young men who are to continue the administration of our affairs.

With the extension of international activities ahead of us as the results of war changes we must train our young scientific men in modern languages, in history, in economics, and above all in the essentials of general culture, that they may hold their intellectual own in competition with the scientists of other lands.

No longer is government simply the administration of a system of statutes, the collection of taxes and duties and the maintenance of a military system. It is a complicated machine by which the citizens themselves drive forward the great industrial, social, commercial esthetic and idealistic entity of the state—in which all their varied interests are inextricably bound. Commercial or industrial problems affect those of education and artistic development; the working classes, from the humblest wage-earner to the executive of the largest corporation, are dependent for their lives, comfort and happiness upon the efficiency of the government's many branches of direction and agency.

And so it is that the designers of our railroads, our electrical systems, our manufacturing plants and machinery, our steamships, our sanitary systems, our defensive weapons—the army, navy, signal, supply and air services—should be prepared for their broadening task with a broadening, cultural education. Our future engineers should stand head and shoulders above the present professional man of to-day to fulfill their duties to the nation and to themselves.

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Interconnection Reduces Steam Reserve Necessary

Benefits Which Have Been Realized by Tying Together Power Systems in Central California—Improvement of Diversity Factor and Pooling of Water Power Resources Have Proved of Great Advantage

BY L. J. MOORE
Electrical Engineer, San Joaquin Light & Power Corporation

ONE of the important advantages obtained by the interconnection of neighboring transmission systems operating hydroelectric plants with steam reserves is the reduction of steam reserve necessary to maintain reliable service. This is brought about in two ways — first, by the improvement of diversity factor by the connecting together of dissimilar groups of load, and, second, by the pooling of water resources. An instance of the realization of this advantage is found in the interconnection of the systems of the San Joaquin Light & Power Corporation, the Mount Whitney Power & Electric Company and the Southern California Edison Company, all operating in the central and southern districts of California.

Briefly, the San Joaquin Light & Power Corporation operates nine water-power plants on the San Joaquin, Merced, Tule and Kern Rivers. Water storage for the San Joaquin River plants only is provided in the 45,000-acre-foot (5550-hectare-m.) Crane Valley reservoir. Steam reserve is provided in a 12,000-kw. plant at Bakersfield and a 2000-kw. plant at Betteravia. The Southern California Edison Company supplies power to Los Angeles and southern California and has in the central California district a plant on Kern River near Bakersfield and the two well-known Big Creek plants. The Big Creek plants have 88,000 acre-feet (10,900 hectare-m.) of storage in the Huntington Lake reservoir. The company also operates other water-power plants in southern California and has steam reserve in the Long Beach plant, as described in the ELECTRICAL WORLD for Aug. 24, 1918, and the Redondo plant, built by the Pacific Light & Power Corporation before that company was consolidated with the Edison company. The Mount Whitney Power & Electric Company operates plants on the Kaweah and Tule Rivers. It has no water-storage facilities but does have a 5000-kw. steam plant at Visalia. The Edison company operates at 50 cycles, but the other companies use 60 cycles. The

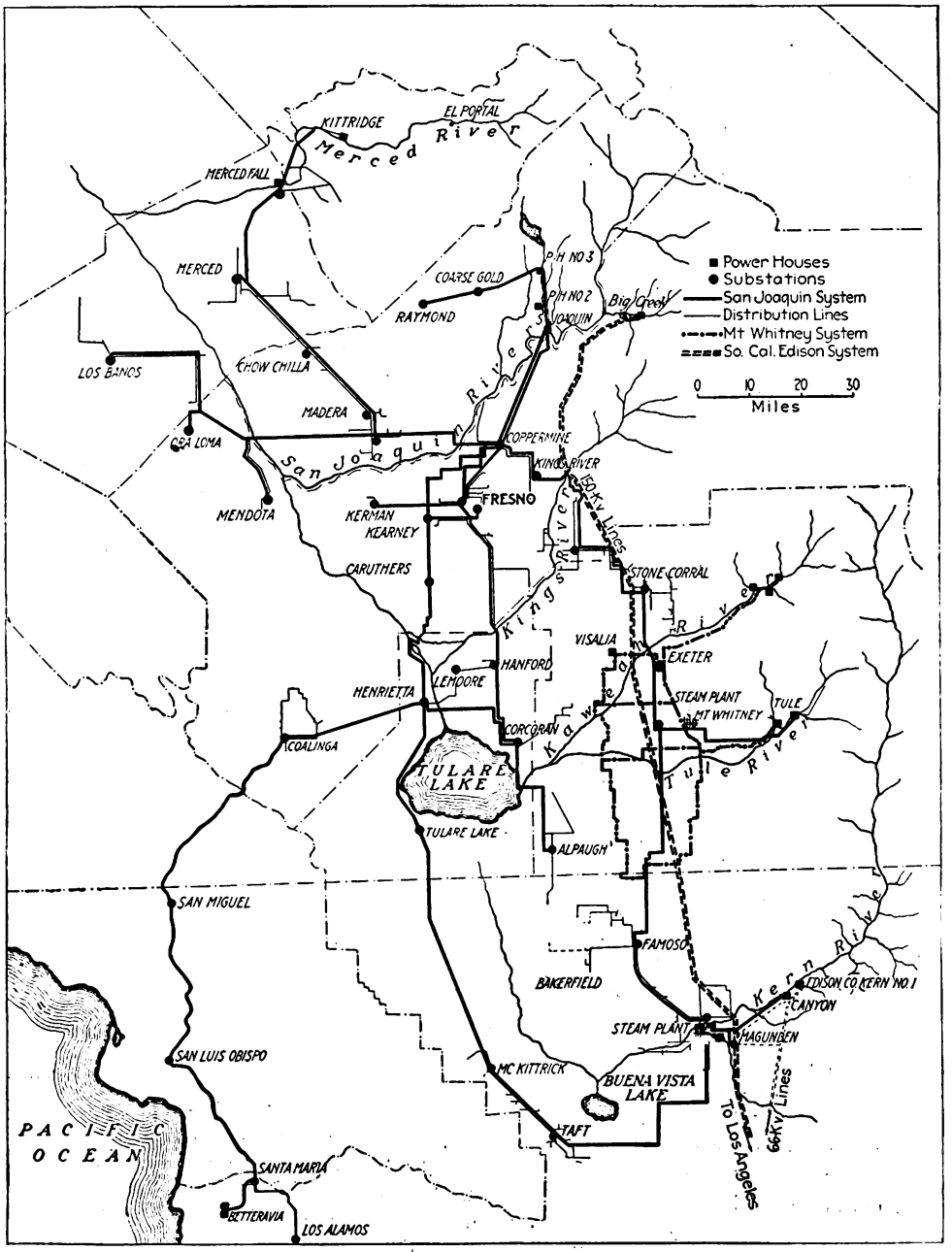

FIG. 1—SAN JOAQUIN, MOUNT WHITNEY AND PART OF SOUTHERN CALIFORNIA EDISON SYSTEMS, THE INTERCONNECTION OF WHICH BROUGHT MANY BENEFITS

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system of the San Joaquin company and the lines of the others directly involved in the interconnection are shown on the accompanying map (Fig. 1).

The necessity for storage or steam reserve for hydroelectric plants operating in this region is well shown by the accompanying curve (Fig. 2), applying the San Joaquin system. The taller curve shows the total available water power of all the streams passing present plants of this company plotted in monthly average loads. The plants, of course, are not of sufficient capacity to utilize all the power at flood times. This curve of flow through the year is practically similar to the curve of each of the streams included. It shows the heavy flow in spring and early summer and the low discharge during late summer and fall, which are characteristic and which make it necessary for plants along these streams to be supported by either storage or steam reserve unless they be developed simply as minimum-flow plants. The flatter curve shows the load on the San Joaquin system for the year 1917 and makes evident the effect of the Crane Valley reservoir, which made it possible to carry the entire load by water. This

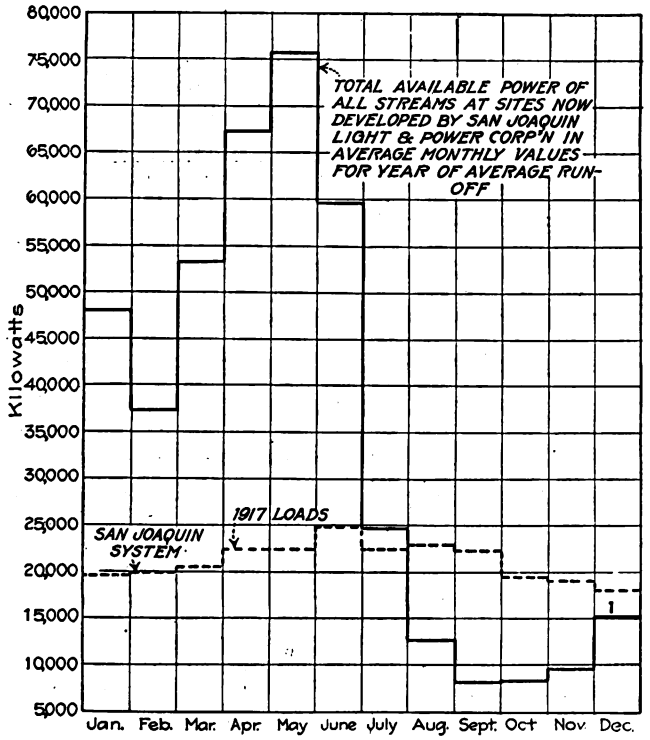

FIG. 2—CURVES INDICATE WHY STORAGE OR STEAM RESERVE IS VALUABLE

load is made up of industrial and lighting load in the towns, a large amount of oil-well pumping, which is practically continuous throughout the year, and a large percentage of irrigation pumping coming on only in the summer months.

The Edison company serves the same classes of business, but the railway and industrial part is much larger because of the larger cities reached, and the peak comes in November. The Mount Whitney company has a larger percentage of irrigation load, no oil-well pumping and probably less industrial load on account of the serving of smaller towns.

The first step toward interconnection came in 1917, when the Mount Whitney company became very short of power during the irrigation season owing to its lack of storage. This company is a subsidiary of the Southern California Edison Company, so an interconnection between the two was arranged to provide the necessary aid. At that time one 150,000-volt line from Big Creek to Los Angeles was in operation, but the second was only partially completed. The completed part, however, ran from the Mount Whitney territory south past the Magunden substation. Accordingly, a line insulated for 30,000 volts was built from the Edison company's Kern River No. 1 plant to Magunden. The Mount Whitney 30,000-volt system was connected directly to the 150,000-volt line, and Kern River No. 1 was also connected to it through the new line to Magunden. One unit at the Kern plant was then speeded up to 60 cycles and synchronized with the Mount Whitney system. Kern No. 1 normally transmits at 60,000 volts, so this arrangement necessitated a bank of transformers at the plant being reconnected for 30,000 volts. The distance of transmission was more than 70 miles (112 km.)—rather long for the low voltage used.

In the spring of 1918 interconnection between these two companies and the San Joaquin company was considered, both as a fuel-saving measure for all concerned and to allow the transmission of power from Kern No. 1 to the Mount Whitney company at 60,000 volts, this being the voltage of both Kern No. 1 and the San Joaquin system. Consequently three banks of transformers stepping down from 60,000 volts to 30,000 volts, of 13,500 kw. total capacity, were installed at Strathmore between the San Joaquin company's Tule River line and the Mount Whitney system. The line from Kern River No. 1 to Magunden passes the San Joaquin company's Kern River plant just across the river, so it was reinsulated for 60,000 volts and a tie was made between the two systems at that point through the necessary air-break switches.

Power is now delivered to the Mount Whitney system by Kern No. 1 placing as many of its four machines as necessary on the 60-cycle San Joaquin system and the Mount Whitney company taking out the equivalent through the transformers at Strathmore. If the Mount Whitney company does not need as much power as the Edison company is able to deliver, the difference is absorbed by the San Joaquin. On the other hand, when the Mount Whitney company has a surplus of power delivery is made by it to the San Joaquin system through the transformers at Strathmore, and the San Joaquin's Kern River plant supplies the Edison system operating at 50 cycles. This method of operation has the effect of storing flood water from the Kaweah River in Huntington Lake and is a regular procedure as far as the San Joaquin system is concerned, the plants on the Tule and Kern Rivers being run at maximum capacity during flood times, thus reducing the load on the San Joaquin River plants and increasing storage in Crane Valley Lake. Further advantage is obtained by the interconnection in that means are provided for interchange of power directly between the San Joaquin and Mount Whitney systems at Strathmore and interchange of plants between the San Joaquin and Edison companies on Kern River. Great aid has been rendered to all concerned on different occasions in cases of powerhouse and ditch troubles.

To decrease transmission losses still farther and improve power factor by the addition of more line capacity, the uncompleted Big Creek line with the 60,000-volt line from Kern River No. 1 to Magunden was paralleled with the east 60,000-volt line of the San Joaquin system by a connection between that line and the Big Creek line where they cross near Ducor.

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This gave good results except that it complicated matters during cases of line trouble. As a result the connection was discontinued in January, 1919, a frequency changer of 5000 kw. capacity was installed at Magunden, and a tie line built from the San Joaquin company's Kern River line to Magunden, making possible an interconnection between the 60-cycle and 50-cycle systems. This, however, has not superseded the interchange of plants on Kern River. The 5000-kw. capacity of the frequency changer is not large compared to the capacities of the two systems connected, so careful manipulation of the load passing through it is required to keep the automatic switches from opening too often because of sudden variations of load on either of the systems. When no power is being transferred through the unit either system can use it for power-factor and voltage correction.

Typical Results Without Frequency Changer

Typical results on Aug. 10, 1918, before the installation of the frequency changer, are shown in Fig. 3. The two lower curves show the Edison delivery to the San Joaquin system (the entire Kern River No. 1 plant was running at 60 cycles at the time) and the Mount Whitney demand at Strathmore. The separation of these two curves measures the amount of power the San Joaquin system was absorbing or delivering. These values added algebraically to the load of the San Joaquin system, had no interconnection existed, give the actual power delivered by the San Joaquin plants. The effect on diversity factor is shown by the two lower curves, where the changes in direction of flow of power at Strathmore are evident. This flow has been controlled somewhat on the day shown by variation of the load on the Visalia steam plant, but the fact remains that in practice often one system may be delivering power to the other at a time of light load for itself and peak load for the other, when within a very short space

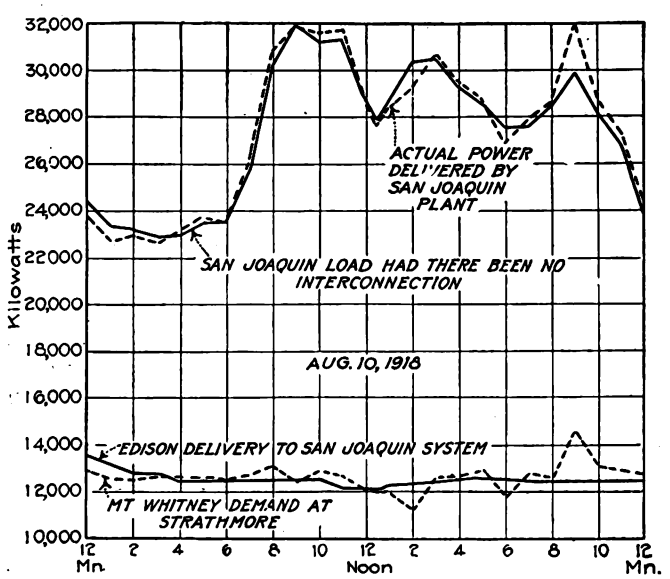

FIG. 3—TYPICAL RESULTS BEFORE INSTALLATION OF FREQUENCY CHANGER

of time the conditions may be completely reversed. This means that they help each other over peaks without the excessive use of steam necessary if they were all operating separately.

The Edison company realizes a saving in delivering power to the Mount Whitney in this way and preventing operation of the Visalia steam plant even at the expense of operating the Long Beach or Redondo steam plant, on account of the much greater efficiency of these two plants. It even pays to let San Joaquin's Bakersfield plant supply the difference, for the reason that Bakersfield is both more efficient than Visalia and because the plant is situated near the oil fields. Delivery of oil to the fire room is much less expensive, and besides

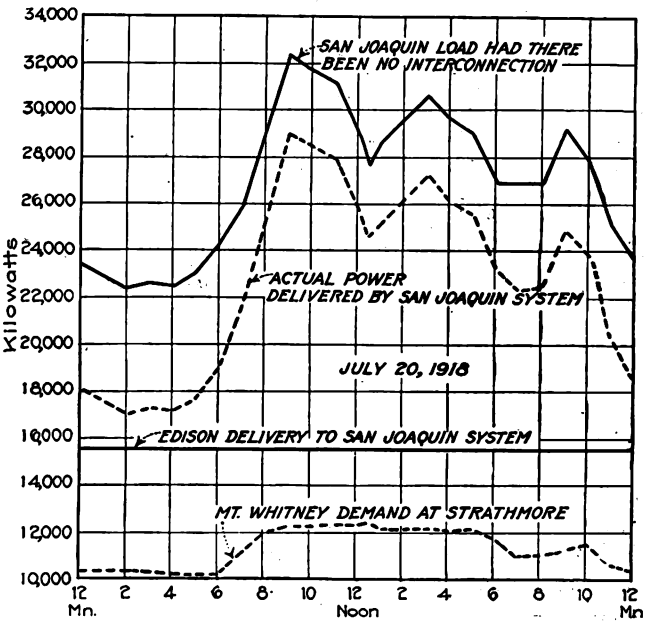

FIG. 4—CONDITIONS AFTER INTERCONNECTION BUT JUST BEFORE LOW WATER HAD RAISED MOUNT WHITNEY DEMAND

a large quantity of natural gas is burned. A gas-pipe line connects the Bakersfield plant directly with the oil fields.

The operation of the interconnected systems on July 20, 1918, is indicated by Fig. 4, which represents conditions just before low water had raised the Mount Whitney demand and decreased the Edison delivery; as a result a considerable quantity of power was delivered to the San Joaquin company.

When one of the 50-cycle impulse wheels at Kern River No. 1 is operating at 60 cycles it is found that the water necessary to generate 5000 kw. at 50 cycles generates only about 4500 kw. at the higher speed. Furthermore, the field current is only approximately two-thirds of normal under this condition. The San Joaquin's prime mover on Kern River is a turbine instead of an impulse wheel, but it gives somewhat analogous results in that a slightly higher output is obtained with the same water when operating on the Edison 50-cycle system. The field current is proportionately higher, too. No particular difficulties are experienced. In fact, the operation is quite satisfactory.

Books Received

LEKTRIK LIGHTING CONNECTIONS. London, England: A. P. Lundberg & Sons. Illustrated. Price, 10d.

PRINCIPLES OF RADIOTELEGRAPHY. By Cyril M. Jansky. New York: McGraw-Hill Book Company, Inc., 242 pages, 179 illustrations. Price, $2 net.

TRAINING FOR THE ELECTRIC RAILWAY BUSINESS. By C. B. Fairchild, Jr. Philadelphia and London: J. B. Lippincott Company. 155 pages, illustrated. Price, $1.50 net.

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CONSUMING BITUMINOUS AND ANTHRACITE COAL*

What Must Be Done to Burn Mixtures of Steam-Size Anthracite with Soft Coal to Get the Most Steam from the Least Fuel

A boiler plant designed for soft coal and operating on natural draft is capable of using 20 per cent of steam sizes of anthracite mixed with soft coal without material loss in efficiency and without change of equipment, provided that sufficient grate surface is available, and this is usually the case. Still higher percentages of fine anthracite may be mixed with the bituminous, provided that certain changes are made in the furnace equipment. Between 20 and 40 per cent of small-size anthracite may be burned with bituminous coal by installing a blower in order to create the necessary draft pressure in the ashpit to penetrate the bed of fuel. When more than 40 per cent of small-size anthracite is to be burned it becomes necessary or advisable to change to grates having smaller air openings, smaller percentage of draft area and larger total area.

WHILE the essential difference between the burning of anthracite and the burning of soft coal consists, in the case of anthracite, in the use of a somewhat smaller volume of air per pound of fuel and a stronger draft, slight alterations in the method of firing and in the furnace designed for one or the other fuel are also necessary in case mixtures of soft and anthracite coal are used. Just what volume of air and what strength of draft must be used to burn any particular fuel in any given furnace can be determined only by actual trial and, being once determined, must be maintained as long as the particular fuel is used.

With ordinary furnace equipment designed for soft coal, up to 20 per cent "buckwheat" or fine sizes of anthracite may ordinarily be burned without any change of equipment or firing practice. Owing to the fact that most boiler furnaces are operated below their normal capacity on soft coal, the above percentage of anthracite can be added without decreasing the capacity of horsepower output of the boiler plant. If a greater percentage of anthracite screenings, 20 per cent to 40 per cent say, is mixed with the soft coal, it may be necessary, in order to obtain full boiler horsepower, to have the air pressure under the grate as high as 2 in. (5 cm.).

If blowers are not already installed, the turbine type may be fitted into the side wall of the ashpit very easily. It should not use more than 3 per cent of the steam developed by the boiler when operating at full capacity. The cost of a steam turbine blower is approximately $200 for boilers of 150 hp. or more.

If desired, a steam jet blower may be used instead of a steam turbine blower. This is cheaper, and the more economical types of steam-jet blowers are quite satisfactory in producing the desired results. In purchasing a steam-jet blower it is most important to investigate its steam consumption. The best type of these blowers will operate on about the same steam as that required by the turbine blower, whereas the poorer ones may take from two to five times that amount of steam, in which case they should not be installed. The cost of the steam-jet blower should be from $50 to $75 or more for a single boiler of 150 hp. and up. The turbine blower or the steam-jet blower should be controlled by means of an automatic draft regulator of the "partial throw" type, in order to obtain efficient results, although fair results are obtainable by hand regulation.

If more than 40 per cent of small anthracite is used, forced draft plus "buckwheat" grates and a good automatic draft regulator are recommended. The grates should vary in the matter of diameter of air openings, draft area and total surface in accordance with the specific fuels used and their proportions in the mixture.

Some plants are able to run efficiently with a good quality of fine anthracite alone if properly equipped for this purpose. The accompanying table furnishes additional data as to mixtures of various sizes of anthracite and soft coal that may be burned under different conditions of draft.

Proper mixing is most essential. It can be done either by delivering in a wheelbarrow alternate and predetermined portions of the two kinds of coal and then mixing by not less than two "turnovers" with a shovel before pumping in front of the furnace, or, on a larger scale, by a similar delivery of carload lots to the coal tipple.

Grates.—Grates for the fine sizes of anthracite have small air openings which vary in form from round holes, as in the pinhole grates, to elliptical holes and straight slots, the width of slot or the diameter of the hole varying from $\frac{1}{8}$ in. up to $\frac{5}{16}$ in. (3 mm. to 8 mm.). The percentage of draft area through the grate would vary from 3 per cent to 30 per cent.

Stationary, shaking or dumping types of grates for burning the fine sizes of anthracite may be obtained. The dumping and shaking types facilitate the cleaning of fire with less drop in steam pressure, which is an important feature. A large ash pit is advisable so that fires may be cleaned by dumping or shaking grates without the necessity of opening the ash-pit doors more than once in twenty-four hours. The ash-pit doors with forced draft are, of course, sealed to make them air-tight, and therefore the less often they have to be opened the better. Or, still better, separate the under-grate air chamber from the ash pit and install a dead plate in front of grates to dump ashes.

Owing to the slower rate of combustion, the grate area for small-sized anthracite is made larger than for bituminous coal in order to develop the same horsepower, except in cases where the soft-coal boiler already has an unnecessarily large grate, which is ordinarily the case. The relation of the grate area to the heating surface is also of importance. This relation is shown below:

For No. 1 buckwheat the proportion should be 1 to 40
For No. 2 buckwheat the proportion should be 1 to 35
For No. 3 buckwheat the proportion should be 1 to 30
For No. 4 buckwheat the proportion should be 1 to 25

The fuel bed should not be less than 6 ft. (1.8 m.) from any point of the boiler-heating surface. There should be from 2.5 cu.ft. to 3 cu.ft. of combustion space to 1 sq.ft. of grate area (0.78 cu.m. to 0.89 cu.m. per sq.m. of grate area).

Another detail of furnace construction which is important is that of the division of the heating surface into the so-called passes. As the furnace gases in passing from the fuel bed to the stack are continuously cooling, their volume is consequently decreasing con-

*Presented through the courtesy of the Fuel Engineering Section of the United States Fuel Administration, and based on information contributed by William P. Frey, fuel engineer.

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tinuously, so that the volume of the passes should be diminished in the same proportion to cause a uniform flow. The relation between the area of the various passes should be about as follows: First pass about 43 per cent of total heating surface, second pass about 32 per cent of total heating surface, and third pass about 25 per cent of the total heating surface. As the width of the gas passage is uniform, the necessary reduction in the volume of the passes is made by reducing the thickness of the gas stream about as follows: In first pass from 100 to 68, second pass from 68 to 52, and third pass from 52 to 50.

PROPORTIONS OF SOFT AND HARD COAL TO BE USED

Size of Coal	Draft	Per Cent Soft	Per Cent Hard
No. 1 Buck.	Forced	30	70
	Natural	40	60
No. 2 Buck.	Forced	40	60
	Natural	50	50
No. 3 Buck.	Forced	50	50
	Natural	65	35
No. 4 Buck.	Forced	65	35
	Natural	80	20

It is extremely important in burning the steam sizes of anthracite to provide against a large excess of air to the fire. The ideal way to burn this fuel is to use under-grate draft and to throttle the uptake damper to a point where the volume of air will be reduced to a minimum for proper combustion. The necessary pressure for penetrating the bed of fuel is supplied by means of the blower, and the volume is regulated by means of uptake damper. With this equipment an automatic regulator should be connected for the purpose of controlling the draft in accordance with steam requirements. All of this is ordinary standard equipment which may readily be obtained for the purpose.

The boiler setting, of course, should be made tight and kept tight. The draft or "suction" over the fire should be kept as low as possible; under ordinary conditions this should run between 0.10 in. and 0.25 in. (2.54 mm. to 6.3 mm.), water gage.

CAST ROTOR WINDINGS FOR SQUIRREL-CAGE MOTORS

Eliminating Welding Between Bar Windings and Short-Circuiting Rings, They Insure Uniform Cross-Section and a Perfect Union

Casting the bars and short-circuiting rings which comprise the induction-motor rotor windings in one operation is the radical development now being applied by one motor manufacturer. This cast winding insures uniform cross-section and perfect union between the bars and end rings, thus ending previous operating difficulties that arose from their opening. Better balance, greater rigidity and increased durability are also obtained by this new process.

Ventilation for either direction of rotation is obtained by means of a series of holes bored radially through the cast end rings. Freedom from blow-holes and other imperfections is secured through spiral casting and machining methods.

The method of casting the rotor winding is particularly interesting because it is done in place. That is, the stripped rotor serves as the mold in which the bars are cast, thus simplifying construction and minimizing expenses.

OBLIGATIONS OF ENGINEERS IN CIVIC AND SOCIAL AFFAIRS

Need of Their Interest and Participation in Solving Social Problems Voiced at Boston Banquet of Engineering Profession

The engineer's opportunity to aid in solving the present social problems of the world and his duty in reconstruction effort were emphasized at the tenth annual engineers' dinner in Boston April 2, which was attended by about 350 members and guests, representing all branches of the profession. Richard H. Rice, acting manager Lynn Works, General Electric Company, was toastmaster, and among the speakers of engineering note were Henry I. Harriman, president Boston Chamber of Commerce and New England Power Company; C. A. Adams, president American Institute of Electrical Engineers; James J. Storrow, former fuel administrator for New England; Leonard Metcalf, president Boston Society of Civil Engineers, and Prof. George F. Swain of the Harvard Engineering School. George H. Moses, United States Senator from New Hampshire, also spoke on "A League of Nations."

Mr. Rice emphasized the vital need of applying engineering methods of analysis to the social and economic problems of the day. Disaster lies, he said, in failure to acquire a sound knowledge of these questions. Political forces and laws are susceptible to exact study. The world's habit of thought is too often to-day along lines exactly opposite those the engineer follows, and such lines heedlessly followed lead to barbarism. The speaker cited the evil days upon which Russia has fallen and the dangers of restricted production and excessive demands by labor in England as examples of neglecting the careful and just methods of attacking economic and social problems which are peculiarly those of the engineer. The engineer must point out and resist wrong demands, direct efforts in the proper channels and influence public opinion through his potent members along constructive lines.

President Adams urged engineers to study the problems of non-employment and industrial discontent with open minds. In far too many cases the engineer takes little or no interest in such matters or else holds prejudiced views. Behind the prevalent unrest, the speaker said, may be lessons worth learning—better ways of doing things and of improving human relations. Misuse of power has caused trouble, and this must be frankly acknowledged and remedied. A fresh outlook can be brought by the engineer to these difficult affairs, often leading to improvements of an almost revolutionary character which will mean that the engineer serves society in a broader way.

President Harriman touched upon the obligations of America to her allies in reconstruction, in view of her comparatively light losses in the war, and the opportunity of the engineer in this great task. Mr. Storrow paid a high tribute to the coöperation of the engineering profession in fuel saving and urged a closer relation between the engineer and the banker in future, as an aid to the more efficient investment of the people's savings. Professor Swain recounted his impressions of France in his recent trip as a member of the engineering commission from America.

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INTERCONNECTION OF TWO ARIZONA SYSTEMS

Seventy-Mile Transmission Line to Connect Pacific Gas & Electric Company of Phoenix with Arizona Power Company

INTERCONNECTION of the generating stations of the Pacific Gas & Electric Company of Phoenix, Ariz., and the Arizona Power Company, Prescott, is to be made through construction of a transmission line 70 miles long. An issue of $300,000 of one-year notes has been sold by Bonbright & Company, Inc., New York, to provide the necessary funds for this improvement and for other additions and betterments. An additional $200,000 in notes of the same issue may be put out. The notes are dated April 15, 1919, bear 7 per cent interest and were offered and sold quickly at 99. At that figure the yield to the investor was over 8 per cent.

The interconnection was arranged to meet the needs of the Arizona districts served by the two companies, which are owned in part by the same people. F. S. Vielé, of New York and Prescott, president of the Arizona Power Company, is vice-president of the Pacific Gas & Electric Company of Arizona. G. H. Walbridge of New York is president of the latter company. The territory served includes mining districts and great irrigation projects. The demand for power has increased, and the districts served have shown substantial progress. It is anticipated that further development will be hastened by provision of additional power facilities.

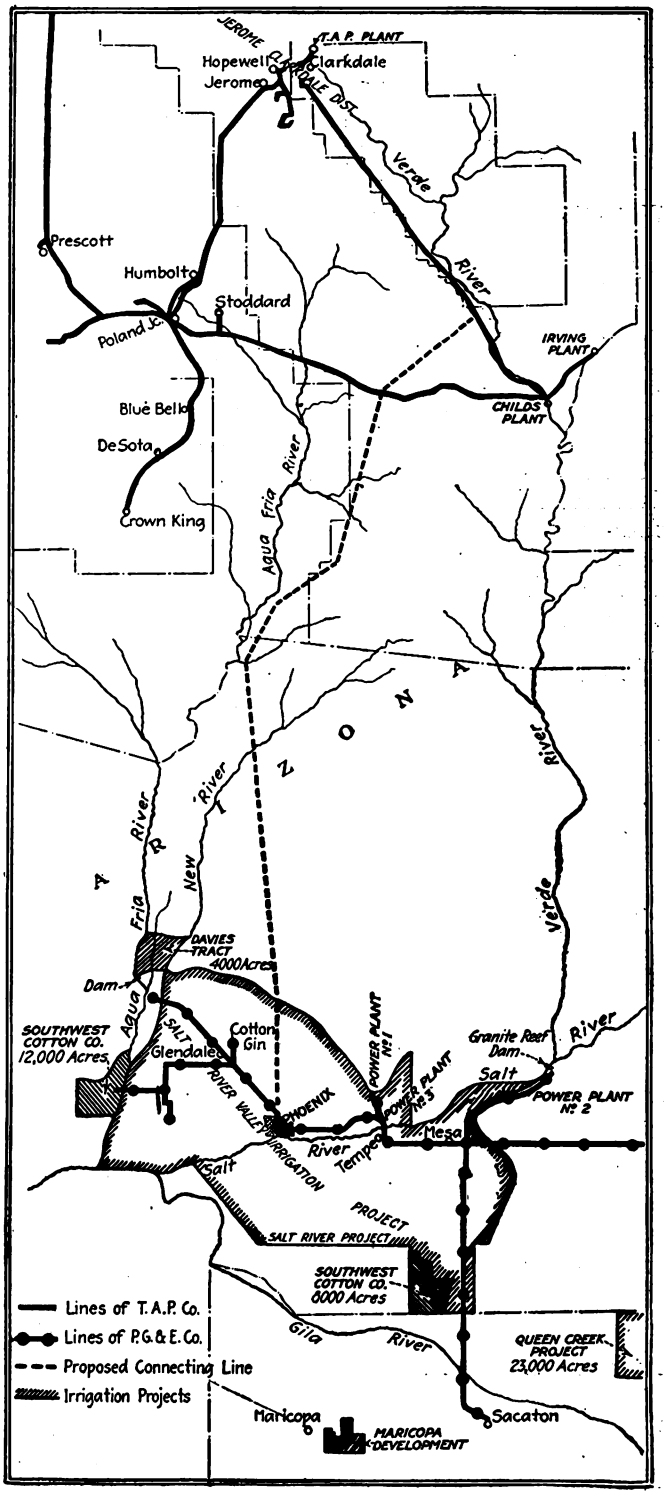
The map on this page, which was obtained from Mr. Vielé in New York last week, gives some indication of the districts reached by the two properties and of the value of interconnection of the systems.

The Pacific Gas & Electric Company furnishes electricity and gas in Phoenix and tributary territory. Its power is obtained chiefly from the Salt River Valley Water Users' Association, which operates the Salt River Valley project of the United States Reclamation Service (Roosevelt Dam). The contract under which this power is secured extends to August, 1926. Connection with the Arizona Power Company will furnish a large additional supply of cheap power. There is a large demand for more power in and about Phoenix, and additional power is not obtainable from the Roosevelt Dam.

The Roosevelt irrigation project, operated by the Salt River Valley Water Users' Association, provided irrigation water for 205,615 acres of land in 1918. The crops from this acreage, including fruits, aggregated $18,200,000 in value, of which cotton and seed alone (50,000 acres) sold for $7,854,000, or a yield of $157 per acre. New land projects with a total acreage of over 100,000 will be dependent on pumping for the necessary water supply. The possibilities for the further use of electrical energy in the territory are therefore most promising.

Both steam and hydroelectric stations are operated by the Arizona Power Company.

This interconnection is a logical development in keeping with the trend of practice throughout the country. It arises from a growing appreciation of the importance of conservation of energy and its sources. The benefits obtainable in this instance from the construction of 70 miles of transmission line call attention anew to similar possibilities in other districts where two plants can be interconnected. Generation of part of the power from hydroelectric systems gives a special advantage which is not found in every possible case where coördination of the plants will improve load factor and lead to economy in fuel.



MAP SHOWING INTERCONNECTION OF TWO ARIZONA SYSTEMS

In this interconnection of Arizona power systems a new example of the value of coördination is presented for the industry. The connection of the systems will provide more power for industrial and mining districts and particularly for the great irrigation projects in that section of the country. Interconnection was facilitated by the fact that there was, in part at least, common ownership of the two companies. The interconnection by construction of 70 miles of line meets an immediate and urgent demand for power in essential industries.

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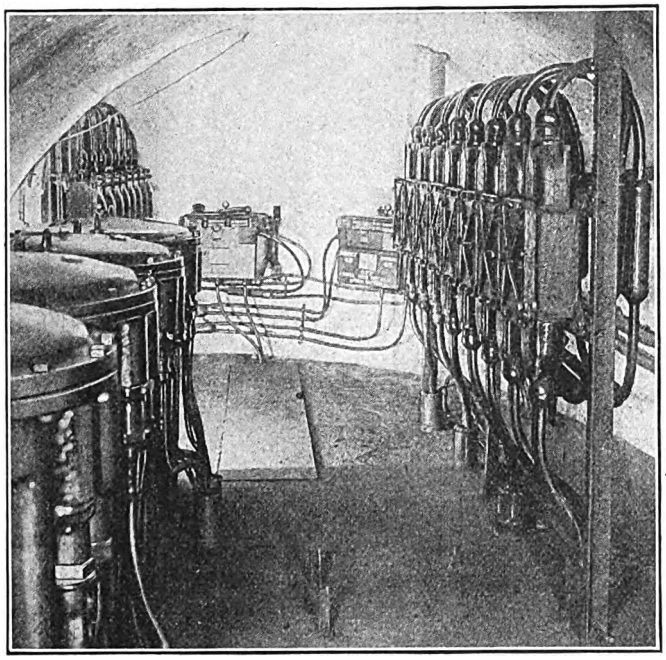
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SUBSTATION WITHSTANDS FLOODS PERIODICALLY

Watertight Connections to Transformers, Fuses and Switches Permit Submerging Without Jeopardizing Service

Underground substation installations which are capable of withstanding flood conditions without damage to apparatus or interruption of service have been developed by the Duquesne Light Company of Pittsburgh to meet a long-felt need. Previously the service to downtown customers fed from certain sections of the underground system was periodically interrupted, whereas now it is unaffected by the stage of the Monongahela and Allegheny Rivers. These substations, which have fairly large transformer capacity, have supplanted small individual transformer installations to a great extent and are usually installed under sidewalks. No attempts have been made to render the vaults waterproof, as the floods frequently rise several feet above



ALL APPARATUS IN THIS SUBSTATION IS WATERTIGHT

the sidewalks anyway. Instead, the wiring, switches, transformers and cut-outs are so inclosed individually that no deleterious effects have been caused even by complete submersion, which has happened twice since this type of installation has been employed.

Lead-covered cables are used for both primary and secondary services and for connections between switches, fuses and transformers in the substation. Enough of the lead sheath is removed from the cable to permit the connections to be made inside the apparatus. The cable is then pushed through a tinned brass thimble, which is wiped to the sheath of the cable. These brass thimbles are fitted to the apparatus in different ways. In the transformers they screw into the case; in the primary cut-outs they are in two parts, one being rigidly connected to the case, while the other part is wiped on to the cable, and the two are connected by means of a pipe union. The lead-covered cable connections between disconnecting switches, transformers, etc., are run in conduits underneath the floor. This conduit is laid on a bed of crushed stone and drilled to allow water to drain out. The substation has always been warm enough to keep water from freezing.

The air vents of the transformers are closed with a pipe plug. As this permits the transformers to be operated at only about 75 per cent of their rating, it is the intention ultimately to connect the vent hole of the transformer to a system of piping which will also vent the primary fuse blocks.

The cast-iron fuse boxes behind the transformers and the disconnecting switch boxes to the right in the picture have rubber gaskets placed under the covers, which are bolted firmly in position. The operating handles of the oil switches are removed when not in use, the holes are plugged up, and the handles are used as a wrench to remove the plugs when necessary.

This information was contributed by P. Conran Petersen of the distribution department.

REDUCING MAINTENANCE EXPENSE BY FREQUENT PLANT INSPECTION

Men Responsible for Operation of Equipment Also Made Responsible for Cleanliness and Maintenance —Inspections Checked by Competent Men

As it is of utmost importance that steam-plant maintenance expenses be reduced to the lowest level possible, inspection of equipment should be made frequently and thoroughly by the men in charge of its operation and care. These inspections should be checked by some competent men both before and after each repair job is done on such equipment to insure against poor work. Some of the rules laid down by the engineering department of the Consumers' Power Company of Michigan to this end are as follows:

Have the cause of all unnecessary noise and vibration eliminated as promptly as possible after it is discovered.

Keep all parts of the equipment subject to rusting, pitting, corrosion, etc., covered by the proper kind of protective coating; avoid unnecessary dampness and corrosive gases such as sometimes escape from the boiler settings on account of improper damper and furnace management; also avoid unnecessary exposure of the equipment to the weather where such exposure will cause deterioration.

Avoid the operation of apparatus not in good condition until it has been properly repaired, when such operation would result in inefficient operation or increase the extent of the repairs required.

Do not allow unskilled. careless or incompetent workmen

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to make repairs that require efficient, thorough, capable mechanics for their prompt, correct and economical completion. Require the engineers, oilers, firemen and other operating men to make all such repairs and adjustments so that the habit will be established of each man doing what he can to keep the time of repair crew at a minimum on each part of the maintenance work.

Use foresight in anticipating repair work and in planning and carrying it on.

When it is discovered that repairs are necessary for any part of the equipment, find out just what causes led up to the necessity for these repairs. Think of means within control that will eliminate or modify these causes and prevent or reduce the extent or frequency of such repairs in the future. Discuss the causes and means for correcting them with the men who operate and repair the equipment with the purpose of making them understand the trouble and its causes so they will coöperate in reducing such repairs in the future. Encourage the men to make suggestions that will result in better care, operation and maintenance of the steam-plant apparatus.

SYNCHRONOUS MOTORS IN THE WORKING OF BRASS

Power Requirements of Rolling Mills in the Brass Industry Where the Trend Is Toward the Use of Synchronous Motors

There is an increasing tendency to use synchronous motors for brass rolling mills and especially for the finishing mills where two or more stands are driven by one motor. The power requirements of each stand of rolls in a sheet brass mill are about as shown in the accompanying table:

Operation	Roll Size	R.P.M. of Rolls	Hp. per Stand
Breaking down cast bars.	20 in. to 24 in. by 36 in. (50.8 cm. to 60.9 cm. by 91.4 cm.).	75 to 100	300 to 750
Running down.....	18 in. to 20 in. by 36 in. (45.7 cm. to 50.8 cm. by 91.4 cm.)..	125 to 250	200 to 400
Finishing.....	10 in. to 20 in. by 36 in. (25.4 cm. to 50.8 cm. by 91.4 cm.).	150 to 250	75 to 200

Mill motors are usually geared to the roll shaft; flywheels are not recommended because the metal is pushed into the rolls almost end to end and the load variations are consequently slight.

These facts were brought out by W. R. Clark of the Bridgeport (Conn:) Brass Company in a recent paper which he read before the Association of Iron and Steel Electrical Engineers.

MILL DRIVE IS UTILIZED TO MOVE RAILROAD CARS

Counter Shaft Extended Through Wall Provides Drum for Pulling Cars Into Position for Unloading When Engine Is Not Available

In a flour mill where it is necessary to unload grain from railroad cars at several doors and to load the finished product at different points on the warehouse platform some difficulty is encountered in moving the loaded or partly loaded cars back and forth on the switch when an engine is not available. This problem has been solved in an ingenious manner at the Pasco (Wash.) Flour Mills Company. A countershaft was belted to the main shaft in the mill, which is driven by a 40-hp. Westinghouse motor, and extended through an aperture in the wall of the mill adjacent to the loading platform. Attached to the end of the counter shaft is a steel drum which can be employed in conjunction with a coil of 1.3-in. (3-cm.) rope to move the cars. To move the cars away from the drum or winch, a pulley can be attached at a point beyond where the car has to be and the cable looped back on itself.

From this drum a power scoop is also operated which unloads bulk wheat into the elevator hopper, unloading 1200 bushels (420 kl.) per hour. Two men are all that are required to operate the scoop when using this drum, whereas it formerly took six; furthermore, the drum has increased the unloading capacity from four to six cars a day.

ELECTRIC FURNACE ECONOMICAL FOR MAKING STEEL CASTINGS

Has Revolutionized Steel-Foundry Practice by Allowing Necessary Speed—Superheats Steel to Any Desired Temperature

The electric furnace has lately become the most economical means for producing suitable steel for castings, said W. E. Moore before the Pittsburgh branch of the American Electrochemical Society recently. He also pointed out that in steel-foundry practice speed is specially important, because, with heats required so close in succession, a smaller furnace can be used for a given foundry capacity, thus enabling the required tonnage of castings to be produced with a lighter crane, ladle and building, less floor room and a smaller set-up of molds. For the same reasons the steel can be poured off more rapidly, so that there is less loss by skulling of the ladles and by "miss-run" and "cold-shut" castings, thus increasing the yield. With the electric furnace it is easy to superheat the steel to any degree desired without any "hit or miss" rule so that small, thin castings are commercially possible.

Since the atmosphere in an electric furnace may be readily maintained in a reducing condition no oxidation of the charge takes place during melting, and it is possible to melt thin, light scrap, such as iron turnings, which in the converter or open-hearth process would be reduced to oxides to a large extent. The melting losses in the electric furnace are far less than with any other process, usually running about one-half to one-third of the loss in the open-hearth process and about one-sixth to one-eighth of the loss in the converter process.

Electric furnace steel, when made to meet any specific chemical requirements, is always better than other steels. Usually such steel will run 15 per cent or better in tensile strength or in ductility, depending upon its heat treatment. Furthermore, it is easier to control the chemistry, and consequently electric steel can be made to more accurate specifications than other steel.

The following is typical operating cost (no overhead included) data for melting a 3-ton rapid-type electric foundry furnace, in continuous operation, melting heavy steel turnings and superheating the steel to a fluidity suitable for small steel castings:

MELTING STOCK	
1 ton heavy steel turnings—"axle turnings"	$12.00
1/20 ton (5 per cent) loss in melting "axle turnings"	.60
Electric power, 550 kw.-hr., at 1 cent	5.50
Electrodes, carbon, 20 lb., at 9 cents (Ante-bellum price 4½ cents)	1.80
33 lb. of mill scale (used as a decarbonizer)	.09
ADDITIONS	
8 lb. 70 per cent ferromanganese at 10 cents	.80
5 lb. ferrosilicon at 5 cents	.50
(Note that Spiegel and 20 per cent ferrosilicon may be substituted at lower cost.)	
½ lb. aluminum	.17
LABOR AND MAINTENANCE	
Wear and tear on refractory roofs and linings at 40 cents per ton (some of our users average 20 cents per ton)	.40
Furnace labor	1.00
Total cost of liquid steel in the ladle	$22.86

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

LAMP SHIPMENTS BY MAIL

Pittsburgh Company Replaces Any Lighting Units Which Are Found Defective on Their Receipt

Incandescent lamps are now being sold by mail by the Duquesne Light Company of Pittsburgh. Upon receiving a telephone call or postal card lamps will be delivered by return mail and the charge placed on the next energy bill.

Broken lamps, if returned immediately, will not be charged for. It seems that the Post Office Department will not insure lamps, so that the company will replace any lamps found defective.

UTILITY MAKES 19 PER CENT ON INVESTMENT IN APPLIANCES

Chart Shows Expenses on Sales of $425,000 Worth of Electrical Devices Made by Western Lighting Company

There is ample evidence that the central station can conduct a retail sales department and sell a large volume of goods at an actual merchandising profit without the necessity of cutting prices or following unethical practices which react against the dealers, according to T. W. Simpson, Western district manager of the Federal Sign System (Electric) before the convention of the Pacific Coast Section of the National Electric Light Association. The outcome of such a condition in a Western city, covering the sales results of ten months ended Dec. 31, 1918, and involving the sale of about $425,000 worth of appliances, was as follows:

	Per Cent
Cost of goods	71.14
Cost of installations	3.49
Total sales expense	5.61
General expense	7.8
Fixed charges	3.75
Net profit	8.16
Selling price	100.00

This central station figures on an average of slightly more than two turnovers of invested capital yearly in the sales department, so that the net profit is not far from 19 per cent on the investment. The table covers all rent, advertising, collection expense, discounts, apportionment of depreciation, executive salaries, etc., and is the result of very careful accounting practice by one of the largest corporations in the country.

"The selling expense," it was stated, "is exceptionally low on account of the weight of authority of the central station. People regard their power company as an oracle on electrical matters and feel that they will be well cared for in their dealings. Every one paying a bill, filing a complaint or ordering a service must pass through the display room, thus creating at no cost a select clientèle which can be reinforced by specialty sales methods of various sorts. The collection expense is very low because the machinery for collections already exists and the extra cost of collecting appliance installments is almost nil. Most important of all, the central station is bound to make a success of appliance selling because the utilization of the devices is wrapped up with its general electricity supply business. The central station has something else at stake besides merchandising profit."

FLAT-RATE CONTRACT IN NORTHWEST STATES

Rate Based on Not Less than 25 per Cent Increase Over Previous Year's Payments, with Mininum of $18 per Annum

A flat-rate system used by the Washington Water Power Company of Spokane, Wash, has served to increase the company's revenue considerably. This rate is optional for such lighting and socket appliances as the consumer may desire, having a demand not exceeding 660 watts, provided that no appliance shall be used for water, air or room heating.

The rate is arrived at on a basis of the consumer's previous year's payment for energy, being not less than 25 per cent increase per annum as shown by the ledger record of the previous year. This is payable monthly in advance. If paid yearly in advance, the customer receives an 8 per cent discount. In any case, however, the net amount shall not be less than $18 per annum. The term of this flat-rate contract is continuous for one year.

CANADIAN RAILWAY COMPANY INAUGURATES LOAN SCHEME

Fifty Thousand Dollars Placed at Disposal of Employees at 6 per Cent Over a Term of Twelve Years

In order to assist its office employees to build or acquire homes during the present scarcity, the British Columbia Electric Railway Company, which supplies electric light and power service to the Vancouver region, has placed $50,000 at the disposal of the office employees' association of the company to be loaned at 6 per cent over a term of twelve years. The scheme is believed to be one of the first of its kind to be launched in the province, and it is already being gladly accepted by the company's employees.

"The reason for making the proposal," said George Kidd, general manager of the company, "was to relieve, as far as possible, our employees from the pressure of high rents, give them homes of their own and thereby induce thrift and interest in the community. Many of them have been inconvenienced, as have others, by having the homes they rent sold over their heads. Many others feel that paying out rent year after year

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without a permanent interest in their home is not profitable.

"Some of our employees already had lots but had not the wherewithal to build on them unless at high rates of interest, which would make the monthly charge for principal and interest much heavier than rent. It was these that we hoped to help, and in view of the need for more houses we expect that the plan will induce some of our employees to build."

The disposal of the fund has been placed in the hands of a joint committee composed of representatives of the office employees' association and the management of the company, and the $50,000 has already been allotted by the committee.

RECORD OF SMALL-TOWN RANGE ACCOMPLISHMENT

Kansas Municipal Plant in Town of 4000 Has Forty Domestic Electric Cooking Services Installed

An excellent example of what can be done in a small town with the electric range is given by the Beloit (Kan.) Light and Water Department, of which F. A. Darst is superintendent. This town has a population of more than 4000 people, with 925 electrical customers, and has in the neighborhood of forty electric ranges on the lines of its municipal plant. This is a part of the effort of the Light and Water Department to build up a day load.

In order further to stimulate the range business, the department ran in the local paper a half-page advertisement, here reproduced, showing the monthly energy consumption and bill during 1918 of each of the thirty-six ranges in service during the year. The monthly average, as shown by the table, for all domestic users of energy was $6.95. The rates are 11 cents per kilowatt-hour for the first 3 kw.-hr. used per room per month and 4 cents per kilowatt-hour for the remainder used. A discount of 10 per cent applies on bills paid prior to the tenth of the month.

This department is making a strenuous effort to get all of this business it can, and, in line with this effort, it expects to cut part of its rate to 3½ cents and probably to 3 cents per kilowatt-hour during the summer of the present year.

In addition to this domestic load, the domestic-science department of the high school is equipped with several hot plates and the Kansas Industrial School for Girls, in Beloit, has ten two-burner hot plates in use. There is one restaurant in Beloit that does all of its cooking with electricity, and there is a bakery using it to a large extent. These examples of range efficiency naturally will tend to bring in additional customers.

Electricity A Cheap Fuel in Beloit

Average cost for Cooking, Lighting, Laundering and Household Appliances $6.95 per month for year 1918

The Beloit City Light and Water department having made many big improvements in its plant, is anxious that there be an additional day time consumption of electricity and believes that if the people of Beloit realized the utility and cheapness of electricity for cooking purposes, there would be a more general use of electric stoves. For the purpose of giving this information, and hoping by securing increased day time consumption to reduce electricity rates, a complete record has been compiled showing the consumption and cost per month for each home in Beloit where an electric cooking stove is used. This includes electricity used for stoves, lighting, laundering and other electrical appliances. The city does not sell stoves, but Supt. F.A. Darst will be pleased to give further data or information to anyone comtemplating the use of an electricstove.

The complete record for the year 1918 follows. Read it, study it, figure out the cost of your lighting and cooking by other methods, and see if you aren't surprised at the cheapness of electricity, in addition to the many other advantages of electricity. SAFE— CLEAN— SURE— ECONOMICAL—

Residence Electric Rate for Lighting and Cooking. 11c per K. W. H. for the first three K. W. H. consumed per room per month. Balance at 4c per K. W. H.

Cost includes Electric Lighting, Cooking, Laundering and other Household Appliance consumption. Covering year 1918.

Consumer	No. of Rooms	January		February		March		April		May		June		July		August		September		October		November		December		K.W.H. Used During Year	Average No. Consumption	Average Monthly Cost
	Number	KWH		KWH		KWH		KWH		KWH		KWH		KWH		KWH		KWH		KWH		KWH		KWH				
1	7	181	$ 8.71	158	$ 8.99	150	$ 7.47	174	$ 8.43	155	$ 7.67	133	$ 6.75	153	$ 7.79	148	$ 7.39	167	$ 8.15	204	$ 9.63	177	$ 8.55	151	$ 7.51	1,986	165	$ 8.09
2	6															82	4.54	132	6.46	147	7.14	128	6.35	121	6.10	603	121	6.12
3	10	316	14.74	201	10.14	210	10.50	240	11.70	164	8.66	183	9.42	166	8.72	207	10.38	200	10.10	245	11.90	195	10.02	188	9.62	2,518	209	10.41
4	4																							67	3.94	67	67	3.94
5	6	184	9.04	157	7.96	150	7.68	157	7.96	154	7.84	147	7.56	159	8.04		1.00	354	15.84	223	10.20	201	9.72	163	8.40	2,054	171	8.44
6	6	334	15.04	239	11.24	251	11.72	154	7.84	165	8.28	169	8.44	67	3.32	45	2.65	245	11.48	229	10.84	204	9.84	193	9.40	2,606	217	10.37
7	6	92	5.57	103	6.01	83	5.21	97	5.77	73	4.77	73	4.81	226	10.73	197	9.66	74	4.85	93	5.45	69	5.45	67	4.87	959	82	5.19
8	5													91	5.53	89	4.23	74	4.01	53	2.57	55	3.25	55	3.25	319	53	3.16
9	6																	103	5.62	104	5.42	32	2.54	46	3.10	291	73	4.17
10	8	456	19.82	366	16.32	377	16.75	403	17.18	302	13.80	314	14.24	472	22.56	228	10.80	223	10.60	258	12.00	254	14.45	254	11.84	3,708	309	14.21
11	9	204	10.05	280	13.09	235	11.29	240	11.49	200	9.89	224	10.85	192	9.57	150	7.80	152	9.17		1.00	601	28.82	218	10.61	2,726	227	11.28
12	12	91	6.16	65	5.13	52	4.60	92	6.20	109	6.88	161	8.96	100	6.53		1.00	75	5.52	236	11.96	153	10.04	104	6.68	1,273	106	6.62
13	6											67	3.96	51	3.92	56	3.92	36	3.12		1.00	46	3.52	2	1.00	228	34	2.78
14	6																							28	2.80	28	28	2.80
15	8	287	13.16	232	10.96	186	9.13	165	8.28	123	6.56	179	8.84	170	8.48	142	7.36	163	8.16	114	6.24	222	10.56	343	15.49	2,324	193	9.43
16	10	275	13.10	256	12.24	222	10.98	134	7.46	170	8.50	185	9.90	35	1.65	256	12.24	333	15.42	175	9.10	193	9.62	182	9.28	2,406	200	10.03
17	7	103	6.59	101	6.51	122	6.32	132	6.76	157	7.75	163	7.89	107	6.76		1.00	102	6.55	124	6.43	124	6.43	165	8.07	1,400	116	6.10
18	8													40	3.28	102	5.76	76	4.73	40	3.28	57	3.96	315	63	4.20
19	6	145	7.06	132	6.64	169	8.02	212	13.74	109	5.62	162	7.74	215	9.86	149	7.22	168	7.90	221	10.10	206	9.50	157	7.56	2,143	174	8.40
20	10	254	12.26	253	12.23	241	11.74	320	14.90	299	14.06	316	14.74		1.00		1.00		1.00	449	20.06	150	9.30	125	7.10	2,437	213	9.95
21	9	154	8.05	148	7.81	184	8.75	236	11.32	222	10.77	292	13.57	330	17.09	326	14.93	280	13.09	276	12.89	252	11.97	301	13.93	3,050	254	12.06
22	8	135	9.08	135	7.08	160	8.08	164	8.24	123	6.60	131	6.92	135	7.08	166	8.32	129	6.84	174	8.64	144	7.44	143	7.60	1,794	149	7.66
23	6	7	3.00	66	3.25	78	4.17	17	1.73	33	2.33	184	8.41	158	7.37	162	7.63	163	7.57	155	7.25	126	6.09	82	4.33	1,219	101	5.09
24	6	139	6.82	99	6.22	101	6.30	113	6.78		1.00	211	9.70	113	6.78	9	1.00	91	4.90	28	2.38	137	6.74	122	6.14	1,162	97	5.06
25	10	110	6.30	110	6.50	74	5.06	93	5.82	67	4.78	134	7.46	86	4.30	364	16.66	104	6.26	102	6.13	82	5.38	119	6.86	1,414	118	6.81
26	6	112	5.53	129	6.17	64	4.61	110	5.46	92	4.73	108	5.37	11	1.21	105	5.25	67	3.72	104	5.21	100	5.06	99	5.01	1,100	91	4.69
27	7	166	8.11	306	13.71	323	14.39	288	12.99	189	9.03	217	10.18		1.00		1.00		1.00		1.00		1.00	325	14.47	1,814	151	7.23
28	7	102	5.55	89	5.03	81	4.71	99	5.43	73	4.39	69	4.22	67	4.15	65	3.78	71	4.31	120	6.27	105	5.67	96	5.31	1,030	86	4.90
29	7	44	3.23	46	3.31	26	2.51	63	3.99	30	2.67	257	11.78	222	10.35		1.00	95	5.27	170	8.27	40	3.07	71	4.31	1,064	89	4.98
30	10	117	6.78	115	6.70	125	7.10	134	7.46	125	7.10	163	8.62	114	6.66	26	2.86	154	8.26	148	7.90	140	7.70	170	8.90	1,528	127	7.17
31	6	185	8.66	145	7.08	136	6.70		1.00		1.00	203	9.50	71	4.10	50	3.26	1	1.00	83	4.55	178	8.38	158	7.53	1,215	101	5.24
32	4			253	11.25	88	4.78	111	5.70		1.00	210	13.66	117	5.94	106	5.50	182	8.54		1.00	224	10.22	169	8.02	1,560	160	6.88
33	6	104	5.43	104	5.42	103	5.38	126	6.30	113	5.78	167	7.54	109	5.63	145	7.06	129	6.42	152	7.54	210	9.66	113	5.78	1,565	130	6.48
34	11	31	3.41	46	4.15	27	2.97	37	3.79	25	2.75	150	6.71	146	6.23	171	9.15	128	7.53	30	3.30	21	2.31	84	5.67	805	72	5.02
35	8							306	13.92	256	11.92	234	11.04	207	9.76	148	7.60	229	10.84	236	11.12	266	16.32	227	10.76	2,209	245	11.27
36	8									60	3.05	59	3.41	71	3.89	51	3.09	78	4.17	65	3.65	69	3.81	78	4.17	621	65	3.65
																									Totals	53,540	4,457	$250.10

$6.95—Average Monthly Cost per Consumer.

135 K.W.H.—Average Monthly Consumption per Consumer.

DAILY CALL PRINT, BELOIT, KANSAS

MONTHLY RECORD OF ENERGY CONSUMPTION OF THIRTY-SIX CUSTOMERS USING ELECTRIC RANGES

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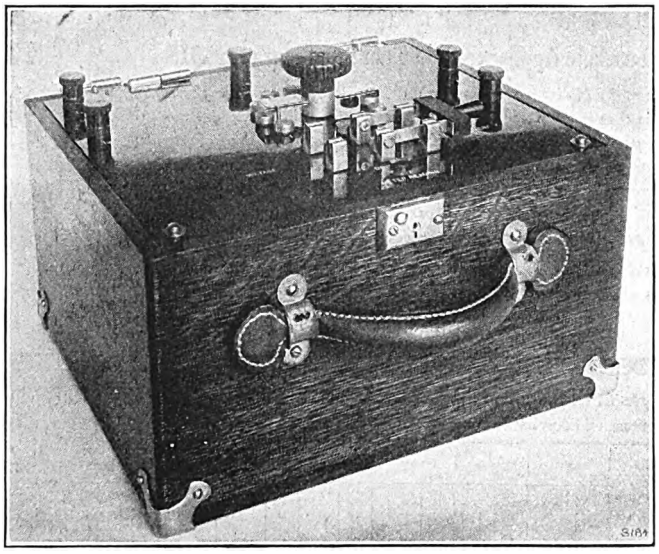
TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Operation of Alternators in Parallel.—M DE MARCHENA.—In this paper, presented before the French Society of Electricians, the author treats the synchronizing torque from a new point of view, studies the influence of amortization upon the conditions of resonance and calculates the period of two groups of electrical machinery operating in parallel, concluding that the groups should be of such a kind that their free oscillations will have a periodicity lower than that of the lowest harmonics of the motor torque. The alternators should have a powerful amortiser circuit; otherwise the amortisers complicate the construction without giving effective results.—*Revue Générale de l'Electricité* March 15, 1919.

Meter for Testing Generator Wave.—A very ingenious portable instrument has been developed through the efforts of the A. I. E. E. committee on telegraphy and telephony, as described by Dr. H. S. Osborn at the recent midwinter convention and reported in the ELECTRICAL WORLD of March 1. The presence of harmonics, in generator waves, of frequencies obnoxious to telephone systems, is determined by very simple manipulation of the instrument shown. It is thus used to find the "telephone-interference factor" of a generator wave. —*Proceedings A. I. E. E.*, February, 1919.



PORTABLE TELEPHONE-INTERFERENCE FACTOR METER

Kind and Characteristics of Motor.—E. ADLER.—Comparatively few compound direct-current motors are used in Germany, but the number of these machines with commutating poles is likely to increase. Lack of a standard ratio of compounding has been a check on utilization of these motors. Speed variation and other mechanical characteristics should be studied more closely, particularly by makers of machines in which the resisting torque is a function of speed. In general there are far more combinations of power and speed than are required and more than are justified by the accuracy with which the power consumption of the load is known. The author discusses at length the rating of motors which are to be used on intermittent load. Standardization of motors for cranes and steel works would do much to simplify design and construction of the driven machines. Belt drive is usual and offers many advantages. An idler pulley (preferably pivoted to the motor frame and sold with the machine) is generally preferable to slide rails in the case of small motors. There is necessarily a considerable variety in the general arrangement of bearings, shaft direction, seatings, etc. Steps should be taken to define and restrict the degrees of inclosure. Ventilated, protected motors are the most widely useful class. Closely allied to the question of inclosure is that of the insulating material and its impregnation. Standardized construction and arrangement of terminals would be advantageous. The dimensions and capacity of starting and controlling gear should be standardized with a view to eliminating inadequate designs which have been produced as a result of price cutting. The American rules for standard starting conditions (in reference to starter rating) are criticised adversely. It is recommended that starters be rated according to the power of the motor and that distinction be made between light-load and heavy-load starters. In the interests of more frequent utilization of variable-speed motors the highest speed obtainable in direct-current interpole motors by field control should be quoted in price lists. Electrodynamic braking is used to an increasing extent where motors have to be stopped frequently. — *Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elektrot. Zeits.*, Oct. 3, 1918.)

Lamps and Lighting

Cathode-Glow Lamps for Control.—O. SCHALLER.—For signal and control purposes low-power lamps are wanted. When in neon or neon-helium lamps the anode is brought up to the glowing column, no special striking device is needed on 220-volt circuits, and the pressure may rise to 250 volts without doing harm. The lamps shown are run on direct or alternating current; in the latter case they act as rectifiers, stopping at 150 volts. Lamps of various shapes and sizes with iron electrodes were exhibited.—*Science Abstracts, Section B*, February, 1918. (Abstracted from *Zeits. Electrochem.*, May 1, 1918.)

Calculations of the Performance of Diffusing Reflectors.—J. ONDRACEK.—This article is mainly mathematical in nature and deals with the properties of diffusing reflectors (*i.e.*, reflectors having a matt surface obeying the cosine law). The calculations and formulas developed are designed to determine the nature of the polar curve of light distribution (which in general approaches a circle in so far as the reflecting surface is

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concerned) and efficiency. The author bases these relations on the inverse-square law and cosine law without utilizing the conception of flux of light. A variety of reflectors—plane, conical, spherical, etc.—are considered, in some cases allowance being made for the effect of multiple diffuse reflection. In conclusion a typical case is worked out assuming a coefficient of reflection for the material of the reflector of 80 per cent. —*Science Abstracts, Section B*, February, 1919. (Abstracted from *Electrot. u. Maschinenbau*, Oct. 27, 1918.)

Generation, Transmission and Distribution

Water Power and Its Utilization.—The world's present power demand is estimated to be of the order of 120,000,000 hp. (steam, gas and water power), and of this amount 75,000,000 hp. is the estimate for factories, lighting and tramways. This is further split up to show its most probable distribution, and a table is given showing the available and developed horsepower per square mile of area in the various countries. Other sections deal with nitrogen fixation, cost of hydraulic power, resources of Canada and resources of Australia. It is concluded that the potential water power of the empire amounts to at least 50,000,000 to 70,000,000 hp. —*Science Abstracts, Section B*, Feb. 28, 1919. (Abstracted from *Nature*, 102, Sept. 5, 1918.)

Fuel for the Merchant Marine.—F. PARKMAN COFFIN.—The operation of the huge merchant marine now being built in the United States will consume large quantities of fuel. Present plans specify oil for this purpose, but the adaptability of powdered fuel for marine use should be investigated in order to relieve the drain on the nation's limited petroleum reserves. The author gives a comprehensive review of the principal problems involved in connection with the preparation, handling and burning of powdered fuels on shipboard. Among the important advantages of semi-coke are its safety in storage and handling and the fact that it can be made by carbonizing lignite and many low-grade coals, which are more widely distributed than high-grade coals.—*General Electric Review*, March, 1919.

Use of High-Pressure and High-Temperature Steam. —J. H. SHAW.—The greatest difficulty in determining whether or not high-pressure and high-temperature steam can be used efficiently in power stations is the effect of these higher heats upon the steel and iron in the machines. The author gives entropy diagrams which show the amount of heat available at higher temperatures and pressures, and schedules which give these data when pressures of 215 lb., 365 lb. and 500 lb. (15, 26 and 35 kg. per sq.cm.) absolute are used at the turbines. The author says that the source of water for use in high-pressure plants will have to be carefully traced and the treatment of the water should be such that a minimum of insoluble salt remains after treatment. The natural development of the turbine for higher pressures appears to be in line with a Parsons two-cylinder machine with a flexible claw-type coupling between the cylinders and a thrust bearing for each cylinder. A table is given showing the coal consumption, cost of coal and the amount of capital that can be expended to absorb the estimated saving by using high pressure. In order to get a higher over-all efficiency it is necessary to increase both the pressure and density of the steam. An increase in the pressure with a constant temperature would mean that the dew point is carried further up the turbine toward the high-pressure end, thus tending to accelerate blade erosion in the lower stages and a reduced stage efficiency of the turbine. Also the high-pressure blading of a turbine is considerably less efficient than the low-pressure stages, and although the losses in the high-pressure end are partly recovered in the low-pressure blades, it is apparent that to assume that a turbine for extra-high pressure can be built with the same efficiency as one for a lower pressure is taking a hopeful view and that there is justification for hesitation before adopting extra-high pressures.—*Journal of the Institution of Electrical Engineers*, January, 1919.

Traction

Zurich Municipal Railways.—Features of this system of electric street railways are discussed, and the monthly traffic receipts are given for several years in this article.—*Electric Railway and Tramway Journal* (London), Feb. 7, 1919.

Testing Railway Control Equipment.—W. H. PONSONBY.—Since railway equipment is subjected to a continual vibratory motion and at times has to perform its functions under adverse weather conditions, the tests must necessarily be of a very rigid nature. The writer deals with both control wiring and the motor equipment.—*Electric Journal*, March, 1919.

Partial Electrification of a Great Network of Railways.—Synopsis of a report by M. Sabouret, engineer for the Compagnie d'Orléans, on the project of that company to electrify about 3000 km. of its many lines, or 40 per cent of the total. The fulfillment of the program will take fifteen or twenty years. Rotative substations, aërial wires and the use of recuperative energy are three of the elements in the plan. An annual saving of 900,000 metric tons of imported coal will, if the scheme is carried out, be made in 1933, on the supposition of a yearly growth in traffic amounting to 5 per cent.—*Revue Générale de l'Electricité*, March 15, 1919.

Carbon Rubbing Contacts for Electric Trams.—As soon as aluminum became scarce experiments were made in Germany to use other materials, such as zinc, carbon, cast iron and alloys, for the rubbing contacts to collect the current from the overload trolley wires of electric tramways. Aluminum has the great advantage that the trolley wires are not attacked so badly as with other metals. With zinc contacts about 8000 car-miles were attained. Carbon contacts of the original type gave 23,000 car-miles, and the aluminum contacts previously used 10,000-11,000 car-miles. With improved carbon contacts, with provision for lubrication, the very high value of 75,000 car-miles was reached. These contacts gave a high polish to the trolley wires, which contributes to their long life. The grade of carbon used was considerably softer than that generally used in carbon brushes for dynamos. Zinc is unsuitable, owing to its low melting point, which causes it to burn easily so as to leave a rough surface. Cast iron can only be used at the cost of a rapid deterioration of the overhead wire owing to violent sparking. In running tests carbon contacts sparked only intermittently at currents between 120 amp. and 150 amp., whereas aluminum contacts sparked continuously at the same load. Carbon contacts should be pressed against the trolley wire with a pressure of 5 kg. to 6 kg.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Mitteil. des V. D. Strassenbahnen und Kleinbahnen-Verwaltung; Schweizer. Elektrot. Zeits.*, Jan. 18, 1919.)

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Installations, Systems and Appliances

Three-Phase to Two-Phase Transformation.—J. B. GIBBS.—The connections shown for three-phase to two-phase transformation include the ones most commonly used as well as others which are given as suggestions for possible emergency connections even though the exact voltage and phase relation may not be obtained. *Electric Journal,* March, 1919.

Making Paper by Electricity.—A reservoir, penstock and power plant all within a few hundred yards, as well as the factory utilizing the power, the raw materials and the shipping facilities immediately adjacent, are features of a paper mill belonging to the Ocean Mills plant and situated 350 miles (560 km.) north of Vancouver. Two power plants operate the machinery of the sawmill and paper mill. These are fed by two penstocks which deliver the water under a head of 130 ft. (40 m.). Power house No. 1 is a reinforced-concrete building with two Francis turbines and a Pelton waterwheel with a combined capacity of 8850 hp. Power house No. 2 is used as a standby plant with three 600-kw. wicket-gate inward-flow turbines directly connected to three 600-kw. generators. There are about 200 motors in use in the installation varying from 10 hp. to 725 hp. The majority are squirrel-cage induction motors. The process of paper making, indicating the use of these motors, is then briefly described.—*Journal of Electricity,* March 15, 1919.

Solder for Aluminum.—As a result of a study of the composition, use and effectiveness of solders for aluminum the Bureau of Standards has reported the following features: (1) All metals or combinations of metals used for aluminum soldering are electrolytically electronegative. A soldered joint is therefore rapidly attacked when exposed to moisture and disintegrated. (2) Joints should therefore never be made by soldering unless they are to be protected against corrosion by a paint or varnish or unless they are heavy so that corrosion and disintegration of the joints near the exposed surface would be of little consequence. (3) Solders are best applied without a flux after preliminary cleaning and tinning of the surfaces to be soldered. The composition of the solder may be varied within wide limits. Suggested ranges of composition are as follows: tin-zinc solders, tin, remainder; zinc, 15–50 per cent. Tin-zinc-aluminum solders, tin, remainder; zinc, 8–15 per cent; aluminum, 5–12 per cent. (4) The higher the temperature at which the "tinning" is done the better the adhesion of the tinned layer; perfect union between solder and aluminum is very difficult to obtain. (5) The joint between previously tinned surfaces may be made by ordinary methods and with ordinary soft solder. Only the "tinning" mixture need be special for aluminum. (6) There is no reason why a good solder for aluminum need be brittle, as several commercial varieties are. (7) The tensile strength of a good aluminum solder is about 7000 lb. per square inch (500 kg. per sq.cm.), the strength of a joint depending upon the type and upon the workmanship. Much dependence should not be placed on the strength of a joint.—*Circular Bureau of Standards,* No. 78, Jan. 28, 1919.

Electrochemistry and Batteries

Farm Lighting as a Field for Small Storage Batteries.—GEORGE W. HILL.—The author is of the opinion that the best results from batteries should be obtained by using them for light loads and for emergency reserve.—*Electrical Review,* Feb. 22, 1919.

Units, Measurements and Instruments

Measurement of Fluid Velocity and Pressure.—J. R. PANNELL.—One of a series of articles on anemometers especially used for the measurement of air velocity.—London *Engineering,* March 7, 1919.

Improved Form of Throttling Calorimeter.—W. R. WOOLRICH.—When using the throttling calorimeter the data of the test are substituted in a formula or are used in connection with a curve sheet to find the quality of the steam. In this article it is explained how the instrument may be made self-contained by having the necessary curves drawn on a metal plate fastened to the barrel of the calorimeter. Thus, having observed the initial pressure of the steam and the temperature in the calorimeter, the quality can at once be found from the curves which are drawn on the plate.—*Power,* April 1, 1919.

Photometric Apparatus for Measuring Illuminating Value of Fluctuating Sources of High Candlepower.—A. P. TROTTER.—A description of the apparatus and experiments in the measurement of the candlepower of flares and sources of like character. Curves give various candlepowers of these light sources, showing that it is possible to take readings at intervals of two seconds.—*Illuminating Engineer,* November, 1918.

Determinateness of the Hysteresis of Indicating Instruments.—F. J. SCHLINK.—The hysteresis loops obtained in the specified cyclic calibration of a non-integrating mechanical instrument nearly free from transient after-effects at rates of operation obtaining in the experiment are highly reproducible and invariant in themselves, even in the presence of very considerable instrumental friction and the resulting so-called unreliability of indication. The limiting values of the variant errors of such an instrument can be accurately set down upon the performance of a calibration of the type referred to for any given range of operation in question, since the major loop corresponding to that range circumscribes and completely incloses all minor or secondary loops observed over ranges of indication between its own terminal limits.—*Journal of Washington Academy of Sciences,* Jan. 19, 1919.

Miscellaneous

Modern Testing Departments in Factories.—E. PHILIPPI.—An outline sketch of the general arrangement of testing departments for electrical machinery, including the lay-out of the building, sources of current, installation of conductors and switchboards, and types of measuring instruments.—*Science Abstracts Section B,* Jan. 31, 1918. (Abstracted from *Elektrot. Zeits.,* Aug. 1, 1918.

Study of Water Hammer at the Floodgates.—E. CAREY.—In another of the extended series of articles on water hammer it is contended that the curves showing the action of this phenomenon opposite the floodgates correspond to a series of typical curves always encountered which define clearly the general form of water hammer in conduits of constant diameter and thickness. The laws governing rapid closing and openings with respect to water hammer are also studied, and formulas are deduced from those determined by Michand for complete closure in $2L/a$ seconds (L being the length of the conduit in meters and a the speed of the propagation of the wave from the water hammer in meters per second) and by de Sparre for slow closing and opening.—*Revue Générale de l'Electricité,* March 8, 1919.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

MORE SPACE LEASED FOR ATLANTIC CITY EXHIBITS

Manufacturers Who Wish Space Can Be Taken Care Of if They Notify Exhibition Committee of N. E. L. A. at Once

By immediate notification manufacturers can still obtain space at the exhibition to be held in connection with the N. E. L. A. convention at Atlantic City, according to H. G. McConnaughy, secretary of the exhibition committee.

"About 5000 sq.ft. additional space has been leased," said Mr. McConnaughy to a representative of the ELECTRICAL WORLD. "This is a continuation of the space already provided. This year the exhibition is ideally located because the delegates will pass through this room on their way to the meetings. Furthermore, the prize contest announced last week is bound to stimulate interest in the exhibits and cause the delegates to study carefully everything being shown."

The exhibition committee will move its headquarters to the Million-Dollar Pier, Atlantic City, on May 1. All communications to it should be addressed there from that date.

It Is the Victory Loan

MUNICIPAL UTILITIES ARE SUBJECT TO REGULATION

Illinois Supreme Court Holds that the Section of the Act Which Exempted Such Properties Is Unconstitutional

The Illinois Supreme Court has rendered a decision that municipally owned public utilities come under the jurisdiction of the public utilities act and that Section 10 of the act, which exempted such properties, is unconstitutional. It reversed the finding of the lower court in the case of the Springfield Gas & Electric Company against the city of Springfield.

Extracts from the decision follow:

In operating an electric light plant and selling electricity to individauls the city is not exercising its governmental powers but its private or proprietary rights, and its duties and liabilities are the same as those imposed by law upon individuals engaged in the same business.

There is no doubt that the exception of municipalities owning or operating public utilities from the operation of the public utilities act, which applies to every other corporation, company, association or individual, grants to such corporations a special privilege which such other corporations do not enjoy and is therefore obnoxious to the provision of the state constitution against special laws unless there exists some reasonable basis, having reference to the object of the legislation, for placing such municipalities in a class by themselves.

The persons who use the products or service of public utilities are entitled to the benefit of the public utilities act and are entitled to its protection against extortion, discrimination and inferior service, by whomsoever furnished. The furnishing of such service is an ordinary commercial business by whomsoever undertaken. Whether a public utility is owned by a private corporation or a municipal corporation, its relation to its customers is not different. They are under the same compulsion to use its service, are at its mercy to the same extent. If a customer is oppressed by extortionate charges or discriminated against by a wrongful rate or inferior service, the wrong is the same whether done by a municipal corporation or a private corporation.

The difference in ownership does not change the character of the wrong done or justify the refusal of a prompt, adequate and complete remedy in one case which is granted in the other. The fact that by organizing with others complaining consumers may be able at some future election to secure a change of administration which will perhaps have the ability and sense of justice voluntarily to correct the wrong does not justify putting municipally owned public utilities in a class separate from other competing public utilities and relieving them from the supervision of the Public Utilities Commission.

Finish the Work—Do Your Part

SETTLEMENT OF THE NEW ENGLAND TELEPHONE STRIKE

Terms on Which Agreement Is Made Between Representative of the Postmaster-General and 20,000 Striking Employees

The strike of New England telephone operators, which began April 15, ended Monday of this week at 3 p.m., following a visit to Boston of First Assistant Postmaster-General Koons, who was empowered by the Postmaster-General to settle the controversy.

About 8000 operators and 12,000 electrical workers in telephone companies, serving all of New England except Connecticut, went out during the past week, and a national strike of telegraph workers was seriously threatened by the continuance of the walkout. By the settlement terms the operators receive an increase, from $8 to $10 per week for beginners, and their maximum pay is raised from $16 to $19 per week. They also receive the right to bargain collectively with the managements of the New England and other companies. Increases of 50 cents per day were granted the men electrical workers in the Boston district, and 62.5 cents per day to those outside.

The agreement was reached after protracted conferences on Sunday between Mr. Koons and the various parties in interest, and it was ratified by the unions at meetings which were held by their members soon after the conferences closed.

You Owe It to Those Who Fought

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CALIFORNIA COMMISSION ON THE RECONSTRUCTION PERIOD

Power Is the Foundation of Industrial and Agricultural Development and Money Must Be Raised to Utilize Hydroelectric Energy

Because of the interest displayed in Kern, Tulare and Kings Counties in the petition of the Mount Whitney Power & Electric Company for authority to add 5 per cent to the 10 per cent surcharge on rates it was authorized to collect by the Railroad Commission, the commission has issued a statement telling of the wide range of territory in which the rate question is demanding attention, the aims of the commission, its methods and the results of the regulatory practices of California's utility commission.

In pre-war times the California commission, in its regulatory policy, held that an 8 per cent return on a valuation that represented a true rate-making base was a fair and reasonable one. It was accepted by the utilities and the investors, because they knew it was fair and reasonable, and the rates which gave this return were acceptable to the consumers, the people, for the very same reason—their fairness was obvious. This view of California utility rates is widespread where thought is given the matter. The surcharge of to-day is simply an addition to "fair and reasonable rates" in order that they may be maintained as fair and reasonable rates.

Abnormal conditions are responsible for the surcharge. Every cent of profit on which utilities must depend if they would give service and provide the development that California's growing needs demand disappeared with our entry into the war. Oil jumped in price from 60 cents a barrel to $1.75 and more. Wages advanced as the cost of living soared, and material costs jumped to almost a prohibitive figure. On top of it all were piled war taxes. Absorption of all these increased costs without increase in revenue meant ruin in the utility field, a situation quickly realized in Washington, whose first appeal was to the utility commissions of the various states to see that "utilities functioned properly, that there was no break-down in the forces upon which industry depended."

The surcharge of the California commission preserved the efficiency of the state's utilities, preserved their financial integrity, insured their proper functioning. With other regulations the surcharge aided in keeping California utilities out of the hands of receivers, a record not enjoyed by every state. Not one ceased to function or failed to meet demands that tested it to the limit.

The reconstruction period brings but little change in the situation. The price of oil has not dropped. Wages have not gone down. Taxes are still high and numerous. These three items of expense, largely responsible for the big increase in operating cost, the almost complete disappearance of the public utility profit up to the time of the granting of the surcharge, still remain the utility burden. And with the reconstruction period has come a danger that involves not only the utilities but the state itself. Many of the large utilities have demands for service that cannot be filled with the present facilities. This accounts for the planned construction activities of the state's utilities.

Millions will have to be spent if the state is to take advantage of the industrial and agricultural development that is coming because of changed conditions brought about by the war. Power is the foundation of this development, the cause of it. Steam-generated power, which means the use of oil as fuel, and therefore added cost for energy, is not what is wanted. The state's natural resources must be utilized. The state's development rests upon its hydroelectric energy. California's mountains are filled with it, but it must be harnessed. The harnessing costs money, and this money may be had from investors only as the utilities show that they are sound financially. That they are sound is largely due to wise state regulation.

The consumer is asked to pay only a fair and reasonable rate for service, and the fairness and reasonableness of the rate is determined by a commission whose expert engineers do their own valuation work. Better by far, as California's history of utility regulation shows, an 8 per cent return and good service and sound utilities, with real development, than a return to the condition that prevailed prior to the establishment of regulation, with its cut-throat and ruinous methods and waste and duplications due to competition.

It Is Victory and Liberty Now

REUNION OF THE EUROPEAN TRAVELERS OF 1889 PARTY

Dinner in New York About May 27 by Survivors of Electrical, Civil, Mechanical and Mining Engineering Societies Who Made Trip

Thirty years ago a party of American engineers, with members of their families, belonging to the four national engineering societies—American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Mining Engineers and American Institute of Electrical Engineers—sailed for Europe, visiting England and the Paris Exposition of 1889 and being the recipients of many high courtesies, official, professional and individual.

Plans have been made for a reunion dinner, to be held in New York City about May 27, at which it is hoped that all the survivors, women as well as men, of that memorable trip may meet again. While the records of the various societies furnish an approximately complete list of the party, it is possible that some have been overlooked or that addresses may require correction. It is therefore urgently requested that any one who was of that party communicate immediately with Jesse M. Smith, secretary of the committee, at the Engineers' Club, 32 West Fortieth Street, New York.

This information is desired from every member of the party, whether attendance at the function is possible or not. Those who cannot come will be heartily remembered when their letters are read. It is hoped that the response to this request will be immediate and complete; the time is brief and the information important. Announcement of the precise date and place and full details will be sent to every individual who can be reached. Henry R. Towne is chairman of the committee.

This Is the Last Call—Be Ready

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PUBLIC UTILITIES COMMITTEE OF THE CHAMBER OF COMMERCE

Membership of New Organization Created by United States Chamber of Commerce to Study Matters Affecting Public Utilities

The Chamber of Commerce of the United States has created a committee on public utilities. This committee is composed as follows:

Lewis E. Pierson, Irving National Bank, New York City, chairman.
Henry G. Bradlee, president Stone & Webster, Boston.
Arthur W. Brady, president Union Traction Company, Anderson, Ind.
F. B. DeBerard, director of research Merchants' Association, New York.
P. H. Gadsden, Munsey Building, Washington, D. C.
E. K. Hall, Electric Bond & Share Company, New York.
Albert W. Harris, president Harris Trust and Savings Bank, Chicago.
Charles L. Harrison, chief of ordnance, Cincinnati district, Walsh Building, Cincinnati.
J. W. Lieb, vice-president New York Edison Company, New York.
P. W. Myers, president St. Paul Association of Public and Business Affairs.
James S. Havens, Eastman Kodak Company, Rochester, N. Y.

At the annual convention of the national chamber in St. Louis a public utility section will be established. It is expected that the committee will have speakers representing the banking interests, the views of labor, representatives of municipal leagues, mayors of cities and others. After the convention the committee proposes to have public hearings on public utility matters, from which to gather material for a referendum to be sent to the national chamber's membership. Then, it is planned, a report will be formulated by the committee, to be sent to each chamber of commerce throughout the United States, particularly to local chambers of commerce, to enlist the interest of all who desire to work out various phases of public utility problems.

V Loan Stands for Victory Loan

ELECTRIC SYSTEM AT HOG ISLAND SHIPYARD

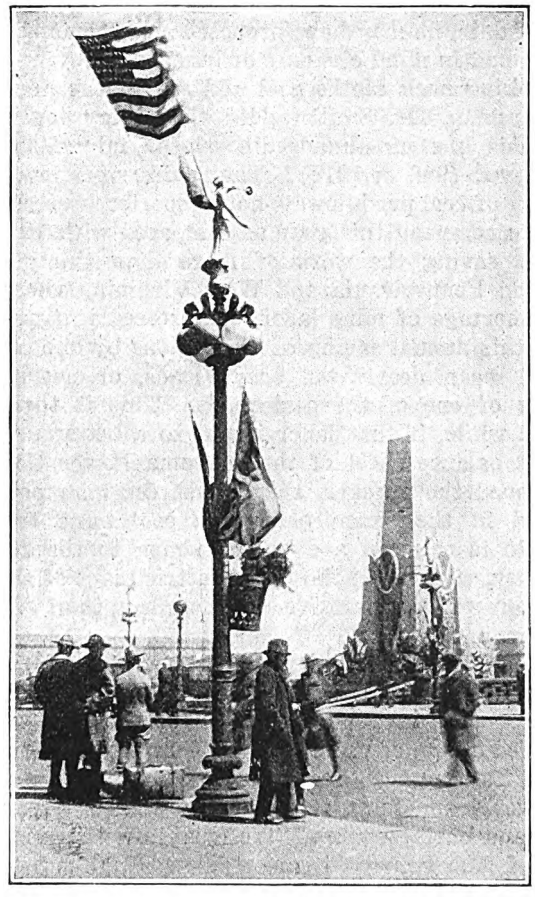
President M. C. Brush of American International Shipbuilding Corporation Gives Details—Service from Philadelphia Electric Company

Testimony given by Matthew C. Brush, president American International Shipbuilding Corporation, before the committee on commerce of the United States Senate gives interesting data in regard to the electric system at the shipyards at Hog Island. Following are the details:

Power purchased from Philadelphia Electric Company.
Transmission lines, double-circuit steel tower, 66,000 volts; length, 7800 ft.
Main substation, brick and steel construction, placed in service March, 1918; capacity, 24,000 kw.
Substations, 35.
Motors, 1149; combined horsepower, 37,100.
Transformers, 577; capacity, 22,252 kw.
Street and yard lamps, 3441; equivalent in capacity to 66,620 40-watt lamps such as are commonly used in residence lighting.
Building lamps, 200,000 outlets.
Electric fans, 1558.
Pumping stations, 10.
Compressor houses, 7.
Fire-alarm boxes, 409
Consumption, 130,000 kw.-hr. received, transformed and distributed.
Time clocks, 422, synchronized with and operated by master clock at main substation.
Electric yard call, 28 stations.
Miscellaneous: Electric tabulating machines for material control and financial accounts; electrically driven potato peelers, dough mixers, dishwashers and hospital appliances.
Overhead wires, 400,000 ft. Equal to more than 75 miles.
Poles for overhead lines, 500.
Underground cables, 400,000 ft., more than 75 miles.
Fiber duct laid in concrete, 237,600 ft., or 45 miles.
Wire used in lighting permanent buildings, 2,000,000 ft., approximately 379 miles.
Temporary work: Overhead wires strung, 531,000 ft., or 101 miles; poles set, 1052; substations built, 3.

Make a Good Job of It—Buy Notes

Electricity's Part in Chicago's Welcome to Her Returning Troops



The artistic lighting standards on Michigan Boulevard, Chicago, materially reduced the task of decorators who were "fixing up" the city for the Victory Liberty Loan and the homecoming of the Middle Western contingent of the Forty-second (Rainbow) Division. The victory trumpeters, the red, white and blue diffusing globes, the flags and the flower baskets on the standards were only a part of the decorative scheme. In Grant Park, which flanks the boulevard on the east, great parks of cannon from the western front, the Liberty Way and arch of jewels were all arranged so that they could be floodlighted to high intensities at night.

Make the Victory Loan a Success

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CONSERVATION OF ENERGY IN GENERATION OF POWER

Dr. George Otis Smith Calls Attention to Economy of Human Energy Through Displacement of Steam-Generated Power by Water Power

In speaking at the meeting of the Engineering Society of Western Massachusetts at Springfield, Mass., on April 16, Dr. George Otis Smith, Director of the United States Geological Survey, supplemented the references that had already been made to the proposal of Secretary Lane for an investigation of the super-power plan. Without touching upon the engineering phases of the plan as developed by W. S. Murray, Dr. Smith referred to the phase of conservation that best meets the present-day need as conservation of energy.

Dr. Smith said that the idea that engineering efficiency is conservation of labor is not novel to engineers, a large purpose in whose profession is nothing more or less than labor saving. When Mr. Murray spoke of displacing steam-generated power with water power and of saving coal in his central stations instead of wasting it in locomotives or local plants, small and out of date, he may have proposed coal economy, but he really had in mind economy of human energy.

Looking back of the coal and seeing the miner and the fireman, Dr. Smith added that every ton of coal saved is one nine-hundredth of the miner's year of toil saved (968 in 1918). The saving of a few ounces (four) of coal per kilowatt-hour reported by the Boston Edison company this year as compared with 1917 thus means saving the work of more than thirty miners back in Pennsylvania and West Virginia, where there was shortage of mine labor. Expressed in transportation, this annual saving of 30,000 tons by one company would mean nearly ten barge loads, or nearly forty trains of one of the coal roads. This is thrift well worth while, if that labor is put to a better use.

The balance sheet of the Alabama Power Company, continued the speaker, shows that the man power required in the steam plant and coal mine tributary thereto is thirteen and one-half men to the 1000-kw. capacity, whereas in the hydroelectric plant of the same company the comparative figure is less than one-sixth of a man.

Industrial New England must plan to safeguard in every way its chief asset, skilled labor, Dr. Smith declared. Just as Emerson said that the civil war had unrolled a map of the Union and hung it in every man's home, so now the great war has unrolled the map of the world and hung it above the desk of every engineer and business man. "We must now think in terms, not of Massachusetts, or of New England, or even North America, but of the whole world," said he.

Dr. Smith then spoke of the preparation of data for the use of the Peace Commission at Paris—a work on which the United States Geological Survey began over a year ago. It mapped in graphic manner the distribution of not only the raw materials—mineral fuels and ores—but also the water powers of the world, both developed and undeveloped. The power question is a world question. France and Italy are interested in making the white coal do the work of the black coal, and for two years now a British commission has been working on this same proposition of consolidation of power systems and centralization of power supply. The speaker added:

"And their reason for economy is outspoken—to meet American competition in the world markets. With more expensive fuel and practically no water power England must get more kilowatts from the ton of coal and so reduce the power item in manufacturing costs. On the other hand, it is New England's clue to keep in the lead by making the power supply free from any danger of shortage such as threatened us in the winter of 1917-1918, by securing cheaper power and thus increasing its use by every industry.

"If the British engineers are planning an annual saving of 50,000,000 tons in the fuel account of England, a tonnage twice New England's consumption of soft coal, our own engineers must meet this competition in industrial efficiency. Since modern machinery multiplies man power, cheap electricity is the only method of harmonizing high wages and low costs. Hitching up America's coal and America's water power most efficiently is absolutely essential if American standards of living are to be maintained. The super-power plan thus becomes a large item in the human welfare plan."

Buy Cheerfully—It Is Your Share

WORK OF THE INTERNATIONAL ELECTROTECHNICAL COMMISSION

Prof. C. A. Adams and H. M. Hobart Are to Attend Meetings in France and England as Representatives of the A. I. E. E.

Prof. Comfort A. Adams, president of the American Institute of Electrical Engineers, and H. M. Hobart of the General Electric Company have sailed for Europe to attend conferences in France and England on engineering standards. A meeting of the special committee on rating of the International Electrotechnical Commission is to be held in Paris, and conferences are also to be held in England.

Advices from England say that the question of reorganization of the entire commission is under consideration. A meeting of the commission will be held at which a number of matters will be taken up. Among these will be that of the question of the enemy countries which were represented on the commission before the war. A delegate will be appointed to represent the British interests as a successor to the late Dr. S. P. Thompson.

It is recognized in England, according to the announcements published there concerning the work of the commission, that Europe has not been able to give much attention during the war to research in connection with the rating of electrical machinery and that consequently there has not been so much progress in knowledge of insulating materials as in the case of America. In addition, misunderstandings have arisen due to the fact that both American and British commissions have, with the best intentions, slightly exceeded in certain cases the limiting temperatures already adopted by the International Electrotechnical Commission. On account of misapprehension which has developed as a result on the part of the French committee, the meeting of the special committee on rating, to be held in Paris, was called. This committee includes representatives from Belgium, France, Great Britain, Italy, Sweden, Switzerland and the United States.

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It is announced that the question of graphical symbols in electrotechnics has been under discussion in this country, Great Britain and Italy, and that as a result a large amount of preparatory work will be at the disposal of the special committee on symbols.

An international standard for the resistance of aluminum will probably be adopted in the same manner as has been done for copper. It is suggested by the French committee that the commission should also take up the subject of screw lamp sockets and holders.

Bring the Boys Home—Buy Notes

NEW AMERICAN ENGINEERING STANDARDS ASSOCIATION PLAN

Report of Bureau of Standards Conference on Industrial Safety Codes and Proposed Development of National Organization

The Bureau of Standards has issued a report of a conference on industrial safety codes held at the bureau on Jan. 15, 1919. A proposal for the organization of an American Standards Association is included. The report was prepared by Prof. Comfort A. Adams, chairman of the American Engineering Standards Committee; H. W. Forster, member executive committee of the National Safety Council and the National Fire Protection Association, and Dr. Edward B. Rosa, chief physicist of the Bureau of Standards.

The first plan submitted by Dr. Rosa on behalf of the Bureau of Standards provides that the bureau shall undertake the formulation of industrial safety codes with the coöperation of all interested bodies, coördinating the work now being done along such lines by a number of independent agencies such as the various state commissions, engineering societies and insurance and manufacturing organizations. It is also proposed by the bureau that it should appoint a large conference committee of twenty-five to fifty members, which shall be thoroughly representative of the many interests concerned in safety standards, with which committee the bureau would consult as to general matters of policy and procedure.

The second plan suggested by Dr. Rosa involves the American Engineering Standards Committee and its procedure. From a series of conferences there resulted a general agreement that the Engineering Standards Committee is organized along the right lines and has a very excellent procedure for supervising standardization work but that it would be more effective if it represented a much larger number of societies and if it had a more generous financial support than the five founder societies would be able to give it.

The matter was finally considered at a meeting, on April 12, of the American Engineering Standards Committee, at which representatives of the fire-protection and safety interests, the federal government and certain engineering and commercial associations were present by invitation of the committee. It was unanimously voted by the committee to ask the five founder societies to amend the constitution of the committee so as to permit other engineering or commercial organizations or governmental departments having an interest in engineering or industrial standards to be admitted to membership in it with full rights and privileges, including the responsibility of approving any subsequent changes in the constitution.

The general sentiment was favorable to a large increase in membership of the committee, and it was voted to recommend to the founder societies that the name be changed to the American Engineering Standards Association. It is confidently expected that the changes requested in the committee's constitution will be approved by the five founder societies in the near future. The way will then be open for the committee, or the American Engineering Standards Association, as it will be called, to develop into a broad democratic organization, which will completely remove the ground for such criticisms as were expressed at the Washington conference.

You Bought the Others—Buy Again

INFLUENCE OF THE WAR ON COMPANY OPERATIONS

Continental Gas & Electric Corporation Had to Operate Seven Uneconomical Stations but Plans to Extend Transmission Lines This Year

Reviewing conditions in the annual report to stockholders for 1918, C. S. Eaton, president Continental Gas & Electric Corporation, Cleveland, says that the results to the company of the more important war regulations were:

1. Increases in costs of coal, labor and material.
2. Increases in freight rates.
3. Reduction in hours of lighting through the daylight-saving plan.
4. Prohibition of street and display lighting on certain days.
5. Loss of power load through the closing down of non-essential industries.
6. The practice of economy on the part of consumers through the appeals to all to save.
7. The calling to the colors of many of the skilled electricians and engineers.
8. Inability to make extensions and additions to business through the restriction to war uses of copper, iron and construction materials.

In some industries such an enlistment in government service was coupled with sales to the government at high prices and large profits. In the case of many public service corporations, adds Mr. Eaton, it meant the paying of double prices for everything consumed and getting the same or only slightly increased prices for the output sold.

The company was further handicapped in that during the preceding year it had acquired seven small power stations lying in the path of projected transmission lines. It was planned to eliminate these stations and to supply their territory from the larger stations. War conditions made it impossible to secure construction material, and it was necessary during the whole year to operate these seven uneconomical power houses.

With the prospect of settled financial conditions it will be the policy of the directors to resume the expansion of the company's business. During the year 1919 plans will be developed to furnish cheaper power to the entire territory, and additional transmission lines will be constructed so that all small, uneconomical power houses can be closed down.

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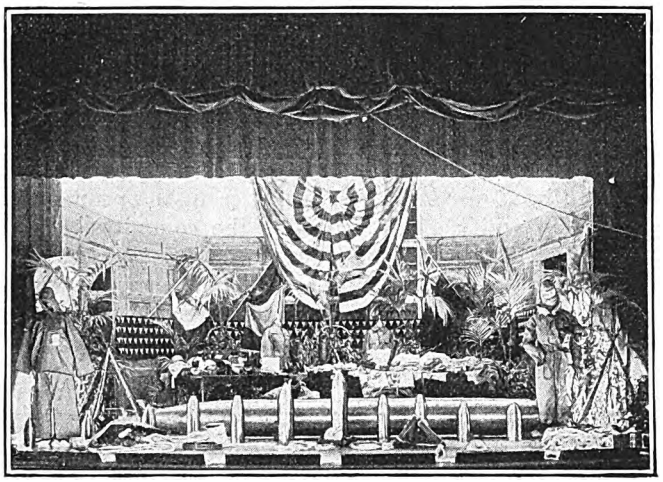
Brooklyn's Part in the Great War



"Brooklyn and the Brooklyn Edison Company in the War" was the subject of a recent address by T. I. Jones, general sales agent of the company, at a meeting under the auspices of the Brooklyn Edison Section of the N. E. L. A.

LIGHTING CODE DISCUSSION AT MEETING IN BOSTON

Illumination Experts Favor Regulation to Obtain Better Service, but Desire Elasticity in the Application of Plan

G. H. Stickney of the Edison Lamp Works of the General Electric Company addressed a joint meeting of the New England Section of the Illuminating Engineering Society and the Boston Section of the American Institute of Electrical Engineers on April 22 upon lighting codes, following his paper of April 11 at New York (ELECTRICAL WORLD, April 19, page 806). At the close of the paper a discussion took place in which the desirability of a code was generally conceded, provided sufficient latitude be left in its enforcement. Dr. Louis Bell, consulting engineer, Boston, stated that he is now engaged in formulating a code at the request of the Masachusetts Board of Labor and Industries and that he welcomes suggestions from engineers and others with regard to specifications. A rather general code, he thought, giving a good deal of liberty to the inspector as to classification, is the safest. A common-sense interpretation of emergency lighting requirements is essential. The latter are vitally important in a plant where, for example, 150 girls are at work in a wooden building on celluloid products, compared with a small machine shop employing a dozen or so men.

J. W. Cowles, superintendent of the installations department, Boston Edison company, questioned the advisability of leaving too much to the inspector. The codes presented by Mr. Stickney must of necessity receive the hearty support of central stations except as regards duplicate lighting provisions. In theaters, for example, the cost of an extra service for emergencies is well warranted, but in general it is undesirable from the central-station standpoint to require a separate auxiliary source in industrial and mercantile lighting. Such a requirement involves the central station in additional expense, forces complications in metering and in carrying out rate regulations, and leads to expensive wiring. Apart from the increased cost of labor, the effect of the rules and regulations extant is to increase the cost of construction, and further tendencies in this direction should be discouraged. During the discussion the value of the portable illuminator for periodical surveys of lighting conditions in industrial plants was emphasized. Instruments accurate to about 95 per cent and costing but $25 each are now on the market and should become a part of the testing paraphernalia of an efficiently managed plant so that production will not suffer from either neglect or the insensible deterioration of the intensity of illumination.

They Are the Victory Notes

STUDY OF MOVEMENTS OF PRICES AFTER THE WAR

Department of Labor Statement Shows that It Was Thirteen Years After Civil War Before Prices Returned to Pre-War Level

Through its information and education service the Department of Labor has issued a statement giving results of a study of prices during the war and readjustment period by the Division of Public Works and Construction Development. This shows that it was thirteen years after the civil war before prices returned to the pre-war level.

The statement says that at the beginning of the year 1865, the end of the civil war being in sight, wholesale prices broke suddenly and violently. During the first six months of the year prices in general fell off 27 per cent from the high level of January. However, the break in wholesale prices, though unprecedented in violence and accompanied by the unsettling influence of the end of the great war, produced no business crisis or depression. Through the latter half of 1865 prices recovered from the low point until in January, 1866, they stood just 16 per cent below the level of January, 1865. From the beginning of 1866 prices dropped slowly downward. They did not reach the pre-war level until the year 1878. As is well known, during that period of inflated currency gold was at a premium. However, commodity prices remained above the prices of gold up to and including the year 1877.

"Building materials declined in price along with other commodities during the first half of the year 1865," the statement continues. "However, the fall was less than in the case of other commodities. Whereas commodities in general dropped 27 per cent, building materials dropped only 14½ per cent. The recovery during the second half of the year was more marked, prices of building materials returning to the level of the last quarter of the year 1864 and remaining at that level for a period of a year before the decline set in. The index figure for the building materials group remained higher than that for all commodities up to and including the year 1874.

"The currency was on a distinctly unsound basis in the civil war reconstruction period. The sharp fluctuations in prices gave rise to much speculation, and the opportunities for development of the resources of the country, such as unused land, rivers and harbors, building of railroads, etc., led to overexpansion of business resulting in the financial panic of 1873. This panic was not accompanied by any sharp decline in prices. . . .

"The principal cause of the return to the pre-war level was the fact that there was such abundant oppor-

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tunity for the development of new and more economic methods of production in the shape of new forms of machinery and new kinds of business organizations. These opportunities we do not have at the present day in any measure comparable with the previous period."

Help by Lending Freely

RATE INCREASES BY NORTH AMERICAN COMPANY PROPERTIES

Despite Inertia of Regulating Authorities, the Subsidiary Companies Obtained Adjustments Which Pave Way for Better Results in 1919

President James D. Mortimer of the North American Company comments on the subject of rate increases by the subsidiary companies in his annual report to stockholders for 1918.

Despite the inertia shown by the regulating authorities in permitting increases in rates to offset increases in operating expenses, the subsidiary companies, Mr. Mortimer said, obtained rate adjustments which permitted the continuation of dividends. Most of these adjustments came so late in the fiscal year just closed that their effect, while important in the general result, was relatively small in adding to the actual net income of the company. They paved the way for better results during the year 1919.

The Victory Is Won—Pay for It

ECONOMY IN HANDLING MATERIALS AT PORTS

Engineering Committee of Material-Handling Machinery Manufacturers to Study Reducing Cost of Handling Cargoes

Port and harbor development throughout the United States and the expected shortage of labor as business is resumed are responsible for many requests for information and suggestions made to the Material-Handling Machinery Manufacturers' Association.

The first meeting of the engineering committee, appointed by President Calvin Tomkins, was held at the association quarters, New York, on April 9. The members of the committee as at present constituted are: W. B. Clarke, Manning, Maxwell & Moore, Inc.; S. H. Libby, Sprague Electric Works; R. W. Scott, Otis Elevator Company; D. V. Jenkins, Watson Elevator Company; L. C. Brown, Elwell-Parker Electric Company; A. F. Case, Wellman-Seaver-Morgan Company; J. C. Walter, Alvey-Ferguson Company, and J. A. Shepard, Shepard Electric Crane & Hoist Company.

The committee will make studies of large industrial plants and a special study, based on the selection of one of the new port terminal projects, of a complete equipment for general cargo handling. The discussion indicated the necessity of taking into consideration the tremendous saving made in quick ship turn-around as an important factor in reduction of the cost of cargo handling, as this cost without the use of modern equipment has increased so much that some of the larger steamers which formerly figured on $7,000 to $15,000 per day loss for every day in port are now compelled to stand 50 to 70 per cent additional.

Arrangements have been made by the committee to meet with the engineers of the New York-New Jersey Port Commission to discuss the various phases of cargo handling and the application of machinery to the problem when plans are made for the complete development of the port of New York and New Jersey; also with the committee appointed by the Sanitary Potters' Association to discuss possible savings in that industry through the use of modern handling equipment. Plans will be made to develop a standard and proper system of cost accounting for the handling of cargo.

Zenas Carter, secretary and manager of the association, asserts that interest in the association by manufacturers and harbor commissions is increasing daily and that the committee on membership is making rapid progress.

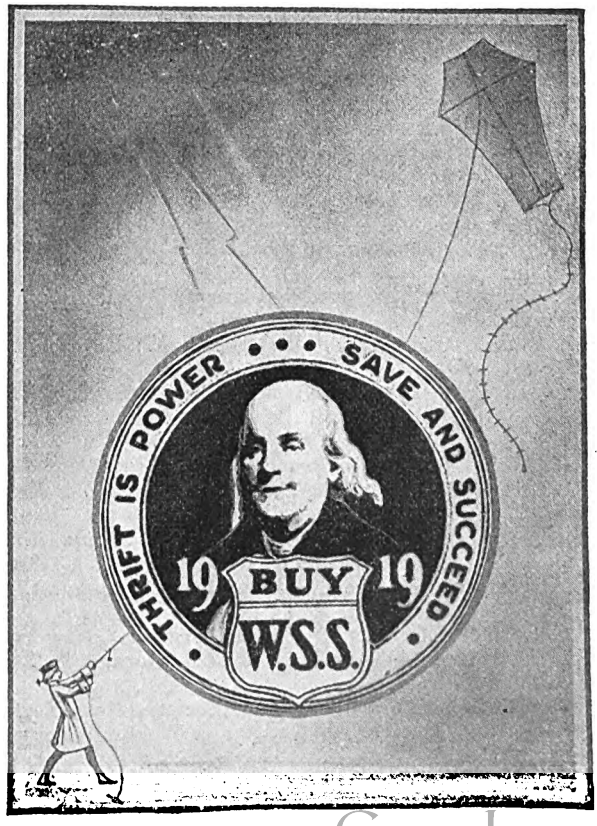
Lend for the Sake of Victory

EXPANSION OF STANDARD GAS & ELECTRIC COMPANY

President H. M. Byllesby Confirms Reports of Negotiations for Established Oil Property-Arrangements Still Under Discussion

Regarding verious reports, President H. M. Byllesby of the Standard Gas & Electric Company says:

"Negotiations have been pending for some time looking to consolidation with the Standard Gas & Electric Company of a large and long-established and prosperous oil property, comprising large acreage, production, complete refining plant, pipe lines, distribution and tank cars. These negotiations are still progressing."



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Census Bureau Report of Electric Light and Power Stations—1917

	Minnesota			Louisiana			Idaho		
	1917	1912	Per Cent of Increase* 1912 to 1917	1917	1912	Per Cent of Increase* 1912 to 1917	1917	1912	Per Cent of Increase* 1912 to 1917
Number of establishments	255	195	30.8	85	50	.....	46	38	.....
Commercial	123	91	.....	49	27	.....	38	35	.....
Municipal	132	104	.....	36	23	.....	8	3	.....
Income	†$12,968,715	†$6,937,841	86.9	‡$3,244,789	‡$2,278,754	42.4	$2,368,619	$1,615,940	46.6
Electric service	$12,080,171	$6,647,199	81.7	$3,220,314	$2,251,102	43.1	$2,202,356	$1,580,082	39.4
All other	$888,544	$290,642	205.7	$24,475	$27,652	—11.5	$166,263	$35,858	363.7
Total expenses, including salaries and wages	$11,191,974	$5,580,525	100.6	$2,459,868	$1,604,019	53.4	$1,947,657	$1,537,260	26.7
Number of persons employed	2,520	1,568	60.7	669	489	36.8	469	324	44.8
Salaries and wages	$2,011,145	$1,222,493	64.5	$530,515	$371,034	43.0	$450,753	$334,063	34.9
Total horsepower	225,541	148,111	52.3	36,005	27,165	32.5	56,422	56,375	0.1
Steam engines:									
Number	250	247	1.2	81	86	.....	10	14	.....
Horsepower	119,001	63,184	88.3	29,248	26,175	11.7	2,650	4,525	—41.4
Internal-combustion engines:									
Number	148	54	.....	72	9	.....	4	.....	.....
Horsepower	8,092	4,755	70.2	6,757	990	582.5	148	.....	.....
Waterwheels:									
Number	88	76	.....	.....	.....	.....	71	63	.....
Horsepower	98,448	80,172	22.8	.....	.....	.....	53,624	51,850	3.4
Kilowatt capacity of dynamos	162,854	93,502	74.2	25,762	19,169	34.4	37,103	35,656	4.1
Output of stations, kilowatt-hours	440,932,508	186,045,055	137.0	26,009,144	18,328,080	41.9	145,307,596	115,812,292	25.5
Stationary motors served:									
Number	20,915	12,203	71.4	2,863	2,428	17.9	867	1,723	—49.7
Horsepower	282,784	75,973	272.2	37,189	24,557	51.4	12,668	27,142	—53.3
Number of street lamps:									
Arc	5,565	6,495	—14.3	4,293	4,474	—4.0	924	1,109	—16.7
Incandescent, etc	48,223	21,776	121.4	7,266	4,451	63.2	6,863	3,886	76.6

* A minus sign (—) denotes decrease; percentages are omitted where base is less than 100.
† Exclusive of $1,831 in 1917 and $123,234 in 1912, reported by street and electric railway companies as income from sale of electric energy.
‡ Exclusive of $691,798 in 1917 and $549,047 in 1912, reported by street and electric railway companies as income from sale of electric energy.

ORGANIZE AMERICAN BUREAU OF WELDING

Prof. C. A. Adams Elected Director of the Bureau at the Organization Meeting—Research Committee to Conduct Investigations

At a meeting of the American Bureau of Welding on April 11, at the Engineering Societies Building, New York, bylaws were adopted and the following officers elected: Director, Prof. C. A. Adams; vice-director, H. M. Hobart; vice-director, A. S. Kinsey; treasurer, W. E. Symons; secretary, H. C. Forbes. Regular meetings of the bureau are to be held on the third Friday of each month. The bureau voted to establish a research committee for the purpose of carrying out the plan of coöperation in conducting investigations in welding and appointed the following members:

Adams, C. A., American Welding Society, New York.
Alexander, D. C., Quasi-Arc Weldtrode Company, Brooklyn.
J. I. Banash, 1724 Forty-second Street Building, New York.
Dr. C. K. Burgess, Bureau of Standards, Washington, D. C.
W. J. Beck, American Rolling Mill Company, Middletown, Ohio.
Alex. Churchward, Wilson Welders & Metals Company, New York.
Jack Churchward, Wilson Welders & Metals Company, New York
H. Jasper Cox, Lloyd's Register of Shipping, New York.
G. H. Clevenger, National Research Council, Washington, D. C.
L. H. Davis, Linde Air Products Company, New York.
J. H. Deppeler, Metal & Thermit Corporation, Jersey City, N. J.
J. G. Dudley, Chester Shipbuilding Company, Philadelphia.
F. C. Elder, Newburgh Steel Works, Cleveland, Ohio.
E. H. Ewertz, Bethlehem Shipbuilding Company, Elizabeth, N. J.
F. M. Farmer, Electrical Testing Laboratories, New York.
F. L. Fairbanks, Quincy Market Cold Storage & Warehouse Company, Boston.
H. C. Forbes, American Welding Society, New York.
C. J. Holslag, Electric Arc Cutting & Welding Company, Newark, N. J.
J. H. Horn, John A. Roebling's Sons Company, New York.
H. M. Hobart, General Electric Company, Schenectady.
Prof. R. G. Hudson, Massachusetts Institute of Technology, Cambridge, Mass.
W. J. Jones, Chester Shipbuilding Company, Chester, Pa.
R. P. Jackson, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.
Zay Jeffries, Aluminum Castings Company, Cleveland.
H. W. Jacobs, Oxweld Railroad Service Company, New York.
Prof. A. S. Kinsey, Stevens Institute of Technology, Hoboken, N. J.
Com. H. G. Knox, United States Navy Yard, Norfolk, Va.
Hermann Lemp, General Electric Company, Erie, Pa.
J. C. Lincoln, Lincoln Electric Company, Cleveland, Ohio.
W. L. Merrill, General Electric Company, Schenectady.
John Martin, American Bureau of Shipping, New York.
Prof. H. F. Moore, University of Illinois, Urbana, Ill.
S. W. Miller, Rochester Welding Works, Rochester, N. Y.
Victor Mauck, John Wood Manufacturing Company, Conshohocken, Pa.
C. A. McCune, Page Steel & Wire Company, New York.
J. W. Owens, Norfolk Navy Yard, Norfolk, Va.
Stuart Plumley, Davis-Bournonville Company, Jersey City, N. J.
E. J. Rigby, Quasi-Arc Weldtrode Company, Brooklyn.
Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.
W. Remington, Thomas Welding Company, West Lynn, Mass.
M. H. Roberts, Air Reduction Company, New York.
W. E. Ruder, General Electric Company, Schenectady.
Prof. A. W. Slocum, University of Vermont, Burlington, Vt.
Bradley Stoughton, American Institute of Mining Engineers, New York.
F. N. Speller, National Tube Company, Pittsburgh, Pa.
H. S. Smith, Prest-O-Lite Company, New York.
William Spraragen, 33 West Thirty-ninth Street, New York.
H. S. Starling, Bureau Veritas, New York.
R. E. Wagner, General Electric Company, Pittsfield, Mass.
H. I. Walsh, Newport News Shipbuilding Company, Newport News, Va.
Prof. H. L. Whittemore, Bureau of Standards, Washington, D. C.
Charles Wirt, Wirt Company, Germantown, Pa.

From time to time the membership of the committee will be increased. At the meeting of directors of the American Welding Society on April 11 J. H. Deppeler, Metal & Thermit Corporation, Jersey City, N. J., was elected a director.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

E. S. J. A. Convention.—The Electrical Supply Jobbers' Association will hold its regular meeting at Hot Springs, Va., June 10 to 12.

A. I. E. E., Toronto Section, and Engineering Institute of Canada, Hamilton Branch.—G. E. Stoltz discussed "Steel Mill Electrification" at the joint meeting of these two bodies held on April 11.

Illinois Association of Electrical Contractors and Dealers.—About the middle of June the midsummer meeting of the Illinois Association of Electrical Contractors and Dealers is to take place in Decatur.

N. E. L. A., Duquesne Light Company Section.—James L. Geary has been elected president of this section of the National Electric Light Association, and Lynn M. Wilson has been chosen secretary.

National Association of Electrical Contractors and Dealers.—The annual meeting of the National Association of Electrical Contractors and Dealers will be held in Milwaukee, Wis., on July 16, 17 and 18.

San Francisco Electrical Development League.—F. E. Anderson, electrical engineer and inspector for the United States Shipping Board, spoke on "Ship Wiring and Wiring Inspection" at the April 14 meeting of the league.

A. A. E., Washington Chapter.—At its March 25 meeting the Washington Chapter, American Association of Engineers, elected Harry Stevens, civil engineer, as president and E. L. Howard, Bureau of Yards and Docks, Navy Department, as secretary.

A. I. and S. E. E.—The monthly meeting of the Association of Iron and Steel Electrical Engineers is to take place to-night in Pittsburgh, Pa. Lieut. A. M. McCutcheon, U. S. N., will have for his subject "Electricity Afloat; Steel-Mill Practice Applied in the Navy."

Jovian Electric League, Los Angeles.—At the April 9 meeting W. G. Eisenmayer, manager of the Los Angeles Ice & Cold Storage Company, gave a talk on "Ice and Electricity." Harry A. Williams, war correspondent for the Los Angeles *Times*, told of his experiences in France.

N. E. L. A., Philadelphia Electric Company Section.—Charles J. Russell, general commercial manager of the Philadelphia Electric Company, spoke on "The Progress of Business During 1918" before the commercial branch meeting of this section of the National Electric Light Association held on April 22.

A. I. E. E., Denver Section, and A. S. C. E., Colorado Association of Members.—At a joint meeting of these two divisions of the American Institute of Electrical Engineers and the American Society of Civil Engineers held on April 9 Lieut.-Col. H. S. Crocker spoke on "The Construction of the Army Supply Base at Brooklyn."

A. I. and S. E. E., Chicago Section.—A joint paper entitled "Safety in Steel Mills" is to be presented at the April 26 meeting of this section of the Association of Iron and Steel Electrical Engineers by C. M. Brading, superintendent of safety, and F. A. Wiley, electrical superintendent, Wisconsin Steel Company, South Chicago, Ill.

Stickney Speaks on Lighting Codes in Chicago.—George Stickney reviewed the industrial lighting codes in effect in the United States at a meeting of the Illuminating Engineering Society, Chicago Section, and the Chicago Section, American Institute of Electrical Engineers, held in Chicago on April 17. J. A. Hoeveler, electrical engineer for the Industrial Commission of Wisconsin, discussed the situation surrounding the Wisconsin code.

A. I. and S. E. E. and A. I. E. E., Chicago Sections.—On May 26 the Chicago Sections of the American Institute of Electrical Engineers and the Association of Iron and Steel Electrical Engineers will hold a joint meeting, at which two lectures are to be given. One will be by J. C. Wilson, assistant chief engineer Cutler-Hammer Manufacturing Company, Milwaukee, Wis., entitled "Measuring Gas Electrically," and the other will be by B. E. Fernow of the same company, on "Lifting-Magnet Operation." Both these lectures are to be illustrated.

American Institute of Electrical Engineers

Spokane Section.—"City Transportation from an Engineer's Viewpoint" was the title of a talk given before the April 18 meeting of this section by T. E. Phipps, former chief engineer of the Washington Public Service Commission.

Madison Section.—"Recent Developments in Electric Lighting" and "The Industrial Lighting Code of Wisconsin" were presented by W. M. Skiff, National Electric Lamp Works, and John A. Hoeveler, Industrial Commission, before this section on April 10.

Lynn Section.—On April 12 this section held its eighth annual banquet, with more than 250 in attendance. Richard H. Rice acted as toastmaster and in the course of his remarks said that the Lynn Section is now the largest one in the Institute, having 1651 local members and 21 national members. Ira Cushing, chairman of the Boston Section, and Marshall P. Thompson were the speakers of the evening.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Reasonable Discrimination.—In a decision relating to the Belgrade Power Company the Maine Public Utilities Commission takes up several matters arising from the fact that the largest consumer is the principal business of the community. It says in part: "The current is taken from the generating station by two wires. One serves the property of the Belgrade Hotel Company, the other serves the public generally. The respondent offers only a lighting service, and cuts off the current in the morning. But current is transmitted over the wire running to the hotel property in the daytime when there is occasion to use it. Customers served over the other wire do not get this service, although some of them would like it. The evidence does not show many of these, but the principle is the same. It appeared that on some dark days the current was turned on to both wires. Respondent claimed that this was done whenever it was requested. However this may be, it is apparent that there is discrimination. It does not necessarily follow that the practice is unlawful. Only unreasonable discriminations are prohibited. It is unlawful if part of the public is arbitrarily and without just cause denied equal benefits from the utility. This is the matter complained of in this respect, and it requires careful consideration. The evidence shows that the plant is not capable of giving unlimited service to all of its customers; it does not satisfy us that the demand for service generally is sufficient to justify an order requiring substantial additions to the plant. Under such circumstances it is allowable for a utility to serve some and deny others, when this is done in such a manner as best to subserve the public interests generally and does not give one an unfair advantage over others in any of the ways indicated above. A utility cannot be required to take on new customers or to extend its service where it can be done only to the disadvantage of the public generally or results in unreasonably diminishing the aggregate benefits to be enjoyed by the community. There is not sufficient power to serve both the lighting customers at night and the hotel and other customers during the day. There is sufficient to give the service now being rendered. There is no evidence that the use of the current at the hotel in the daytime impairs the night service. The hotel is the principal business of the community. It is improbable that an electrical plant could be maintained at all without it."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Every House Wired in Pasadena, Cal.—Pasadena, Cal., in responding to the call of the Society for Electrical Development for participation in the "Electrify your home" campaign, claims that every house in the city is wired for electricity. The message says: "Sorry we have no need for your campaign literature inasmuch as every house in Pasadena is wired and connected. Population, 42,000; electric meters connected, 15,600. Can you beat it?"

Cost of Arc Lighting.—The twenty-third annual report of the city of Detroit, Mich., covering the period from July 1, 1917, to June 30, 1918, shows that the cost of operating arc lamps in the station has increased steadily over the last three years covered by the report. The costs per lamp follow: Year ended June 30, 1916, $24.16; year ended June 30, 1917, $27.24; year ended June 30, 1918, $32.71. Since a new accounting system has been installed it has been possible also for the city to allocate the cost of producing power for arc lighting and for incandescent lighting and power in public buildings. The cost for arc lighting is 3.72 cents per kilowatt-hour, and the cost for incandescent lighting and for motor service is 3.3 cents per kilowatt-hour.

Armored Cables of Unusual Length.—The Habirshaw Electric Cable Company, Inc., is making two cables which are somewhat unique in the history of the cable industry in this country. One cable is for the United States Coast Guard and consists of two conductors, each of seven-strand No. 18 B. & S. insulated to 10/32 in., 30 per cent Para, and taped. The two conductors are twisted together with paraffined jute fillers, taped, with serving of jute, armored with No. 6 B. W. G. galvanized-iron armor and then served with jute and asphalt. The cable is a little over 1½ in. in diameter and weighs 2610.8 lb. per 1000 ft. The particular feature of this cable is that it must be delivered in one continuous length of 30 miles, which means a weight of more than 413,000 lb. The other cable is being made for the government of the Philippine Islands. It consists of a single conductor, made of seven-strand No. 20 B. & S., insulated to 3/32 in. with 40 per cent compound, taped, a serving of jute, armored with 0.092 in. galvanized-iron armor, over which is a serving of jute and asphalt. The diameter of this cable is approximately 1 in. and its weight 796 lb. per 1000 ft. The total quantity is 200 miles, to be delivered in four lengths of 50 miles each, so that each length will weigh over 210,000 lb.

Revenue from Appliance Sales Not to Be Taxed. — The legislative committee on finance in Connecticut has prepared an amendment which will exempt electric, gas, water and power companies from including the proceeds from the sale or rental of appliances in the assessment of 1½ per cent of gross earnings which has been in effect for some time.

Massachusetts Companies Reduce Rates.—The Quincy (Mass.) Electric Light Company has reduced its rate from 13½ cents per kilowatt-hour to 12 cents. The company renews tungsten lamps of all usual sizes free and has been doing so for several years. The Worcester Electric Light Company has reduced its lighting rate from 8 to 7½ cents per kilowatt-hour and on May 1 will abandon the 4-mill surcharge on small power business which it put in effect late last year. The coal clause in the Worcester power rates will, however, be retained by the company.

Repairing the Kaiser's Ravages.—The Society for Electrical Development, New York, has issued a booklet in regard to its work and the benefits of membership in electrical coöperation.. Pointing out the need of cooperation, the Society for Electrical Development goes on to say: "To meet this post-war crisis, to meet these increased costs and pay our share of the world debt caused by the Kaiser's madness, the electrical industry has got to do more business and do it quick. It must expand—speed up. Dormant markets must be vitalized; active markets must be forced. Where there is no business it must be created; where it exists it must be stimulated."

Shortage of Electrical Energy in Japan.—The *Electrician's Friend* of Tokyo, Japan, notes that "the phenomenal scarcity of electric power in recent times has resulted in the appearance of premium on the use of electric power and even on electric light. A premium as high as 300 to 400 yen on the use of a 1-hp. motor is bidden in a certain city where weaving industry flourishes. In other cases over 100 yen on a 1-hp. motor is claimed by the seller of the power right. In another case a premium of over 1 yen is claimed on the transfer of each incandescent lamp. The extraordinary phenomenon is due to the sudden growth of general industry on one hand and inability on the part of power companies to enlarge their plants owing to the unprecedented high price of machines and other equipments on the other hand. In Tokyo the scarcity of electric power during the winter season has been so acute that the power companies had made an agreement not to sell further energy to the customer, new or old, until the season of drought is over."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Workmen's Compensation Grievances.—One not an employee in an excepted class in the Texas workmen's compensation act may not assert any grievance that excepted class might have regarding the validity of the act, according to the Supreme Court of the United States in Middleton versus Texas Power & Light Company (39 S. C. R. 227).

Tax for Electric Lights.—A city, under Code, Section 894, Subdivision 6, cannot tax agricultural land within the city limits for electric light purposes, in view of Section 616, providing that land within the city limits not divided into parcels of 10 acres or less, occupied in good faith for agricultural purposes, shall not be taxable by a city except for road taxes, the Supreme Court of Iowa holds in a recent decision (171 N. W.).

Reasonable Rate Order Affirmed.—On an appeal from an order of the Corporation Commission of Oklahoma fixing the rates to be charged for electric light and other electric service, the presumption obtains, by reason of Section 22, Article 9 of the constitution, that the order is reasonable, just and correct. Where there is evidence in the record reasonably tending to support the findings of fact as to the value of the property used by the electric company as a basis for determining what is a reasonable return on the investment, the Supreme Court of Oklahoma has held that the order will not be disturbed (179 P. 26).

Powers of Public Service Commissions.—The fundamental theory of the Public Service Commissions law is that there shall be one rate for the same service, the Appellate Division of the Supreme Court of New York holds (174 N. Y. S. 868). The Public Service Commission is a body of limited powers and has no judicial functions to discharge, having power to regulate services rendered and prices to be charged, but no power to enforce its acts or restrain violations of law. The Public Service Commission cannot exercise equity jurisdiction and attempt to compel a public service corporation to perform its contracts with its patrons according to their terms. An unexpired contract does not authorize a public service company to charge a less rate for service rendered than that prescribed by effective schedules, even though schedules of such rates are filed by the public service company, the Appellate Division holds.

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

J. M. Smith has resigned the position of managing engineer of the Triumph Electrical Company of Cincinnati to become associated with the Texas Company, New York City.

Thomas A. Reed has been promoted from coal traffic manager of the Central Power Company of Canton, Ohio, to new-business manager, succeeding Robert E. Lane, who has resigned to enter another class of business.

George A. Murch, who for the past three years has been manager of the Public Electric Light Company, St. Albans, Vt., and superintendent of the St. Albans & Swanton Traction Company, has resigned, effective the early part of the summer.

Prof. Comfort A. Adams, dean of the faculty of the Harvard School of Engineering at Cambridge, Mass., and H. M. Hobart of the General Electric Company have sailed for France to attend a meeting of a special committee on rating of the International Electrotechnical Commission at Paris, May 5 to 7. Professor Adams and Mr. Hobart will represent the American Institute of Electrical Engineers and the American Engineering Standards Committee. They will also attend a meeting of the British Engineering Standards Committee, to be held in London, and return to the United States about the middle of June.

E. L. Andrews has recently been appointed general agent of the Underwriters' Laboratories, a position which has been vacant since the death of James E. Latta on Jan. 17, 1918. The work of the general agent covers matters of publicity and development and the investigation of special questions arising therefrom. Mr. Andrews, after graduation from the Massachusetts Institute of Technology, was engaged in electrical engineering first with the Western Electric Company and then with the American Telephone & Telegraph Company. He was later a member of the engineering staff of Westinghouse, Church, Kerr & Company. During the war he has been associated with the Air Nitrates Corporation of New York on the design and construction of three large plants to produce ammonium nitrate for the Ordnance Department.

D. H. Braymer, formerly editor of the *Electrical Record*, has been appointed managing editor of the ELECTRICAL WORLD. Mr. Braymer, prior to becoming editor of the *Electrical Record* in 1917, was for two years engineering editor of the ELECTRICAL WORLD. Before that he was editor of *Electrical Engineering* of Atlanta, Ga., and of its predecessor, the *Southern Electrician*. Mr. Braymer was born in 1884 in Hebron, N. Y., and was graduated from Cornell University in 1906, with the degrees of A.B. and E.E. Upon graduation he engaged in special work on alternating-current apparatus for the Electrical Testing Laboratories, New York City, resigning to become factory inspector for the Western Electric Company at New York. Later he was appointed special engineer for that company. In 1910 he resigned to engage in editorial work in the electrical field, becoming editor of the *Southern Electrician*.

Obituary

George E. Claflin, a vice-president of the Electric Bond & Share Company, died suddenly April 18, at Atlantic City, where he had gone for the Easter holidays, his death coming as a great shock to his family and associates. Mr. Claflin was a pioneer in the electric light and power industry. He was born in Providence, R. I., April 4, 1866, and after being graduated from the Massachusetts Institute of Technology in 1888, entered the service of the Westinghouse interests and was connected with some of the earliest electric generating stations in the country. He then helped to organize the Franklin Electric Company of Kansas City, Mo., which built and equipped electric light plants throughout the Middle West. Later he was a member of the firm of Lewis & Claflin, consulting engineers of Providence, R. I. In 1904 Mr. Claflin became associated with the United Electric Securities Company of Boston, and in 1913 he was elected a vice-president of the Electric Bond & Share Company. In this latter position he was in general charge of the operation of all the electric light and power and gas properties under the management of this company. He was a director and a vice-president, among other companies, of the American Power & Light Company, the Idaho Power Company, the Lehigh Power Securities Corporation and the Utah Securities Corporation.

G. E. CLAFLIN

Theodore Stoll, the founder and member of the firm of Russell & Stoll, New York, N. Y., manufacturers of electrical marine fittings and appliances, died at his home in Westfield, N. J., April 18. Mr. Stoll was sixty-one years of age.

Patrick Whitty, the oldest employee in years of service of the Gregory Electric Company, Chicago, died suddenly of heart failure, on April 11. Mr. Whitty started with the Charles E. Gregory Company when that company began business in 1875 and remained with that concern and its successor, the Gregory Electric Company, continuously until his death.

Charles Brinkerhoff Richards, for twenty-five years Higgins professor of mechanical engineering at Sheffield Scientific School of Yale University and professor emeritus for the past nine years, died at New Haven, Conn., on April 20, in his eighty-sixth year. Professor Richards was the inventor of the Richards steam indicator, which contains the essential features of modern indicators. He was one of the founders of the American Society of Mechanical Engineers and was the editor of engineering and technical words and terms in Webster's International Dictionary.

Paul Lüpke, one of the pioneers in the electrical industry, died on Feb. 9. Mr. Lüpke was born in Osnabrück, Germany, in 1861, and was educated at the local Real-Gymnasium and at the Royal Polytechnic Institute, Stuttgart, Württemberg. Prior to coming to the United States in 1884 he had been connected with the Siemens & Halske Works in Charlottenburg and the Allgemeine Elektrizitäts-Gesellschaft in Berlin. Soon after his arrival in this country he installed the first Brush arc-lighting apparatus in Trenton, N. J., and later entered the service of the local company, with which he continued in one capacity and another throughout many changes and consolidations. At the time of his death Mr. Lüpke was in charge of the extensive library of the three companies which make up the Public Service Corporation of New Jersey, besides being editor of *Service*, the official publication of the corporation. For many years he was superintendent of the southern division of the Public Service Company at Trenton, N. J. Mr. Lüpke was an active member of both the N. E. L. A. and the A. I. E. E., being editor of the N. E. L. A. "Question Box" in 1906 and 1907, and also being an occasional contributor to the technical magazines. He will be best remembered by the members of the N. E. L. A. for his short but eminently practical papers of a philosophical flavor, presented at the annual conventions held from 1907 to 1904.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

SECOND-HAND MARKET IN NEW ENGLAND IMPROVED

Boston Lacking in Used Direct-Current Motors— Shortage in General of Good Equipment Prevents Activity in Market

Business is improving in the second-hand electrical machinery market in New England. A record-making volume was handled in 1918, but after the armistice was signed the demand for both new and second-hand equipment declined greatly, and at the opening of 1919 the market was decidedly dull. Within the last few weeks a better tone has been manifested, with considerable recovery of business. The present volume of business in the second-hand field in this district may be estimated at about 75 per cent of that enjoyed in 1918, or approximately 15 per cent in excess of the 1917 rate.

Stocks are somewhat spotty. Dealers in second-hand equipment also generally handle new machinery, and the supply of new equipment on hand is fairly large. Dealers are buying direct-current motors of low voltage and small sizes wherever these are offered, and the demand for small alternating-current motors is also good. In the Boston district in particular there is a decided scarcity in used direct-current motors of moderate size, standard voltages and first-class quality. Odds and ends may be picked up readily enough, but there has not been any general release of motors or other industrial electrical equipment by war-service plants on a scale to affect the market materially so far. On the whole, second-hand stocks of good quality are running rather low.

Prices of second-hand equipment are far above the levels of pre-war business, but late quotations show a reduction of 10 to 20 per cent below those of last fall. During the height of the war many buyers paid prices in excess of quotations on new equipment in order to secure immediate delivery, these prices often being quoted by second-hand dealers outside New England on equipment rushed into this territory. Deliveries of new apparatus have improved so much now that the normal differential between old and new equipment may be expected to hold from henceforth. Prices of used equipment have been forced down somewhat by the manufacture and better deliveries of new apparatus and the tendency to shade prices in the latter to secure the benefits of cash payments and a quick turnover.

The feeling in the second-hand trade is strong that current prices are not likely to fall much for some months. Owners of equipment purchased for war-plant service are holding it rather closely for future use in peace-time commodity production. High labor costs are perhaps the chief factor in maintaining the price of new apparatus, and there is little prospect of a surplus of second-hand equipment of good quality being placed on the market for some time in quantities capable of lowering present price levels. The cost of doing business in the second-hand field seems likely to increase this year perhaps 10 to 15 per cent over 1918. The pressure for lower prices and competition for the available business resulting from the limited supply of high-quality second-hand apparatus now available bid fair to develop a second-hand apparatus market of great activity, and the opinion is expressed in well-informed circles that the volume of business recorded in 1919 will equal or exceed that of last year.

The business now being handled includes varied apparatus which is being thrown upon the market by the modernization and betterment of central stations and industrial plants and rewiring and improvement of mercantile establishments using motors. Many motor drives hastily installed lack efficiency, and these are now being gone over and extensive studies and changes are being effected to enable future production to be more efficiently handled. The rapid expansion of central stations during the war released considerable auxiliary equipment for second-hand service, and this development has not yet ceased in New England. Isolated-plant equipment is in some demand, and interest is growing in the development of small water powers.

FEBRUARY'S ELECTRICAL EXPORTS EXCEED $7,000,000

Batteries, Generators, Insulated Wire and Cable and Motors Show Large Totals in the Month's Foreign Trade

During February, the shortest month of the year, exports of electrical apparatus rose above the seven-million-dollar mark to $7,566,089, distancing January, the previous record holder, by more than $800,000.

Telegraph apparatus exports rose from $56,541 in January to $129,596—an increase of 129 per cent. Telephone apparatus increased 55 per cent over January. This is the highest month for telegraph apparatus, while telephones were exceeded only last March.

Last October $1,147,159 in motors were exported, the highest that has been noted, while in February the value of motors exported was $1,107,268. Transformers increased over January 13 per cent and switches 7 per cent. The assorted apparatus rose 12 per cent over January and 130 per cent over last February. Total exports for the month of February exceeded totals for last February by 120 per cent. Generator exports were surpassed only last May, while February battery exports hold the record of $420,437.

For the eight months ended February last the exports of electrical goods amounted to $46,395,454. This gives much assurance that the $70,000,000 for the fiscal year ended next June will be surpassed, with the remaining four months showing as well as did the month of February.

The accompanying figures were compiled by the Bureau of Foreign and Domestic Commerce:

Articles	February 1918	February 1919	Eight Mos. Ended February 1918	Eight Mos. Ended February 1919
Batteries	$140,742	$420,437	$2,213,082	$2,369,667
Carbons	148,776	161,117	982,036	1,165,977
Dynamos or generators	247,028	387,445	1,533,969	2,346,990
Fans	22,045	121,003	362,776	598,708
Heating and cooking apparatus	49,614	71,136	365,799	578,535
Insulated wire and cable	270,334	710,830	4,038,350	4,608,559
Interior wiring supplies, including fixtures	109,894	211,402	987,280	1,074,949
Arc lamps	387	2,702	7,702	10,383
Carbon-filament lamps	9,626	16,658	114,112	89,729
Metal-filament lamps	228,866	403,379	1,882,873	2,621,817
Magnetos, spark plugs, etc.	152,222	256,280	2,290,168	1,875,682
Meters and measuring instruments	159,753	255,495	939,533	1,531,217
Motors	386,168	1,107,268	4,157,481	6,630,154
Rheostats and controllers	8,520	16,442	115,139	235,188
Switches and accessories	210,643	189,669	1,506,842	1,358,108
Telegraph apparatus, including wireless	24,601	129,596	198,703	435,540
Telephones	125,855	333,180	1,499,085	1,791,144
Transformers	125,240	401,594	1,304,468	2,900,554
All others	1,026,577	2,370,456	10,274,300	14,172,553
Total	$3,446,891	$7,566,089	$34,773,698	$46,395,454

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INDUSTRIAL HEATING DEVICES ARE NOW ON SHORT DISCOUNT

Change in Schedule Brings Maximum Discount of 10 per Cent on Soldering Irons, Glue Pots, Large Immersion Heaters and Other Appliances

Soldering irons, rectangular heating plates, immersion heaters over 660 watts, glue pots and hotel toasters have been put on short discounts under the Marsh patent schedule, effective April 13. Formerly all of these items were listed under Part 1 of the schedule and consequently enjoyed the maximum distribution discounts. Jobbers, for instance, were entitled to a maximum discount of 42 and 3 per cent on articles listed under Part 1 (unless billings were over $15,000 for twelve months) and contractors to 30 and 7½ per cent. Now these industrial devices come under Part 3, which provides a short discount of 10 per cent.

The reason given for this change in discounts was that the bulk of these devices are billed by the manufacturer direct to the industrial user and that consequently there was not the necessity for large discounts for trade distribution. The new prices, it was pointed out, make the net price to the user lower than it was previously.

METAL MARKET SITUATION

Copper Slightly Lower, but Buyers are Lacking—Export to Central Powers Anticipated

After a brief season of slight activity, the copper market is again moving along at a dull rate. Copper is quoted at 15.25, which is ⅛ cent below last week, but sales are almost at a standstill. Sales to date for April have been around 20,000,000 lb., and at this rate the month will close with a total movement about one-third that of March. Only enough copper is being bought to carry manufacturers along from week to week.

Exports for February amounted to about 18,000 tons, whereas January showed about 13,500 tons. England, France and Italy have rather large copper stocks, but the Central Powers have little. Purchasing by the latter is expected to open up after peace terms have been settled and methods of payment determined.

Spelter has eased off slightly to 6.40 cents, but demand from consumers shows no improvement.

The spot tin situation in New York is quiet. Difficulty in obtaining the metal in New York quickly is due to the reported stocks of government tin held in the Pittsburgh district only.

The used-metal market continues dull, with aluminum and tin the only moving members.

NEW YORK METAL MARKET PRICES

	April 15	April 22
Copper:	£ s d	£ s d
London, standard spot	76 10 0	76 10 0
	Cents per Pound	Cents per Pound
Prime Lake	15.50	15.50
Electrolytic	15.37½	15.25
Casting	15.00	15.00
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.00	5.00
Antimony	6.75	6.75
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.50	6.40
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	30.00	31.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 13.75	13.50 to 13.75
Brass, heavy	7.50 to 8.00	7.50 to 8.00
Brass, light	6.50 to 7.00	6.50 to 7.00
Lead, heavy	4.00 to 4.25	4.00 to 4.25
Zinc, old scrap	4.25 to 4.75	4.25 to 4.75

THE WEEK IN TRADE

CONDITIONS in the market for wiring supplies and socket devices are improving rapidly. Sales of the latter are running large. Prices are holding pretty firm, although there continues to be an unmistakable tendency toward a lower market. Wire for the first time in many weeks shows no change.

Deliveries are excellent, showing generally that manufacturers have produced stocks again which at least are ample to meet all current requirements. Labor conditions are getting better. Less lack of employment is reported and some places are now calling for labor.

Building is marking time until something more definite shall come out of the iron and steel situation. This matter, however, is expected to be cleared up shortly, after which more building can be expected.

NEW YORK

There is a fine spirit of optimism found among manufacturers. Even the present market is so much more satisfactory than many predicted at the first of the year that their hopes for the near future are indeed bright.

Large orders have been few in the last months, but the number of orders has been high. They have been sufficiently spread among manufacturers to keep a certain steady volume of business going, and a rather sweeping survey is necessary to comprehend that there actually is a fair amount of business.

Manufacturers are not looking for any great jump in sales. The slow, steady, steady increase of the past month or two is expected to continue—this slow, steady increase giving a very pronounced stability to the market. Impetus is expected to be given the market when the Victory Liberty Loan is a thing of the past and the peace terms are accepted. The former is a financial proposition. The latter is a psychological proposition and as such is a vital factor in the market. The stability of the market is found to rest to a great degree on world affairs, and manufacturers, with others, assert their belief that business confidence will return with the signing of peace terms.

Manufacturers report satisfactory collections. The month of March has been good, with some collections under forty days. It is not uncommon to find collections from jobbers around forty-five days, showing the increasing sense of responsibility in the payment of obligations.

The use of bankers' acceptances in export collections is gaining favor, and one prominent manufacturer looks to it as an extremely satisfactory method to be employed in dealing with foreign customers.

SINGLE-PHASE MOTORS.—Several manufacturers have reduced the price of single-phase motors 10 per cent. In some cases the entire range of sizes is down, in one case only the small sizes. The demand is holding high, and factory stocks are holding in fair amounts. Considerable outlet is reported for refrigeration both for household use and for small commercial purposes. Bakers' machinery is utilizing many of these motors.

HEATERS.—The demand for radiant heaters is negligible. Regular dealers are not cutting prices, but some department stores are. Most houses carrying heaters have large stocks with little hope of disposing of them this season.

RANGES.—Several central stations in the East have recently incorporated heating rates favorable to electric range use. One prominent manufacturer reports March sales better than the whole of 1918. The highest-class apartments and large estates are purchasing electric ranges.

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CABLE.—The market for transmission and power cable is showing a gradual improvement. Orders are still rather small and well spread out among the manufacturers. The West shows considerable activity.

FLEXIBLE METALLIC CONDUIT.—The demand is running high, and manufacturing is in cases up to normal capacity. Some overtime is noted. Manufacturers hope to be able to get ahead on stocks to take care of the increased buying movement they expect in a few months.

RUBBER-COVERED WIRE.—There has been no change in base reported this week. The demand is not heavy, but there is a steady flow for repair and recircuiting work now going on.

WIRELESS SETS.—Costs are up 10 to 15 per cent over what they were before the ban was placed on them by the Navy Department. The market has opened up well this past week.

BOSTON

The telephone strike in New England, which began April 15 and lasted until the afternoon of the 21st, proved a great inconvenience to industry and upset the electrical trade considerably. Practically all New England except Connecticut was without telephone service for the period, barring extreme emergency calls. The larger jobbers report a comparatively small loss of business after the first two days of the strike. Customers resorted to mail and telegraph communication, and representatives of three prominent houses informed the ELECTRICAL WORLD that their total volume of business for the week was not seriously affected. The smaller houses came through pretty well also, but orders for small quantities of material normally telephoned in from suburban contractors and dealers were in many cases cut out entirely. Retailers and contractors were seriously embarrassed in connection with the shipment and delivery of material owing to the absence of the usual telephone communication with express firms, forwarders, etc. High-salaried men in many branches of the trade were forced by the strike to spend much time on petty errands, and this slowed down business to an annoying extent. During the early part of the strike an enormous amount of work was accomplished within the offices of many electrical establishments in the way of "clean-up" jobs. There is a feeling in the trade that the success of the strike from the employees' standpoint will make for considerable uncertainty in future between employing contractors and their men, although it is believed that a willingness to deal frankly with labor will help to maintain good relations.

Despite the strike a very fair week's business was handled by the jobbers. Collections are rather poor at present and credits are being sharply watched. The increasing activity of contractors is helping the situation somewhat. In some cases the large mills are paying more slowly. New construction is still at a low ebb, but it is announced that the Bethlehem Steel Company has approved the building of a five-million-dollar dry dock at its Fore River plant. Prices show little change. Stocks are well maintained. A shortage is reported in two makes of vacuum cleaners, and metallic flexible conduit is rather scarce. House-wiring campaigns are being pushed successfully in some of the larger cities of New England. Deliveries are excellent, with the exception of a few lines.

SCHEDULE MATERIAL.—Prices are firm, with fair local stocks. Since the middle of March the volume of business has been increasing, and in some cases it is practically as satisfactory as at the time of the armistice. Most of the buying, however, is of the so-called "pick-up" order.

WASHERS AND CLEANERS.—Business is exceedingly brisk. The telephone strike greatly hampered the demonstration of washing machines on account of time lost in making appointments by mail. Machines are being brought into New England by the carload and are being absorbed most satisfactorily.

INDUSTRIAL ELECTRIC TRUCKS.—Sales during March fell considerably below normal. Inquiries are constantly being received, however, and as soon as industry reaches more stable conditions a vigorous expansion in buying is anticipated. The failure of Congress to appropriate funds for army and naval purposes at the late session has temporarily quashed many desirable orders.

STORAGE BATTERIES.—The demand holds up well, the diversity of applications now available serving to steady the business.

ELECTRIC ROAD TRUCKS.—A revival of road-truck development at Boston was predicted at a conference last week in that city attended by manufacturers' representatives and central-station men. Two commercial garages are to be built this spring or summer at Boston, and sales efforts will be concentrated on making sure that the proper economic applications of road trucks are made.

FANS.—Stocks are well prepared to meet early demands. Little retail trade as yet appears, and orders handled favor smaller-sized outfits.

CHICAGO

The interest of the Middle West in foreign trade has been stimulated considerably during the last few weeks by newspaper reports concerning the activities of the Mississippi Valley Association's trade mission to Mexico. This mission is just now returning from that country. The committee on transportation reports that arrangements have been made to facilitate the handling of parcel-post and express packages over the border.

COPPER WIRE.—Both weatherproof and rubber-covered copper wire are holding steady at a 20-cent base.

CONDUIT.—Since the 4-point drop in conduit a few weeks ago no further changes have occurred.

STORAGE BATTERIES.—With the opening of the automobile season the demand for storage batteries is keeping jobbers' stocks pretty well depleted.

FANS.—Jobbers are busy lining up contracts among their dealers for the summer's stock of fans. Jobbers themselves are not stocking more fans than they feel certain they can handle during this year, because they feel that 1920 will bring a price reduction in fans, and they do not care to be caught carrying stock over the year.

SCHEDULE MATERIAL.—There is very little movement in schedule material at the present time. Even manufacturers of fixtures are not buying sockets.

SECOND-HAND APPARATUS.—Dealers in second-hand apparatus are very optimistic about the business of the present time, stating that orders for the medium-size and small equipment continue to come in in good volume. The volume of business in some quarters is reported to be almost equal to war-time business owing to the demand for this small class of goods. The demand seems to have changed from a majority in favor of alternating-current motors to a heavier demand in favor of direct-current motors.

ICE MACHINERY.—One manufacturer recently secured an order for $132,000 worth of ice machinery in Chicago. Other ice plants are making improvements as rapidly as possible since the coming summer seems to be destined to produce an exceptional artificial-ice business.

WIRING DEVICES.—Jobbers profess to see a state of weakness in the market for these goods and predict rather freely that there will be some reduction in price in the near future.

WASHING MACHINES.—The demand for washing machines appears to be in no wise abating, the main difficulty in the industry being one of delivery. The design of machines appears to be undergoing the first stages of a change in which there is an attempt to incorporate more of an element of style and good appearance with satisfactory mechanical operation.

ELECTRIC RANGES.—One Middle Western central-station company has bought 1500 electric ranges, expecting to install them upon its lines in the coming spring and summer season.

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ATLANTA

The general situation looks favorable, and activity in certain lines is increasing. There is more or less hesitancy on the part of buyers, due to the present agitation of price reduction on steel and basic metals. Building operations are assuming a larger scope, and the lack of housing facilities in a number of Southeastern cities has further tended to stimulate apartment-house construction. An organization of a cotton corporation for $200,000,000 is of interest from a credit and collection viewpoint, as the general cotton market, together with the financial aspects, has considerable bearing on the Southeastern electrical interests indirectly.

FARM-LIGHTING OUTFITS.—The volume of sales is reaching large totals. Comparisons from week to week show big gains, and the present outlook is bright for a continued growth in demand for this product. While a large area of this section has been covered, there still remains territory that has not been scratched and distributers are becoming more active in placing agents covering a wide and well-balanced area. All interests are alive to the fact that a potential market exists for a full line of supplies, and dealer-contractors are arranging to take care of profitable inquiries that are increasing. On the whole, factory shipments are very satisfactory, and better deliveries are being promised.

ELECTRIC CHURNS.—A steady demand is observed, with an increasing number of inquiries and orders from the central-station cities of 1500 to 5000 population. Retail sales in the larger cities are much better than at the same period last year. Prices are holding up well. Factory shipments are excellent, and local stocks appear to be ample to handle the present demand.

WIRE.—Rubber-covered holds on a 20-cent base. The movement this week showed signs of increasing activity. A greater call for weatherproof is noted. In fact, the total transactions may be safely put as 30 per cent over those of the previous week. Stocks are in good condition and being amply filled by improved shipments from Eastern points. The circular-mil sizes and heavier cables are especially active, and jobbers report an improved spot demand. An analysis of sales shows that the buying element is taking more interest in present-day quotations and making purchases now that for a time it was thought would be postponed anticipating further declines in the basic metal.

SCHEDULE MATERIAL.—Industrial buying is comparatively light, and sales are not much better than from hand to mouth. The volume is well maintained, however, and the condition is fairly satisfactory under present circumstances; but manufacturers complain of the lack of big future orders. The general opinion prevails in purchasing quarters that prices are going to seek lower levels, and until a reduction does come or buyers are finally convinced that no material change will take place no large movement can be expected. Stocks in most places are reaching normal conditions; that is, covering jobbers' ordinary turnover. No complaint is heard regarding shipment, and outlying distribution is well up to standard.

SOCKET APPLIANCES.—For this time of year all heating and labor-saving devices are going strong and retail sales show nominal gains compared with 1918. The increasing temperature coincident with better factory facilities and greater production has tended to weaken prices on circular radiant heaters about $1 per unit. Irons are off 50 cents in the face of larger sales. Washing machines and vacuum cleaners are in great demand, and no change in price is recorded. Percolators are beginning to show some life, and toasters are moving fairly well.

SEATTLE—PORTLAND

The volume of business which has been handled for the past month shows no particular change in spite of predictions that early spring would show a noticeable increase in new building projects and new industrial enterprises. From present indications it will be several months or even longer before the larger industrial projects really materialize. In some cases particularly applying to machinery manufacturing establishments the uncertainty of the government's attitude regarding cancellation of existing contracts with shipyards and letting of new contracts is given as the reason. Lumber production and movement is comparatively satisfactory, although the mills and camps are not producing to the extent originally expected. It was announced recently that steel ship contracts held by Seattle yards, which were canceled during the recent strike, will be reinstated. This order affects four large plants in Seattle and involves more than thirty vessels. Dealers' reports for the week show a well-sustained volume of sales of domestic appliances, particularly washing machines and electric ranges. Fixtures and house-wiring devices moved a shade faster. The Spokane territory reports that the wholesale trade is picking up and that the retail trade is good with brisk demand for domestic appliances. Collections are fair in Spokane and outlying districts. The demand for farm labor cannot be filled. The Portland district reports that business generally is dull in the electrical field. This condition is particularly noticeable along the line of industrial equipment. The greatest activity at the present time is in household appliances. Reports indicate that there is a large movement in washing machines and kindred appliances, but the general impression seems to be that total sales in these lines are no greater than they were a year ago. The number of small automobile tire shops which have sprung up in the last few weeks have provided a marked outlet for small motors. A constant increase is noted in the amount of residence construction.

PORCELAIN.—A slight increase in demand is noted, but stocks on hand are sufficient to meet any emergency. Prices are steady, although a decrease would not be unexpected. Movement of high-tension insulators for maintenance only is noted.

CONDUIT.—Sales show a slight increase, particularly in the smaller sizes. No change in prices has been noted for some time, although reductions are expected. In Seattle especially stocks are in good condition.

SAN FRANCISCO

Most of the prominent electrical men are preparing to attend the big Santa Barbara convention, and a proportion of the remainder are out canvassing for Victory Liberty Loan subscriptions, so that business will be more or less of a passive character for the next three weeks.

Building operations are piling up ready for actual work. There is reported a project of $3,000,000 for reconstruction of the University of Southern California in a series of six buildings, and for ferry improvements in San Francisco of considerable size.

HEATING MATERIAL.—General Electric and Hotpoint irons have been slightly reduced in price, the 6-lb. size now listing at $6.50. This change created considerable activity. Soldering irons, glue pots and other industrial devices have advanced from 15 to 20 per cent.

RANGES.—Power companies are intending to begin an active campaign on electric ranges with the coöperation of electrical dealers. A tentative campaign allowing the dealer to carry the account or turn it over to the power company for handling at a smaller profit is under way. A 3-cent range rate is now effective in San Francisco.

VACUUM CLEANERS.—The season is the best ever reported, with many new makes out. In this connection the California coöperative campaign committee is securing solicitors to be sent to electrical dealers who will guarantee the solicitor a minimum weekly wage of $25, to be based upon a commission of 15 per cent on the sale of each motor-driven device and 20 per cent on the sale of each heating device. The dealer makes up the difference if the commission falls short of $25. The scheme so far has worked exceedingly well, the difficulty being to get enough competent solicitors to take care of the applications for them.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	20%
Coil to 1000 ft	25%
	No. 12 Solid
Less than coil	20%
Coil to 1000 ft	25%

Twin-Conductor

	No. 14 Solid
Less than coil	20%
Coil to 1000 ft	25%
	No. 12 Solid
Less than coil	20%
Coil to 1000 ft	25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
1	50	13.00
1¼	50	21.00
1½	50	26.00
2	25–50	35.00
2½	25–50	45.00
3	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
½-in. single trip	$75.00	$63.75— 69.75
½-in. double strip	75.00— 82.50	72.00— 75.00
¾-in. single strip	100.00	85.00— 93.00
¾-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.25 to $63.75
½-in. double strip	78.25 to $78.75	71.25
¾-in. single strip	100.00	75.00 to 85.00
¾-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¾	.06	1¼	.33
⅞	.09	1½	.40
1	.12	1¾	.47
1⅛	.15	2	.55
1¼	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00	$18.00	$16.00
¾-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00–26.50
¾-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb	7% to 12.1%	9% to 14.1%
2500 to 5000 lb	10% to 15.1%	12% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.00 to $7.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.18
Coil to 1000 ft.	25.94

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft.	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%-38%	20%-33%
$10.00 to $50.00 list	36%-47%	31%-43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%-32%	10%-27%
$10.00 to $50.00 list	30%-40%	20%-35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $17.00
1/5 to std. pkg.	12.00 to 14.00

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00-$24.15
1/5 to std. pkg.	17.85- 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$16.00	$22.00
1/5 to std. pkg.	13.60	18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.00-$18.40	$32.00-$36.80
1/5 to std. pkg.	11.50- 16.00	27.20- 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%	List
$2.00 to $10.00 list	28%	5%
$10.00 to $50.00 list	45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39
No. 18, full spools	.37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15-$14.50	$10.50-$12.65	$10.50-$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.00-$20.00	$13.00-$15.00	$11.50-$13.00
12	17.50- 21.63	17.55- 21.63	17.55- 18.54
10	24.05- 28.91	24.05- 28.91	21.16- 24.78
8	33.35- 39.34	33.35- 33.72	29.35- 33.72
6	52.95- 61.74	46.60- 52.92	46.60- 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$24 00
25 to 50 lb	24 00
50 to 100 lb	23 00

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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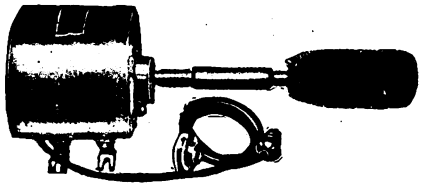
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Electric Milk-Bottle Washer

As a quick and efficient means of washing milk bottles at dairies an electrically driven bottle washer is being offered by the Electric Specialty Company, Stamford, Conn. In using the



IRON SHIELD PROTECTS MOTOR WINDINGS FROM MOISTURE

washer it is mounted so that the brush rotates over a tub of water. The bottles are filled about half full of water and forced over the brush, which rotates at a high speed, coming in contact with all parts of the bottle's interior and cleaning it thoroughly.

The motor used to rotate the brush is of ½-hp. rating and is said to be capable of withstanding a heavy overload. Less power is consumed by it than by two standard 16-cp. incandescent lamps. The motor is of rugged and durable design and is equipped with an iron shield to protect the windings from moisture. Connection may be made with any lamp socket since a plug and 6 ft. (1.8 m.) of cord are provided with the washer.

Motor Generator for Mine Substation

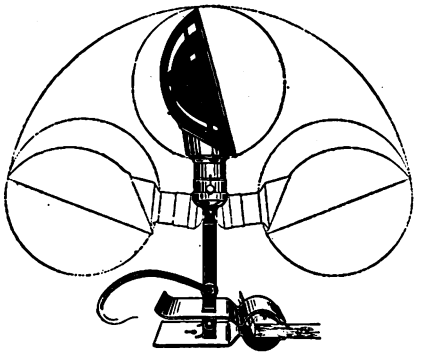
For mine substation use a synchronous motor-generator set which embodies the continuous power-factor correction common to such sets with very high overload and "peak" capacity has recently been put on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It consists of a three phase, 60-cycle synchronous motor driving a 150-275-volt compound generator. The machine has three bearings, the pedestals and field frames being mounted on a common bed plate. The compound field is adjusted to give 19 per cent increase in voltage from no load to full load.

In addition to commutating poles of the generator, there is a compensating winding placed in slots in the faces of the main poles. This gives extremely good commutating characteristics and consists of but one continuous coil per pole. Each coil is put into open slots in the pole faces, where it is held by wedges. This construction gives one joint per pole instead of two joints per conductor. No difficulty is found in removing and replacing coils.

The motor is a six-pole revolving-field machine, provided with squirrel-cage damper winding in the pole faces. This permits starting the set from the alternating-current side and also insures its stability under sudden variation of load. The field may be over-excited to draw "leading" reactive current from the line, thus compensating for the "lagging" current.

Adjustable Portable Lamp

The important feature of the "600" adjustable and portable lamp recently brought out by S. W. Farber of 141 South Fifth Street, Brooklyn, N. Y., is a clip which enables the lamp to be clamped on any projecting edge or post. Also the lamp may be hung on the wall or placed on a flat surface, using the clip as a base. Since practically all articles of furniture have either an



CLAMPS ON EDGES OR POSTS, HANGS FROM WALL OR USES CLIP AS BASE

edge, a post or a flat surface, it is possible to use this lamp almost anywhere. As the clamp is felt-lined, there is no danger of scratching or denting polished surfaces. The lamp is equipped with a Bryant push-button socket, uses a standard bulb and comes complete with 6 ft. (1.8 m.) of silk cord and an attachment plug. Finishes of brushed brass, statuary bronze, nickel and silver plate are obtainable.

One-Piece Night Lamp

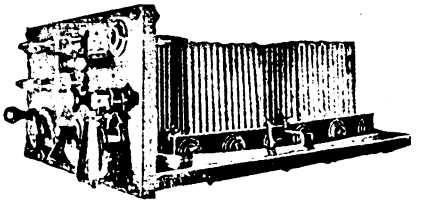
For nurseries, sick rooms, halls, bedrooms and wherever a night lamp is desirable the "Baby Light" is offered by the St. Louis Brass Manufacturing Company, St. Louis, Mo. It is about 6 in. (15 cm.) high and 5 in. (13 cm.) wide and is made in one piece of white glazed porcelain. A 2-cp., 6-volt automobile-type bulb is used, energy being supplied through a transformer in the base of the lamp from an ordinary 115-volt, 60-cycle alternating-current lighting circuit. The amount of light furnished, the maker says, is not enough to disturb sleeping persons, but is adequate to illumine objects that are likely to be tripped over otherwise. Since the base of the lamp is broad, there is no danger of its tipping over.

Wire Grip with Automatic Locking Device

An automatic locking device is the feature of the improved Buffalo wire grip No. 471 made by the Smith & Hemenway Company, 114 Coit Street, Irvington, N. J., and which will be ready for distribution about the middle of next month. By throwing the loop of this tool in an upright position the grip is locked open so that the lineman or electrician can handle it with one hand. When the pull or strain is placed on the loop it automatically engages the telegraph, telephone or electric light wire being stretched. This improvement will also be placed on grips with loops or with double pulleys. The tool is made of high-carbon cold-rolled steel, white-nickel-plated, and is supplied in three sizes, one for No. 6 wire and smaller, another for No. 0 wire and smaller, and the third for No. 000 wire and smaller.

Sectional Automatic Battery-Charging Equipment

Simplicity of installation and flexibility of usage are said to characterize the Unipanel automatic sectional battery-charging equipment now being manufactured by the Automatic Electrical Device Company, 120 Opera Place, Cincinnati, Ohio. Each section



SECTIONS ARE WIRED COMPLETELY, WITH LINE AND BATTERY TERMINALS BROUGHT TO BOARD

is equipped with a heavy double-pole fused knife switch, adjustable rheostat shunt-trip circuit breaker arranged for automatic operation from ampere-hour meter, special meter switch, special arrangement for series charging of Edi-

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son batteries, and indicating lamp for showing to which section a particular battery is connected. Furnished for charging either lead or Edison batteries, these sections are wired completely with line and battery terminals brought to a terminal board at the rear of each section and standardized busbars furnished to connect the various sections together. To install additional panels these are inserted into the standard angle-iron frame and interconnected with the standardized busbars at the rear.

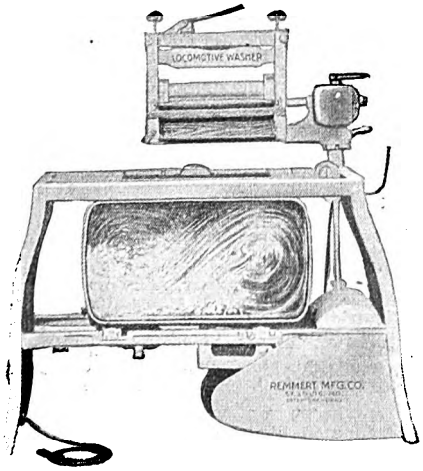
Through the use of a special meter switch only one meter section is required for a number of charging sections, this number being limited only by the attendant's ability to read the meter from a distance.

Swinging-Pivot Flood Lamp

To permit changes in divergence of light rays for floodlighting purposes, the bulb of the unit being manufactured by the Pittsburgh Reflector & Illuminating Company, Pittsburgh, Pa., is arranged to be adjustable so that its filament lies in the exact focus of a specially designed silvered-glass reflector. The door of this device can be opened on its hinge, swinging in a horizontal plane upon the withdrawal of a pin at either side. It is furnished either with a base standard or with a side-arm bracket.

Reciprocating-Tub Washing Machine

The clothes-holding tub of a motor-driven washing machine recently placed on the market by the Remmert Manufacturing Company, Belleville, Ill., has no internal moving mechanism but reciprocates on a horizontal plane, thereby forcing the water through the fabric of the clothes and cleaning without tearing or injuring them. A



WATER IS KEPT MOVING BY RECIPROCATING ACTION

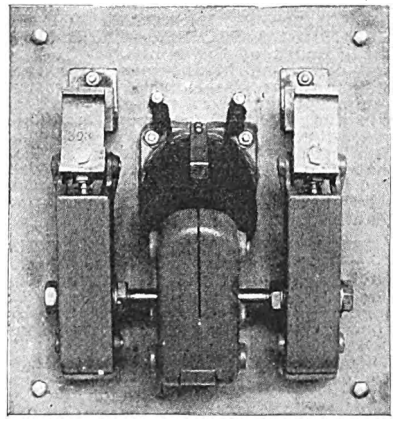
gas heater is provided to keep the water constantly at the boiling point. The machine has a capacity of eight sheets and is equipped with a swinging wringer. Motor and driving mechanism are completely inclosed.

Hand-Power Metal Punch

A deep throat which allows use of large material, a one-piece automatic disappearing stripper, crowned punches of the floating type that direct the power to the center, and the fact that it will not twist or turn in operation, are the features of the "Jiffy" hand-power punch recently developed for cutting holes in metal up to No. 10 gage. It will cut holes $\frac{5}{32}$ in. (3.9 mm.), $\frac{3}{16}$ in. (4.7 mm.), $\frac{7}{32}$ in. (5.5 mm.) and $\frac{1}{4}$ in. (6.3 mm.) in diameter. The weight of the punch is 5 lb. (2 kg.) and its length is $9\frac{1}{2}$ in. (30 cm.). Paul W. Koch & Company, 19 South Wells Street, Chicago, market this punch, which may be operated either entirely by hand or clamped in a vise.

Two-Pole-Magnet Contactor for Heavy Service

The two-pole-magnet contactor which is a recent addition to the products of the Automatic Switch Company, 4 White Street, New York City,



HEAT AT ARCING CONTACT DOES NOT BLISTER CONTACTING ELEMENT

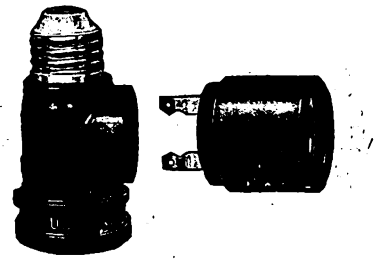
is especially fitted for heavy, continuous alternating-current service. The contacts of this device are so constructed that the arcing elements are some distance from the contacting elements. In this way the latter cannot be affected by the heat occurring from opening and closing the contacts.

Washer with Automatic Stop and Lock

An automatic stop and lock on its washing drum are pointed out as important features of a clothes-washing machine recently developed by the Fosston-Carpenter Company, 473 Cleveland Avenue North, St. Paul, Minn. By placing the automatic lever in a vertical position the drum is automatically stopped with its cover in line with the wringer, ready for removing and wringing out the clothes. This device also locks the drum in this position, so that if the machine is accidentally started while the operator's arm is in the drum no injury will result. Other features of the machine are adjustable legs and an automatic friction release which allows the motor to revolve freely in case the machine is started under an overload sufficient to damage the motor.

Combined Current Tap and Lamp Receptacle

The wiring devices manufactured by Harvey Hubbell, Inc., Bridgeport, Conn., have been recently supplemented by the addition of the No. 6700 current tap, which is a combination of a current-tap body and a lamp receptacle, both made of heat-resisting composition. Not only is an extra source of



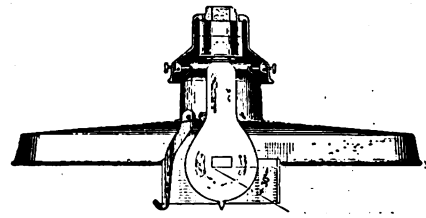
TAP TAKES ONE-PIECE SCREW-BASE PLUGS

current supply provided without interrupting the service from the lamp, but the additional outlet will take all standard plug caps or any one-piece screw-base plug. Another feature is found in the fact that the lamp hangs in the correct vertical position and the tap is so designed as to allow the use of glass or metal reflectors.

Wide-Distribution, Glareless Industrial Lighting Unit

The desirable qualities of a shallow-bowl-type reflector — namely, wide distribution and an extensive area of light source—are combined with the eye protection of deep-bowl equipment in "Factorylite" No. 800, now being manufactured by the Henkel & Best Company of Chicago and distributed by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago.

These fixtures can be spaced at two and a half times the mounting height from the working plane. Two sizes of the units are obtainable, one for lamps



CROSS-SECTION SHOWING OPAL-GLASS DIFFUSING RING AND HANGER

of 200 watts and the other for 300-500-watt bulbs. The reflector is made of porcelain enamel and is finished in green outside and white inside. An opal-glass diffuser ring is suspended from the reflector by hangers. The unit can be used with any standard porcelain socket and $3\frac{1}{4}$-in. (8-cm.) flat shade holder.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A man in Switzerland (No. 28,975) desires to secure an agency for the sale of electrical apparatus.

A man in Italy (No. 29,052) desires to secure an agency for the sale of electric lamps and electrical machinery.

A company in Norway (No. 29,062) desires to purchase and to secure an agency for the sale of electrical supplies. Payment will be made against documents.

A man in Norway (No. 29.045) desires to purchase and secure an agency for the sale of electrical industry supplies. Terms, cash against documents in Norway.

A firm in Spain (No. 29,079) desires to purchase electrical machinery. Quotations should be f.o.b. New York. Payment, cash against documents. Correspondence should be in Spanish.

The manager of a trading corporation in Belgium (No. 29,090) desires to be placed in touch with manufacturers able to supply all kinds of electrical machinery, fittings and apparatus.

A merchant in France (No. 28,959) desires to represent manufacturers and exporters for the sale of machinery and materials for electrical plants. Correspondence may be in English.

An electrical machinery manufacturer in France (No. 29,088) desires to secure an agency, on a salary and commission basis, for the sale of electrical products. Correspondence may be in English.

A business man in France (No. 29,017) desires to secure an agency for the sale in France, Belgium, Italy and Switzerland of electrical apparatus used by barbers, hairdressers and manicurists. He states that he has space in which to store a stock of goods. Correspondence may be in English.

A business man in Norway (No. 28,960) desires to secure an agency for the sale of electrical motors, transformers, storage batteries, dry cells, wires, cables, resistance alloys, apparatus for cooking and heating, insulators, insulating materials, tapes and other electrical supplies; also varnish, carbon and metal brushes, metals, transformer and dynamo plates, tools, etc.

Daniel T. Pierce, formerly assistant to the president of the General Asphalt Company, who has just returned from more than a year's service in France, is established temporarily at Room 1031, 120 Broadway, New York. Mr. Pierce will represent important Franco-Italian interests as well as acting for American manufacturers seeking business in France and other European countries.

H. W. Butler, of Cravon House, Kingsway, London, England, is staying at the Manhattan Hotel, Forty-second Street, New York City, and will be glad to hear from manufacturers of small electrical tools, fractional-horsepower motors and varnished-fabric and paper insulating materials, with the view of development of trade in European markets. Mr. Butler is well known in English trade circles, having been chairman of the British Electrical Manufacturers' Association for two years from 1910 to 1912 and also chairman of the organizing committee of the last electrical exhibition held in England, in 1911.

NEW SERVICE BUILDING FOR NATIONAL LAMP WORKS.—The National Lamp Works of the General Electric Company, Nela Park, Cleveland, Ohio, are preparing plans for a new service building at Nela Park, which will cost upward of $200,000, it is reported. The expectation is to construct it this year. The building will include a larger cafeteria, the dispensary, rest rooms for employees and space for the treasury and accounting departments. Later a wing may be added to include a library and possibly some recreation facilities for employees, but that construction will not be made this year. A new laboratory also is contemplated, but decision to build it has not yet been reached.

METAL STATISTICS FOR 1919—The American Metal Market and Daily Iron and Steel Report, New York, has issued its twelfth annual edition of "Metal Statistics." The preface states that "there is now so much interest in what occurs during and after wars that attention may be directed to the long span of some of these tables."

ROUMANIAN TRADE INTERESTS.—The American-Roumanian Chamber of Commerce has been formed, with headquarters at the Woolworth Building, New York City, to assist American business interests in the development of important opportunities in connection with the reconstruction of Roumanian industrial and commercial life.

RESTRICTION ON EXPORTS TO GERMAN AUSTRIA.—Announcement is made that after April 2 applications will be considered to export or import all commodities to or from German Austria, except that, for military reasons, the importation into German Austria of electrical appliances adapted for use in the war and their component parts will be restricted, and export licenses for these articles will be granted only in exceptional cases.

WEBER SNAP-SHELL PATENTS UPHELD.—Judge Thomas, in the United States District Court, Connecticut, has upheld the Weber Electric Company snap-shell patents against the Connecticut sockets of the Connecticut Electric Manufacturing Company. This is similar to the action sustaining these patents against the Cutler-Hammer Manufacturing Company, decided Jan. 22, 1919, and noted on page 706 of the April 5 issue of the ELECTRICAL WORLD.

ENGLAND'S DISPOSAL OF WAR ELECTRICAL STORES.—The English Disposal Board of the Ministry of Munitions has completed arrangements for the sale of quantities of electrical apparatus and equipment that were manufactured to help win the war and are now available for peace-time development. The stores include lighting accessories and fans, cables, bell materials, electrical instruments, telegraph and telephone materials, wireless apparatus, searchlights, arc lamps and equipment and plants.

FOREIGN TRADE EDUCATIONAL COMMITTEE.—In furtherance of a resolution adopted at the last annual convention of the American Manufacturers' Export Association the board of directors has appointed the following committee on education for foreign trade service: W. W. Nichols, Allis-Chalmers Manufacturing Company; G. H. Carter, W. R. Grace & Company; H. E. Cole, Standard Oil Company; H. H. Merrick, Chicago Association of Commerce; H. S. Smith, Gulf States Steel Company; E. P. Thomas, United States Steel Products Company.

THE PACIFIC DIVISION, Electrical Supply Jobbers' Association, will hold its meetings May 28-29.

THE LEONARD ELECTRIC MANUFACTURING COMPANY, Cleveland, Ohio, is the new name of the Leonard-Bundy Electric Company.

THE POWER SPECIALTY COMPANY, Dansville, N. Y., manufacturer of Foster superheaters, is arranging for the manufacture of a new fuel-saving device now being developed.

THE PAGE STEEL & WIRE COMPANY, with its main plant at Monessen, Pa., has, it is reported, put all departments on an eight-hour-day basis in order that more men may be employed.

C. E HAGUE, formerly production engineer of the Mid-West Engine Company, Indianapolis, Ind., has been appointed sales manager of the American Steam Conveyor Corporation, Chicago, manufacturer of steam ash conveyors and other ash-handling equipment.

CARLISLE MASON, INC., 207 Broadway, New York City, and 81 Rue St. Lazaire, Paris, consulting engineers, announce that Major Mason, having returned from France and resigned his commission, will resume his practice of general engineering in a consulting capacity, assisted by a staff in the specialized branches.

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Finance Building, Philadelphia, reports the successful starting up of a "Greaves-Etchells" electric furnace at the plant of the Davidson Tool Manufacturing Corporation, Brooklyn, N. Y. This furnace is used in conjunction with Mr. Davidson's special process for the manufacture of high-speed steel castings. The company also reports the starting up of a 6-ton furnace at the Mare Island Navy Yard. In England Greaves-Etchells furnaces have been started up for the Tyne Electric Steel Foundries, Ltd., for the manufacture of steel castings, and a special 6-ton furnace has been installed for W. W. McGregor of Airdrie, for the manufacture of alundum.

THE MULTIPLE STORAGE BATTERY COMPANY, New York City, has arranged for the construction of a new plant, 60 ft. by 120 ft., at Jamaica, L. I.

ROY BURLEW, formerly with the Novelty Company, Emporium, Pa., is one of the purchasers of the Kentucky Electric Lamp Company, Owensboro, Ky. M. E. Pierson, formerly general superintendent of the Novelty Company, is directly in charge of operation in the lamp company.

THE HOME SPECIALTY COMPANY, Cleveland, Ohio, maker of the Laun-Dry-Ette" washing and drying machine, announces the awarding of the contract for a new factory to be built and completed in May. The new plant will be of brick fireproof construction and will increase the output.

THE A. P. GREEN FIRE BRICK COMPANY of Mexico, Mo., has opened an Eastern district sales office in New York City at 30 Church Street. Howard C. Thayer, formerly field mechanical engineer for the J. G. White Engineering Corporation at the United States nitrate plant No. 2, is in charge.

J. T. GIBSON, who has been appointed sales manager of the One-Minute Manufacturing Company, Newton, Iowa, was assistant and branch manager of the International Harvester Company at Des Moines, Iowa, for eight years. Prior to that he was connected with the same company at Kansas City and other points in the Southwest territory.

THE HOME MANUFACTURING COMPANY, Brooklyn, N. Y., has established a branch office at 222 Grand Trunk Dock, Seattle, Wash. The company is considering the establishment of a factory in Seattle for the manufacture of electrical equipment of various kinds and is looking over the field with this end in view. Details of site and plant will be available later.

S. J. STEWART (ELECTRIC), New Orleans, La., announces the completion of twenty years in the business of repairing and rebuilding of electrical equipment and the manufacture of switchboards. There is also a retail department and construction department connected with the shop. Starting with a 10-ft. by 10-ft. back-yard shed, the space occupied is now a four-story structure on Carondelet Street.

THE GELLERT ENGINEERING COMPANY, Philadelphia, is erecting electrical precipitators at the plant of the American Manganese Manufacturing Company at Dunbar, Pa., for the purpose of cleaning the gases from its blast furnaces. Erection of these precipitators will be completed about June 1. The Gellert Engineering Company has just completed tests made with a small precipitator at the plant of the Woodstock Operating Corporation, Anniston, Ala.

THE ALLOY METAL WIRE COMPANY, INC., New York City, has leased the two-story factory building at No. 10 and 12 Woodworth Avenue, Yonkers, N. Y., for a term of years for the manufacture of electrical resistance wire, pure nickel, monel metal, spark plug wire, bronze, brass and copper. S. A. Murray, president and general mill manager, was until recently engaged as wire-mill superintendent for the Electrical Alloy Company of Morristown, N. J., and prior to that time was for a period of ten years employed in a like capacity for the Driver-Harris Company of Harrison, N. J.

GEORGE W. HUBLEY, who recently terminated his office as administrative engineer and chief of conservation, United States Fuel Administration, has opened an office in the Starks Building, Louisville, Ky., as consulting and advisory engineer and power plant specialist. Previously Mr. Hubley was general manager and chief engineer of the Merchants' Heat & Light Company of Indianapolis, Ind., and was identified for a number of years with the public utility interests at Louisville. In addition, his organization will be prepared to take care of general consulting engineering practice, making surveys, investigations, appraisals, reports, plans and specifications.

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THE HOWE SPECIALTY COMPANY, Cleveland, Ohio, has let contracts for a factory building to cost $70,000.

THE MOTOR PROTECTOR MANUFACTURING COMPANY of San Francisco, Cal., is the new name of the Baruch Electric Controller Corporation.

HENRY D. SEARS, general sales agent of the Weber Electric Company, announces the removal of the district sales office to 345 Fifth Avenue, New York City.

THE BROWN-HUNKELE CORPORATION, 12 Mechanic Street, Newark, N. J., manufacturer of motors, has increased its capital from $30,000 to $100,000 for expansion.

THE LANGSTADT & MEYER COMPANY of Appleton, Wis., it is reported, is contemplating the erection of a factory and shop for the manufacture of farm-lighting-systems and appliances.

J. D. MOONEY, formerly manager of the Hyatt Roller Bearing Company's industrial division, has been discharged from the service and become connected with the General Motors Corporation, New York City.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces the transfer of E. C. Cherrington to the Pittsburgh office of the central district as office manager, and of T. R. Cooley to the same office as engineering correspondent.

G. H. COHEN, formerly sales manager of the Wesco Supply Company, St. Louis, has resigned to become vice-president and general manager of the Fidelity Electric Company, which is a new corporation organized to engage in the electrical jobbing business.

THE CHICAGO PNEUMATIC TOOL COMPANY has moved its Milwaukee office from Room 1305 Majestic Building to Room 1418 in the same building, where more convenient quarters necessitated by the growing business of the company in that district have been obtained.

THE OKONITE COMPANY announces that its entire executive staff was transferred on April 1 from 501 Fifth Avenue, New York City, to the company's plant at Passaic, N. J., where the main office will hereafter be located. A sales office will be retained at 501 Fifth Avenue, New York.

THE VAN DORN ELECTRIC TOOL COMPANY, Cleveland, Ohio, will soon erect a four-story addition to its plant. The new plant, like the present factory, will be devoted entirely to the making of portable electric drills and grinders. All parts of the specially designed motors are made in the plant.

P. C. GUNION has been appointed advertising manager of the industrial divisions, General Motors Corporation, according to the announcement of D. Gleisen, chairman board of managers of the industrial divisions, General Motors Corporation, New York City, and manager industrial bearings division of the Hyatt Roller Bearing Company.

LIEUT.-COMMANDER H. J. ELSON, United States Naval Reserve Force, has been released to inactive status and has resumed his civilian work as secretary and treasurer of the Walter A. Zelnicker Supply Company, St. Louis, where he is in charge of internal management and manufacturing operations. His assignment was inspector of machinery, Ninth, Tenth and Eleventh Naval Districts, with headquarters at Chicago, where he had charge of the design and conversion to salt-water use of the machinery department of Great Lakes vessels taken over by the Navy Department.

THE ELECTRO-DYNAMIC COMPANY of Bayonne, N. J., has bought the business of the Stamford Electric & Manufacturing Company, Stamford, Conn., and will continue the manufacture of the alternating-current motor heretofore manufactured by the Stamford company. The purchase does not include the Stamford company's factory building. Edward Heitman, president and general manager of the Stamford company, will be associated with the Bayonne company as chief engineer in the production of the motor he designed. Until now the Bayonne company has made only direct-current motors of standard type up to 150 hp. and motors of 400 hp. to 1000 hp., interpole type, for the main driving motors of submarines. The alternating-current motors in sizes from ¼ hp. to 50 hp. are ready for immediate delivery to the purchasers.

Trade Publications

BOTTLE WASHER. — An electrically driven milk-bottle washer is the subject of a circular from the Electric Specialty Company of Stamford, Conn.

MALLEABLE IRON.—The American Malleable Castings Association, 1900 Euclid Building, Cleveland, Ohio, announces a publication on malleable iron.

LIGHTING PLANTS.—Automatic lighting plants are the subject of a recently issued circular of the Mathews Engineering Company, Sandusky, Ohio.

INDICATING INSTRUMENTS.—Descriptive matter on type W duplex indicating instruments is contained in a new booklet from the Esterline Company of Indianapolis, Ind.

LAMP GUARDS.—Lamp guards and lamp guards for portable uses are illustrated and described in a circular prepared by the McGill Manufacturing Company of Valparaiso, Ind.

FUSED OIL SWITCHES.—The type N-2 fused oil switches made by the Condit Electrical Manufacturing Company of South Boston, Mass., are described in bulletin No. 440, now being distributed.

GENERATOR BRUSHES.—The Corliss Carbon Company, Bradford, Pa., manufacturer of motor and generator brushes, has just published bulletin No. 6, which gives data in condensed form on brushes.

DISCONNECTING HANGERS.—"How to Make Reflectors Reflect" is the title of a circular on disconnecting hangers being distributed by the Thompson Electric Company, 5606 Euclid Avenue, Cleveland, Ohio.

SIGN FLASHERS.—Bulletin No. 36, dated March 15, 1919, issued by the Reynolds Electric Company, 422 South Talman Avenue, Chicago, is devoted to information on Reco flashers for electrical signs and displays.

ELECTRIC HOISTS.—The Electric Hoist Manufacturers' Association, 9 West Fortieth Street, New York City, has issued an illustrated booklet called "The Strong Arm of Industry," which contains general information about electric hoists.

RADIOTELEGRAPHY.—"The Wonderful Achievements of Radiotelegraphy in War and Peace" is the title of an interesting thirty-page booklet written by William Dubilier of New York City, which also contains a discussion of the Dubilier condenser.

INDUSTRIAL LIGHTING FIXTURE.—The Amco industrial lighting unit is the subject of a recently issued folder of the Art Metal Manufacturing Company, East Sixty-first Street and Curtis Avenue, Cleveland, Ohio.

ATTACHMENT PLUGS. — Superseding bulletin No. 16-4, bulletin No. 16-9, dated March, 1919, has been issued by Harvey Hubbell, Inc., Bridgeport, Conn. It catalogs composition attachment plugs for small motors and heavy-duty polarized attachment plugs.

AUTOMOTIVE ELECTRIC EQUIPMENT.—The subject of publication 1532-E from the Westinghouse Electric & Manufacturing Company, 110 West Forty-second Street, New York City, is automotive electric equipment for automobiles, airplanes, trucks, motorboats, tractors and locomotives.

BATTERY-CHARGING EQUIPMENT.—Bulletin No. 601 prepared by the Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, Ohio, tells about its "Unipanel" sectional automatic battery-charging equipment for industrial trucks, tractors and engines. The "Chargometer" is also described in this publication.

IRON RODS AND WIRE FOR WELDING.—The Page Steel & Wire Company, 30 Church Street, New York City, has prepared an interesting sixty-page booklet entitled "Armco Iron Rods and Wire for Oxy-acetylene and Electric Welding." A large portion of its contents are of handbook character. Many tables and information on welding are included.

HIGH-VOLTAGE PROTECTIVE AND SWITCHING EQUIPMENT. — Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago, are distributing a new catalog describing their high-voltage protective and switching equipment. Among the apparatus described in the catalog are high-voltage fuses, safety disconnecting switches, fuse mountings, choke coils, protective combinations, fuse tongs, switch sticks, high-voltage circuit breakers, cut-outs, lightning arresters, voltage detectors, multiple-circuit relays, differential relays, reverse-phase relays, recording synchroscopes, etc. The catalog has five sections and is well illustrated.

New Incorporations

THE FOREMAN (ARK.) LIGHT & WATER COMPANY has been chartered with a capital stock of $25,000 to construct and operate an electric light plant in Foreman.

THE CLIO (KY.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,000 by A. L. Calhoun, Jr., J. G. McRae and W. J. Rabon.

THE CLARKSVILLE (TEX.) BATTERY & ELECTRIC COMPANY has been incorporated with a capital stock of $3,000 by W. A. Collins, W. G. Moore and Wortham Collins.

THE GHENT (KY.) ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $5,000 to construct and operate an electric lighting system in Ghent.

THE NORTHERN OHIO HYDRO-ELECTRIC COMPANY of Cleveland, Ohio, has been incorporated by George R. McKay and Raymond Bolivar. The company is capitalized at $300,000.

THE RECTOR ELECTRIC COMPANY of New York, N. Y., has been incorporated by W. Claman, A. Goetz and F. W. Martin. The company is capitalized at $10,000 and proposes to manufacture electrical appliances and equipment.

THE TITAN BATTERY SERVICE COMPANY of Trenton, N. J., has been chartered with a capital stock of $25,000 to manufacture storage batteries. The incorporators are Norman T. Rogers, Marcus B. Robinson and Thomas E. Lunger.

THE DOUGHTY & WELCH ELECTRIC COMPANY of Fall River, Mass., has been chartered with a capital stock of $50,000 to manufacture electrical appliances, etc. The incorporators are: W. H. Doughty, William T. Welch and M. D. Riley.

THE HARTFORD (CONN.) BATTERY MANUFACTURING COMPANY has been incorporated by Fred W. Barhoff of Hartford and S. P. Griswold of West Hartford. The company is capitalized at $200,000 and proposes to manufacture electric batteries.

THE RADISHAW MANUFACTURING COMPANY of New York, N. Y., has been incorporated by L. J. Haines, M. Ganya and J. Connors, 80 Broadway, New York, N. Y. The company is capitalized at $250,000 and proposes to manufacture telephones, etc.

THE PIERCETON (IND.) LIGHT & WATER COMPANY has been incorporated by J. T. Brosnahan, M. P. Kirkpatrick, G. A. Leifer, P. A. Ashley and J. L. Radcliff. The company is capitalized at $35,000 and proposes to supply water, light and power in Pierceton.

THE CANADIAN DRILL & ELECTRIC BOX COMPANY, LTD., of Ottawa, Can., has been incorporated by Frank J. Hughes, 72 Queen Street West; Leo J. Phelan, 12 Seaforth Avenue, Henry Catley and others. The company is capitalized at $100,000 and proposes to manufacture electrical supplies, etc.

THE T. J. CORCORAN LAMP COMPANY of Cincinnati, Ohio, has been incorporated with a capital stock of $400,000 to manufacture automobile lamps. The company has taken over the plant of the Corcoran Victor Company at Winton Place, which it will enlarge in the near future. T. J. Corcoran is president.

THE EUREKA POWER COMPANY of Eureka, N. S., Canada, has been incorporated by James O. Kerr and Thomas G. Grant of Eureka, Alexander McPhene of Windsor, N. S., and others. The company is capitalized at $100,000 and proposes to construct and operate electric light, heat and power plant and to manufacture electrical machinery, etc.

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New England States

ST. ALBANS, VT.—The Public Service Commission has granted the Public Service Lighting Company of St. Albans permission to extend its electric transmission line to Burlington and through the highways of the city and to increase its capital stock by $50,000. These grants will make possible the completion of the transmission line between St. Albans and Fairfax and Burlington over which the company is to furnish electricity to the city for a period of ten years. The cost of the proposed line is estimated at $150,000, of which the power plant at Georgia will take about $80,000.

WEBSTER, MASS.—Contract has been awarded to Walter Stone of Webster for the new electric lighting units, etc., in connection with alterations and improvements to the Bartlett High School.

PROVIDENCE, R. I.—The City Council has granted the Narragansett Electric Lighting Company permission to erect a 66,000-volt transmission line from its power house across South and Points Streets.

WARREN, R. I.—The Narragansett Electric Lighting Company is erecting an outdoor substation at the power station of the New York, New Haven & Hartford Railroad Company off Main Street for the purpose of increasing the transmission service to Fall River and Bristol.

Middle Atlantic States

BATAVIA, N. Y.—The Genesee Light & Power Company has petitioned the Public Service Commission for permission to issue $220,000 in bonds. Part of the funds are to be used for refunding purposes and the remainder for extensions and improvements, which will include the erection of transmission lines to Attica and Le Roy, and also equipment for Attica to cost about $88,000.

CORNING, N. Y.—Arrangements, it is reported, are being made by the Corning Glass Company for the erection of a new power plant, 50 ft. by 80 ft., at its works. S. Firestone, Granite Building, Rochester, is engineer.

ELLENVILLE, N. Y.—The Ellenville Electric Company is contemplating extending its distribution lines (6 miles) in the Brigg Street district. G. C. Davis is engineer.

KINGSTON, N. Y.—The United Hudson Electric Corporation of New York has petitioned the Public Service Commission for permission to acquire the capital stock of the Kingston Gas & Electric Company, including the Ulster Electric Light, Heat & Power Company of Saugerties, and 775 shares of the Upper Hudson Electric & Railroad Company of Catskill. Authority is also asked to acquire the stock of the Rifton (N. Y.) Land Corporation and the development of two water-power sites on the Wallkill River at Dashville, one in the immediate future, with an estimated capacity of 50,000 hp., and also to acquire some transmission lines recently erected near Poughkeepsie, Newburgh and Kingston.

LONG ISLAND CITY, N. Y.—The Factory Construction Company of Brooklyn has been awarded general contract for the construction of a factory building, four stories, 90 ft. by 200 ft., on Nott Avenue east of the Boulevard in Long Island City, for Repetti, Inc., candy manufacturers. The cost of the building, exclusive of machinery and equipment, is estimated at $350,000. M. A. Cantor is architect.

MOUNT UPTON, N. Y.—The Public Service Commission has granted Messrs. Jewell and Rockwell of Guilford permission to construct an electric light plant to serve the Mount Upton lighting district.

POTSDAM, N. Y.—The St. Lawrence Transmission Company has increased its capital stock from $525,000 to $3,000,000, the proceeds to be used for extensions to its electric system.

UTICA, N. Y.—The Adirondack Electric Power Corporation, it is reported, is considering the erection of a new power plant in Utica. The company has recently completed its high-tension transmission line from Amsterdam to Utica.

NEWARK, N. J.—Plans have been filed by the American Oil & Supply Company, Lafayette Street, for a power plant, 40 ft. by 50 ft., to be erected at its proposed new works to be located on Wilson Avenue.

FARRELL, PA.—Plans are under consideration by the City Council for the installation of an ornamental street-lighting system on four thoroughfares. The cost is estimated at about $25,000. The Shenango Valley Electric Light Company furnishes electrical service in Farrell.

MONT ALTO, PA.—Extensive additions and improvements will be made to the State Sanitarium at Mont Alto during the coming season, including the installation of an electric light and power plant, the erection of a community house for recreation and amusement, a house for female help, etc. The cost is estimated at about $300,000.

PHILADELPHIA, PA. — Arrangements have been made by the Lester Piano Company for the installation of new electrical equipment in its plant, including a 500-kw., non-condensing, revolving-field, two phase, 60-cycle, 220-volt electric generating unit and other apparatus.

PITTSBURGH, PA.—The Pittsburgh Model Engine Company is planning to build a new plant in the Point Breeze section, to cost about $200,000. Two buildings will be erected, one two stories, 60 ft. by 320 ft., and the other one story, 40 ft. by 160 ft., to be equipped throughout with electrically operated machinery.

SAYRE, PA.—The Sayre Electric Company is extending its electric transmission to East Athens to furnish electrical service in that town.

WILLIAMSPORT, PA.—Plans are being prepared by the Citizens' Electric Company for the erection of a new one-story power plant, 60 ft. by 120 ft., in Williamsport, to cost with equipment about $250,000. J. Fischer is manager.

SMYRNA, DEL.—At a special election held recently the proposal to issue $35,000 in bonds for improvements to the water and light systems was carried.

MILLVILLE, W. VA.—The Northern Virginia Power Company has begun work on the extension to its local plant on the Shenandoah River. This power plant, it is said, will be connected with the Valley branch of the Baltimore & Ohio Railroad at Millville.

SOUTH CHARLESTON, W. VA.—Application has been made by the West Virginia Water & Electric Company of Charleston for a franchise to extend its electric transmission system through South Charleston.

WASHINGTON, D. C.—Bids will be received at the office of the purchasing agent, Commissioners of the District of Columbia, Washington, D. C., until April 30 for furnishing 15,982 ft. telephone cable or signal cable for the electrical department.

WASHINGTON, D. C.—Bids will be received by the District Commissioners about June 1 for building foundation, power house and tunnel work in connection with the new Gallinger Municipal Hospital. The plans provide for twenty-one buildings, for which $500,000 has been appropriated.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 9 for a fire-alarm watchman's clock and low-voltage feeder systems in the Arlington Building, Washington. Plans and specifications at the above office.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 29, South Brooklyn, N. Y., Schedule 7940½—one knife switch and one motor-generator with equipment. South Charleston, Schedule 7941½—two pumps with motors. Until May 2, Portsmouth, Schedule 7946½—three inclinable power presses and horning and wiring. Until May 6, Philadelphia, Pa., Mare Island, Cal.; and Puget Sound, Wash. Schedule 7950½—52 direct-current voltmeters. Norfolk, Va., Schedule 7954½—induction motors. Until May 9, New Orleans, La., Schedule 7951½—two switchboards and spare parts. Application for proposal blanks should designate the schedule desired by number.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until April 29, Brooklyn, N. Y., Schedule 3913—miscellaneous interior communication cable; Schedule 3922—five combined ironers, steam-heated, electrically operated, roll 18 in. by 8 in.; sets of mechanical spare parts; sever return apron ironers, flat work, 48 or 50 by 16 in., 120 volts, direct current; sets mechanical spare parts, complete; Schedule 3914—miscellaneous solid, triple-braided, weatherproof wire. Washington, D. C., Schedule 3916—miscellaneous stranded, single-conductor wire. Pensacola, Fla., Schedule 3906—miscellaneous rubber-covered, braided, stranded copper wire. Philadelphia, Pa., Schedule 3906—plain, single-conductor lighting and power wire. Boston, Mass., Schedule 3918—four steam turbine-driven two stake, centrifugal gasoline pumps. Until May 6, South Brooklyn, N. Y., Schedule 3924—miscellaneous galvanized-steel conduit pipe. Application for proposals should designate the schedule desired by number.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

ALLIANCE, OHIO.—At an election held April 8 the proposal to issue $400,000 to establish a municipal electric light plant in Alliance was defeated.

ARCADIA, OHIO.—Bonds to the amount of $13,000 have been voted to provide funds to obtain electricity for the village.

CINCINNATI, OHIO.—Bids will be received by C. W. Handman, business manager of board of education, Cincinnati, until April 28 for electrical work in the Hoffman Public School on Woodburn Avenue. The cost of the building is estimated at $250,000.

CLEVELAND, OHIO.—The Van Dorn Electric Tool Company is planning to erect a new factory, 50 ft. by 100 ft., for its electrical department. New equipment, including dynamos, pumps, drills and lathes, to cost about $60,000, will be installed.

MIDDLETOWN, OHIO.—The Ohio Gas & Electric Company of Middletown has entered into contracts with the towns of Monroe and Jacksonboro to supply electricity in those municipalities. The company is also negotiating with other villages in this section to furnish electrical service.

NORWOOD, OHIO.—Bids will be rereceived by the board of education of Norwood until May 12 for electrical work in the new Allison Street school building. Harold Ryan is clerk.

TOLEDO, OHIO.—The Toledo Factories Company, Southard and Twelfth Streets, is contemplating the construction of a machine shop, to cost about $150,000. I. B. Hiett is president.

ZANESVILLE, OHIO.—The Baltimore Railroad Company, it is reported, is contemplating the construction of a shop in Zanesville, to be used principally for repairing electrical equipment.

LOUISVILLE, KY.—The directors of the Louisville Million-Dollar Factory Fund are considering the construction of a large factory building, which will probably be built in four units of 200,000 sq.ft. each. It will be ten stories high and will have a railroad connection. It will also be equipped with a central lighting and heating plant and a central shipping department. The elevators will be a part of the shipping department. The cost of the building is estimated at $1,600,000.

EAST ST. LOUIS, ILL.—Contract has been awarded by the East Side Packing Company to the Keeley Brothers Contracting Company for the construction of a factory and cold-storage building, to cost about $300,000.

PETERSBURG, ILL.—The Abbot Light & Power Company of Petersburg has been granted a certificate of convenience and necessity for the construction of a high-tension transmission line from Petersburg to Pleasant Plains. The company is also given authority to erect and operate a distribution system in the village of Pleasant Plains and to furnish electrical service to residents along the route.

QUINCY, ILL.—New machinery, including a motor generator, is being installed at the power house of the Quincy Railway Company to utilize power from the Keokuk plant. The steam-power plant will be held for use in emergencies.

ROSSVILLE, ILL.—The Rossville Electric Light Company has been granted a franchise by the Public Utilities Commission to erect a 6600-volt electric transmission line from Rosville to Alvin and to furnish electricity in Alvin and to residents along the line between the two towns.

ASHLAND, WIS.—The Ashland Dairy Products Company is planning to remodel the plant of the Ashland Brewing Company into a cold-storage warehouse, at a cost of about $75,000. New machinery, refrigerating and other equipment will be installed.

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PRAIRIE DU CHIEN, WIS.—The Interstate Power Company of Galena, Ill., is erecting a high-tension transmission line across the Mississippi River at Prairie du Chien to McGregor, Iowa. This circuit will be supplied with power from the Galena power house. Among the Wisconsin towns to be served by the new system are Finnimore, Lancaster, Boscobel and Prairie du Chien. The Interstate company is controlled by the Northern States Power Company and operated by H. M. Byllesby & Company of Chicago, Ill.

OSHKOSH, WIS.—The Morgan Company is contemplating the construction of an addition to its power plant, including the installation of several new boilers and other equipment.

ANOKA, MINN.—The Legislature has appropriated $50,000 for completion of administration building and also $5,000 for electric wiring and water supply for farm building, the money to be available July 31, 1920.

BRAINERD, MINN.—Bids will be received until May 8 by the city of Brainerd for improvements to waterworks, including 14 miles of new water mains, six 8-in. tube wells, one open well, pumping station, equipped with electrically operated pumps, and a 300,000-gal. tank on a 90-ft. tower. The cost is estimated at about $250,000. L. P. Wolff, Guardian Life Building, St. Paul, is consulting engineer.

MINNEAPOLIS, MINN.—Plans are being prepared by Hewitt & Brown, architects, 716 Fourth Avenue, South, for an eleven-story exchange and office building for the Northwestern Telephone Exchange Company, to be erected on Third Avenue South and Fifth Street. The cost is estimated at about $1,000,000.

ST. PAUL, MINN.—Plans have been prepared for the erection of a hospital building and power plant at Simpson and Edmund Streets for the Northern Pacific Mutual Beneficial Association. Bids, it is understood, will be ready about May 1. Lambert Bassingdale, Railroad Building, is architect.

INDEPENDENCE, IOWA.—Contract has been awarded to the Currie-Simpson Construction Company of Waterloo for the construction of an addition to the power plant of the People's Hospital.

MARSHALLTOWN, IOWA.—A bill is before the Legislature asking for authority to extend the lines of the Iowa Railway & Light Company to the grounds of the Old Soldiers' Home.

CLARKSVILLE, MO.—The Clarksville Electric Light & Water Company, recently organized, has been granted a franchise, subject to the approval of the voters, to install an electric light and power plant here.

KANSAS CITY, MO.—The Park Board has petitioned for an appropriation of $100,000 for improvements to Swope Park. The plans provide for a complete lighting system.

ST. JOSEPH, MO.—Ordinances are being prepared by Charles L. Faust, city counselor, which will be submitted to the Council, providing for a bond issue of $1,810,000, for the following purposes: $500,000 for an electric light plant, $500,000 for a new city hall, $760,000 for sewers and $50,000 for motorization of the fire department.

ST. LOUIS, MO.—Contracts, it is reported, will soon be awarded by Swift & Company, Thirty-ninth and Papin Streets, for addition to power house, to cost about $70,000. H. A. Green is superintendent.

ST. LOUIS, MO.—Work, it is reported, has started on the construction of the power plant and the woodwork buildings for the proposed plant of the General Motors Company to be erected at Natural Bridge Avenue and Union Boulevard, at a cost of about $4,138,000.

FARGO, N. D.—Bonds to the amount of $150,000 have been voted to establish a municipal electric light plant in Fargo.

BEATRICE, NEB.—The construction of a hydroelectric power plant, to cost about $56,000, is under consideration by the City Council.

OMAHA, NEB.—Bids will be received by the Skinner Packing Company, First National Bank Building, Omaha, until May 15 for the erection of a cold-storage plant, to cost about $500,000.

KANSAS CITY, KAN.—The City Commissioners have authorized a special election to be held on June 17 to submit to the voters the proposal to issue $500,000 in bonds to enlarge the municipal electric light plant.

OTTAWA, KAN.—The City Commissioners have awarded contract for a 500-kw. electric generating unit at $27,760. Prof. George C. Shaad of Kansas University is consulting engineer.

ST. JOHN, KAN.—Bonds to the amount of $45,000 have been authorized for improvements to the municipal water and light plans.

SCRANTON, KAN.—Bonds to the amount of $12,000 have been voted to erect an electric transmission line from Burlingame to Scranton to supply electricity for the local system.

SEDAN, KAN.—The Sedan Electric Light & Power Company is considering extensions to its plants and system, including the erection of electric transmission lines to Peru, Chautauqua and Elgin and increasing the output of its power plant to provide for the proposed additional service. The installation of fuel-oil engines is contemplated. The cost of the work is estimated at $32,000.

TURNER, KAN.—The Standard Electric Company is planning to supply electricity for lamps and motors in Turner. For further information address J. J. Swigley of Turner.

Southern States

FAYETTEVILLE, N. C.—The Cumberland Railway & Power Company is building a 3000-hp. hydroelectric development at Fayetteville. Herbert L. Jones, 54 Haddington Block, Norfolk, Va., is president.

GREENVILLE, N. C.—Bonds to the amount of $50,000 have been authorized for improvements to the water and light plant.

WILSON, N. C.—The City Commission is considering issuing $75,000 in bonds for extensions to the municipal electric lighting system, including the purchase of additional equipment. R. J. Grantham is manager of the municipal plant.

CHATSWORTH, GA.—Steps have been taken to organize a company with a capital stock of $50,000 to establish a hosiery mill and electric plant here. The company will be capitalized at $50,000. Roy McGinty, J. G. Neely and others are interested.

SOUTHWEST LA GRANGE, GA.—At an election to be held April 30 the proposal to issue $25,000 in bonds for the installation of a municipal electric lighting system in Southwest La Grange will be submitted to the voters. Post office address is La Grange.

GAINESVILLE, FLA.—Bids will be received by the Board of Public Works, Gainesville, Fla., until May 6 for new equipment for the municipal electric light and waterworks plant, including crude-oil boilers of the steam atomizer type, with steam-driven oil pumping units and all necessary accessories for complete equipment of two Erie City water-tube boilers of 220 hp. each and a Stirling boiler of 240 hp.; also for two crude-oil storage tanks of 15,00 gal. capacity each. T. M. Early is superintendent.

MIAMI, FLA.—Extensions and improvements involving an expenditure of more than $200,000 are contemplated by the Miami Electric Light Company. New equipment, including a 3750-kw. generator, condenser, pumps and an additional boiler, twenty switchboards, etc., will be installed. The entire system will be changed from single-phase and two-phase to three-phase throughout. H. H. Hyman is manager.

CLARENDON, ARK.—The Commonwealth Power Company is contemplating the installation of an electric power plant in Clarendon.

HEBER SPRINGS, ARK.—The Arkansas Hydro-Electric Development Company is planning to resume work on construction of its hydroelectric plant on Little Red River near Heber Springs. Contract was to have been let in 1917, but was postponed owing to the war. The cost of the plant is estimated at $500,000. A. R. Amos of Heber Springs is president of the company.

PARIS, ARK.—The Harley Hardwood Company is planning to establish a new plant. Machinery and power equipment, costing about $50,000, will be required.

ARCADIA, LA.—Bids will be received by the Mayor and the Board of Aldermen of Arcadia until May 14 for improvements to the municipal electric light plant and waterworks system, including furnishing and installing alternators, switchboards, street-lighting regulator and miscellaneous line material for electric plant; for waterworks, erection of building, cast and galvanized iron pipe and fittings, valves and hydrants, oil engine, pumps, deep-well and air-lift system, reservoir, elevated tank and oil-storage facilities. Specifications, form of proposal, etc., may be obtained upon application to Xavier A. Kramer of Magnolia, Miss., engineer.

MARKSVILLE, LA.—Bids will be received by the Mayor and Board of Aldermen of Marksville until May 8 for improvements to the waterworks system, including oil-engine-driven pumping set, deep well, reservoir and elevated tank, cast-iron and galvanized pipe and fittings and fire hydrants. Plans and specifications, etc., may be obtained upon application to Xavier A. Kramer, engineer, Magnolia, Miss.

NORMAN, OKLA.—Bonds to the amount of $125,000 have been voted for the installation of an electric light and power plant in Norman.

TISHOMINGO, OKLA.—Bonds to the amount of $50,000 have been voted for the installation of a municipal electric light plant.

DALLAS, TEX.—The City Commission has approved of expenditures of approximately $500,000 by the Dallas Power & Light Company, which include the purchase of the properties of the Dallas Ice, Fuel, Light & Power Company and the Carroll Electric Company, both of which are to be taken over and merged into the system of the Dallas Power & Light Company.

FORT WORTH, TEX.—Bonds to the amount of $50,000 have been voted for extensions and improvements to the municipal electric lighting system.

HOUSTON, TEX.—The Humble Oil & Refining Company is planning to install an electric power plant and equipment for operating the pumping plants for its oil wells in the Goose Creek district. The proposed plant will also provide power for outside industries.

OAK FOREST, TEX.—The Houston-Guadalupe Water Power Company, Foster Building, Houston, recently organized with a capital stock of $200,000, is planning to build a hydroelectric plant to develop 500 hp. The cost is estimated at $500,000. H. A. Halverton is interested in the project.

Pacific and Mountain States

CHEHALIS, WASH.—At a special election held recently the proposal to grant the Washington-Idaho Light & Power Company of Clarkston a franchise to supply electricity in Chehalis was carried.

BRAWLEY, CAL.—The Board of City Trustees has engaged the Olmstead & Gillilen Company, engineers, Los Angeles, to prepare plans and supervise the construction of the proposed municipal electric light plant. It is proposed to install two units of 250 kw. each. The minimum cost is placed at $116,000.

CALEXICO, CAL.—The City Trustees have adopted a resolution providing for establishing electric and gas plants in Calexico. The cost of the electric plant is estimated at $160,000 and the gas plant at $165,000.

FRESNO, CAL.—The California Packing Corporation of Fresno is planning to erect an electric power plant in connection with its new factories. The proposed plant will be equipped with mechanical and electrical equipment, including automatic machinery for handling and packing. Philip Bush, 101 California Street, San Francisco, is engineer.

LOS ANGELES, CAL.—The installation of an ornamental lighting system on Westmoreland Place between Seventh Street and Wilshire Boulevard has been authorized by the City Council.

ORLAND, CAL.—The installation of an ornamental lighting system in the business district is under consideration.

SACRAMENTO, CAL.—A bill which provides that irrigation districts may utilize water used for irrigation purposes to develop electrical power has been passed by the State Legislature.

CEDAR CITY, UTAH.—The City Council is negotiating with the Dixie Power Company to remove its electric poles from the main street into the block centers.

SALT LAKE CITY, UTAH.—Improvements to the waterworks supply lines, power plants, etc., to cost about $1,000,000, are contemplated by the City Council.

Canada

CLOVERDALE, B. C.—The British Columbia Electric Company is planning to extend its transmission lines to Surrey Centre to furnish electricity for lamps and motors there.

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Record of Electrical Patents

Notes on United States Patents

(Issued March 25, 1919)

1,298,622. MEANS FOR SYNCHRONIZING ROTARY DEVICES; George M. Yorks, New York, N. Y. App. filed Jan. 5, 1915. Separate divisions of commutators, for effecting synchronization are dispensed with.

1,298,623. ELECTRIC ATTACHMENT PLUG; Carl Zeigler, Lewiston, Me. App. filed Oct. 20, 1917.

1,298,624. IGNITION DYNAMO; James G. Zimmerman, Sumter, S. C. App. filed May 12, 1916. Produces two simultaneous sparks and may be used on two-cylinder engine having cylinders 180 deg. apart.

1,298,627. RESISTANCE ELEMENT; Theodore W. Case, Scipio, N. Y. App. filed Feb. 19, 1917. Interposed in electric circuit for exposure to light rays.

(Issued April 1, 1919)

1,298,644. MANUFACTURE OF ELECTRIC CABLES; Charles J. Beaver and Ernest A. Claremont, Chester, Eng. App. filed April 4, 1918. Twin wires insulated from one another and inclosed within small space.

1,298,649. SYSTEM AND MEANS FOR DIFFERENTIALLY METERING ELECTRICITY FOR LIGHTING AND HEATING PURPOSES; Lawrence Birks and John R. Templin, Fendalton, Christchurch, New Zealand. App. filed July 8, 1916. Records directly all current supplied under special differential rates.

1,298,654. FUSE PLUG; Davis E. Bown, Pittsburgh, Pa. App. filed April 25, 1918. Renewable type; upper edge of shell is serrated.

1,298,664. VACUUM PUMP; Lewis W. Chubb, Edgewood Park, Pa. App. filed Jan. 18, 1915. Moves electrically conducting liquids by the effect of moving magnetic field.

1,298,665. TERTIARY COILS FOR TRANSFORMERS; Lewis W. Chubb, Edgewood Park, Pa. App. filed Jan. 26, 1917. Effectively operates under all load conditions.

1,298,695. DAMPING DEVICE FOR DYNAMO-ELECTRIC MACHINES; Floyd T. Hague, Pittsburgh, Pa. App. filed Dec. 29, 1915. Damps out fluctuations in armature flux under interpoles.

1,298,696. SYSTEM OF CONTROL; Arthur J. Hall, Wilkinsburg, Pa. App. filed Jan. 4, 1916. Regenerative type for plurality of direct-current electric railway motors.

1,298,701. MAGNETIC DEVICE; Clinton O. Harrington, Edgewood Borough, Pa. App. filed June 13, 1916. For relays.

1,298,704. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed April 29, 1915. Independently excited alternating-current commutating machines with direct-current series-machine characteristics.

1,298,705. ARMATURE WINDING; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed June 4, 1915. Single-phase commutator type with small inductive disturbances.

1,298,706. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Aug. 9, 1915. For regenerative operation in electric railway vehicles.

1,298,707. ELECTRICAL APPARATUS; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Dec. 26, 1913. Reduces brush sparking.

1,298,710. BURGLAR-ALARM SYSTEM; Simon B. Hess, New York, N. Y. App. filed May 17, 1915. Accidental breaking of any of a plurality of normally closed currents gives an alarm.

1,298,711. ELECTRIC DISTRIBUTION SYSTEM; Simon B. Hess, New York, N. Y. App. filed May 17, 1915. Public service or other electric mains utilized for protective or other work circuits, eliminating use of batteries.

1,298,712. CONTROL SYSTEM; Lloyd J. Hibbard, Wilkinsburg, Pa. App. filed March 2, 1917. Motors of railway vehicle quickly reversed in case of emergency.

1,298,715. ARC-REGULATING SYSTEM; Harry Hollis, Lebanon, Pa. App. filed Sept. 10, 1917. Electric furnaces are controlled by differential generator field-magnet windings.

1,298,718. MACHINE FOR METAL WORKING; William F. Hosford, Oak Park, Ill. App. filed Nov. 27, 1916. Metal is automatically fed, cut, heated and formed.

1,298,722. METHOD OF REFINING VOLATILE METALS; Sven Huldt, Stockholm, Sweden. App. filed Aug. 7, 1916. Zinc vapors exhausted for condensation in electric radiating furnace.

1,298,726. RECTIFIER; Ray P. Jackson, Edgewood Park, Pa. App. filed Feb. 19, 1914. Magnetic blow-out type.

1,298,727. VIBRATING RECTIFIER; Ray P. Jackson, Edgewood Park, Pa. App. filed March 25, 1914. Needs no permanent uni-directional exciting current.

1,298,728. ELECTRICAL SYSTEM; Ray P. Jackson, Edgewood Park, Pa. App. filed Feb. 3, 1916. Current through primary circuits of ignition systems is periodically reversed.

1,298,736. CIRCUIT BREAKER; Jean Kuntziger, Herman Chauvin and Felix Fontaine, Liège, Belgium. App. filed Sept. 7, 1916. Decrease in tensile strength of wire effects rupture of circuits.

1,298,746. ELECTRICALLY OPERATED SWITCH; Walter O. Lum, Wilkinsburg, Pa. App. filed March 21, 1914. Operates when energy supplied to winding falls between predetermined limits.

1,298,757. DYNAMO-ELECTRIC MACHINE; Friedrich W. Myer, Pittsburgh, Pa. App. filed March 24, 1915. Electromagnetic yielding clutch provided between shaft and armature of electric locomotive motor.

1,298,770. ELECTRIC FIXTURE; Edmund F. Mould, Cleveland, Ohio. App. filed Aug. 12, 1915. Uses gas-filled lamps and provides for efficient heat radiation.

1,298,771. TELEPHONE HANDSET; George H. Nash, Sidcup, Eng. App. filed July 2, 1917. Folded up when not in use.

1,298,774. SYSTEM OF STARTING PHASE CONVERTERS; Stanley G. Nottage, Wilkinsburg, Pa. App. filed Jan. 5, 1916. Reduces possibility of burn-out during starting.

1,298,795. SPARK TESTER; Frederick A. Robens, Toledo, Ohio. App. filed Aug. 2, 1918.

1,298,818. CONTROL SYSTEM; Norman W. Storer, Pittsburgh, Pa. App. filed April 23, 1915. For electric railway motors regeneratively connected to supply circuit.

1,298,829. BRUSH GEAR FOR DYNAMO-ELECTRIC MACHINES; James Todman, Acton, Eng. App. filed Oct. 15, 1918. Readily applied and removed.

1,298,850. TELEPHONE-EXCHANGE SYSTEM; Joseph L. Wright, Cleveland, Ohio. App. filed May 7, 1913. Semi-automatic type.

1,298,854. LIGHTING SWITCH; Forrest E. Altemus, Philadelphia, Pa. App. filed Oct. 28, 1915. For automobile lights.

1,298,856. BATTERY SEAL; Chester M. Angell, Chicago, Ill. App. filed Nov. 12, 1918. Acid-resisting, non-freezing nut cuts its own thread upon post.

1,298,857. BATTERY; Chester M. Angell, Chicago, Ill. App. filed Jan. 3, 1919. Additional supports provided for plates to withstand heavy jolts.

1,298,858. CONNECTOR; Stanley Anthony, Boston, Mass. App. filed March 10, 1915. Contact elements and locking elements are not exposed.

1,298,864. ELECTRICALLY OPERATED MUSICAL INSTRUMENT; Daniel W. Barton, Oshkosh, Wis. App. filed Sept. 16, 1916.

1,298,868. TELEGRAPH SYSTEM; John H. Bell, East Orange, N. J. App. filed May 16, 1916. Receiving operator can interrupt sending operator.

1,298,871. INDICATING DEVICE; Bornett L. Bobroff, Milwaukee, Wis. App. filed June 16, 1917. For voting machine.

1,298,879. ELECTRIC CONNECTION; William H. Brown, Philadelphia, Pa. App. filed Dec. 13, 1917. Forms protection from water, heat, dirt, etc.

1,298,889. METHOD AND APPARATUS FOR THE OXIDATION OF COMBUSTIBLE GASES; Edwin M. Chance, Wilkes-Barre, Pa. App. filed Aug. 14, 1917.

1,298,896. SPARK-PLUG TESTER; Walter G. Clink, Danville, Ill. App. filed March 26, 1917.

1,298,943. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed May 4, 1915. For generative operation of direct-current motors in electric railway vehicles.

1,298,950. CIRCUIT CLOSER; George E. Hull, Minneapolis, Minn. App. filed Dec. 4, 1918. Actuates by gravity.

1,298,965. METHOD OF APPLYING INSULATED PIECES TO CARBON BRUSHES; Cecil Y. Knight and William N. Wilson, Battersea, London, Eng. App. filed Nov. 30, 1918. Applied as plastic composition.

1,298,966. ELECTRICALLY OPERATED TOOL; James S. Knowlson, Oak Park, Ill. App. filed June 16, 1915. Electromagnet supplied with direct-current by motor-driven generator of low voltage.

1,298,974. METHOD AND MEANS FOR CONTROLLING ELECTRIC ENERGY; H. Ward Leonard, Bronxville, N. Y. App. filed July 22, 1914. After full voltage is obtained, charging rate is reduced.

1,299,008. HAIR-WAVING DEVICE; August Neyer, San Francisco, Cal. App. filed Aug. 13, 1918.

1,299,042. FIXTURE; Lindsley Schepmoes, Hasbrouck Heights, N. J. App. filed Nov. 3, 1916. Junction box supports lamps and pendants of all kinds.

1,299,053. DYNAMO-ELECTRIC MACHINE; Albert A. E. Sterzing, New York, N. Y. App. filed March 25, 1914. Field magnet of magnet-electric induction type without polar fittings.

1,299,090. PUNCHED-CARD-CONTROLLED MECHANISM; John E. Wright, New York, N. Y. App. filed April 25, 1917.

1,299,110. ELECTRIC FURNACE; William K. Booth, Chicago, Ill. App. filed April 4, 1918. Equipped with wall terminals adapted to coact with electrodes.

1,299,116. CLOCK-WINDING MECHANISM; James W. Bryce, Bloomfield, N. J. App. filed July 31, 1917.

1,299,119. NON-GROUNDED OR METALLIC LINE-CIRCUIT SYSTEM; Raymond H. Burfeind, Chicago, Ill. App. filed April 18, 1907. Automatic telephone systems.

1,299,132. RENEWABLE FUSE; Franklin N. Conant, Newburyport, Mass. App. filed March 9, 1918. Cartridge type, having knife-blade contact blades.

1,299,144. ELECTRICALLY CONTROLLED PNEUMATIC BRAKE; Edward H. Dewson, New York, N. Y. App. filed June 1, 1916. For railway systems.

1,299,147. CIRCUIT-CONTINUING DEVICE; Harry A. Douglas, Bronson, Mich. App. filed July 23, 1917. Connecting plug.

1,299,149. BATTERY TERMINAL; Stanley A. Duvall, Chicago, Ill. App. filed Sept. 21, 1918. Flexible conductor for portable primary batteries.

1,299,152. TROLLEY HARP; Albert J. Edwards, Washington, D. C. App. filed July 12, 1917. Trolley-wheel connection locked immovably with harp.

1,299,155. CIRCUIT FOR POLE CHANGERS; Charles J. Erickson, Chicago, Ill. App. filed June 11, 1917. Pole changer may be operated from common exchange battery.

1,299,159. ELECTRICAL WATER HEATER; Joseph C. Feldman, New York, N. Y. App. filed Sept. 23, 1918.

1,299,163. TWO-TONED AUTOMOBILE-HORN CONTROL; George W. Fleming, Springfield, Mass. App. filed April 27, 1918.

1,299,213. AUTOMATIC CABLE-HANGER DISTRIBUTER; William Nick, Minneapolis, Minn. App. filed May 16, 1918. For crimping cable hangers onto a messenger strand.

1,299,248. MOTOR CONTROLLER; Arthur Simon, Milwaukee, Wis. App. filed May 20, 1914. Maintains continuity of motor circuit during regulation of potential.

1,299,252. MEASURING DEVICE; Joseph Slepian, Pittsburgh, Pa. App. filed April 4, 1918. Current-measuring instrument for high-voltage direct-current circuits without current shunt.

1,299,257. GEAR-SHIFT CONTROLLER; William C. Stevens, Milwaukee, Wis. App. filed July 25, 1918. May be ultilized for both gear-shift and ignition control.

1,299,265. ZIGZAG CARBON ELECTRIC REGISTER; John Thomson, New York, N. Y. App. filed May 28, 1918. Large capacity of thermal emission.

1,299,269. ELECTROPNEUMATIC BRAKE; Walter V. Turner, Wilkinsburg, Pa. App. filed May 4, 1918. Quick release of brakes effected after emergency application.

1,299,271. ATTACHMENT PLUG; Clarence A. Vetter, Pittsburgh, Pa. App. filed April 10, 1915. Swivel type which has no loose parts.

1,299,280. ELECTRICAL CONDUIT; Chauncey W. Abbott, Pittsburgh, Pa. App. filed April 17, 1915. Edges of resilient metal cap can be readily sprung over edges of base member.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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An Agency for Publicity

IN AN important campaign of publicity advantage should be taken of every useful existing agency. Skill and experience are just as essential in the preparation of publicity matter as engineering advice is in power-house work. Without either the results may be disastrous. The electrical industry has an organization formed for the express purpose of acquainting the public with the advantages and uses of electricity; namely, the Society for Electrical Development. This organization has done some excellent work and if properly supported by the central-station industry can undertake a publicity campaign which will have a telling effect. Thus one phase of the needed publicity for the National Electric Light Association can be solved by an agency already in existence. However, no great results are possible without adequate financial support. The electric power and lighting industry, therefore, cannot shift the burden entirely. There is a great deal of work which it must do for itself and which it can easily undertake. All that is necessary for an organization like the National Electric Light Association to possess is a still more inspiring and effectual zeal to promote the work of the industry in every community and a widespread diffusion of its confidence that electricity offers a solution for many of the present industrial and domestic problems. While all the imperfections of government ownership and operation are fresh in the minds of the public, the merits inherent in private ownership and operation can be presented to advantage.

More intense application of electricity can be brought about through education. It is surprising what excellent results can be obtained thereby and how many evils succumb to its influence, but educational movements must be rational to be successful, and all that is fictitious and non-essential must be eliminated. The convenience of electricity is not capitalized enough.

Synchronous-Motor Characteristics

THE synchronous motor in running operation may have its electrical performances represented graphically on a straight-line chart, on a circular chart or on a V-chart, according to the purpose of the diagram, as was pointed out originally by Blondel. It is not so generally known, however, that during the starting or non-uniform running operation a synchronous motor behaves in such a manner as to conform to a Heyland circle diagram, like an ordinary induction motor.

In the article by Theo. Schou, the second part of which we print this week, the circle diagram is applied with considerable advantage to the starting régime of a synchronous motor. The comparative effects of brass and copper squirrel-cage bars are discussed in relation to this diagram. The synchronous-motor circle diagram bears many resemblances to the induction-motor circular diagram; but there are also various differences in detail between them. The article by Mr. Schou is well worth the study of those interested in this subject.

Managers of electric utilities should appreciate that expediency will never suffice to solve problems which by their nature call for the application of something more fundamental. It is useless to talk of mere policy if what is actually involved is principle.

Standardizing Park and Boulevard Lighting

THE lighting of parks and boulevards is a branch of the street-lighting art which stands rather by itself. To a certain extent the requirements are alike in both parks and boulevards. The locations in parks are, of course, somewhat arbitrarily determined by the topography, while on the boulevards the units must be placed somewhat as in ordinary street lighting, but with the requirements of a moderate and well-distributed light rather than the high intensities necessary in first-class streets or the much lower requirements of average residence districts. A paper by F. H. Murphy elsewhere in our columns this week gives a very instructive report on the way in which the joint problem of parks and boulevards was solved in Portland, Ore.

After several experiments the park superintendent, under skilled advice, settled on a uniform system of 400-cp. series tungsten lamps operated at 6.6 amp. from constant-current transformers. These, with the appropriate switchboards, were housed in suitable combination buildings planned to be as harmonious as possible with respect to their surroundings. The available circuit is 2300-volt, 60-cycle primary, and the transformers, for one or two circuits as the case may be, are installed after a uniform plan with standard switchboard units. The distribution at constant current is through lead-covered, varnished-cambric cable, the lead sheath being served with tarred jute, armored and again wrapped with jute filled with preservative. For the installation of the lights themselves a single-lamp reinforced-concrete standard approximately 12 ft. high was selected, and upon this the lamp is mounted in an Alba globe. Particular precautions, described in detail, are taken to secure safe and well-insulated lamp connections. Somewhat more than 200 units of this character have already been installed, and as the park and boulevard system grows it is necessary only to duplicate existing equipment in order to reach a thoroughly satisfactory result.

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Emergency Repairs

WE GIVE a detailed description this week of a rather notable feat in generator repairing performed by the Union Electric Light & Power Company of St. Louis. The field of a 12,000-kva. turbo-generator went bad. Tests showed that it was grounded and that the coils were damaged. The insulation proved to be in poor shape. The original insulation was fiber paper and oiled linen, and this was found to be subject to carbonization at an unpleasantly low temperature, so that when it was decided to replace the insulation it was done with horn fiber, mica, and mica and asbestos tape. The job was done by expert workmen from the factory, bringing with them the necessary kit of tools; then on the spot a repair shop was extemporized with all necessary provisions for treating, replacing and reinsulating the coils. Each separate coil was heated by a current heavy enough to soften the old varnish and tape, was stripped down, soaked out in caustic soda until all the old insulation was clear, washed, dried and repaired when necessary by oxyacetylene welds. Then the slow job of reinsulating began, and one after another of the coils was finished, dried and put into place in the reinsulated slots. The whole job never required more than ten men at any one time, and at various periods it required carpenters, ironworkers, machinists, blacksmiths, electricians, armature winders, laborers and drivers. So efficiently did they put in their time that the machine was actually out of service just 731 hours and 17 minutes, which, considering the amount of work necessary to be done, may be reckoned as record time.

It may be noticed that the Commercial Section proposes to step on the accelerator at the National Electric Light Association convention at Atlantic City. Its members want everybody to know that they have something to sell. This is the first move toward making the actual sale.

Revealing Transformer Overloads and Underloads

THE limiting output of a transformer on a distributing system is either its regulation or its temperature elevation. That is, a load on the transformer becomes excessive either when the voltage drop at secondary mains becomes excessive or when the transformer coils become too hot. In practice it is usually the heat limitation which controls. The tendency in many systems is for the load on distributing transformers to increase as time goes on. As originally installed, a transformer for a group of houses may be amply large enough when the installations are new. As the years go by more fans, lamps, heaters, irons, toasters and other domestic conveniences find their way on to the house mains, to say nothing of occasional new house services being added to the secondary mains. The transformer may thus gradually become overloaded and run hot.

Frank A. Robbins, in an article in this issue, points out that a self-registering maximum thermometer may conveniently be placed in an oil duct between the windings of a transformer, so as to record automatically the maximum temperature elevation attained in the oil. It might even be worth while to install such a thermometer permanently in particular types of transformers, so as to allow the maximum registration to be read at any time on the outside, and with facilities provided for the inspector to reset the register externally on any visit. A glance at the register would show at once whether the transformer had been thermally loaded nearly to the limit.

As is pointed out in the article, it is nearly as bad to have transformers much underloaded as to have them in occasional danger of overload. Good engineering aims at operating materials continuously at proper loads, with safeguards against either idleness or excess. The maximum temperature record is again a suitable indication as to underloading.

It is interesting to note that as a matter of general average experience "the demand of one consumer is equal to a little more than one flatiron." This is an easily remembered rule. The flatiron has many and undeniable advantages in the home, but its adaptability as a unit of demand has remained unsuspected hitherto.

The Postmaster-General's little journey into the Elysian fields of government operation of everything is now being fully revealed as an abject failure. It started the advocates of states' rights, it made employees disgruntled, the public dissatisfied. Who does it reverence now?

Serving Small Communities

ONE of the problems of long-distance transmission is the difficulty of serving local communities along the line from the high-tension main transmission. We give this week some account of the manner in which this difficulty has been faced in the vicinity of St. Louis. The territory to be covered in the long run would reach something like 5000 square miles (13,000 sq.km.), and it was necessary to develop a feasible distribution system to be fed from lines of any available tension and permitting economical delivery of power over considerable distances. To this end a standard type of outdoor station has been developed, planned for operation at 26,400 volts primary and 2300-4000 four-wire secondary for the actual distribution. The primary voltage is high enough to meet the practical requirements of the case. The large units could be fed, if necessary, from any available voltage, and the four-wire distribution gives a long and efficient radius for serving the communities concerned.

The outdoor substations, of which eight have been already installed, are built up from a framework of six expanded steel poles inclosing a space 12 ft. by 42 ft. and 25 ft. high (3.6 m. by 12.7 m. by 7.6 m.). Each station has four three-pole air-break switches for the high voltage, two for each of the duplicate transmission lines feeding the stations. There are also switches for tying the lines together, choke coils and fuses. The smallest size of transformer used in these substations is of 100-kva. rating, with units up to 1000 kva. when necessary. The lighting service from each substation is supplied through an automatic induction regulator—in some of the smaller stations out of doors, in cases where the load is considerably heavier housed in an adequate inclosure adjacent to the substation proper. The metering is all done on the low-tension side of the transformers, which simplifies the situation considerably, as all the losses of transmission and transformation are taken care of by the transmission company. By adopting this simple and systematic arrangement of substations it has been possible to keep down costs

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to a very gratifying degree. For example, even at the 1917 prices a substation for the minimum capacity of 500 kva. was erected ready for service, including transformers, at a total cost, including all items, of just about an even $20 per kva., while the larger stations in which the only substantial increase of cost is an added transformer capacity dropped to little more than half this figure—all of which goes to show that a properly designed standard outdoor substation solves the difficulty of cheap distribution in a very satisfactory manner.

It can be only a question of time when the serious deficiency in housing accommodations in many localities will force active building in this direction. If we are not ready for the demand for materials and energy which this will mean, now is the time to take that far-sighted look ahead.

Conservation of Human Energy

IN THE long run the utilization of water power means the saving of human energy for purposes to which power-driven machinery is not yet adapted. The discussion of conservation with reference to its effect on human industry by Dr. George O. Smith at Springfield, Mass., the other day brings impressively to our consideration the real importance of economizing natural resources, and above all of economizing labor. The mere change from steam power to water power is not only significant of lowered costs in manufacturing and of the saving of the earth's stored fuel for its most important use, but it relieves the labor necessary in mining the coal and the still greater burden of transporting it. The miner's output is something less than 1000 tons a year, so that for every 1000 tons diminution of the fuel requirement the equivalent of one man is set free for other activities. Every water power harnessed and displacing steam power implies, therefore, a great band of laborers in the mine and on the railroads freed from this particular necessity of toil for other and more useful labor. Now, at the end of the world war, the time has come when we must look sharply to conservation in every line. The price of labor has risen beyond the wildest dreams of the wildest socialists of the last generation, and the labor cost in all manufactured articles almost staggers belief.

If we are to come in this country to a condition of production that shall give us the remotest chance of successful competition in the world's market, it must be through the most determined efforts at cheap power production and all possible saving in the field of human labor. The great power enterprises of the present day give opportunity such as has not yet been realized. Whether the plan for super-power stations and the linkage of hydraulic output all along the Atlantic seaboard are carried out or not, we are still certain to demand much of power transmission in the very near future. England has undertaken a carefully developed scheme for the general economical distribution of power, and in virtue of it will infallibly be put into a position to command the world's markets unless similar efforts are made elsewhere. Where the power is, there will manufactures be gathered. Only the other day we noted in an English journal an advertisement of cheap hydro-electric power to be had in quantity just south of the Pyrenees on the Spanish border. Such an advertisement tells a story that we must heed of the vital importance of cheap power to success in the world's market, and of the danger of wasting time in futile debate over the development of the great powers on the public domain, now unused, lest some man of vision and enterprise should win a decent return for bringing them to his country's markets.

In the uncertain and sometimes conflicting currents which make up to-day the sum total of what we call "business," there is room and need for the stabilizing voice of the electrical industry in each city. It is essentially an optimist industry, a great upbuilder, yet sensitive to real conditions.

Returned to the Owners

DURING the early stages of government operation of the systems of wire lines the federal authorities were not, at least outwardly, over-sensitive to public dissatisfaction or to uneasiness on the part of investors whose property they were experimenting with. They had decreed; they were satisfied; they would go from war-time operation to peace-time operation. Was it the affair of any one but themselves? Even when the storm of unrest began to gather and the clouds to lower, there was little modification in the complacent attitude of official Washington.

It may not be rash to assume that a change began to develop in the viewpoint of official Washington as to the expediency of its persistence about the time the state commissions acted on telephone rates. Here was a clear questioning of the official federal contention. It could be fought in the courts, but it could not be easily explained away. It could not be truthfully described as politics. It was not partisan; it showed in all sections of the country a desire for state regulation of rates. It showed a conviction that the policy of private ownership subject to state regulation was not obsolescent.

This aroused opinion, as voiced by the state commissions, was followed by other signs. There was the strike in New England, and the public developed a strange opposition to the quality of service and the steady deterioration in the value of the telegraph and telephone adjuncts to commercial and domestic convenience.

Last week the state commissioners met in Chicago to complete their plans for carrying their case on telephone rates to the highest tribunal in the land. Quickly the announcement of their deliberations was followed from Washington by the statement that the cable systems would be returned to their owners forthwith. The wondering citizen sees then that the telephone lines are to be given back to their owners just so soon as Congress shall pass legislation which the Postmaster-General believes is necessary. Whether these developments foreshadow also the early return of the railroads to their owners is a subject on which individuals may guess to suit themselves.

It is a cause for congratulation that the properties whose operation was acquired by the government under stress of war are, in part at least, to be returned to those who own them and that the entirely anomalous situation whereby control was retained in peace time under authority of a purely war measure is, at any rate in partial degree, to be corrected. What Congress sought was the defence of the nation, not experiments in government operation.

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Synchronous Motor Characteristics—II

A Compound Squirrel-Cage Winding Has Been Developed with Which Synchronous Motors Will Pull Into Step, Carrying Full Load at Reasonable Kva. Intake—This Characteristic Should Increase the Usefulness of Synchronous Motors

BY THEO. SCHOU
Consulting Electrical Engineer Electric Machinery Company

THE starting torque of synchronous motors with squirrel-cage windings, as derived by a circle diagram, was discussed in the first article of this series. In addition to good starting torque, synchronous motors used for general power purposes should be capable of pulling into step even under considerable load. Unfortunately, however, high starting torque cannot be obtained without sacrificing pull-in torque, to a certain extent, by a simple squirrel-cage winding. A new type of starting winding is now described and analyzed with which it is possible to attain both of these desirable characteristics.

If synchronous motors were called upon only to start a certain load, they could meet any reasonable condition without much trouble. Usually, however, the synchonous motor is also called upon to pull into step with various loads, depending upon the nature of load to which it is connected. This fact introduces the pull-in torque and the pull-in kva., which are just as important to arrange for as the starting torque and starting kva. In discussing the pull-in characteristics it should be kept in mind that, depending upon load and flywheel effect, it is necessary to bring synchronous motors starting as induction motors up to 92 to 96 per cent of their synchronous speed before a pull-in to synchronism is effected. As with induction motors, the synchronous motors are started up by using compensators or autotransformers to reduce the applied voltage. Full voltage applied at starting would draw prohibitively large current from the line, and the torque developed would in most cases be much in excess of that required.

As the torque and kva. drawn from the line vary with the square of the applied voltage, their values at reduced voltages can easily be computed from the diagram, which is based on full normal applied voltage.

Referring to Fig. 7, torque and kva. input curves at 50 per cent of normal voltage are plotted against per cent slip and show the effect of copper and brass in the squirrel-cage winding of a synchronous motor, the magnetic circuit of which is shown in Fig. No. 9. The torque curves, as plotted in full, show zero value at zero per cent slip. This would be the case if the rotor construction were similar to that of induction motors. As was pointed out, however, at the beginning of this discussion, a synchronous motor of the defined pole construction will run at synchronous speed and exert some torque without field excitation. The torque curves, therefore, in reality will run as indicated by the dotted lines. If the starting and pull-in duty of a synchronous motor are known, then these may conveniently be referred to curves as per Fig. 7 and the design of the squirrel-cage winding definitely settled. Referring again to Fig. 7, it is seen that if the motor required heavy starting torque but only a small pull-in torque, then a squirrel-cage winding with brass bars might be satisfactory. If, however, both the starting and pull-in torque required were rather heavy, copper bars should be used or a combination of copper and brass bars might give the most satisfactory results. Owing to the limited space of active or magnetic material in the rotor of the defined pole construction, the proportioning and distribution of the squirrel-cage winding—and thus the starting characteristics—depend more or less upon the pole span or pole embrace (ratio of pole arc to pole pitch). Fig. 9 shows the magnetic circuit of a 100-hp. synchronous motor having the same stator, but the rotor in one case has poles of 76 per cent, in the other case 66 per cent pole embrace. Fig. 6 (see first installment of article) shows the respec-

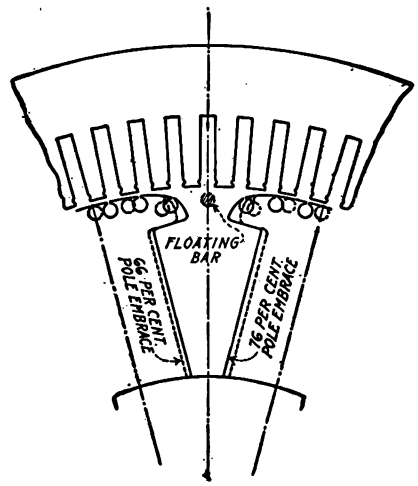
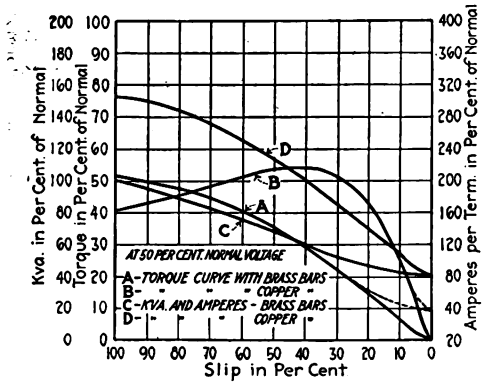
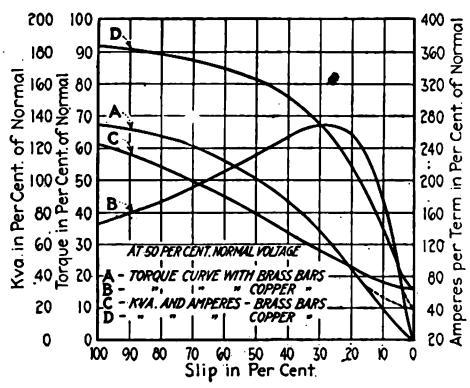


FIG. 9—MAGNETIC CIRCUITS FOR 66 AND 76 PER CENT POLE EMBRACE





FIGS. 7 AND 8—STARTING CHARACTERISTICS FOR MOTORS WITH (7) 66 PER CENT, (8) 76 PER CENT POLE EMBRACE

100-hp., 2200-volt, three-phase, 60-cycle, 600-r.p. m. synchronous motor with squirrel-cage winding.

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tive field forms of these rotors. The rotor bars in both cases are of the same size but not of the same number. Figs. 7 and 8 show the starting characteristics of this motor for 76 and 66 per cent pole embrace respectively. Fig. 10 shows the same characteristics, but here torque per kva. is plotted against per cent slip. These curves are interesting as they bring out clearly the importance which the compactness of the rotor construction has and also tend to verify the statement that good start-

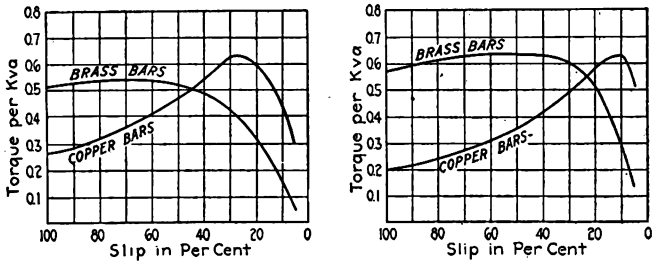


FIG. 10 — STARTING CHARACTERISTICS IN TERMS OF TORQUE PER KVA.
Same motor as in Figs. 7 and 8

ing characteristics can hardly be expected by "turning" a standard alternator into a synchronous motor by merely adding a squirrel-cage winding.

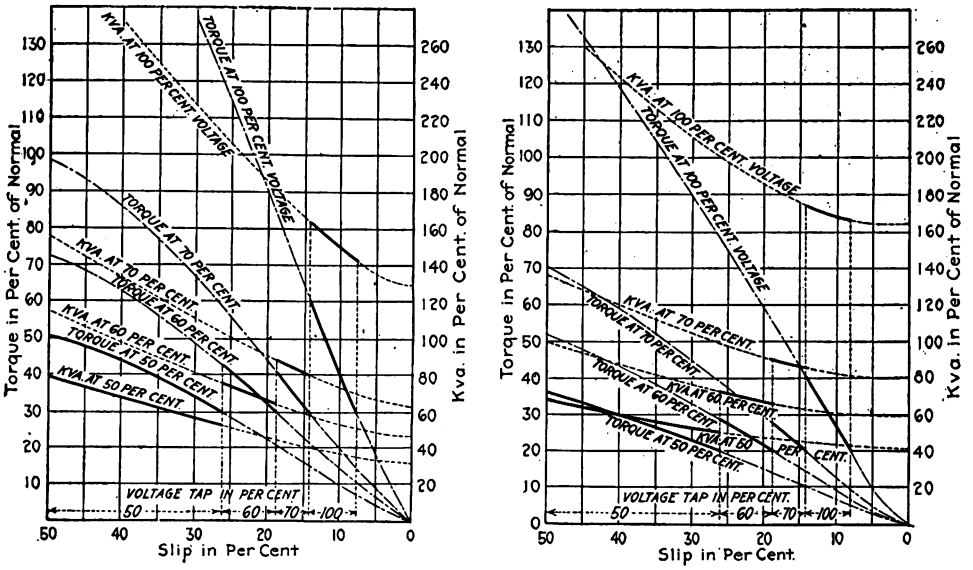
Let us now investigate what load this 100-hp. motor could pull into step with rotors having 76 and 66 per cent pole embrace when equipped with brass bars in the squirrel-cage winding. We will assume that it is required to bring the motor up to approximately 8 per cent slip before pull-in can be effected. Figs. 11 and 12 show starting characteristics constructed from Figs. 7 and 8 for 50, 60, 70 and 100 per cent voltage, or approximately at voltages corresponding to the taps of a standard auto-transformer. Referring to Fig. 8, which gives these starting characteristics for 76 per cent pole embrace, we note that the torque exerted at normal voltage is 30 per cent of normal at approximately 8 per cent slip. At this slip we are drawing approximately 142 per cent of normal kva. from line. If now the motor is started on the 50 per cent tap, carrying 30 per cent of its normal load, it will come up to approximately 26 per cent slip, drawing at this speed approximately 53 per cent of normal kva. from line. If we now throw over to the 60 per cent voltage tap, the motor will speed up to approximately 18.5 per cent slip, drawing at this speed approximately 65 per cent of normal kva. If 70 per cent of normal voltage is applied, the motor will speed up to approximately 14 per cent slip, drawing at this speed 80 per cent of normal kva. from line. Finally the motor will have to be thrown on full-line voltage in order to bring its connected load (30 per cent of normal) up to the required slip of 8 per cent. In a similar way Fig. 12 shows that the same motor, but equipped with 66 per cent pole embrace, would only be able to pull into step with 20 per cent of its normal load. It is interesting to note that the motor in this case is drawing considerably heavier current from the line than the same motor with 76 per cent pole embrace, although the pull-in torque is heavier in the latter case.

In order to improve somewhat a poorly proportioned and distributed squirrel-cage winding due to low percentage of pole embrace, a "floating" bar (or bars) is sometimes applied between the poles in the interpolar space (see Fig. 9). In some cases this construction may improve both the starting and pull-in torque, but the torque per kva. is low, and thus the current drawn from line is heavy. At the best this construction may be looked upon as a makeshift. It is obvious from the diagram and the characteristic curves that, with a motor equipped with the common squirrel-cage winding, it is hard, if not impossible, to secure both good starting and good pull-in characteristics.

STARTING SYNCHRONOUS MOTORS UNDER LOAD

In order to eliminate this drawback, the writer has proposed and developed (patent applied for) a new, compounded squirrel-cage winding to be used in synchronous motors which require both high starting and pull-in torque without drawing excessive kva. from the line.

This object is attained by making use of two sets of bars in the pole face (see Fig. 13). The upper winding, the bars of which are nearest the air gap in the upper holes (marked x) in the pole punchings, is of high resistance but low reactance. The lower winding, the bars (marked y) of which are farther from the air gap, is of lower resistance, but as it is embedded deeper in the pole punching the reactance is high. At 100 per cent slip the current circulating in the squirrel-cage winding is of the same frequency as the primary current. The resulting high reactance of the lower winding will therefore permit only a small current to circulate, and the torque of the lower winding is thus weak at starting. The upper winding, however, because of its high resistance and low reactance, will develop a high torque at starting. As the motor speeds up the frequency of the current in the squirrel-cage winding will decrease and decrease the reactance of the lower winding. This will cause heavier currents to



FIGS. 11 AND 12—STARTING CHARACTERISTICS FOR VARIOUS PER CENT VOLTAGES
Curves derived from Figs. 7 and 8.

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circulate in the lower squirrel-cage winding, and the torque produced by this winding increases up to nearly synchronous speed, whereas the torque due to the upper winding will fall off as the speed increases. Fig. 14 shows the starting characteristics of the same 100-hp. motor discussed previously, equipped with the compounded squirrel-cage winding, and brings out clearly

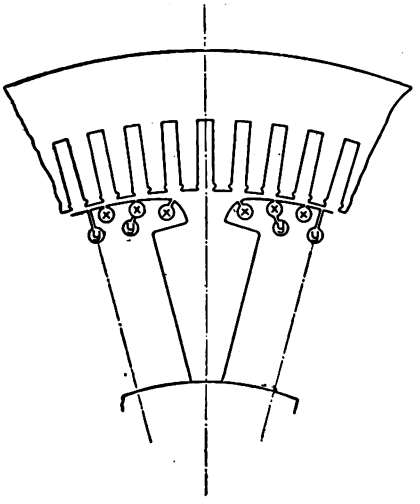

FIG. 13—SYNCHRONOUS MOTOR WITH COMPOUND SQUIRREL-CAGE WINDING

Magnetic circuit for 76 per cent pole embrace, 100-hp., 2200-volt three-phase, 60-cycle, 600-r.p.m. motor.

the good features of such a winding in connection with motors having heavy pull-in duty. Fig. 15 gives actual test results of this motor rated at 115 hp. Referring to the resulting torque curve (Fig. 14, curve C), it is desirable to eliminate or minimize the dip which occurs here at about 24 per cent slip. This is not always possible, due to limits set by mechanical reasons.

The slip, in per cent at which minimum torque will occur, is given by the equation:

$$\text{Slip} = 100/X_2 \sqrt{R_2(R_1 - R_2)}$$

Where:

R_1 = resistance of upper winding in ohms per phase, reduced to equivalent primary resistance.

R_2 = resistance of lower winding in ohms per phase, reduced to equivalent primary resistance.

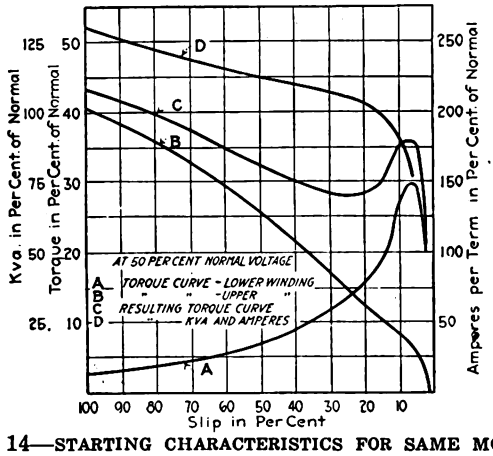

FIG. 14—STARTING CHARACTERISTICS FOR SAME MOTOR AS IN FIG. 13

X_2 = reactance of the lower winding in ohms per phase, reduced to equivalent primary reactance.

Fig. 16 shows the assembled field of a 500-hp., 360-r.p.m. synchronous motor equipped with compounded squirrel-cage winding. Referring to Fig. 13, it is seen that slots are punched in the pole punchings from the lower holes to the rotor surface in order to force part of the alternating flux to interlink with the bars of this winding and to give the lower winding the proper reactance. By carefully designing the compounded squirrel-cage winding to get the proper ratio of resistance and reactance it is possible to build synchronous motors that will pull into step carrying full rated load with approximately 200 per cent of normal kva. drawn from line. This feature will obviously broaden the commercial field of application of the synchronous motor and also eliminate the clutches which sometimes were necessary with synchronous-motor drives.

STABILITY AND PULL-OUT CHARACTERISTICS

The stability, limit of stability or pull-out torque of a synchronous motor depends directly upon the angle of lag which exists between the alternating-current and direct-current field, or the displacement angle between the line voltage and the motor emf. This angle of lag depends upon the load, the line voltage and the motor emf. If there was no lag between the alternating-current and direct-current field, the line voltage and

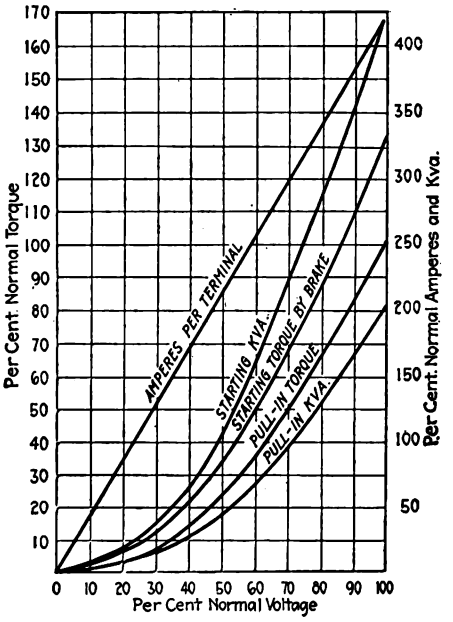

FIG. 15—STARTING AND PULL-IN TORQUES AS FUNCTIONS OF APPLIED VOLTAGE

For 115-hp., 2200-volt, three-phase, 60-cycle, 600-r.p.m. motor.

the motor emf. would be in exact phase opposition and only a wattless current would circulate in the armature winding of the synchronous motor. This wattless current would be leading or demagnetizing on the motor field if the motor emf. was larger than the line voltage; it would be lagging or magnetizing if the line voltage was in excess of the motor emf. As the current in either case, however, is wattless, it could produce no torque, and the motor therefore could not carry any load whatever if the displacement angle was zero. As the motor is loaded, however, the rotor will lag back sufficiently to cause a displacement between the line voltage and motor emf. that will send a current through the armature winding of the synchronous motor, the watt component of which will produce a torque that will balance the load on the motor. With a given line voltage and constant field excitation, the sine of the displacement angle varies directly with the load.

In Fig. 17, which refers to the 100-hp., 600-r.p.m. synchronous motor previously discussed, vector O-A rep-

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resents the line voltage; vector *O-B* the motor emf., *E*, which corresponds to the field excitation for 100 per cent load at 100 per cent power factor. Vector *A-B* represents the resulting voltage, which vectorially balances the diagram. This resulting voltage causes a current, *I*, to flow through the armature winding of the synchronous motor, where $I = A\text{-}B/Z$ = current per

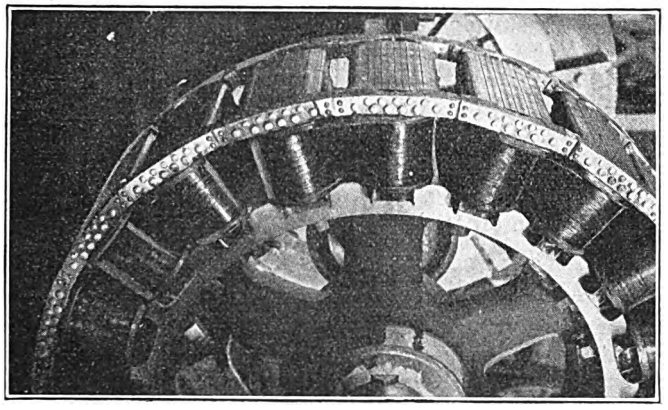


FIG. 16—SYNCHRONOUS MOTOR ROTOR WITH COMPOUND POLE-FACE WINDINGS

phase, Z is the synchronous impedance equal to $\sqrt{R^2 + X^2}$, R being the resistance and X the reactance per phase in ohms. As the reactance is by far larger than the resistance, the impedance angle, ϕ, is very small, and therefore the vector $I \times Z$ will lag approximately 90 deg. behind the current vector I.

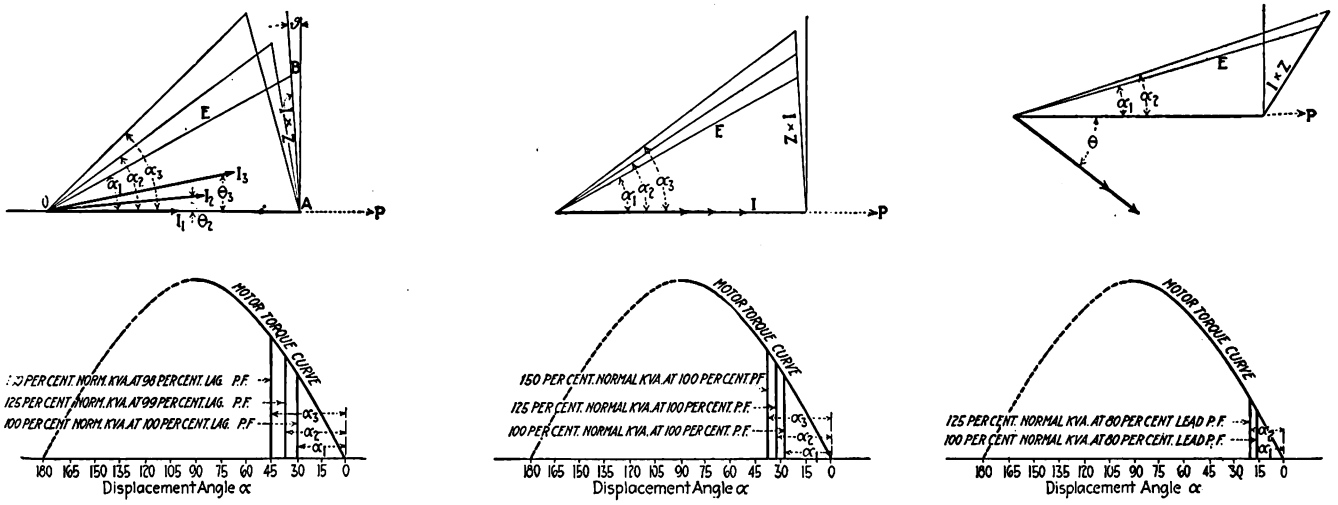
Fig. 17 and the accompanying table give the displacement angle α for three load conditions while keeping the line voltage and motor emf. constant. They also give the relation between these different load conditions and the corresponding values of the displacement angle and show the overload capacity or the pull-out torque, which will occur at $\alpha = 90$ deg. Only values of α between zero and 90 deg. can be considered, as the dotted part of the motor torque curve from 90 deg. to 180 deg. is unstable. Fig. 18 shows the same load conditions as Fig. 17, but the field excitation for each load condition is now adjusted to give 100 per cent power-factor operation. It is to be noted that the displacement angle, α, is increased and thus the overload capacity reduced at lagging power factor. If, however, the motor should be overexcited or operate at leading power factor, the displacement angle will decrease materially and thus the instantaneous overload capacity is increased by over-excitation. Referring to Fig. 19, it is seen that the displacement angle of the motor when carrying its full rated kilowatt load at 80 per cent leading power factor is 18 deg., as against 29 deg. when the motor is carrying the same load but at 100 per cent power factor.

DEPENDENCE OF DISPLACEMENT ANGLE UPON EXCITATION AS INDICATED IN FIGS. 17, 18 AND 19

	Fig. 17			Fig. 18			Fig. 09	
Displacement angle α	29°	36°	45°	29°	33°	37°	16°	18°
Load, per cent of normal kva	100	125	150	100	125	150	100	125
Per cent power factor, $\cos\theta \times 100$	100	99	98	100	100	100	80	80
Motor emf. in per cent normal, E	111	111	111	111	115	120	128	133
Impedance drop in per cent normal voltage, IZ	54	67	81	54	63	72	42	49

If test data, as per Fig. 5, are available, the displacement angle for different load conditions of the motor, when line voltage, current and power factor are known, may easily be found by means of the vector diagram. The line voltage is conveniently taken as zero axis and the current vector laid off as to magnitude and power factor. The impedance drop is now added vectorially to the line voltage. The impendance angle ϕ is known since sine ϕ = ohmic drop ÷ inpedance drop = $(I \times R)/(I \times Z)$. The resistance per phase, R, is found from the short-circuit losses and is for a three-phase machine equal to watts loss ÷ $(I^2 \times 3)$.

The third vector, which closes the triangle, is the motor emf. which corresponds to the actual excitation required as found from the no load saturation curve. As pointed out, operation of the motor at leading power factor will decrease the angle of lag and thereby insure greater stability of operation. On the other hand, however, the motor is drawing a heavy current from the line and the excitation is high, thereby increasing the heating of the motor. Furthermore, the efficiency is considerably lower when running overexcited than when operating at 100 per cent power factor. In cases where condenser effect is desired it may be very satisfactory to operate at leading power factor.



FIGS. 17, 18 AND 19—VECTOR DIAGRAMS AND DISPLACEMENT ANGLE AS AFFECTED BY EXCITATION. LINE VOLTAGE CONSTANT IN ALL CASES

(17) Three different loads; excitation set for 100 per cent load at 100 per cent power factor.
(18) Same loads as in (17); excitation adjusted each time for 100 per cent power factor.
(19) Motor overexcited to give 80 per cent leading power factor.

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Outdoor Substations for Intercounty Development

Utility Makes Use of Convenient Method by Which to Serve Small Communities Without Great Expense in Cases Where Line Voltage Is Too High for Regular Pole Connection

DESIRING to connect up all business contiguous to its lines within a radius of 100 miles (160 km.) of St. Louis and having many transmission lines operating at too high a voltage for small tap-offs, the Union Electric Light & Power Company has developed a substation through which small groups of consumers can be served from 26,400-volt circuits economically. The combined efforts of the utility's and the manufacturer's engineers resulted in a 4000-kva. steel outdoor substation structure which cost $1,050 installed in 1917. This is at the rate of about 26 cents per rated kilowatt, exclusive of electrical equipment and connections. The installations now in use are equipped with transformers rated at only 1000 kva., but the structures were designed to provide for the future development of a territory extending over about 5000 square miles (1,295,000 hectares) and having a population of from 1,000,000 to 2,000,000 people. A substation structure was required which would carry two through transmission lines, also five three-pole switches to tie the lines together and to permit either incoming line to be cross-connected with either outgoing line. A three-wire transformer bus for 13,200 volts or 26,400 volts was required to feed distribution transformers and a 2300-4000 volt four-wire bus was needed to distribute service from the low-tension side of the distribution transformers. It was also necessary to mount on the framework choke coils, disconnecting switches and insulators for distribution lines radiating from the station.

In addition to the equipment mounted on the structure, provision had to be made for setting transmission and distribution transformers and lightning arresters on a concrete floor under the steel work. The structure had to meet all these requirements, and at the same time it had to be inexpensive, simple, rugged, durable and made of standard material which could be easily replaced.

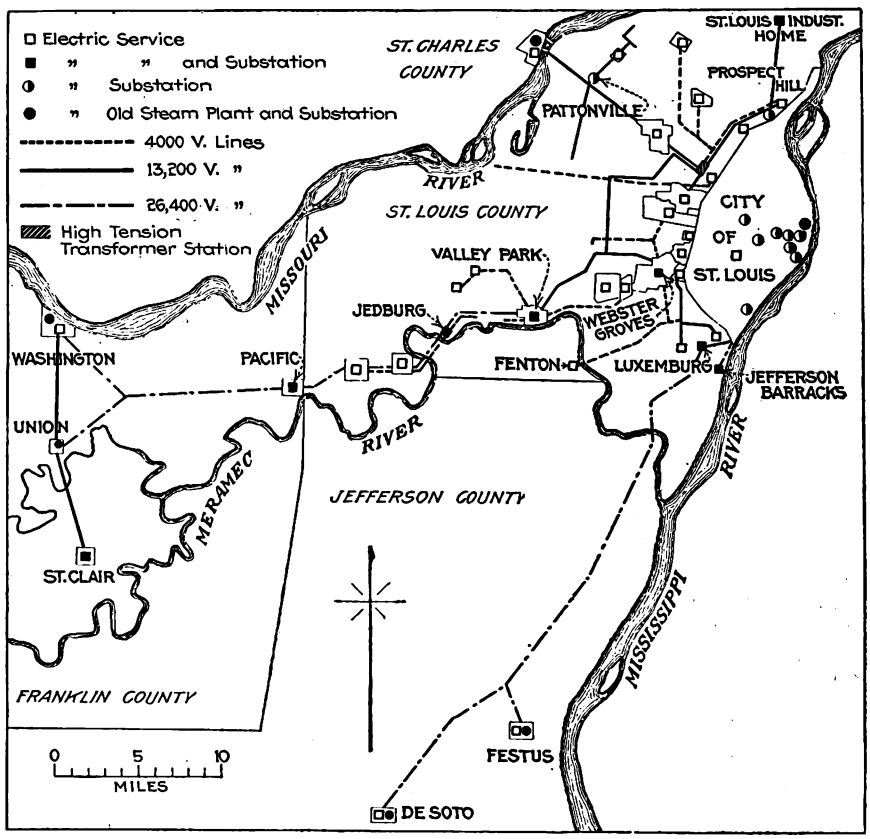

FIG. 1—INTERCOUNTY TRANSMISSION SYSTEM OF ST. LOUIS UTILITY

The substation which most nearly met these requirements for transmission line usage is shown in Figs. 2 to 10 inclusive. Eight have been installed within the past two years at Valley Park, Jedburg, Pacific, Washington, Union, Luxemburg, De Soto and Festus, Missouri, with slight differences in equipment to meet local conditions. The location of the towns named with relation to each other and to St. Louis is shown on the map of the intercounty transmission system (Fig. 1). The substations have proved easily adaptable to any conditions with which the company has met. The cost of installation was comparatively small, being merely the expense of constructing a foundation for the steel work, on which equipment could be placed, and assembling the individual parts. A neat-appearing, strong, compact, fireproof, easily enlarged, long-lived structure was the result, whereas the wooden-pole substations are not so neat, are comparatively short-lived, more subject to the elements and liable to serious damage by fire from the arcs or outside sources. Wooden-pole substations are still used by this company for individual consumers and for groups of consumers where a simple step-up or step-down transformer station is required for a maximum potential of not over 13,200 volts. One of these four-pole wooden substations which is at Pattonville is shown in Fig. 3.

The outdoor steel structure has proved more desirable in transmission substations where higher voltages are involved, more apparatus is required and a greater territory served. The steel station is also preferred where a large load is supplied and continuity of service is of great importance. Attempts to design outdoor wooden substations as strong in all respects and with all the equipment of a steel station usually result in a bulkier and unsightly arrangement.

The substations which were adopted are of the Bates expanded-steel pole design. Each station has six vertical supports inclosing a ground space of 12 ft. by 42

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ft. 8 in. (3.7 m. by 13 m.). The overhaed framework is 24 ft. by 48 ft. (7.3 m. by 14.6 m.), and its height above the ground is 25 ft. (7.6 m.). The complete equipment for each substation consists of four type PM Delta-Star

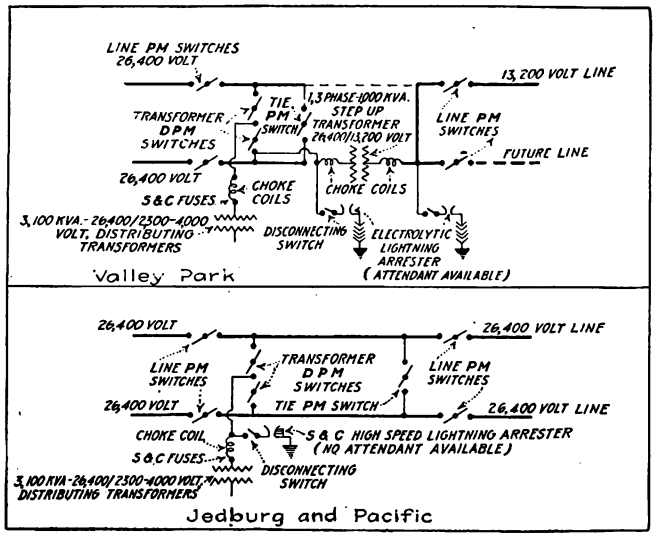

FIG. 2—OUTDOOR TWO-CIRCUIT STEP-UP AND STRAIGHT-THROUGH DISTRIBUTION SUBSTATIONS WITH TRANSFORMERS AND ARRESTERS

33,000-volt, 200-amp., three-pole double-break-per-phase air-break switches complete with operating rods, locking handles and special underframing. Two of these switches are used for disconnecting and sectionalizing each of the two transmission lines. For tying the two lines together a type DPM double-break-per-phase, double-blade, double-throw switch of the same capacity is pro-

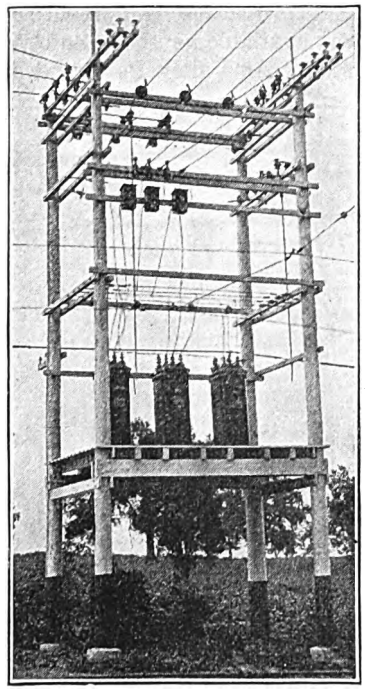

FIG. 3 — WOOD-POLE 13,200-VOLT DISTRIBUTION SUBSTATION WITH INSULATORS FOR SECOND THROUGH CIRCUIT IN UPPER FOREGROUND

vided. Type GF single-pole, 33,000-volt, 200-amp., long-turn, cylinder-form choke coils and mountings for carbon tetrachloride fuses are in series with the transformers. The high-tension bus consists of 0.25-in. (6.35-mm.) galvanized-iron pipe and fittings, which were much cheaper and just as effective as copper.

In outlying substations where there is no local agent Schweitzer-Conrad type SC three-phase, 33,000-volt high-speed, sphere-gap, graded-resistance arresters are mounted on galvanized-iron pipe framework for protec-

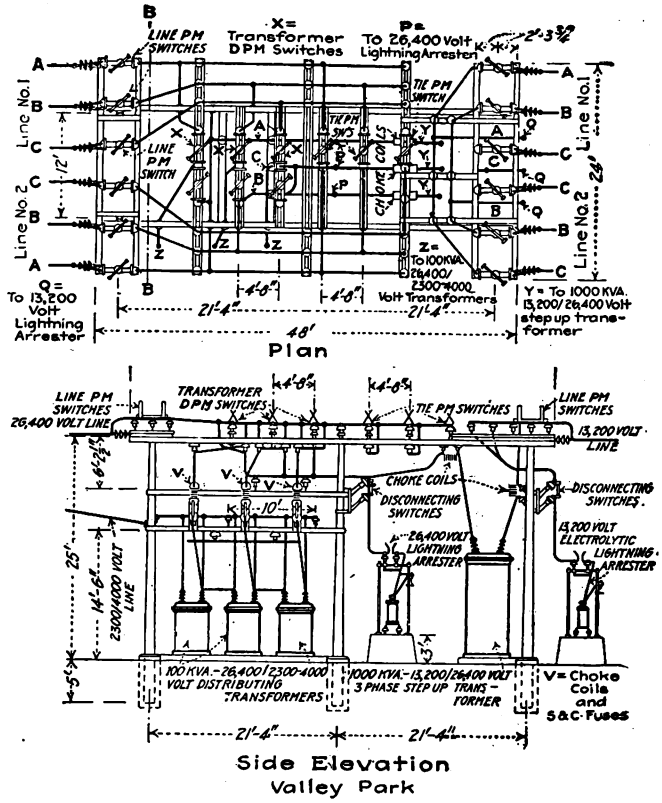

FIG. 4—OUTDOOR TWO-CIRCUIT 13,200-26,400-VOLT STEP-UP AND DISTRIBUTING SUBSTATION (SAME AS FIG. 5)

tion against lightning. Where the services of a local agent can be secured to charge the arresters daily without great additional expense or inconvenience to the company, as is the case at the Valley Park step-up and distributing substation, outdoor-type General Electric electrolytic lightning arresters are used. At this par-

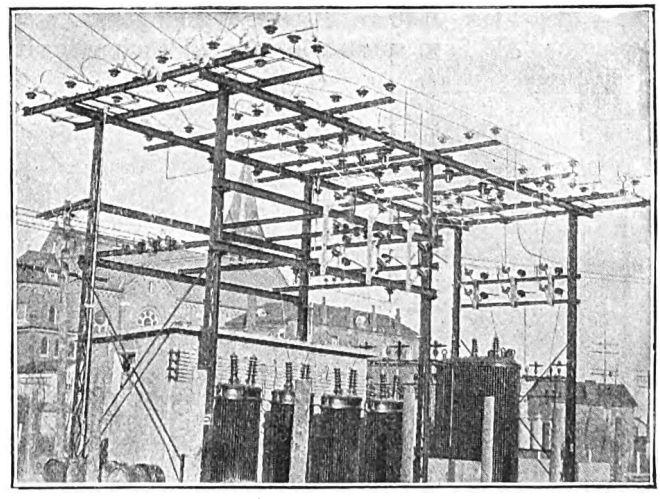

FIG. 5—OUTDOOR STATION WITH THREE-PHASE STEP-UP AND ONE-PHASE DISTRIBUTION TRANSFORMERS AND SECONDARY CONTROL HOUSE (SAME AS FIGS. 4 AND 10)

ticular station two arresters are used, one on the 13,200-volt side and one on the 26,400-volt side of the 1000 kva., three-phase, 60-cycle step-up transformer, which is connected delta on the primary side and star on the secondary.

From its high-tension side this transformer supplies

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five banks of three 100-kva., 13,200-26,400/2300-volt, one-phase, 60-cycle outdoor type H General Electric transformers, with 5 per cent taps above, and below 26,400 volts of four 2.5 per cent taps on the 13,200-volt winding. Transformers rated at 100 kva. are the

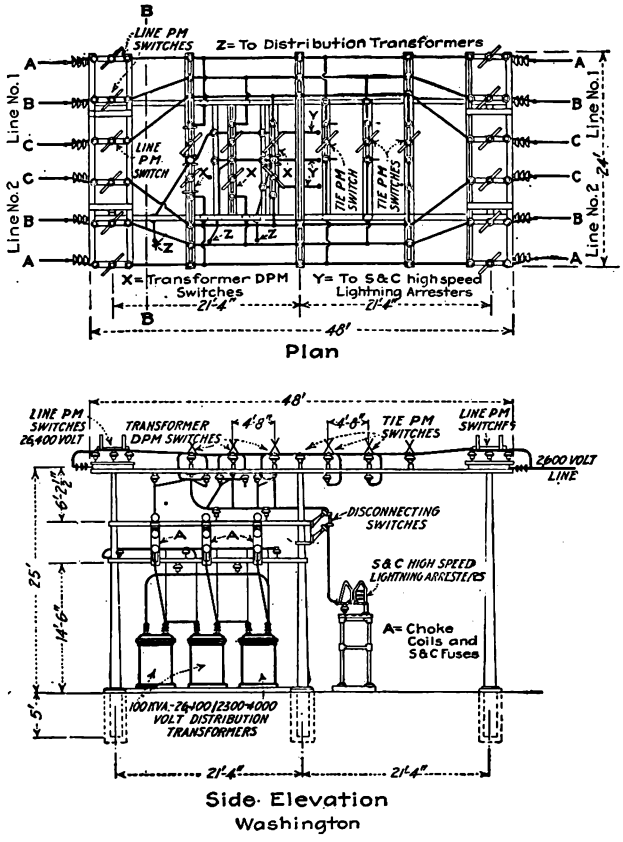

FIG. 6—OUTDOOR SUBSTATION WITH TWO STRAIGHT-THROUGH LINES, DISTRIBUTION TRANSFORMERS AND GAP RESISTANCE ARRESTER (SAME AS FIGS. 7 AND 8 FOR STATION)

smallest size used to supply the 2300-4000 four-wire networks radiating from each substation even when the load could be carried by much smaller transformers. The Valley Park, Jedberg, Pacific, Washington, Union, Festus and De Soto substations are all equipped with

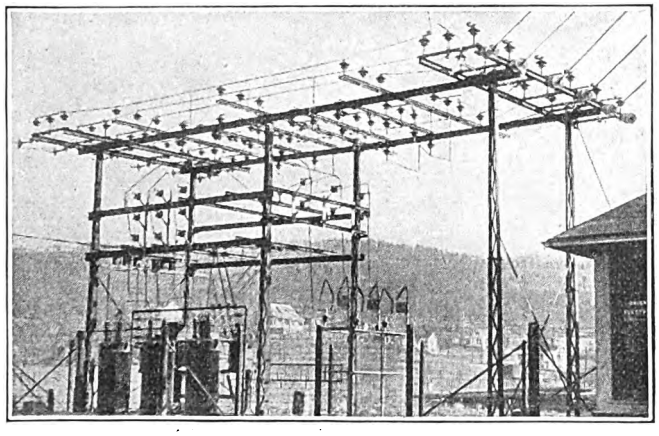

FIG. 7—OUTDOOR DISTRIBUTION SUBSTATION WITH TWO 26,400-VOLT STRAIGHT-THROUGH CIRCUITS

sets of three 100-kva. transformers. A spare transformer is kept on the foundations at Valley Park, Pacific, Union and De Soto ready for immediate connection in case of trouble in the bank in service. The spares are at strategic points from which the transformers can be taken to other substations when needed.

An automatic induction regulator is installed on the lighting service supplied from each substation. If the load is small or comparatively unimportant, outdoor transformer type of regulators are used. However, when the lighting load warrants the installation of in-

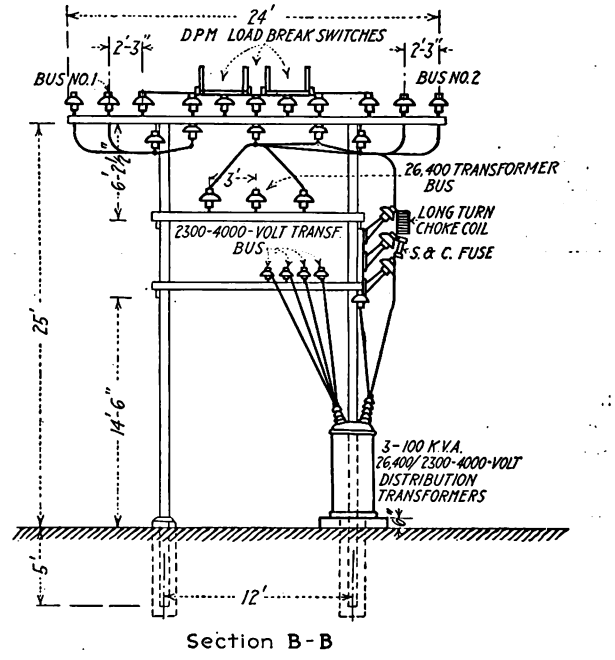

FIG. 8—SECTION THROUGH *B-B* FIG. 6 (SIMILAR TO SECTION *B-B* FIG. 4)

door automatic motor-operated induction voltage regulators an inclosure was erected, adjacent to the outdoor substation, of sufficient size to house all the 2300-4000-volt control and protective equipment unless an old power house was available as at De Soto, Festus, Washington and Union. At Valley Park and at Luxemburg

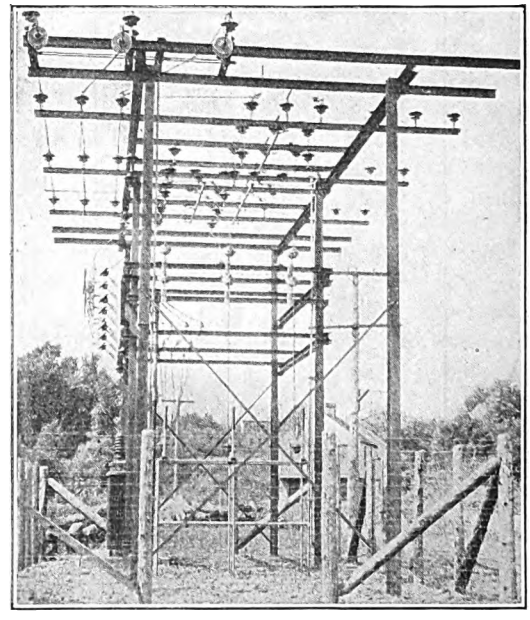

FIG. 9—VIEW OF SUBSTATION LIKE FIG. 7 EXCEPT THAT THERE IS ONE CIRCUIT INSTEAD OF TWO

the switch house was built out of 8-in. (20.3-cm.) hollow tile with stucco-finished walls, a reinforced-concrete floor and a similarly constructed roof, through which the entrance bushings extend. The inside dimensions are approximately 9 ft. by 17 ft. by 9 ft. (2.8 m. by 5.3 m. by 2.8 m.). These buildings serve to house the automatic

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induction regulators, oil switches, metering equipment, disconnecting switches, choke coils and multigap lightning arresters, all of which are installed on the 2300-volt side of the distributing transformers. Outdoor metering outfits are employed when load conditions do

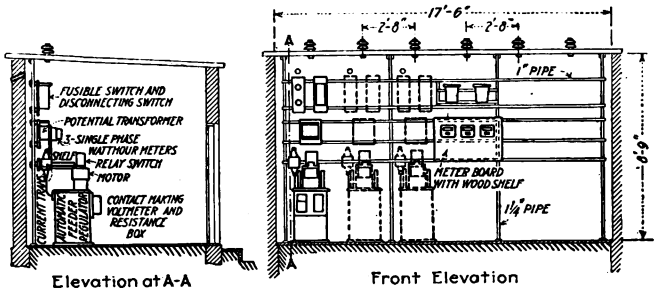

FIG. 10—DISTRIBUTION, METERING AND CONTROL EQUIPMENT HOUSE SHOWN IN FIG. 5

not justify the use of equipment which must be housed and operated indoors. All metering is done on the 2300-4000-volt side of the distribution transformers, all losses of transmission and transformation being absorbed by the transmission company.

TABLE I—DETAILED COSTS OF VALLEY PARK SUBSTATION WITH SWITCHBOARD

	Material	Labor	Freight Handling and Sundries Handling	Total
Steel structure	$560	$275	$90	$925
Concrete piers and foundation	75	40	10	125
Tile and stucco switch house	155	85	10	250
Switches, buses, two electrolytic arresters, etc	2,601	293	150	3,044
Meters, regulators, etc. (indoors)	756	261	106	1,123
Oil treating and filtration apparatus, etc	.....	60	20	80
Fence	245	75	....	320
Total, excluding transformers	$4,392	$1,089	$386	$5,867
One 1000-kva. three-phase and four 100-kva. one-phase, 60-cycle transformers	5,515	325	150	5,990
Grand total	$9,907	$1,414	$536	$11,857

As a safety measure each substation is inclosed by a 7-ft. (2.1-m.) fence to keep children and stray cattle from coming in contact with the high-voltage equipment. The inclosure is made of galvanized-iron 11BWG woven

TABLE II—DETAILED COSTS OF OUTDOOR SUBSTATIONS WITHOUT SWITCH HOUSE

	Material	Labor	Freight Handling and Sundries	Tota
Steel structure	$560	$275	$55	$890
Concrete piers and foundations	50	40	10	100
Switches, buses, one gap resistance arrester, etc	1,706	351	90	2,147
Meters, etc. (outdoors)	225	30	11	266
Oil-treating and filtration, apparatus, etc	.....	20	5	25
Fence	250	50	....	300
Total excluding transformers	$2,791	$766	$171	$3,728
Three 100-kva., one-phase transformers	2,115	125	60	2300
Grand total	$4 906	$891	$231	$6,028

wire fencing with 7BWG pickets supported on a 2-in. (51-mm.) galvanized-iron framework. At each end is a gateway made of the same material as the fence.

All these substations were purchased during the first half of 1917, and the prices given in Tables I and II are those which prevailed at that time.

The Luxemburg substation is similar to the one at Valley Park except for transformers. If transformer costs are excluded, the Valley Park costs may be used for both stations. The costs for the other four stations on the Valley Park line are given in Table II. Except for the stations at Union and Washington, which are equipped for only a single-circuit at present, the stations on this line are equipped for two through circuits.

Four-post outdoor substations could be substituted for the six-post structures which have been described wherever the transmission voltage is not changed except for distribution purposes and no line-switching equipment other than transformer disconnection is required, as at the end of a line. The saving of structural steel, labor of installation and sundries would amount to about $195. However, the company does not consider the saving sufficient to offset the extra cost of increasing the size of the structure at some other time. Furthermore, with the standard construction the line can be extended at any time without delay.

THE PROPER LOADING OF DISTRIBUTION TRANSFORMERS

For Best Operating Economy Transformers Must Be Continuously Loaded Nearly to Limit Determined by Maximum Operating Temperature

BY FRANK A. ROBBINS
Electrical Engineer Superior (Wis.) Water, Light & Power Company

BOTH the city and the business of the company with which the writer is connected have been growing so rapidly that many distributing transformers have become badly overloaded. A problem has arisen, therefore, to find a satisfactory method of determining the load on a given transformer and also the maximum safe load it is possible to carry. One method is being tested which involves placing self-registering maximum-temperature thermometer against the coils of a transformer for a period of several days and reading the maximum temperature reached during that time. This method is believed to be more satisfactory than other methods usually employed because any load can be carried if no point in the transformer exceeds 105 deg. C. If the load is not continuous or the surrounding air is less than 40 deg. C., the safe maximum load for a transformer may be considerably more than the rated load. The important thing to know is not whether the maximum load is 50 per cent or 150 per cent of rated load, but whether or not the transformer is overheated. Therefore, the use of a self-registering thermometer is the most direct and logical method of testing transformers, in the opinion of the writer.

While the insulating materials used in transformers can withstand a temperature of 105 deg. C., it is impossible to place the thermometer at the point of highest temperature, so that some lower recorded temperature must be taken as the maximum safe temperature. The standardization rules of the American Institute of Electrical Engineers specify a temperature of 15 deg. C. less, or 90 deg. C. There are so many variations in outside temperature and in load, however, that the

* From a paper read by the author before the Wisconsin Electric Association.

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writer feels that 65 deg. C. is as high as should be allowed in actual practice.

A surrounding temperature of 40 deg. C., or 104 deg. Fahr., which is specified by standardization rules, often occurs in crowded stations, but practically never in distributing transformers on poles during periods of heavy loads. This makes it safe to carry a little overload on lighting transformers even in the summer time. In the winter months the load increases greatly, but the cooler weather also increases the ability of the transformer to carry overloads. Statistics for maximum temperatures during the lighting peak are not readily obtainable, but an idea of the surrounding temperatures which are likely to occur in Wisconsin, where the system under consideration is situated, is given below, in degrees Fahrenheit:

	Superior	Chicago		Superior	Chicago
January	18°	31°	July	74°	80°
February	22	33	August	71	77
March	32	41	September	64	71
April	46	54	October	52	57
May	58	64	November	36	45
June	69	74	December	25	36

Chicago has on the average nine days per year with a temperature above 90 deg., and Superior has less than two such days a year.

During the summer months the lighting peak is of such short duration, especially when the daylight-saving law is in force, that transformers do not have time to reach their full operating temperature. The rate at which distributing transformers heat up when full load is applied to a cold transformer and held constant in a room temperature of 40 deg. is indicated by the following:

Hours	Coil Temperature	Hours	Coil Temperature
0	40 deg. C.	3	56.5
½	45	3½	58
1	49	4	59
1½	51	4½	60
2	53	5	61
2½	55	10	64

From these tables it is evident that when the load lasts for only about three hours a considerable overload is permissible.

No doubt, most distribution engineers consider fall the proper time to check up transformer capacities, since that is the time of load increase and because transformers fail from overload in the early winter. However, the writer is not sure whether the damage is done by high loads in the fall and early winter or by the combination of high surrounding temperature and moderate loads in summer. In this connection there is one thing that is likely to be forgotten. A transformer may be badly overloaded for a time and come through without failure, but it has probably been seriously injured and is ripe for failure at some later date. For this reason it seems advisable to run a series of tests on transformers carrying typical loads under both summer and winter conditions to determine at what season of the year a transformer reaches the highest temperature.

A few years ago the writer conducted some tests which indicated that if a transformer is surrounded by air at 0 deg. C., or freezing, it is possible to carry a 50 per cent overload continuously without the transformer becoming as hot as when run at rated load and standard temperature. These tests were conducted with great care, temperatures being taken by the resistance method as well as by several thermometers. Furthermore, they were conducted on several transformers and the runs made at several different loads. The tests were run on old-style transformers, and it would not be safe to overload new transformers to the same extent.

Occasionally a transformer is installed in an underground vault where ventilation is poor and the surrounding air reaches very high temperatures. In such cases any method which measures the electrical load only is unsatisfactory because even part load may overheat the transformer. If transformers are supplying a variable load, such as some power installations, it is sometimes rather difficult to determine with any degree of satisfaction whether a transformer is overloaded. Here again the thermometer is of assistance in determining safe operating conditions.

Another condition under which it is more desirable to take temperature readings than measure load is when transformers which have been rated by the old as well as the recent standardization rules are employed. The older rules are much more liberal than the new, hence the older transformers can stand heavier loads for a given rating. This difference in overload capacity is automatically taken into account by measuring the temperature.

The thermometers used should have the scale etched on the glass, with no metal exposed to cause short circuit. The registering feature should be the same as that used on clinical thermometers. It is useless to expect satisfactory results with ordinary thermometers, because the mercury drops so rapidly after the bulb is removed that it would be impossible to get accurate readings. Some care must be used in placing the thermometer, the best place being in an oil duct between windings. This can usually be done in the newer and smaller transformers. The next best way is to let the bulb rest on the top of the core. In this way it has been possible to get consistent results, although it has taken a little experience for the linemen to learn to place the thermometer properly. The atmospheric temperature should, of course, be noted and allowed for.

The test is not a particularly expensive one, especially as it permits an inspection of the transformer oil at the same time. It is not the plan of the writer to test any and all transformers indiscriminately, as this would be too expensive. If it is felt that a transformer should be changed, it is tested first to determine the size of equipment to put in its place. To aid in selecting the transformers which are most likely to be overloaded, the following rules applying to residence lighting consumers are observed:

The maximum demand in watts of N consumers is $400 + 160N$, and a 40 per cent overload is permitted before it is thought necessary to test the transformer. This is equivalent to saying that the demand of one consumer is equal to a little more than one flatiron. If twenty consumers are supplied from one transformer, their demand will be 3.6 kw. and their diversity factor is 3.1. (This diversity factor is practically that found by H. B. Gear in his investigations on residence consumers in Chicago.)

The foregoing rule is, of course, a rough rule of thumb, but it has come surprisingly close to facts in both the better and poorer parts of our city. If used with a reasonable amount of common sense, it is believed that this rule will serve the purpose admirably as a method for estimating the load on transformers, and it is simpler and more satisfactory than basing the demand on a certain fraction of the connected load.

By using the above method it should not be necessary to test more than 15 per cent of the transformers in any one year. Probably many consider this too often and feel that the cost of testing is not warranted.

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However, assume that there are 100 transformers in service and that fifteen are tested each year at a cost of $1 each—a high figure, especially if the inexpensive thermometer test is used. The total cost of testing would be $15. If by this testing the installation of only one 1-kw. transformer could be saved, it would pay more than twice the cost of the testing. Suppose also that in a given locality there is installed one 7½-kw. transformer where a 5-kw. unit would be sufficient. The difference in cost is about $25. Assuming the fixed charges on this investment are 12 per cent, the 7½-kw. transformer has an annual investment charge of $3 more than the smaller one. The 7½-kw. transformer also has about 14 watts greater core loss, which at $0.01 per kilowatt-hour is $1.23 per year. The difference in annual cost of the two transformers is $4.23. A few cases where transformers larger than necessary are used would cause an annual loss to the company greater than the cost of the proposed method of testing.

Summarizing, it may be stated that it is the writer's belief that to secure the best operating economy it is essential to keep all distributing transformers loaded nearly to their limit. That limit is defined, not by the rated capacity, but by the maximum safe temperature. How nearly this maximum safe temperature is reached is best determined by a self-registering thermometer. A limited amount of testing is a very wise expenditure.

Park and Boulevard Lighting in Portland

An Artistic Effect Has Been Arrived at by the Employment of Concrete Posts with Alba Globes—Substations Combined with Comfort Houses and Tool Shelters Are a Feature—Steel-Armored, Lead-Covered Underground Cable Used

BY F. H. MURPHY

THE policy of having a uniform system of lighting for parks and boulevards is undoubtedly a beneficial one for large and growing cities as it avoids a great deal of confusion each time a new park or boulevard is to be lighted as well as the expense of calling in a consulting engineer in each individual case and the possibility of having several different systems to maintain.

Considered from the distribution standpoint, a lighting system which is satisfactory for boulevards will usually prove to be best for park lighting. The distribution problems are similar. The circuits must be carried underground, continually subjected to moisture; the lighting units are placed at widely varying distances from the service, some at relatively great distances, and the sources of service are necessarily few and far between. Since there does exist such a uniformity of general requirements, the wisdon of calling for expert engineering advice to determine the best system of distribution to adopt as a standard is at once apparent. Otherwise, as each installation comes up for consideration the officials are confronted anew with a maze of systems and prices, and they must select from among these what presumably is the best plan for the city in each particular case. Consequently in a short time they have acquired a heterogeneous collection of lighting systems, each with its own peculiar maintenance maladies.

After two or three very unsatisfactory experiences of this nature, the park superintendent of Portland, Ore., determined to call in an engineer to decide upon a proper system and one which could be used universally. As a result the system of which a description follows was adopted. Since the electric lighting company had 2300-volt, 60-cycle, single-phase, alternating-current service available in the vicinity of every location at all likely to use this system, it was decided that the city should purchase the energy at this voltage. Furthermore, this was the most desirable voltage for the system selected, which was a 6.6-amp., constant-current, series-incandescent system.

The substation which had to be provided to house the transformer and switchboard is perhaps the most novel feature of the system. Since it was also necessary to provide comfort stations and a housing for the tools used in caring for the park or boulevard, these various features, together with the substation, were placed under one roof and the building was designed to be as harmonious as possible with its surroundings. Each station is divided into four rooms, of which the substation proper occupies only one. The first one built is shown in Fig. 1, while one of the later and more elaborate types is shown in the lower corner of the picture illustrating park lighting (Fig. 2).

The service consists of a two-conductor lead-sheathed cable of No. 8 B. & S. gage, stranded copper wire, insulated for 2300 volts, which is carried in unlined metal conduit from the back of the switchboard panel in the substation underground to the electric lighting company's pole and up the pole to the primary cross-arm. The cable terminates both at the primary cross-arm on the pole and in the substation in approved single-conductor open-air tunnels. Constant-current transformers designed to operate on a 2300-volt, 60-cycle primary and to deliver a constant current of 6.6 amp. on the secondary side are employed. These transformers are required to meet all the purposes of operation, regulation, insulation and temperature rise which are required of standard transformers of this type. The details of these, however, need not be given here. The switchboard is made of 1½-in. (3.8-cm.) blue Vermont marble mounted on a self-supporting iron frame and equipped with an ammeter connected directly in series with the secondary circuit, as well as a full complement of both primary and secondary plug switches. Where two independent circuits are desired for the secondary, provision is made so that they may be switched together. The instrument and switch equipment are standard.

Distribution is accomplished by means of a complete metallic circuit of varnished-cambric cable consisting of No. 8 B. & S. gage stranded copper single conductor. The conductor must, by the requirements, be covered with varnished-cambric insulation at least $\frac{6}{32}$ in. (4.8 mm.) in thickness and in addition with a sheath of

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pure lead of at least $\frac{5}{64}$ in. (2 mm.) thickness. The lead sheath is served with tarred jute armored with two layers of steel tape wound on spirally, the whole being finally covered with tarred jute and well filled with a preservative compound. The material used for insulation has to comply with the National Board of Fire Underwriters' rulings regarding dielectric, physical, chemical and insulation tests is so far as these apply to the insulation material proposed for use.

For the boulevard posts a single-light standard of reinforced concrete was selected, approximately 12 ft. (3.6 m.) high, with a 1½-in. (3.8-cm.) conduit extending up through the center. The posts are painted white and each is surmounted by a 10-in. by 18-in. (25-cm. by 45-cm.) Alba globe. Series tungsten lamps rated at 400 cp., 6.6 amp., are used. The cable which is installed underground is brought to the bottom of each boulevard post in turn and looped up through the 1½-in. iron conduit pipe to a series receptacle mounted in the top of the post. Before entering the conduit the outer covering of the cable is stripped off down to, but not including, the lead sheath for that portion of the cable which is looped up into the post. About 6 in. (15 cm.) below the series receptacle in the top of the post, the lead sheath is removed from the cable, leaving the wire with only the varnished-cambric insulation. At this point the conductor is spliced to not less than No. 12 B. & S. gage rubber-covered wire, the insulation being equivalent to that of the varnished cambric. In the top of the pipe directly beneath the receptacle is wedged a hard-maple block containing two holes of the proper size and the proper distance apart to permit the wires to extend through it. Before driving in the plug the pipe is filled with oakum down below the top of the lead sheath up to within 1 in. (2.5 cm.) of the top of the lead sheath and packed in such a way as to prevent moisture from entering the sheath of the cable; above this the pipe is filled with Okonite compound completely covering the splice and up to the hard-maple plug. The

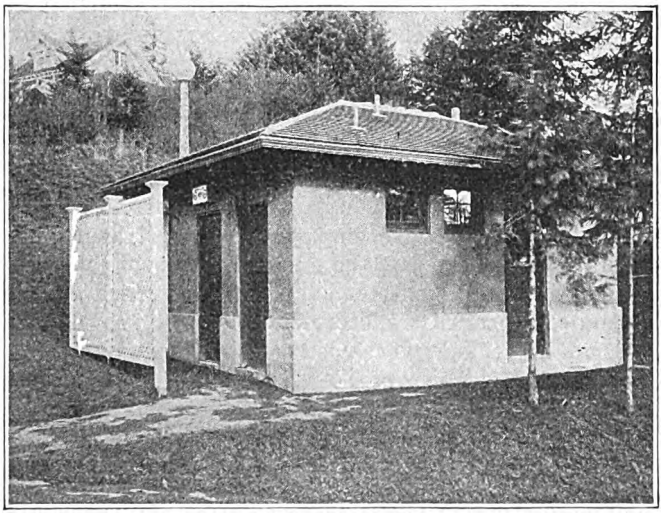

FIG. 1—COMBINATION COMFORT STATION, TOOL HOUSE AND ELECTRIC SUBSTATION

wires extend through the plug and are attached directly to the series receptacle mounted above the pipe.

The first installation under this system consisted of fifty units used in completing Terwilliger Boulevard. A portion of the boulevard which had been completed earlier had already an installation of forty-one units. In this case, however, a multiple system had been installed. The distribution was underground by means of a 2300-volt primary to vaults containing transformers, thence to the lamps by means of a three-wire, 120-240-volt secondary. The lamps used were 400-watt tungsten units, but the posts and globes were identical

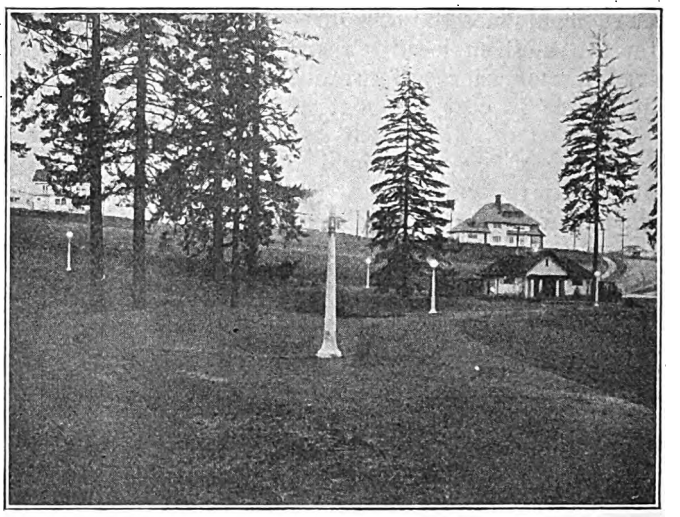

FIG. 2—PARK LIGHTING INSTALLATION, SHOWING STANDARDS AND SUBSTATION

in the two installations. The substation in this case has been so selected that the first installation can eventually be cut over into a series system.

Since the completion of the Terwilliger installation five others have been made as follows: Columbia Park, 31 units; Laurelhurst Park, 50 units; Kenilworth Park, 14 units; Holladay Park, 16 units; Sellwood Park, 23 units, and Mount Tabor Park. All the instalaltions are giving excellent satisfaction and the starting and cutting out of the circuits is handled by the patrolman in the district, who has been taught how to do this even on a constant-current switchboard.

THERE is a feeling on the part of many business men that their competitors, at home as well as abroad, are not playing the game fairly. This is largely imaginary. We hear a great deal these days about what is going to happen to American business when Great Britain and the other nations, supposed to have certain advantages over us, get into full swing. After three months studying the situation in Europe I have not observed any outstanding advantage which they have over us. This is true not merely of manufacturing but with reference even to shipbuilding. Here we find some cloistered critics asserting we will never be able to compete with British shipping. Over in England you will hear English critics telling their government that Great Britain will never be able to compete with us. We should not complain about Great Britain, France and Italy placing temporary restrictions on a number of commodities which they import. They are the best judges concerning what particular products they can do without during the trying economic period which they are going through.—*Edward N. Hurley.*

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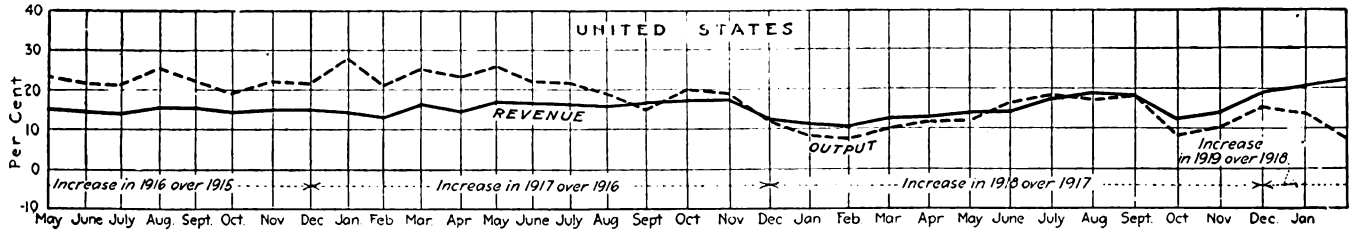
Central Station February Operations



THE INCREASE IN OUTPUT WAS NOTICEABLY LESS THAN THE INCREASE IN REVENUE

CHANGES in business conditions in some cities of the country are reflected in the February returns of central stations to the ELECTRICAL WORLD. While the increase in revenue as compared with February, 1918, is 21.9 per cent, the increase in kilowatt-hour output is 7.7 per cent. The gain in revenue is above the level reported for a number of months. The gain in output of energy is the smallest reported since February of last year, when the increase over February, 1917, was 7.1 per cent. As the statistics presented for February of this year are based on the preliminary returns from 48 per cent of the industry, it is possible that some modification may be made by the fuller returns.

The most striking feature of the February results is the fact that the increase in revenue is so much greater than the increase in output. It was in September, 1917, that the rate of increase in output began to be lower than the rate of increase in revenue. During the year following the curves crossed several times. In October, 1918, the rate of gain in output fell below the rate of gain in revenue, and the tendency thus indicated continued until it became widely extended.

Under present conditions it is difficult to say how much significance is to be attached to the fact that the rate of increase in the output of energy is less than the industry has been accustomed to expect. Sharp recessions have taken place in some industries, as in copper. There is unsettlement in other industries, as in iron and steel. On the other hand, some of the luxury industries, as automobiles and accessories, have taken great spurts in activity. As all industries are dependent upon electrical energy for power to operate, the shifts in the current of general business in various lines of manufacture and in different sections of the country are certain to be reflected in the returns.

From the returns the ELECTRICAL WORLD estimates the results for February for the entire industry as follows: Revenue, $50,510,000; output, 2,158,478,000 kw.-hr.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Mar.	60	$25,396,000	$22,702,000	12.3	1,418,222,000	1,294,561,000	9.4
Apr.	60	25,864,000	22,966,000	12.6	1,450,221,000	1,297,843,000	11.5
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,372,935,000	11.9
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,319,444,000	16.0
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,156,692,000	18.5
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,417,150,000	16.3
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,348,820,000	17.0
Oct.	56	26,254,000	23,228,000	13.0	1,517,866,000	1,392,359,000	9.0
Nov.	57	29,883,000	25,894,000	15.4	1,528,836,000	1,383,747,000	10.5
Dec.	56	32,058,000	27,128,000	18.1	1,539,161,000	1,369,542,000	12.3
		1919	1918		1919	1918	
Jan.	57	33,294,000	27,589,000	20.6	1,522,660,000	1,357,460,000	12.1
Feb.	48	24,245,000	19,884,000	21.9	1,036,069,000	961,633,000	7.7

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States			Atlantic States			Central States			Pacific and Mountain States		
		Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase
REVENUE	March	62	$2,985,000	$2,724,000	9.2	59	$9,904,000	$8,922,000	11.0	53	$7,947,000	$6,735,000	18.0	84	$4,560,000	$4,321,000	5.5
	April	62	2,890,000	2,578,000	12.1	59	10,054,000	8,946,000	12.4	53	8,431,000	7,103,000	18.7	84	4,489,000	4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824,000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sept	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct	63	3,360,000	3,036,000	10.6	51	8,872,000	7,924,000	11.3	50	9,218,000	7,848,000	17.4	81	4,854,000	4,420,000	9.8
	Nov	64	3,695,000	3,238,000	14.1	55	11,877,000	10,400,000	14.2	50	9,277,000	7,704,000	20.4	81	5,034,000	4,552,000	10.6
	Dec	64	4,097,000	3,449,000	18.7	55	11,927,000	10,199,000	16.9	50	10,781,000	8,836,000	22.0	79	5,253,000	4,644,000	13.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb	63	3,869,000	3,015,000	28.3	51	10,378,000	8,540,000	21.5	29	5,976,000	4,723,000	26.5	73	4,022,000	3,606,000	11.5
			1918	1917			1918	1917			1918	1917			1918	1917	
KW.-HR. OUTPUT	March	62	121,518,000	111,576,000	8.9	59	501,320,000	452,250,000	10.8	53	398,166,000	356,860,000	11.5	84	397,218,000	373,875,000	6.2
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct	63	139,784,000	128,970,000	8.3	51	481,272,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov	64	138,559,000	123,033,000	12.6	55	542,699,000	495,812,000	9.4	50	444,012,000	396,665,000	11.9	81	403,566,000	368,237,000	9.6
	Dec	64	145,543,000	129,838,000	12.1	55	475,253,000	421,973,000	12.6	50	489,864,000	443,544,000	10.4	79	428,906,000	374,187,000	14.6
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan	63	143,254,000	124,637,000	14.9	60	525,322,000	458,545,000	14.5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	5.2
	Feb	63	126,591,000	107,389,000	17.8	51	393,463,000	363,618,000	8.2	29	228,754,000	197,307,000	15.9	73	287,261,000	293,319,000	0.2

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Rewinding 12,000-Kw. Turbo-Generator Field

How the Union Electric Light & Power Company, St. Louis, Got a Large Generator Back on the Bus Thirty Days After the Field Broke Down—Detailed Account of the Work Performed on the Insulation and Damaged Coils

HAVING to reinsulate the field windings on one of its generators and not wishing to be without the service of this machine all the time required to ship the field to the factory for repairs and get it back, the Union Electric Light & Power Company of St. Louis made arrangements for doing the work at its plant and thereby got the generator back on the bus thirty days after the field broke down. Since other companies may benefit by doing likewise in some cases, the arrangements made and methods employed will be explained in detail.

To give some idea of the magnitude of the work it may be pointed out that the generator was rated at 12,000 kw., 4500 volts, three-phase, 60 cycles and 720 r.p.m. Tests indicated that the field was grounded, and examination showed that the coils were also damaged. The insulation was so thoroughly dried out and fatigued that it was deemed advisable to reinsulate the field windings throughout. Since fiber paper and oiled linen tape, which were originally used on this machine, were found to carbonize at too low a temperature for this class of service, horn fiber, mica, mica tape and asbestos tape were used instead.

The work of reinsulating a field of this size and construction is practically all manual labor, so two of the manufacturer's expert workmen were obtained from the factory and the necessary clamping presses, tools and insulating material were shipped by express. A temporary repair shop was improvised, consisting of trestles, workbenches, caustic soda tanks, hot-water tanks and receptacles for bolts, laminations, special tools, etc. In the meantime the brass wedges holding in place the blocks of laminations were removed. As each bolt or lamination was taken out it was stamped with a number, and its proper position on the spider was stamped with a corresponding number. The caustic-soda and hot-water tanks, which measured 33 in. by 34 in. by 7.5 ft. (84 cm. by 86 cm. by 2.3 m.) were made of 2-in. (5-cm.) by 12-in. (30-cm.) planks and were held together by planks bolted over the top and under the bottom. Seams were calked and made water-tight, and a 0.75-in. (2-cm.) steam jet was provided for heating. By the second week all of the laminations and coils had been removed from the rotor. The rotor was then carefully cleaned, filed smooth, painted and made ready to receive the coils when reinsulated.

Each coil when removed was heated by passing a current of 700 amp. through it to soften the old varnish and tape. The tape and insulation were then removed, the turns separated, and the entire coil was placed in the tanks containing a strong solution of caustic soda heated with a steam jet. There the parts were allowed to soak for several hours until the old varnish and fiber paper were removed. The solution contained about 100 lb. (45 kg.) caustic soda to 2000 gal. (7570 l.) of water, which was sufficient for the whole job. After the coils were taken out of the tanks they were washed in hot, clean water to remove all traces of the solution and placed on trestles, where they were carefully sandpapered to remove any sediment or burrs on the copper. The burned places between turns were filled with new copper welded on by the oxy-acetylene process.

The next step was to varnish the copper coils with shellac and stick on the between-turn insulation consisting of 0.006-in. (0.15-mm.) asbestos, 0.005-in. (0.125-mm.) mica and 0.0001-in. (0.025-mm.) Japanese paper. After the shellac had been allowed to congeal, the insulation was trimmed to about the width of the copper turns, shellacked on the outside and allowed to dry. As soon as the coils were sufficiently dry to handle wooden screw clamps were attached to hold the coils together and they were transported to the pressing and cementing forms, pressed to the required dimensions and given the proper shape. These forms consisted of sets of inside and outside machined steel blocks set on a sheet-steel body. They were bolted into place to give

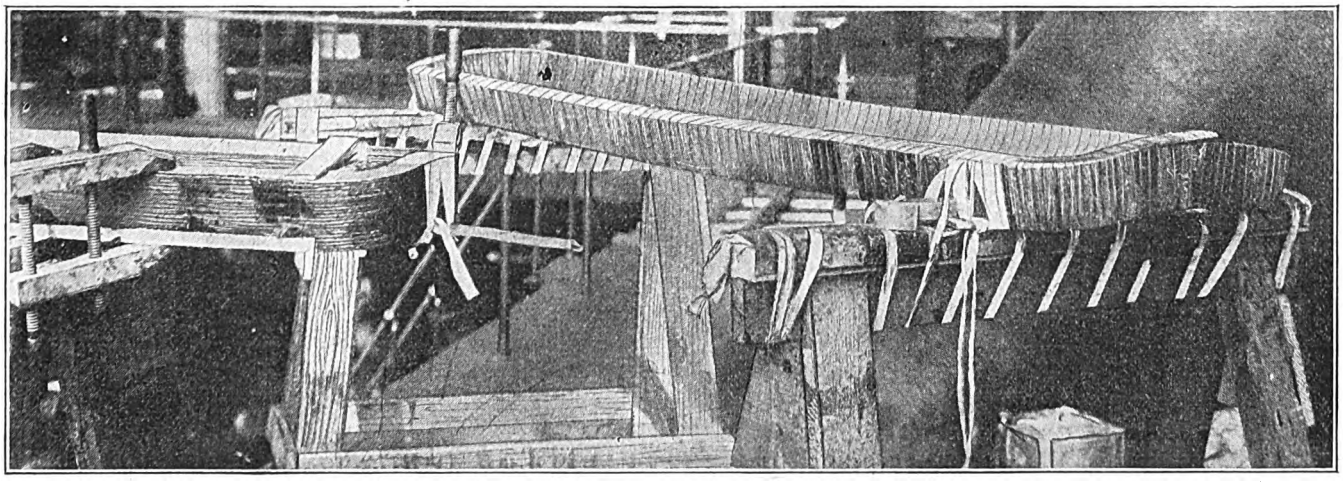

FIG. 1—WORK ON THE DAMAGED COILS IN PROGRESS

The coil to the left has just been removed from the pressing and cementing forms and is ready for the outer insulation; the right-hand coil is in process of insulation with asbestos and mica tape

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the coils their finished shape. Studs and U-bolts were used to press the turns together so that when heated by a current of 600 amp. the insulating varnish and shellac cemented them into a solid coil. After the coils had been properly formed and checked for height they were allowed to cool and then taken off the form.

Upon removal from the press each coil was tested for short circuit between turns by passing a current through the whole coil and checking the voltage drop between turns. Each coil was then trimmed of surplus varnish and shellac, the copper connection strips were riveted and soldered in place, and an asbestos strip was pasted over the edges. The coil was then ready for the final taping. The taping process consisted of winding two layers of mica and one of asbestos tape around the straight portions of the coil and around the end portions. One layer of mica and two layers of asbestos tape reinforced with 0.060-in. (15-mm.) mica fillers cut to fit were wrapped around the turns and varnished.

After twenty-four hours' drying over a hot-air grating the coils were replaced in the rotor. The slots had been prepared by lining each with an armor of horn fiber 0.030 in. (7.6 mm.) thick on bottom and sides and 0.060 in. (15.2 mm.) thick on top. The laminations or pole-piece sections, from which all rough sharp edges had been filed, were then placed in the dovetailed slots, one set at a time, and driven into position, where they were wedged by brass pieces. These wedges were driven in to within 0.5 in. (12.7 mm.) of their full length, the remainder being taken up after the coils had all been assembled and heated.

When the coils were all in place and cross-connections between the coils had been made up temporarily the whole field winding was given a high-potential insulation test of 4000 volts for one minute from a 100-kw. testing transformer. The permanent cross-connections were then made and insulated with mica and asbestos tape. Pieces of 0.060-in. (15.2-mm.) mica and 0.005-in. (0.125-mm.) rawhide fiber were fitted over each pole,

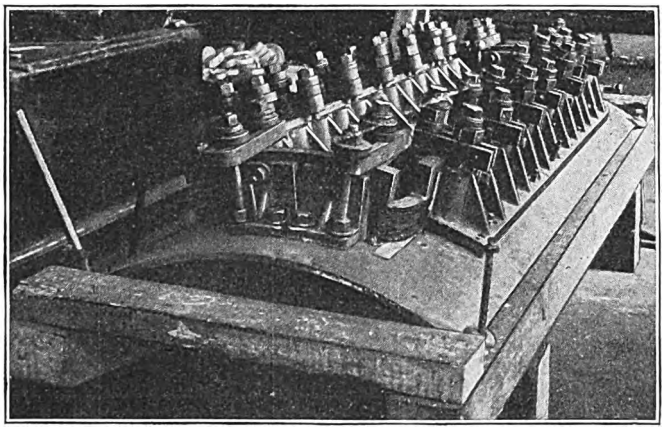

FIG. 2—PRESSING AND CEMENTING FORM, SHOWING A FIELD COIL COMPRESSED TO THE PROPER HEIGHT

after which the ends and the retaining plates were bolted on with the insulated bolts. The coils were again heated to 60 deg. C. and the bolts and wedges tightened and clinched.

A final test of 1500 volts to ground was applied for one and a half minutes when the field was cold. Voltage drops across each pole were compared to see that they balanced. A current of 300 amp. was applied to the finished field for twelve hours, in which period the temperature rose to 50 deg. C.

To assemble the entire field element the trunnions were removed and the lifting bolts fitted up. Then the spider was heated and the completed field fitted on the shaft. The connections from the rotor to the shaft were made, air hood, governor, bearing spider and collector

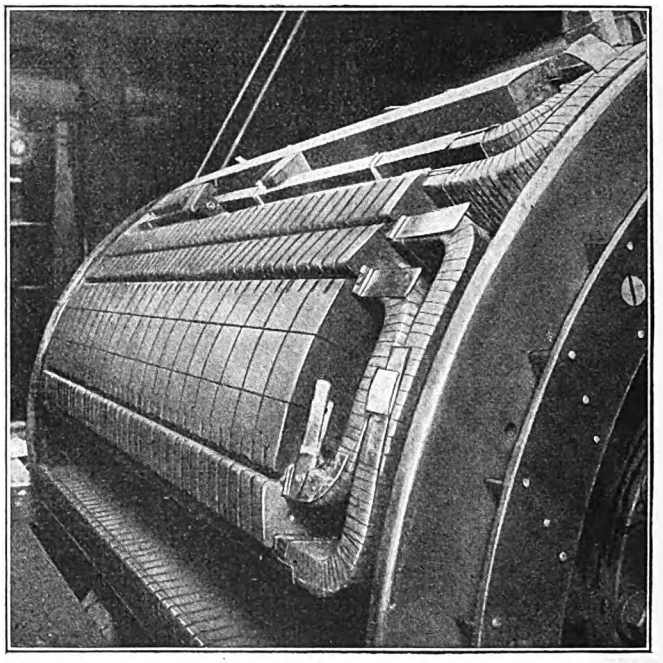

FIG. 3—SOME OF THE COMPLETED COILS MOUNTED IN POSITION ON THE CORE OF THE ROTOR

The pole-piece laminations are driven into position, one riveted section at a time, and clamped with brass wedges to prevent movement.

rings replaced, wiring and piping completed, and the machine was replaced in regular operation.

The repair gang never consisted of more than ten men at any one time, but the job required the services of carpenters, ironworkers, machinists, blacksmiths, electricians, armature winders, laborers and drivers. The machine was out of service 731 hours and 17 minutes, which was a short period considering the magnitude of the work and the fact that the insulating materials had to be obtained from Schenectady, N. Y.

Modern Bus and Switch Structures

In the issue of April 19 an error occurred in the article "Modern Bus and Switch Structures," by C. D. Gray and M. M. Samuels. The captions with Figs. 6, 7, 8 and 9 should refer to stations of 100,000 kva. instead of 1,000,000 kva. or 1,000,000 kv.

THE National Foreign Trade Council was among the first to see the necessity of making our tariff system more flexible and to advocate the adoption of an adequate bargaining tariff. Desirable as such a measure was before the war, it has now become essential to our commercial development. Our new and influential position in foreign commerce and finance makes imperative a bargaining tariff for the protection of American commercial interests in foreign countries.—*W. S. Culbertson, United State Tariff Commissioner.*

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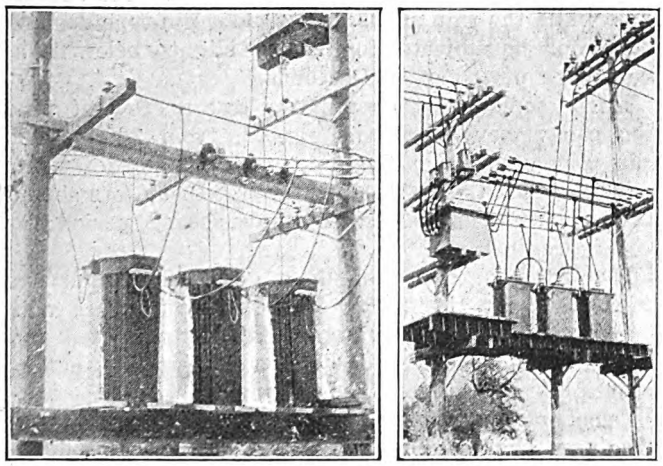
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

POLE SUBSTATION COSTS FOR 13,200 VOLTS OR LESS

Inexpensive Structures for Supporting Temporary and Permanent Outdoor Transformer Installations Which Serve Small Consumers

The temporary installation of three 50-kva., 2300/13,200-volt transformers shown in the illustration cost, exclusive of transformers, $340 in 1917. The permanent substation, which has the same rating, was installed by the same company at about the same time for



PERMANENT SUBSTATION (RIGHT) COST THREE TIMES AS MUCH AS TEMPORARY STRUCTURE (LEFT)

$1,100. This figure is exclusive of transformers, but it includes a Burke switch and lightning arrester, metering outfit, expulsion fuses, buses, etc. The transformers are mounted about 15 ft. (4.5 m.) above the ground in each case, and the permanent construction illustrated is often used where an inexpensive substation is required to serve a load of about 150 kva. from lines with a potential of not over 13,200 volts.

OPERATING RESULTS FROM TESTS OF UNIFLOW ENGINE

485-hp. Unit of Special Design for Driving Electric Generator and Feeding Steam-Heating System Shows Low Steam Rate

Designed especially for the conditions under which it operates in the plant of the Noblesville (Ind.) Heat, Light & Power Company, a Chuse uniflow engine has shown by acceptance tests that it entirely fills the requirements for which it was made. This engine, which is rated at 485 hp., has two single-acting cylinders placed in tandem with the low-pressure ends together and with metallic packing between them. It is possible to operate the engine with both cylinders discharging into the condenser or with either cylinder discharging into the company's steam-heating system or discharging to atmosphere. This special design was considered desirable in order to get the best efficiencies from the unit, which, under the conditions, drives a 400-kva. generator and also supplies the variable amount of steam required by the steam-heating system. The results of the tests made by the engineers of the Chuse company and the Noblesville company are given in the following table:

Load:	Steam Consumption (Lb. per Kw.-hr.) Exhausting to Atmosphere	Steam Consumption (Lb. per Kw.-hr.) Operating Condensing
One-half	32.30	21.22
Full	29.08	21.31

ELECTROSTATIC PRECIPITATION IN THE SMELTING INDUSTRY

Some Troubles with Remedies—Treatment of Lead Fumes Particularly Advantageous Because of Valuable Elements Recovered

After two years of pleasing results with the Cottrell treater, Charles S. Barnum, general superintendent of the Pennsylvania Smelting Company, has become very optimistic regarding the future of electrostatic precipitation. This attitude was not reached without preliminary difficulties, but these manifested themselves chiefly in the mechanical arrangement of the treater rather than in the electrical end. Some of the faults may be of interest to any one having in view the installation of an electric treater. A few will be cited and the remedies mentioned.

About the first change was to remove the porcelain resistance rods which carried the suspended electrode chains and to suspend the chains from insulated busbars. At the same time the throttling arrangement in the top of the pipes was changed because it was found that the porcelain insulators would not last, since the throttling arrangement did not prevent arcing. Next followed the absolute necessity of some form of rapping device because the precipitated fume clung persistently to both pipes and chains. As the treater had not been designed with this need in view, it required no little ingenuity, together with much labor and time, to devise and install a suitable system of knockers for the pipes and chains. Third, insulators had to be renewed frequently since they are set in the hopper immediately under the bottoms of the pipes, in the direct current of the fumes and in close contact with the precipitated matter in the hoppers, which will frequently take fire to the consequent destruction of the insulators. In later designs of treaters these insulators are placed outside and away from the path of the gases. Another mistake was to have the fumes blown in below the treater pipes, throwing the work of precipitation on the back lines of pipes, By cutting down the speed of the exhaust fan this fault was partially overcome.

Lead blast-furnace fume is particularly easy to clean

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by electrostatic precipitation, 95 to 98 per cent clean-up being obtained most of the time except when the capacity of the treater is exceeded. The operating cost is nominal; with the occasional help of an electrician any intelligent workman can soon learn to care for the treater and the apparatus. The energy consumption is small. In the case under notice the amount of high-tension energy consumption varies from 24 kw.-hr. to 70 kw.-hr. in twenty-four hours, depending on whether one or two furnaces are operating and on the condition of the furnace. Adding to this the energy needed for the two small auxiliary motors, it is seen that the total consumption is not large. A high-tension voltage of 60,000 to 70,000 is usually employed. The precipitated fume mixed with a varying percentage of mechanically settled flue dust assays about as follows: Zinc, 9 to 10 per cent; sulphur, 5 to 6 per cent; arsenic, 2 to 4 per cent; antimony, 0.5 to 1 per cent; silver, 1 to 2 oz. per ton (31 to 62 gr. per 0.9 t.); lead, 55 to 60 per cent.

This information was presented before a recent meeting of the American Electrochemical Society.

PACIFIC COAST PRACTICE IN TESTING INSULATORS

Conditions Under Which Each Method Is Particularly Applicable—Both Pin and Link Insulators Receive Consideration

Megger, 60-cycle, high-voltage, oscillator, spark-coil and telephone-detector tests are the principal methods of testing insulators used on the Pacific Coast according to the report of the insulation committee of the Pacific Coast Section of the N. E. L. A., of which John A. Koontz, electrical engineer with the Great Western Power Company, is chairman. The applicability and limitation of each method, as determined from analyses made by this committee, are indicated below.

For the megger test a crew of four men, consisting of two linemen, one megger-man and a driver, has been found sufficient. Basing figures on an eight-hour day, they will test from 200 to 700 link insulators per day, depending on the number of insulators used per string, the height of towers or poles and accessibility of lines.

Any good insulator with clean, dry surfaces should have an insulation resistance of from 500,000 megohms to 750,000 megohms, so that if an insulator has reached a resistance value of 2000 megohms or below, it should be discarded, as it is near the end of its useful life.

At times of humid weather conditions it may be necessary to carry two or three good insulators for checks when all insulators give low reading owing to surface moisture. The practice of one large company is to megger all units once every two years, and the places where highest depreciation is occurring once every year.

The series gap should always be used in 60-cycle testing. By observing the color and character of the arc across the gap, porous porcelain can be detected. The reddish glow of the arc in the series gap will indicate porous material, while the arc will have a bluish "snappy" appearance, that of charging current, for good material.

Suspension insulators of the later designs should be subjected to flashover four or five times before acceptance, while the thin shells of the older pin-type designs should only be subjected to a voltage slightly below flash over for a period of five seconds.

When employing the oscillator test a crew of nine men can remove, test and replace from 200 to 600 units per day, depending upon the number of units per string and the strings per tower. Insulators should stand flashover for at least a five-second period for acceptance.

Two linemen, one groundman, one tester and one driver can test 150 to 500 units a day in place with a spark coil. Perfect contacts with the cemented surfaces on both sides of a porcelain part are not so essential as in other methods of testing.

Telephone detector sets are generally used as a shunt circuit on the wood pole to detect leakage current to earth through the pole. The arcing and overstressing of insulator parts give rise to high-frequency currents which will give a distinctive tone in the receiver. By going to the cross-arm it is generally possible to locate the pin or link string in question on wood-pole construction.

DATA ON PACIFIC COAST PRACTICE IN TESTING INSULATORS

Testing Apparatus	Applicability	Pin Insulators				Link Insulators			
		One-Piece		Built-Up		One Unit per String		More Than One Unit Per String	
		Laboratory Test	Field Test	Laboratory Test	Field Test	Laboratory Test	Field Test	Laboratory Test	Field Test
Megger (80 lb.)	Suitable except in extremely wet or dry climates	Can be used	Not suitable	Can be used	Individual parts can be tested but cement must be wetted to get results	Can be used	Not suitable	Can be used	Well adapted
60-cycle high-voltage	Most conclusive test	Well adapted	Not suitable	Well adapted	Suitable extreme case	Well adapted	Suitable extreme case	Well adapted	Suitable extreme case
Oscillator (4000 lb.)	Will detect defects away from cap in dry insulators. Will sometimes pass low megohm insulators	Suitable	Not suitable	Suitable	Not suitable	Suitable	Not suitable	Suitable	Not suitable
Induction coil (80 lb.)	Results intermediate between oscillator and 60-cycle high voltage. Detects cracks as well as porous insulators	Can be used	Not suitable	Better than megger	Can be used	Can be used	Not suitable	Can be used	Can be used
Telephone detector	Will not detect between leakage over dirty insulator	Not suitable	Can be used, limited	Not suitable	Can be used, limited	Not suitable	Can be used, limited	Not suitable	Can be used, limited

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

INSTRUMENT FOR RECORDING INTENSITY OF DAYLIGHT

Employed by Boston Central Station, Based on Discovery that Resistance of Tungsten Lamp Varies with Amount of Daylight

The amount of daylight throughout the different portions of the year is a matter which is of considerable interest to a corporation furnishing electricity to the public, for the amount and variation of this daylight is reflected to a greater or less degree in the load curve of the company. Occasionally a customer objects to the charge rendered for electricity during the winter

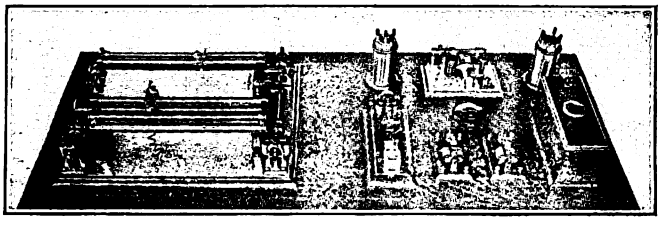

FIG. 1—TOP VIEW OF DAYLIGHT RECORDER

months and bases his objection on the amount of his bill for the corresponding month in the previous year. If the company has data on file showing the percentage of clear and cloudy days for these two months, however, it is possible to show the customer that the increase is due to a period containing many cloudy days which called for an increased use of electricity for illumination during daylight hours.

For the purpose of measuring such changes in daylight and recording them for comparison, F. A. Swan of Boston developed an instrument known as the meteorograph, which consists of two principal parts, the receiver and the recorder. The receiver is installed on the roof of the laboratory of the Boston Edison company in such manner that it is exposed to radiation from all parts of the sky. The recording apparatus is contained in a cabinet in the standardizing laboratory of the company.

The device operates on the principle of a Wheatstone bridge. The bridge is in balance when no light falls upon it. The action of light on the receiver throws the bridge out of balance and causes a deflection of the galvanometer. The galvanometer is combined with a relay, and the action of this relay causes a slider to move until the bridge is again in balance. The slider carries with it a pen arm, and by this means a curve is drawn on a chart in accordance with every change of daylight. The accompanying curves show the action of the instrument on a rainy day (Fig. 2) and on a sunny day (Fig. 3).

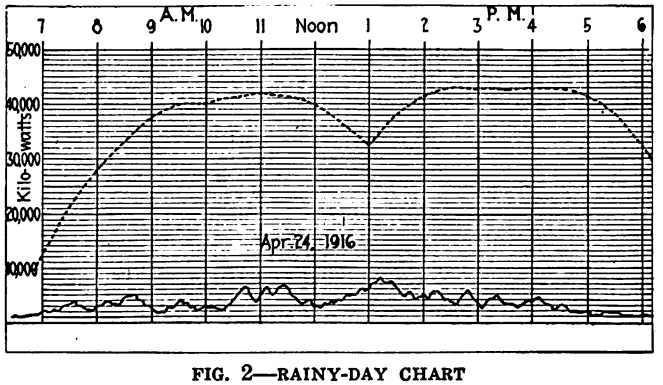

FIG. 2—RAINY-DAY CHART

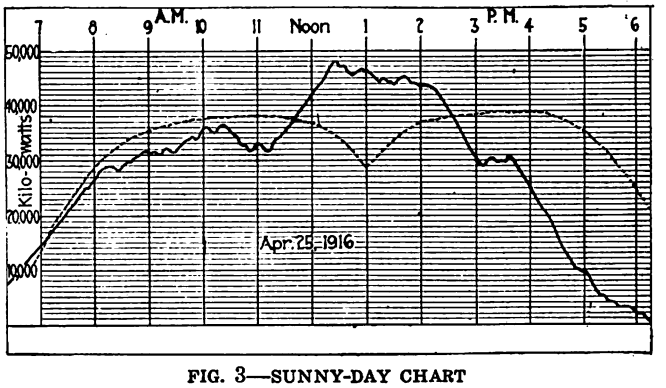

FIG. 3—SUNNY-DAY CHART

NEW MARKETS FOR ENERGY USED IN WAR INDUSTRIES

Estimated Transformer Capacity of 2,100,000 Kw. Devoted to War Industries in 1919 Now Available Turns Attention to Appliances

Calling attention to the discontinuance of energy consumption by war industries, the Society for Electrical Development, New York, says that central stations should not overlook the use of electric cooking devices and certain of the more widely used electrical appliances.

While it is difficult to verify the figures, the statement has been made that transformer capacity amounting to 2,120,000 kw. was devoted to war industries in 1918. The distribution, as given by the society, was about as follows: South Atlantic States, 20,000 kw.; New England States, 300,000 kw.; Central West district, 250,000 kw.; Rocky Mountain district, 50,000 kw.; Pacific Coast, 150,000 kw.; New York, 750,000 kw.; Pennsylvania and Maryland, 500,000 kw.; Southwest district, 100,000 kw.; total, 2,120,000 kw.

It is also recalled by the society that, owing to government restrictions, the high cost of material, labor and so on, very little extension of transmission lines was done during the past eighteen months. To remedy this condition various house-wiring campaigns were inaugurated throughout the country, and the nation-wide society movement, "Electrify your home," was carried on.

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POSITION OF UTILITIES APPLIANCE SALES IN MARKET

Figures Showing Sales During 1918 of Utah Central-Station Company and of Dealers Doing Business in Territory

Some interesting figures showing the relative part played by the central station and other retail distributers in the market for appliances were given by T. W. Simpson, Western district manager of the Federal Sign System (Electric), before the Pacific Coast Section of the National Electric Light Association. These figures, which are given in the table, are for the Utah Power & Light Company, which serves a territory of 50,888 residence consumers. The table shows the totals in numbers of articles sold during 1918 by the company and the estimated sales of dealers during that period.

ARTICLES SOLD IN TERRITORY OF UTAH COMPANY, 1918

Total	Sold by Central Station	Sold by Dealers	Sold by Both Dealers and Central Station	Number of Articles in Use on Line
Lamps	156,000	226,000	382,000	.....
Ranges	679	None	679	2,396
Grills and disks	1,462	950	2,412	11,536
Water heaters	224	few	224	750
Percolators	405	300	705	1,560
Fans	309	300	609	3,500
Irons	3,741	2,500	6,241	56,924
Washing machines	1,708	1,700	3,408	11,265
Cleaners	956	1,000	1,956	4,469
Other appliances	2,497	2,000	4,497	8,500
Signs*	31	10	41	1,122
Window reflectors	857	1,500	2,357	.....

* Lightless nights and steel restrictions in 1918 affected this item adversely.

POPULAR SUBSCRIPTION TO $750,000 BONDS IN TWO WEEKS

New York Property Serving a Few Small Communities Gets More than 1000 Subscriptions for $1,000 or Less

In a space of two weeks, the time allotted, the Central Hudson Gas & Electric Company, Poughkeepsie, N. Y., serving a few towns and cities no one of which is particularly large, received from customers and residents of its territory subscriptions for the entire amount of an issue of $750,000 of 7 per cent ten-year debenture bonds.

Customers had the option of purchasing bonds on the partial-payment plan by payments extending over twenty months, provided that the subscription was $2,000 or less, the installments, if desired, to be paid with bills for gas and electricity. Larger subscriptions could be paid either in full or half down and the remainder by April 15 last.

Letters were sent out to all customers and were followed up by advertisements in the local papers and by personal calls by regular company employees on virtually every customer.

The first letter was sent out on Feb. 24 and, in addition to stating the terms, said:

We believe that every opportunity should be given to our customers to purchase the company's securities instead of selling them to brokers for distribution outside of the company's field of operation. These securities are to provide new capital for additions and extensions to take care of the increasing demands of the territory. They represent a favorable opportunity for investment, created by the rapid growth of the business, and we believe that it is of advantage to the company as well as to its patrons to have the company's securities owned in communities it serves for the following reasons:

First—To make the public and the company financial partners in an enterprise which is essential for community advancement.

Second—To provide investment for the surplus capital and savings of citizens in a safe business which they have under their personal observation.

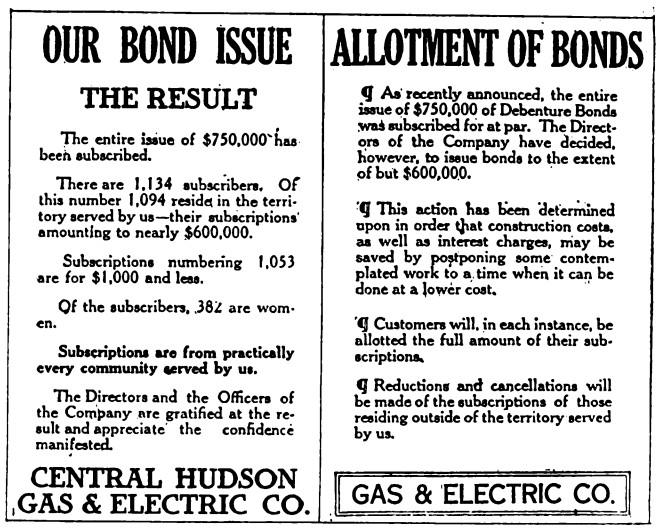
Third—To increase the prosperity of the territory by distributing earnings locally.

On March 13, three days after the campaign closed, the company announced by advertisement that the response had been very gratifying, stating that the tabulated result would be announced later. This came on March 19, showing that the entire issue was subscribed by 1134 persons, of whom 1094 reside in the company's territory, their subscriptions amounting to nearly $600,000. Subscriptions numbering 1053 were for $1,000 and less. Of the subscribers 382 were women. On March 22 the company announced, as shown, that only $600,000 would be allotted, but that customers would be allotted the full amount of their subscriptions.

No difference was made in price between bonds sold on partial-payment plan and otherwise, except for proper adjustment of interest. Customers receive 7 per cent on all cash paid the company from the time it is paid. The bonds are held as collateral until payments are completed.

In answer to the question of how much was saved by marketing securities in this way, L. H. Scherch, commercial manager of the company, who handled the publicity and directed the sale of the bonds, said:

We do not place the securities on the market primarily with the idea of effecting a saving, but because we believe that utilities should be financed by their patrons and everything should be done to encourage customers becoming partners in the enterprise. The cost of marketing securities in the way we did is very small and involves simply the newspaper advertising and circularizing, to which, of course, should be added the solicitation, but this was entirely by our own organization. No bonus was offered to salesmen, but several prizes were offered to those employees who obtained the most subscriptions.



OUR BOND ISSUE

THE RESULT

The entire issue of $750,000 has been subscribed.

There are 1,134 subscribers. Of this number 1,094 reside in the territory served by us—their subscriptions amounting to nearly $600,000.

Subscriptions numbering 1,053 are for $1,000 and less.

Of the subscribers, 382 are women.

Subscriptions are from practically every community served by us.

The Directors and the Officers of the Company are gratified at the result and appreciate the confidence manifested.

CENTRAL HUDSON GAS & ELECTRIC CO.

ALLOTMENT OF BONDS

¶ As recently announced, the entire issue of $750,000 of Debenture Bonds was subscribed for at par. The Directors of the Company have decided, however, to issue bonds to the extent of but $600,000.

¶ This action has been determined upon in order that construction costs, as well as interest charges, may be saved by postponing some contemplated work to a time when it can be done at a lower cost.

¶ Customers will, in each instance, be allotted the full amount of their subscriptions.

¶ Reductions and cancellations will be made of the subscriptions of those residing outside of the territory served by us.

GAS & ELECTRIC CO.

ADVERTISEMENT ANNOUNCING RESULT OF BOND ISSUE

Customers will be billed for the partial payments on regular gas and electric bills in the place provided for merchandise.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Influence of Distribution Losses on Efficiency Curves of Continuous-Current Motor.—THOMAS CARTER.—In this number of the series the writer discusses the maximum output which can be obtained from a motor and the values of input and efficiency at which it occurs. He also gives the direction relation between input and output.—London *Electrician*, March 7, 1919.

Parallel Running of Alternators.—DE MARCHENA.—The object of the article is to show how to apply the known theories on the parallel running of alternators to special cases. The investigation was suggested by the instability of running met with in the case of certain generating sets driven by gas engines that were installed at the generating station at La Rochelle. After stating the general theory, numerical applications are made showing how to estimate the danger of hunting, and figures are given for the usual free periods of oscillation of various types of alternators, the range of the frequency of the impressed oscillations produced by various types of engines and the weight of flywheel per horsepower required for stable running. — *Technical Supplement to Review of Foreign Press.* (Abstracted from *Bulletin* of Société Française des Electriciens, January, 1919.)

New Extra-High-Tension Transformer.—E. WELTER.—The ordinary high-tension transformer is called upon to effect a certain transformation of pressure and to withstand the resultant dielectric stresses. In the new system one transformer provides for pressure transformation and the other deals simply with the dielectric stress. Dessauer's investigations of the new and old systems of connection are summarized. The elimination of brush discharge renders the new transformer safe at even the highest voltages. The new transformer is considered to be of very great importance in connection with the development of high voltages and relatively low power for such purposes as deep therapeutic treatment, testing, dust and smoke precipitation and other electrostatic applications. Voltages from 100 kv. to 200 kv. or higher can be developed safely in compact apparatus.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elektrot. Zeits.*, Sept. 19 and Sept. 26, 1918.)

Lamps and Lighting

Neon Lamps for Direct Current.—F. SCHROTER.—Neon is a suitable gas for glow-discharge lamps because of its low dielectric cohesion of 5.6 (air 419). The chief spectrum lines lie in the yellow and orange red. In tubes of 50-mm. diameter the potential gradient is 1 volt per centimeter. The glow is exceedingly sensitive to very slight impurities of the neon, however, which is purified after Gehlhoff, and it is very essential that all gases be expelled from the electrodes and lamp walls before sealing off. The author discusses this question with special respect to the cathode metal (mercury—the alkali amalgams of Skaupy). He uses anodes of sheet iron and cathodes of an alloy of cadmium and thallium, melting a little above 200 deg. C. The bulb gas is commercial neon containing 25 per cent helium; higher helium percentages are undesirable. The helium turns the glow tint into pink. When the neon-lamp tube is bent to a nearly closed ring it gives 1.7 hefner candle (spherical) and 2 (horizontal) per watt up to 400 hefner candles with currents of 1 amp. at 220 volts. A small device is needed to start the ionization. It consists of a self-induction coil, a vacuum interrupter and an iron-wire resistor. The lamps last a few thousand hours and do not become hard by occlusion of the neon. The alternating-current lamps will be of different, not yet settled construction.—*Science Abstracts, Section B*, February, 1919. (Abstracted from *Zeits. Elektrochem.*, May 1, 1918.)

Generation, Transmission and Distribution

Effective Resistance, Impedance, Self-Induction and Power Losses in an Armored Cable.—R. BOUZON.—A brief article showing that the effective resistance, the impedance and the self-induction in a monophase steel-armored cable vary in intensity with the magnetization of the steel and cease when saturation is attained. This fact is used to effect a separation between losses by hysteresis and losses by Foucault currents and the Kelvin effect.—*Revue Générale de l'Electricité*, March 15, 1919.

Transmission of Electrical Energy to the American Arsenal at Beauvoir.—MICHEL BERTHON.—When the American army began to arrive in France an arsenal for the production and repair of war material was established at Beauvoir, in the Arrondissement of Bourges, and the problem of furnishing electrical energy to it arose. The plan of building a power house having been rejected, it was decided to connect the arsenal with the central station at Mazières, which already supplied important military establishments at Bourges. The American arsenal, designed for more than 6000 workmen, the buildings covering 25 hectares (62 acres), demanded an initial supply of 500 kw., which was to have risen to 7500 kw. before the end of 1919. This article gives a description of the installation and the transmission line, especial attention being paid to the outdoor substation, built after the American plan, where three-phase, 5000-volt energy was transformed to 30,000 volts for transmission 16 km. over copper cables of 60 sq.mm. section to the arsenal, where it was stepped down to 2300 volts and finally to 110, 220 or 240 volts for power and lighting.—*Revue Générale de l'Electricité*, March 22, 1919.

Traction

Railway Electrification in Washington.—About July 1 of this year the Chicago, Milwaukee & St. Paul Rail-

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way will begin operating its trains electrically through the Cascade Mountains. The electrification covers 218 miles (350 km.) between Othello, in eastern Washington, and Seattle and Tacoma. Electrical energy is to be supplied by the Washington Water Power Company on the east over a 110,000-volt transmission line from the Long Lake hydroelectric station and from the Snoqualmie plant of the Puget Sound Traction, Light & Power Company, also over a 110,000-volt line on the west. There are substations at Tacoma, Renton, Cedar Falls, Hyak, Cle Elum, Kittitas, Doris and Taunton. Details of the substation and transmission-line equipment are given in this article, and it may be noted that the trolley voltage is to be 3000 volts direct current, as in the case of the Montana-Idaho electrification on this system. When this electrification work is completed the company will have 660 miles (1060 km.) of trunk line electrified in the Northwest.—*Journal of Electricity*, April 1, 1919.

Selection of Apparatus for Railway Converter Substations.—C. F. LLOYD.—Features governing choice of types of equipment for direct-current railway substations are outlined. The writer also goes over the factors which must be considered in the design of the building.—*Electrical Review*, April 5. 1919.

General Discussion on Joining Metals.—E. WANAMAKER and H. R. PENNINGTON.—Pressure welding, resistance welding, thermit welding, gas welding, electric arc welding and the electric arc are discussed in this paper, which relates particularly to joining metals in railway work.—*Railway Electrical Engineer*, March, 1919.

Installations, Systems and Appliances

Electric Welding and Welding Appliances.—In the fifth number of a series on the subject of electric welding resistance welding machines made under the Pontelec welding patents are described. Although the service is severe inasmuch as the load is intermittently thrown off and on several times per minute and the power factor is about 0.6, the machines answer the purposes very well.—London *Engineer*, March 14, 1919.

Electricity in Household Service; Heating and Cooking.—GEORGE A. HUGHES.—The development of heating and cooking applications is discussed. Domestic electric heating appliances in use in the United States are estimated as follows:

Grills	150,000	Percolators	150,000
Heating pads	90,000	Chafing dishes	40,000
Teapots	10,000	Disks	250,000
Heaters and radiators	250,000	Ranges and hot plates	50,000
Irons	4,000,000	Water heaters	35,000
Toasters	480,000	Miscellaneous	25,000

This is a total of 5,530,000. After discussing the relative advantages of electric cooking and heating devices, the writer points out the immense development that may be expected in the use of such devices along with the extension of the central-station business.—*General Electric Review*, March, 1919.

Melting Brass in the Induction Furnace.—G. H. CLAMER.—Discusses the general principles of the induction furnace and describes in detail the Ajax-Wyatt type. This furnace employs a closed channel with a pool above and circulation of the liquid metal in the channel. Brass (60/40) may be melted without volatilization of Zn in the channels of the secondary circuit so long as the cold metal is being fed into the furnace or the bath has not in entirety reached the volatilized point of Zn. In charging it is necessary to guard against bridging of the charge. Constant energetic automatic circulation results from the motor effect, pinch effect and Joule effect. The power factors of 30-kw. and 60-kw. furnaces are 85 per cent and 72 per cent respectively. These furnaces operate on single-phase circuit, 220 volts, 60 cycles. The furnace as developed is intended only for Cu-Zn alloys containing no more than 3 per cent Pb.—*Chemical Abstracts*, March 10, 1919.

Wires, Wiring and Conduits

Substitutes for Rubber-Insulated Wires.—R. NAGEL.—The author describes tests made on various "war wires," particularly in respect of mechanical strength and resistance to moisture and heat. The insulation on the wires investigated consisted of regenerated rubber, bitumen or a series of layers of impregnated paper strip wound on spirally. The last-named system of insulation gives particularly good results, equal in fact to the results given by the best pre-war rubber-insulated conductors. Compared with the latter, paper insulation does not "age" appreciably; it is less affected by prolonged heating and has great uniformity of quality. The substitutional insulations considered do not involve the use of imported raw materials, and it is considered that they may continue to be used after the war. Tests of this wire showed excellent uniformity. The wires insulated by bituminous "substitutes" became quite eccentric with the insulation after twenty hours at 50 deg. C. Regenerated rubber is less objectionable in this respect. Paper insulation is unaffected mechanically and loses only 20 per cent breakdown strength at 75 deg. C., as compared with 39 per cent in regenerated rubber and 73 or 74 per cent in bituminous insulation.—*Science Abstracts, Section B*, February, 1919. (Abstracted from *Elektrot. Zeits.*, Oct. 31, 1918.)

Stresses in Wire Rope.—SHORTRIDGE HARDESTY.—The development of a new formula for the determination of bending stresses in wire rope.—*Journal A. S. M. E.*, March, 1919.

Electrophysics and Magnetism

Glasses for Protecting the Eyes from Injurious Radiations.—W. W. COBLENTZ and W. B. EMERSON.—The object of the paper is to give the general characteristics of certain newly developed glasses sometimes used for protecting the eye from radiant energy, especially the infra-red or so-called heat rays. For shielding the eye from infra-red rays, deep-black, yellowish-green, sage-green, gold-plated and bluish-green glasses are the most serviceable. Data are given showing that of the infra-red rays emitted by a furnace heated to 1000 deg. to 1100 deg. C., (1) about 99 per cent are obstructed by gold-plated glasses, (2) about 95 per cent by sage-green or bluish-green glasses, (3) about 60 to 80 per cent by very deep-black glasses, and (4) about 60 per cent by greenish-yellow glasses. For protecting the eye from ultra-violet light, black, amber, green, greenish-yellow and red glasses are efficient. Tabulated data are given also of the transmission of the radiation from the quartz mercury-vapor lamps, the magnetic arc and the gas-filled tungsten lamp through various glasses.—*Technical Paper No. 93*, Bureau of Standards, 1919.

Dielectrics in Electric Fields.—This article consists of a summary of three lectures given by G. L. Addenbrooke of which no copies were available. Mr. Addenbrooke dealt with the variations of current and power

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factor as a dielectric approaches breakdown in an electric field. The current flowing has a true capacity component, the energy of which is returned to the circuit with each reversal, and a power component, which seems to be wholly converted into heat. There does not appear to be any chemical action. As the temperature rises the dielectric losses increase, whether the dielectric is heated by external means or by alternating stresses set up by the field. Thus the power factor rises up to the point of breakdown. The presence of water has a great effect in increasing the losses, and the author asserts that the dielectric losses appear to be wholly due to moisture and that if perfect dryness could be obtained the dielectric loss would vanish. Many experiments were made with celluloid and glass.—London *Electrician*, March 28, 1919.

Electrochemistry and Batteries

Nickel-Plating Cast or Sheet Aluminum.—After cleaning, polishing, etc., the aluminum is plated at 3 volts to 3½ volts in a solution containing: Water, 3791 g.; $NiSO_4 7H_2O$, 284 g.; $NiSO_4(NH_4)_2SO_4 6H_2O$, 56.7 g.; $MgSO_4 7H_2O$, 56.7 g., and H_3BO_3, 56.7 g. A double-throw switch is used, whereby the aluminum articles are momentarily made the anode and the oxide film is dissolved. Then, reversing the switch, the articles become the cathode and nickel is deposited. Contamination of the acid dip or deoxidizing solution with copper is prevented by the use of soft iron for stringing purposes. This also maintains the Fe necessary in the dip. After nickel plating, aluminum articles may be plated in any cyanide bath for brass, copper, silver or gold.—*Chemical Abstracts*, March 10, 1919.

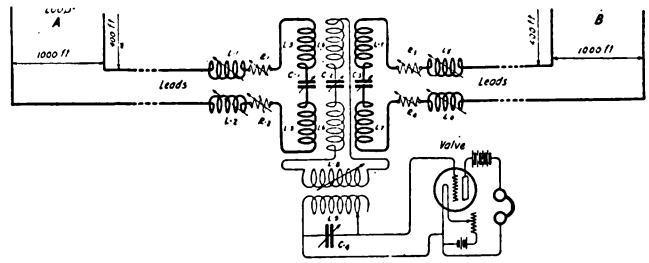
Making Electric Furnace Bottoms.—A. W. LORENZ.—The refractory mixture used for the bottom should be rammed well in layers an inch thick. FeO should be kept down, as this is reduced to Fe by the coke, thus diminishing the strength of the bottom. It is probable that to secure the best results a basic electric furnace bottom should contain as little oxidizing material as possible and should be burned in thoroughly with non-reducing flame.—*Chemical Abstracts*, March 10, 1919.

Units, Measurements and Instruments

Substitute Materials in Electricity Meters.—New regulations have been issued in Germany relating to the use of substitute materials in electricity meters. Series coils of alternating-current meters up to 5 amp. are to be made of zinc or aluminum; up to 30 amp. aluminum may be used, and above 30 amp., copper. In direct-current meters the series of coils are to be of aluminum up to 20 amp. and may be of copper above this current. The shunt-circuit armature winding of direct-current meters and the shunt coils in alternating-current meters must be made of copper. Magnets may be made of tungsten steel instead of chrome steel. Terminals for currents up to 30 amp. may not be of substitute metals. For currents from 30 amp. to 100 amp. brass may be used, and copper for higher currents.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Elektrot. Zeits.*, Jan. 9, 1919.)

Telegraphy, Telephony and Signals

Weagant's Anti-Static Invention.—ELMER E. BUCHER.—Up to the time of Roy A. Weagant's discovery of the nature of static interference, there existed no definite idea of the directions from which this interfering field came. Early efforts to eliminate the static disturbances in wireless transmission of signals were therefore unsuccessful. Upon finding, however, that such static disturbances were vertical in direction, it was not long before Mr. Weagant successfully developed apparatus to shut out static interference. The principle of the apparatus developed for the elimination of static interference is best understood from the diagrams. Here two equal closed circuit loops *L*-1 and *L*-2, are shown coupled to a common secondary *L*-3 of the receiving apparatus application. The vertically propagated static waves are indicated by the downward arrows above the loops, and the advancing signal wave is seen to pass from left to right as shown by the arrows *AA*. Since



STATIC WAVES ARE BLOTTED OUT WHEREAS SIGNAL WAVES COMBINE

the static waves are propagated vertically, they act on loops *A* and *B* simultaneously and generate in them emfs. of equal intensity, which when opposed in the secondary *L*-3 result in zero current and thus blot out the static interference. If the two antennas are spaced one-half wave length from center to center, the emfs. generated in *L*-3 of the signal currents will be in phase, and the resultant will be the arithmetical sum of these two emfs. It is not essential that the effective spacing of the loops be one-half wave length, for one antenna can be employed for a considerable range of wave lengths, provided it is possible to sacrifice part of the signal current. It is thus evident that the signal current may be received through this apparatus, but that no disturbance in the receiving system results from static waves spreading the loops. The discovery opens up the possibility of very important performances.—*Wireless Age*, April, 1919.

Miscellaneous

The Liberal Element in Engineering Education.—GEORGE F. SWAIN.—The author believes that the motto for the future in education should be to make the instruction practical, useful, well within the comprehension of the students and the field of their experience and to motivate it.—*Engineering Education* (Bulletin of the Society for the Promotion of Engineering Education), December, 1918.

Continental Wireless Telegraphy.—An article on the use of wireless telegraphy for communicating between Continental countries. The Telefunken and Marconi systems cannot be used for this purpose on account of the kind of waves emitted by them. The writer points out, however, that two other systems exist, known as the "high-frequency" and the "arc-light" systems, which have the advantage that two stations at a distance of 200 km. from each other can reach a third one at a distance of 200 km. without interfering with each other, in spite of the fact that the two former stations are distant from each other by only one-tenth of their wave reach.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Weltwirtschaftszeitung*, Feb. 7, 1919.)

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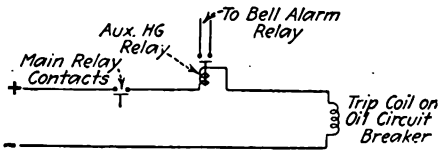
Readers' Views and Comments

Bell-Alarm Protection

To the Editor of ELECTRICAL WORLD:

SIR: In a letter to the editor published in the ELECTRICAL WORLD of Feb. 22, 1919, there appear several statements in regard to the recommendations of the General Electric Company in connection with protection by means of bell alarms.

Bell Alarm for Electrically Operated Oil Circuit Breakers.—The authors of the letter just referred to state that it is practically impossible to obtain extra contacts on the induction-type relay. We wish to thank them for calling attention to the fact that it is not possible actually to get these extra



WIRING SCHEME FOR BELL-ALARM RELAY

contacts self-contained on the relays themselves. The writer is accustomed to thinking of the auxiliary relay (as illustrated in the attached sketch) as an extra contact device of the main relay, and he had this in mind when his original comments were made. As a matter of fact this same relay, known as the type HG, is included within the case of some of the induction-type relays and serves to relieve the primary contacts. If an extra contact is desired, an extra type HG relay is used and mounted outside of the case. In the instantaneous plunger-type relay the extra contact is actually self-contained on the relay itself.

In any event the general comparison of the two schemes for bell alarm remains the same, namely, the simple and inexpensive two-circuit contact arrangement (whether self-contained in the relay or whether a one-circuit contact relay and an auxiliary relay as shown in the sketch), as against the troublesome and expensive passing contact auxiliary switch. In the former scheme one contact is connected to trip the breaker and the other to energize the bell-alarm relay. In the latter scheme a passing contact auxiliary switch on the oil circuit breaker temporarily energizes the bell-alarm relay while the breaker opens. In each of these cases the bell-alarm relay is reset by hand.

Bell-Alarm Air Circuit Breakers.—The authors of the letter state indirectly that the General Electric Company does not recommend the automatic reset bell-alarm switch with manually operated air circuit breakers. The following extract from Volume 3, Section 47,500, of the "Switchboard Apparatus Handbook" will be of interest in this connection:

"Where a bell alarm is desired with resetting device on a circuit where no lever switch is connected in series with the circuit breaker, the circuit-closing switch as illustrated is recommended. The construction of this switch is such that it may be opened by hand after the breaker opens, thus interrupting the bell circuit. It is automatically reset when the breaker is closed."

E. H. BECKERT,
Switchboard Department, General Electric Company, Schenectady, N. Y.

Economical Circuits for Central Stations

To the Editor of ELECTRICAL WORLD:

SIR: In articles published in the ELECTRICAL WORLD on May 25, 1918, and March 8, 1919, by P. O. Reyneau, on "Determination of Economical Power Circuits," the equivalent hours were derived to be 9.69 hours for the average industrial power circuit. The equivalent hours are defined as the number of hours per day in which the maximum load would produce the same copper loss as the actual load produces in the entire twenty-four hours. In the first article it was stated that 9.69 hours "represent an average obtained from the study of actual conditions and should be applicable to such circuits in many localities with a fair chance of accuracy."

Upon study of the method used in deriving the 9.69 equivalent hours, it is found that it is correct only when the maximum daily load is constant throughout the year. The following formula is taken from the article of May 25, 1918: "$t_e = (\Sigma I^2) / (I^2_m)$, where t_e = equivalent hours, I = average current for each hour, I_m = maximum current for the day." This formula gives the equivalent hours for one day, but as each is based on a different maximum load (unless the maximum is constant for every day) it is impossible to average the equivalent hours for the entire year.

Furthermore, in the formula for the copper loss of the circuit the value taken for "I is the maximum (yearly) current carried." The only method to determine t_e correctly for substitution in the copper-loss formula is based upon the yearly maximum current. Therefore I_m in the formula quoted above should be equal to the maximum current for the year and not the maximum current for the day.

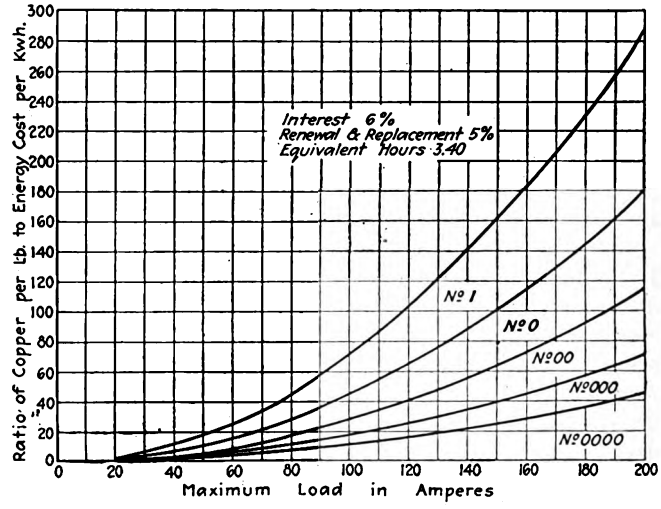
Further, it is to be noted that the average equivalent hours are derived directly from two average days each month and the calculations of copper loss based upon 300 days. This assumes that the load every day for the month is the same as the average, without any consideration of the fact that Saturday is usually but a half day for power load.

An investigation has been made covering sixteen central-station circuits supplying chiefly power, but also supplying a little lighting, as will be found on almost all central-station circuits. The average equivalent hours for these circuits were found to be 3.40 hours, which was determined in the following manner, based upon the annual maximum load:

A representative day was selected for each month and the equivalent hours were obtained for each circuit. Periods of one week were then selected, and the equivalent hours for every circuit for each day were calculated. In this way the ratio between the hours for the average day and the hours throughout the entire week was obtained. This will vary with the type of industry supplied and with the sixteen circuits varied from 81 per cent to 91 per cent.

By means of the above ratio the average hours for each circuit, based on 365 days, were obtained, and as the maximum load on all circuits was approximately the same, the equivalent hours of all circuits were obtained by averaging the equivalent hours of the individual circuits in proportion to their maximum loads.

The curve shown in the figure has been prepared using an average equivalent hours of 3.40, and it shows results far different from those shown in the articles referred to. This curve represents much more usual conditions, but as other companies may find their load conditions of a different character, it is advisable to investigate the actual conditions before determining the most economical size of wire to be used.



MOST ECONOMICAL SIZE OF DISTRIBUTION LINE CONDUCTORS

W. F. BUTCHER,
Assistant Engineer, New York & Queens Electric Light & Power Co.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

PACIFIC COAST HOLDS ITS THIRD JOINT CONVENTION

Central Stations, Jobbers and Contractors and Dealers Meet in Coronado, Cal., to "Develop Co-operation and the Spirit of Harmony"

For the third time practically all branches of the electrical industry on the Pacific Coast are holding a joint annual convention. A combined registration of about 400 was reported on Wednesday of this week, the first day of the joint sessions which are being held at Coronado, Cal. The organizations included are the Pacific Coast Section of the National Electric Light Association, the Pacific division of the Electrical Supply Jobbers' Association and the California Association of Electrical Contractors and Dealers.

The purpose of the joint meetings is primarily to "develop coöperation and the spirit of harmony" and secondarily to exchange experience on problems common to all branches of the industry.

The jobbers' sessions held on the the first two days of the week included, besides the usual golf tournament, papers by D. C. Pence, Illinois Electric Company, on "Competition Based on Vindictiveness"; W. S. Berry, Western Electric Company, on "Service on Returned Goods," and H. L. Harper, Western Electric Company, on "Relations Between Contractor, Jobber and Manufacturer."

The contractors' meetings began on Tuesday, and on Wednesday the National Electric Light Association held its opening meeting. At the latter an address of welcome was made by William Clayton, managing director for the Spreckles properties, and Albert H. Elliott, secretary of the jobbers' association, replied for the convention.

There followed the address of Samuel Kahn, Western States Gas & Electric Company, president of the association, and the reports of officers and chairmen of the various committees.

Even on this first day of the convention it was apparent that team work would be the keynote of the gathering and that earnest endeavor would be made toward furthering the general good of the industry. Samuel Chase, Westinghouse Electric & Manufacturing Company, and W. L. Goodwin, General Electric Company, demonstrated by their coöperative endeavors how rival companies could work together. Practically all of the jobbers, representing about twenty jobbing houses, remained for the joint meetings, which were divided into three classes, commercial, engineering and general or combined sessions. All papers were printed in advance so that the sessions could be devoted exclusively to discussion.

We Sent Them Over—Bring Them Back

COMMITTEE ON INDUSTRIAL LIGHTING AT ATLANTIC CITY

It Will Present a Brief Review of Industrial Lighting Practice, Together with Remarkable Results in Increased Factory Production

An announcement from the Commercial Section of the National Electric Light Association says that the committee on industrial lighting is scheduled to present at the Atlantic City "Victory Convention" a brief review of the present average lighting practice in factories and other industrial establishments in comparison with the remarkable results in increased production obtained from some test installations giving true "productive intensities."

This material has been obtained by applying the ideas of the Lighting Sales Bureau's lecture at the 1916 convention, "Lighting By-Product or Buy-Product." As in the earlier talk, the points are illustrated with a model and demonstrations. The new apparatus shows both the defects of common practice and the principles and advantages of good lighting in such a simple manner that the facts are easily remembered and applied Productive intensities are developed as equally attractive to the central station and to its customers.

"W. A. Durgin's lecture and demonstration will be a treat. Don't miss it at Atlantic City," the announcement says.

MORE EXHIBITORS FOR THE ATLANTIC CITY CONVENTION

Additional Names of Exhibitors at the National Electric Light Association Supplement Earlier List—Committee Moves to the Pier

An additional list of exhibitors at the National Electric Light Association convention, Atlantic City, during the week beginning May 19, has been issued by the exhibition committee. It has again been necessary to increase the space to take care of the many applications that have been received. The committee opened its office on the Million-Dollar Pier, Atlantic City, on May 1.

The list of additional exhibitors supplements the names published in the ELECTRICAL WORLD of April 19, page 800, and is as follows:

J. B. Beans, Philadelphia, Pa.
B C K Manufacturing Company, New Britain, Conn.
Central Station, New York.
Coffield Motor Washer Company, Dayton, Ohio.
Duplex Lighting Works of General Electric Company, New York.
Grether Fire Equipment Company, Dayton, Ohio.
Iske Company, Chicago.
Majestic Electric Development Company, Philadelphia.
Marlow Manufacturing Company, Cleveland, Ohio.
Shapiro & Aronson, New York.
Volk Manufacturing Company, Westport, Conn.
Wadsworth Electric Company, Covington, Ky.

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TOTALS LARGE IN REPORT OF GENERAL ELECTRIC COMPANY

Orders Received in 1918 Aggregate $234,100,000, While Sales Billed in the Year Aggregate Total of $216,800,000—Service of the Men

While the totals of orders received by the General Electric Company in 1918 reached large figures, they were not so great as in the preceding year. On the other hand, the amount of sales billed was larger in 1918 than in 1917. The figures compare as follows:

	1918	1917
Orders received	$234,134,037	$246,778,491
Sales billed	216,815,277	196,926,318

In the twenty-seventh annual report to stockholders C. A. Coffin, chairman of the board of directors, refers twice, in his opening and in his concluding paragraphs, to the work done for the nation by those who are in the service of the company.

"The time and energies of many of your officers, engineers and experts," he says, "have been devoted to work of a distinctly national character, and every department and facility of the company have at all times been at the service of the government throughout the period of the war.

"The devotion of the employees in all branches of your company's service during the strain and high pressure of war-time demands is worthy of high praise, and the board of directors cannot conclude this report without making grateful acknowledgment of their splendid coöperation."

In speaking of the value of orders received in 1918, Mr. Coffin says that a considerable portion was represented by contracts with the United States Navy Department. Earnings compare as follows:

YEAR ENDED DECEMBER 31

	1918	1917	1916
Net sales billed	$216,815,277	$196,926,318	$134,242,289
Less: Cost of sales billed, including all operating, maintenance and depreciation charges	188,439,521	167,921,778	118,948,198
Total	$28,375,755	$29,004,540	$15,294,091
Interest and discount	$2,112,280	$1,433,317	$1,539,499
Income from securities	2,325,782	2,661,150	1,844,645
Sundry revenue	168,254	417,822	482,738
	$4,606,315	$4,512,289	$3,866,882
Net income	$32,982,070	$33,516,829	$19,160,973
Interest on debentures	$571,645	$571,645	$571,445
Interest and discount on notes payable	1,805,443	541,356	.....
	$2,377,088	$1,113,001	$571,445
	$30,604,982	$32,403,828	$18,589,528
Less: Federal income and excess profits taxes (estimated)	13,500,000	5,500,000	.....
Profit available for dividends	$17,104,982	$26,903,828	$18,589,528
Less: 8 per cent cash dividends	9,165,622	*11,165,882	8,121,646
Surplus for the year	$7,939,360	$15,737,946	$10,467,882
Previous surplus	49,898,699	34,160,753	23,692,871
	$57,838,059	$49,898,699	$34,160,753
Less: 4 per cent dividends payable in stock	4,587,398	.....	.....
Total surplus	$53,250,661	.....	.....

* Includes 8 per cent cash, 1 per cent cash "Red Cross" and 2 per cent stock.

An important feature of the year was the provision of increased manufacturing facilities. Regarding these and the curtailment of production which followed the armistice Mr. Coffin says:

In order to expedite the completion of government and other contracts essential to the prosecution of the war, your company was forced to make heavy expenditures for additional manufacturing facilities. As a result the rate of production had reached the highest point in the company's history when the armistice was signed on Nov. 11, 1918. The cessation of hostilities resulted in suspensions and cancellations of orders, estimated at the date of closing the accounts at $30,000,000, leading a balance of approximately $80,000,000 of unfilled orders at the end of the year.

The expenditures for additional land, buildings, machinery and other equipment aggregated $21,593,996. As these facilities were required for the manufacture of apparatus and supplies urgently needed in the prosecution of the war, it was imperative that they be provided with the least possible delay and under circumstances which made economy of construction impossible.

In view of the fact that a portion of the recent additions to manufacturing facilities will for a considerable time be unused, and having regard to the high cost of such additions, the sum of $15,224,162 has been written off the plant account, and $3,186,793 will be included in the cost of unfinished contracts.

Of the total of $18,410,955, the sum of $1,918,702 was charged against the general plant reserve, leaving an increase of $5,101,744 in the book value of plant and equipment, as follows:

	Gross Book Value	General Plant Reserve	Net Book Value
Real estate and buildings	$43,146,598	$15,061,826	$28,084,772
Machinery	31,810,044	15,854,665	15,955,379
Patterns	1,900,750	1,900,749	1
Furniture and fixtures	3,083,396	3,083,395	1
Total	$79,940,789	$35,900,635	$44,040,154

On Jan. 31, 1918, the book value of the manufacturing plants was $3,958,528. During the twenty-five years ended Dec. 31, 1917, additional expenditures were made aggregating $110,955,804. There was expended during 1918 $21,593,997. The total of these items is $136,508,329. The company wrote off or carried to "general plant reserve" during the twenty-six years $92,468,175. This left the book value of all plants, Dec. 31, 1918 at $44,040,154.

The total factory floor space in 1918 was 19,581,000 sq.ft., as compared with 17,573,000 sq.ft. in 1917.

A number of other matters are then taken up by Mr. Coffin, as follows:

The increased prices of material and much higher labor costs have resulted in increasing the inventory accounts. After providing proper reserves and making adjustments in recognition of the decrease in market prices since November, 1918, the inventories in factories, district warehouses and consignment stocks are carried at $88,305,680, an increase of $6,454,369 as compared with 1917.

Customers' accounts and notes receivable have been carefully valued in accordance with the usual practice and, after allowing for necessary reserves, are carried at $41,548,688, an increase of $3,141,695 over the amount shown in December, 1917.

The book value of investment securities is $40,830,213, an increase of $3,481,605 as compared with Dec. 31, 1917. The principal increases represent the balance of your company's investment in Liberty bonds and in the capital stock of the Edison Electric Appliance Company, Inc.

Advances to subsidiary companies have been increased chiefly by advances to the Lawrence Park Realty Company of Erie, Pa., made at the request of the government for the purpose of erecting houses for the increased force of workmen engaged on contracts with the Navy Department. The government coöperated by a loan to your company of $1,000,000 of the required amount, to be liquidated within ten years.

The government has also advanced to your company $500,000 as part of the cost of power and transportation facilities in the city of Erie, urgently needed for the production of machinery and apparatus for the navy. This sum your company in turn loaned to the public utility companies of Erie, receiving their obligations therefor. The total of your company's debt to the government is thus $1,500,000.

In order to provide additional facilities for the manufacture of incandescent lamps, your company has leased the Sandusky works of the Libbey Glass Company, with contract to purchase. Pursuant to the terms of the contract,

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the General Electric Company has deposited with a trustee its 5 per cent debenture bonds of the par value of $2,265,000.

At the close of the year, after careful consideration, the board of directors decided that the interests of your company would best be served by segregating its investments and activities in foreign countries in manufacturing, selling, engineering and utility enterprises, etc., and transferring them to a separate company. For this purpose the International General Electric Company, Inc., was organized in January, 1919. It will at once take over the investments and conduct the activities above described in all foreign fields. Charles Neave, a valued member of your company's legal staff, has been elected chairman of the board of the new international company. Gerard Swope, formerly vice-president of the Western Electric Company, has been elected president, and M. A. Oudin, for many years manager of the foreign department of the General Electric Company, has been chosen as vice-president.

The outstanding capital stock of the company has been increased from $101,512,500 to $115,874,800 in the following manner: Subscriptions by shareholders in January, 1918, at par, on the basis of one additional share for each ten shares then outstanding, $10,061,218; amounts of the semi-annual stock dividends of Jan. 15 and July 15, 1918, $4,301,082; total increase, $14,362,300.

Of the employees, 8421 joined the military or naval forces of the United States during the war. Of these, 1880 have already returned and have been reinstated. All returning employees honorably discharged from military or naval service have been or will whenever possible be reëmployed, and when so reëmployed, Mr. Coffin states, will be held to have been continuously in the service of the company in regard to participation in pension and other benefits.

The balance sheet as of Dec. 31, 1918, shows that real estate, buildings, warehouses, etc., other than manufacturing plants are carried at $672,465. Furniture and appliances other than in factories stand at $1. Following the conservative policy of the company patents and franchises appear at $4,304,973 less a reserve of $4,304,972, or $1 net. Cash on hand was $24,010,024. Current assets stood at $156,288,707. Current liabilities were $27,416,082. The total surplus stood, as stated, at $53,250,661. There was also a general reserve of $6,100,000.

Peace Hath Its Victory Loan

STATE UTILITY COMMISSIONS FIGHT GOVERNMENT CONTROL

About Forty Commissions Represented in Chicago Conference on Plans for Testing Federal Authority on Rates Before Supreme Court

Commissioners acting in behalf of public utility and railroad commissions of about forty states met in closed session at Chicago on Monday of this week to prepare briefs for submission to the United States Supreme Court on May 5, when the various suits to determine the respective authority of the United States government and the states in the matter of railroad and telegraph rates are to be heard. These briefs will maintain the position which the states have consistently taken, namely, that their own regulatory bodies, the railroad commissions and public utility commissions, have authority over intrastate rates. The events leading up to the suit are principally as follows:

In North Dakota the Railroad Commission was sustained in the state courts when it asserted its rights to regulate intrastate rates. This case has found its way to the United States Supreme Court. In Massachusetts the commission was not sustained when it asserted in the state courts its right to regulate intrastate telephone rates, the courts acting on the theory that the government cannot be sued. This case also has gone to the United States Supreme Court. A similar case in South Dakota has been heard. The state courts there sustained the commission. Once more the suit has been appealed to the Supreme Court of the United States. More recently in Illinois an injunction in the state courts was granted and later dissolved enjoining the Public Utilities Commission, the state courts and the Attorney-General from interfering with government action on intrastate telegraph rates.

The commissions of these states and of other states have been invited to be represented at the hearings before the United States Supreme Court and to file briefs "as friends of the court." Two separate briefs will be filed by the committee representing the various commissions, and separate briefs will be filed by some of the individual state regulatory bodies. The hearing before the United States Supreme Court has been advanced to May 5 at the instance of counsel for the Postmaster-General and the Railroad Administration.

They Went, They Saw, They Conquered

ADMINISTRATION TO RETURN WIRE LINES TO THE OWNERS

Official Announcement that Government Will Surrender Control of Cables—Indication of Action on Telephone and Telegraph

In official statements issued in Washington on Monday of this week the Postmaster-General announced the early return of the ocean cable systems to their owners and that he would recommend the return of the telegraph and telephone properties as soon as legislation can be passed. The statements follow:

The Postmaster-General has recommended to the President that the government return the cable lines to their respective owners. This action is made possible by the fact that the congestion resulting from war conditions has largely passed. The enemy commercial blacklist has been abolished and the tremendous volume of government cable messages from and to the War Trade Board has ceased. The bar to commercial code messages has been removed, thus materially lessening the cable loads. The use of the cables in connection with the peace conference has been greatly diminished. The Postmaster-General hopes that the return of the cables may be effective not later than May 10.

The Postmaster-General will also recommend that the telegraph and telephone lines be restored to their respective owners as soon as legislation can be secured from Congress safeguarding the interests of the owners in every way that it is possible to safeguard them. The information of the Postmaster-General as to the condition of the wire companies convinces him that it is imperative that such legislative action must be had before the various telegraph and telephone lines are returned. This is not true as to the cable lines, which are in a condition to be returned at once.

A later order fixed the date for the return of the cable systems as midnight May 2.

Your Money Will Bring Some Back

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HELP ALONG "NATIONAL PROSPERITY CAMPAIGN"

"The Public Should Have a Clear Conception of the Changed Economic Conditions of the World," Says P. H. Gadsden

An exensive organization is pushing the "National Prosperity Campaign." Its slogan is "Let's go," and its headquarters are in the Hotel Commodore, New York. P. H. Gadsden, vice-president United Gas Improvement Company, Philadelphia, and chairman of the National Public Utilities Committee, is chairman of the organization committee. The other members are as follows:

Milton E. Ailes, vice-president Riggs National Bank, Washington, D. C.
E. P. Albrecht, president Philadelphia Bourse, Philadelphia.
John J. Arnold, vice-president First National Bank, Chicago.
Alexander C. Brown, president Brown Hoisting Machinery Company, Cleveland, Ohio.
Joseph E. Davies, former chairman Federal Trade Commission, Washington, D. C.
Cardinal Gibbons, Baltimore, Md.
H. W. Gossard, president H. W. Gossard Company, Chicago.
John Hays Hammond, Washington, D. C.
Charles F. Lang, president Lakewood Engineering Company, Cleveland, Ohio.
James H. McGraw, president McGraw-Hill Company, Inc., New York City.
Franklin T. Miller, president F. W. Dodge Company, New York City.
Julius Rosenwald, president Sears, Roebuck & Company, Chicago.
Frank A. Sieberling, president Goodyear Rubber Company, Akron, Ohio.
E. T. Trigg, general manager John Lucas Company, Philadelphia.
S. M. Williams, president Highway Industries Association, Washington, D. C.

In a letter to American business men Mr. Gadsden discusses the needs of business conditions to-day. He declares that American prosperity now depends upon the spirit of service of business men.

"The country needs education even more than it was needed during the war," says Mr. Gadsden. "The changes of conditions, commercially, economically and socially, since the European war began have been so vast and so rapid that the average man has only a faint appreciation of how far-reaching and how fundamental they are. People think that because the war is over we can go back to pre-war conditions, levels of prices and wages.

"This, of course, is impossible, but until its impossibility and the reasons why it is impossible are understood by the general public the public mind will be in a state of hesitation and confusion, particularly with regard to buying and selling.

"With a sense of this situation and a belief that the country is waiting for leadership, several of the leaders of thought in the country have given their approval to the inauguration of a campaign to stimulate a clear understanding of conditions as they are, to bring about a realization of the fact that we are in a new world, and to start the thinking of the public along lines which are in accord with to-day's conditions.

"Advertisements have been prepared to visualize and exploit some of the simple fundamental and most important points in the situation in an effort to give direction to public thought and action. It is believed that if this and similar educational material is brought to the attention of the country in a sufficiently emphatic and continuous way to get it definitely across, it will lead to a go-ahead spirit in business which will be reflected in the immediate and continuous improvement of business conditions in general.

"It is in the interest of American business that the public should have a clear conception of the changed economic conditions of the world and of the basic reasons why this country should now go ahead energetically and enthusiastically in a spirit of unity and harmony.

"In your own interest and in the interest of American business will you see to it that this campaign is given full publicity so that it will effectively reach your customers and your buying public?"

An executive staff, of which Mr. Gadsden is chairman, is ready to furnish copies of the advertisements and other material designed to promote prosperity upon application to the "National Prosperity Campaign," Suite 700, Hotel Commodore, New York City.

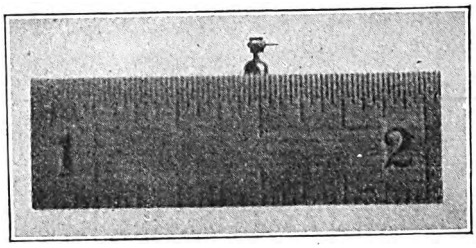
BATTLESHIP TENNESSEE LAUNCHED IN BROOKLYN

Electrically Propelled Superdreadnought, Is Now 60 per Cent Completed and Will Be Ready for Service Early in 1920

The battleship Tennessee, which is to be electrically propelled, was launched at the Brooklyn Navy Yard on Wednesday of this week. This superdreadnought, representing the largest unit in the navy of any nation, is now more than 60 per cent finished. The expectation is that it will be fully equipped early next year.

A sister ship of the Tennessee, the California, is under construction at the navy yard at Mare Island, Cal. It is to be launched in the fall.

The Smallest Turbine in the World



What is believed to be the smallest operating turbine ever built has been completed by Ivan T. Nedland, Hillsboro, N. D. Mr. Nedland also built the smallest electric motor and the smallest steam engine in the world, these being on exhibition at the Panama Pacific Exposition in San Francisco and also at the University of North Dakota. The turbine is smaller than either of the other small devices. The rotor is made of steel and has six slots. The diameter of the rotor is 0.032 in. and the shaft is 0.007 in. in diameter. The weight of the rotor is 2 mg. The diameter of the complete turbine is 0.048 in., or about one-half the diameter of an ordinary pin head. The complete turbine weighs 12 mg. The turbine will not run with steam as that fluid is too heavy for it to operate on. It is mounted on a hollow pedestal so that an air hose can be attached to the bottom. It will run at vary high speed when air is applied. The casing of the turbine is made of gold. The complete machine consists of eight parts. It is kept in a glass case so that moisture, which would affect its running, will be excluded.

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PROGRAM FOR CONVENTION OF CONTRACTORS AND DEALERS

Nineteenth Annual Gathering to Be Held at Milwaukee from July 14 to 18 Will Consider Many Subjects of Interest

Following is the tentative program for the nineteenth annual convention of the National Association of Electrical Contractors and Dealers to be held in Milwaukee from July 14 to 18:

Monday, July 14, 1919.—Executive committee meetings at the Hotel Pfister at 10 a. m. and 2 p. m.; registration bureau to open at the Hotel Pfister at 4 p. m. on this day.

Tuesday, July 15, 1919.—Executive committee meetings at the Hotel Pfister at 10 a. m. and 2 p. m.

Wednesday, July 16, 1919.—Opening session of convention at auditorium at 10 a. m.: opening address, representative of the Wisconsin State Association; address of welcome, representative of the state government; response by national chairman, W. Creighton Peet; address on coöperation, speaker to be selected. Convention session at auditorium at 2 p. m.: address on standard cost-accounting system, illustrated by lantern slides; report on estimating forms and methods. Reception and dance at Hotel Pfister at 9 p. m.

Thursday, July 17, 1919.—Outing at Waukeshaw Beach; special trolley cars to beach leaving at 8:30 a. m. Convention session in pavilion at 10:30 a. m.: address on general business conditions and outlook, speaker to be selected; address by W. L. Goodwin; lunch to be served in the pavilion; afternoon to be devoted to sports.

Friday, July 18, 1919.—Convention session at auditorium at 10 a. m. Section meetings: "Repair and Sale of Used Apparatus," A. L. Swanson, chairman; addresses on methods of determining value of burned-out apparatus, what constitutes efficiency in the repair business, methods of dealing with the public; discussion. "Merchandising and Fixture Dealing," J. A. Fowler, chairman; addresses on arrangement and conduct of a retail store, relation of the dealer to the public in merchandising; discussion. Meeting of state and local secretaries, J. P. Ryan, chairman. Convention session at auditorium at 2 p. m.: address on labor, speaker to be selected. Matters referred to the convention by the executive committee. Annual dinner (informal) at Hotel Pfister at 6:30 p. m.; no speaking; singing led by James R. Strong.

Saturday, July 19, 1919.—Meeting of executive committee at Hotel Pfister at 10 a. m.

Additional entertainment features, including the entertainment provided for the ladies, will be announced in later program. All meetings of the convention and the executive committee are open to all persons interested and full discussion of all subjects presented is invited. The association headquarters will be the Hotel Pfister.

RATE ORDER MODIFIED BY NEW YORK COMMISSION

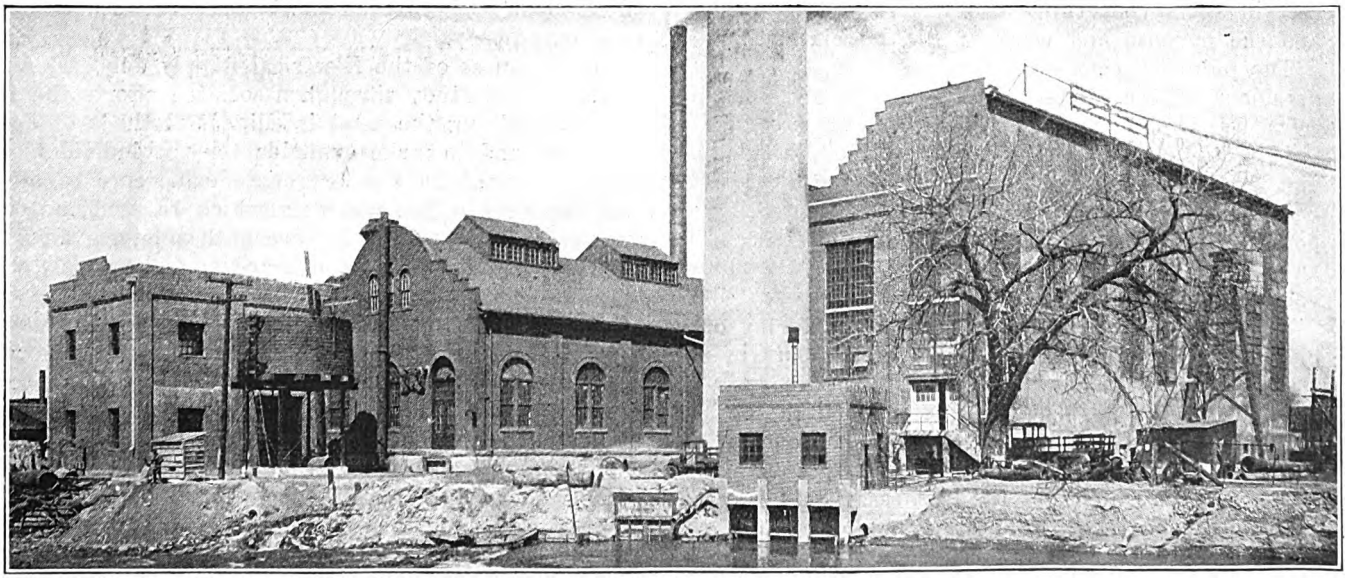
First District Commission Rescinds Order for 8-Cent Rate in Flatbush and Authorizes a Maximum of 10 Cents

On motion of Commissioner Charles S. Hervey, the New York Public Service Commission for the First District has issued an order fixing the maximum rate to be charged by the Flatbush Gas Company for electricity at 10 cents per kilowatt-hour, effective on and after May 1, 1919.

The order of the commission follows a rehearing after a decision made by it on Feb. 1, 1918, at which time the rate charged by the company was 12 cents per kilowatt-hour. The order of Feb. 1 fixed rates effective at various times, the final rate to be 8 cents per kilowatt-hour on and after March 1, 1919. An appeal from this order was taken to the courts by the company on several grounds, particularly in reference to the forecast of the commission as to the company's earnings during 1918 and 1919, which the company held was too low an estimate. The appeal is still pending. The company also applied to the commission for a rehearing, which was granted with the above result.

Commissioner Hervey found that the estimates of the commission as to the probabilities of revenue and expenses during 1918 and 1919 were too low.

New Generating Facilities at the Denver Central Station



Additions have been made to the Lacombe generating station of the Denver Gas & Electric Company, a Doherty property. As the existing engine room had ample capacity for the turbine and condenser equipment, the new buildings are a boiler room and a transformer house. That additional facilities were necessary is shown by the fact that the output of electrical energy for the three months ended March 31, 1919, increased over 30 per cent above 1918.

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NEW YORK COMPANIES PLAN CONSOLIDATION

United Hudson Electric Corporation to Acquire Kingston and Water-Power Properties and Transmission Lines in District

Application has been made to the New York Public Service Commission, Second District, by the United Hudson Electric Corporation for authority to acquire the capital stock of the Kingston Gas & Electric Company, including the Ulster Electric Light, Heat & Power Company, and 775 shares of stock of the Upper Hudson Electric & Railroad Company of Catskill. Authority is also asked to purchase the stock of the Rifton Land Corporation and to develop two water-power sites on the Wallkill River at Dashville. One of these will have a capacity estimated at 50,000 hp. in the near future. Another proposed activity of the company, for which it asks authority from the commission, is the purchase of transmission lines built recently near Kingston, Newburgh and Poughkeepsie. The company was incorporated on Feb. 14 to operate in Ulster, Greene, Albany, Dutchess, Putnam and Orange Counties. Its capital is $3,000,000.

You Got the Victory—Buy Notes

AIM OF PUBLICITY CAMPAIGN OF THE JOBBERS' ASSOCIATION

Statement of Its Purpose in Connection with Relations of Jobber to Other Elements in the Industry

The following has been issued in regard to the publicity campaign of the Electrical Supply Jobbers' Association:

At the meeting of the Electrical Supply Jobbers' Association held at Hot Springs, Va., May 22-23, 1918, a publicity committee was appointed to make an investigation of the means to be employed and the expense involved in conducting a campaign of publicity the purpose of which would be to set before the trade certain facts concerning the nature of the business and the purpose and work of the association.

The publicity committee, composed of A. M. Little, president of the Mohawk Electrical Supply Company, Syracuse, N. Y., chairman; F. R. Elliott, president of the Elliott-Lewis Electrical Company, Inc., Philadelphia, and F. D. Van Winkle, president of the Post-Glover Electric Company, Cincinnati, Ohio, presented its report at the Cleveland meeting of the association, Dec. 9 to 11, 1918, and an appropriation of $12,000 was voted for the committee to continue its work.

Subsequently arrangements were made to lay out a plan which includes the use of advertisements in electrical journals, reprints of these advertisements for mailing by the members of the association, booklets describing the campaign for the use of members and members' salesmen, booklets for distribution to the trade, a prize contest for the best essay on jobber distribution from the central-station and contractor-dealer standpoint with suitable and generous compensation for the winner, conference and correspondence with the editors of the electrical journals, and an exchange of experiences, ideas and suggestions with other associations in the industry and with other associations of jobbers.

In connection with the use of the electrical journals it was decided to spend approximately $8,000 for advertising space out of the total of $12,000 available. The schedule includes a total of 108 pages of advertising in the papers selected, not less than nine pages in any one month, as many as thirteen pages in one month, and including six double-page spreads.

The publicity campaign began in the March issues of the publications selected and will be continued throughout the remainder of the present year.

There has been some misapprehension regarding the purpose of the publicity campaign, especially with regard to the motives back of it, in connection with the relations of the jobber in general to other elements in the industry.

The publicity campaign is directed primarily to increase the use and consequently the sale of electrical apparatus and supplies. Anything that retards the rapid introduction and wide distribution of electrical goods holds back the industry. The business of the jobber has been evolved out of the necessities of both producer and buyer. On the part of the producer there is and has always been since the electrical industry assumed national proportions a need for means to speedily reach all points of possible demand and the assurance of business in such quantity as would stabilize production. On the part of the buyer there is and has always been a need for access to stocks near at hand in such combinations that, no matter how numerous or how few his requirements might be from day to day, his wants might always be supplied at short notice and at low cost.

In the great growth of the industry the function of the jobber has never been displaced, and the trade channels which have been established through the necessities of the producer and buyer have never been diverted. While, on the one hand, the functioning of the jobber has contributed thus to the rapid development of the industry, this very development has, on the other hand, brought about many problems of distribution which have made this jobber function more and more a necessary factor, and constant study of all of of the elements entering into such distribution have been made to keep even the balance between economy and expediency.

The purpose of the Electrical Supply Jobbers' Association is to study through associated efforts the factors underlying the most intelligent methods of doing business and to make available for the individual the lessons taught by the aggregate experience of all of its members. The statistics which the various committees of the association are gathering are analyzed and business methods so adjusted as to keep pace with the development of the electrical industry and the consequent increasing demand for jobber representation.

This being the purpose of the association, the purpose of the publicity campaign is to reveal to the trade definite information along these lines, so that every element interested, from producer to ultimate consumer, may understand clearly the advantages that all derive from adherence to a policy of jobber distribution.

In carrying out the publicity campaign no effort is intended to usurp the function of other elements in the industry, nor to divert to the jobber any recognition other than that which a fair and honest evaluation of his services inspires. In the benefits that may accrue all elements in the industry—non-members as well as members of the association—will participate.

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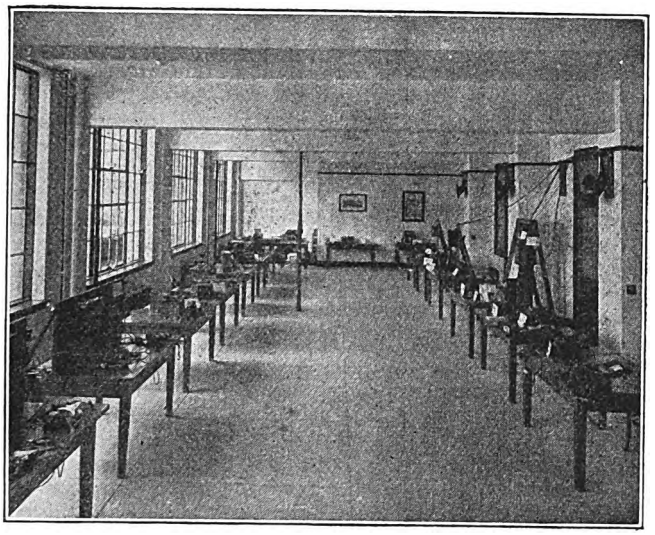
Exhibits at Bureau of Standards



An extensive exhibit of war materials was made at the Bureau of Standards, Washington, on April 25 to 29 in connection with the ninety-seventh regular meeting of the American Physical Society.

Private manufacturers, educational and other research laboratories and government departments furnished exhibits. One of the exhibit rooms is illustrated herewith.

NEXT MEETING OF THE ELECTRIC POWER CLUB

Gathering to Be Held at Hot Springs, Va., on May 22, 23 and 24—Copies of the Standardization Rules in Hands of Secretary Roth

The Electric Power Club will hold its next meeting at the Homestead Hotel, Hot Springs, Va., on May 22, 23 and 24.

C. H. Roth, secretary of the club, 1410 West Adams Street, Chicago, has copies of the standardization rules of the club, which will be sent to persons interested.

Please Lend on These Notes—U. S.

ENGINEERING SOCIETIES FOR DEPARTMENT OF PUBLIC WORKS

Seventy-four Societies Represented at Conference in Chicago—Principles Adopted with Reference to Character of Proposed Department

Representatives of seventy-four engineering societies, having a combined membership of over 100,000, met in Chicago last week and, as a result of discussions occupying two full days, formed an organization to promote the passage by Congress of a bill creating a federal department of public works. Principles were adopted for determining the character of the proposed department and specific recommendations made as to the services and bureaus to be incorporated therein. The drafting of the bill itself was left to a committee with full power and the management of the organization to an executive committee, which was authorized to appoint a finance committee, to which in turn will be left the problem of raising the necessary funds. A campaign committee was also authorized and in part appointed. Sessions were also devoted to a consideration of government coördination in mapping the United States and to the relations of non-member organizations to the Engineering Council A dinner was given the delegates by the general committee of the technical societies of Chicago (F. K. Copeland, chairman), while the Western Society of Engineers placed its meeting hall, stenographic and other facilities at the disposal of the conference.

J. Parke Channing, chairman of the Engineering Council, set forth the purpose of the conference and the general reasons why engineers had repeatedly urged the formation of a federal department of public works. He made it clear that the Engineering Council desired, in connection with the conference, to afford only the means of bringing the delegates together, and that it had no desire to be a determining factor in the conclusions reached. For that reason the Engineering Council and its members who happened to be present would have no voice in the proceedings.

M. O. Leighton, chairman National Service Committee, was elected chairman of the conference, and E. S. Nethercut, secretary Western Society of Engineers, secretary of the conference.

Philip N. Moore, St. Louis, presented the report of the National Service Committee. This stated that the public good demanded the coördination of the engineering activities of the government and that this demand was so fundamental that sooner or later it was sure to be complied with. It would be better, he contended, that engineers should be instrumental in bringing about the necessary coördination than that it should be left to others.

There was general appreciation of the necessity of organizing the profession down to the last congressional district in order that the merits of the proposed measure might be brought home to members of Congress through the public and through engineers resident in each congressional district. The lack of national organization of the profession was brought up repeatedly and much deplored, the discussion at times broadening out to include suggestions for the coördination of all elements of the profession. J. Parke Channing, chairman of the Engineering Council, pointed out that the council was still in its formative stage and so far had included only national engineering societies. An amendment was pending, however, which, if adopted, would permit of the affiliation of local societies as well. He was of the opinion that engineers might learn from the American Federation of Labor, which is very loose in its organization and admits all bodies that can contribute to its ends. He offered the services of the National Service Committee to the conference in its work of promoting the public works department bill.

W. H. Hoyt of Duluth maintained that there was need for a paper devoted to the public and civic interests of engineers. Mr. Channing agreed on the need for such a paper, pointing out that it had been considered by the Engineering Council but that the council could do nothing in the matter for lack of funds. E. J. Mehren, on behalf of the McGraw-Hill Company, offered to the conference space in the journals owned by that company in the promotion of the bill. A similar offer was made by other papers.

A resolution was passed providing that the conference be known as the Engineers, Architects and Constructors' Conference on National Public Works.

Victory Notes We Sing, Also Buy

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MORE THAN PROFIT TAKING IN INTERNATIONAL TRADE

Maurice Coster Tells National Foreign Trade Council that This Is the Time to Assist in Restoring Normal Conditions in Allied Countries

Maurice Coster, managing director Westinghouse Electric Export Company, made an address on "Our Export Trade with Europe" before the National Foreign Trade Council, which met in Chicago on April 24 to 26. Mr. Coster returned recently from a personal investigation of European conditions. He directed attention to the great importance to the manufacturing exporters of this country of a proper understanding of conditions on the other side before they make plans for development of their European sales.

Mr. Coster said that Great Britain, for instance, in addition to the enormous debt which she incurred during the war, has sold almost all her foreign holdings with the exception of £2,000,000,000 of South American securities, which she has retained to prevent the severance of her trade relations in that quarter.

The debt of France is so great that it has been estimated that every man, woman and child in France now owes the rest of the world a thousand dollars.

Italy is laboring under an enormous burden of debt and, without adequate natural resources of her own, such as coal and iron, is in even a worse position than Great Britain or France.

However, even more important from an industrial viewpoint than the financial difficulties of these countries, declared Mr. Coster, is the staggering loss to their productive man power which they have endured.

It is true that in certain industries women were called in during the war to take the place of the men at the front. There is general agreement that the labor of these women has been satisfactory and that they will continue to occupy an ever-increasing place in the industrial life of Europe. On the other hand, it must be remembered that it will take some years for the infiltration of women into general industry to be accomplished and even longer for them to take the place of the skilled workers who will never return.

The speaker said that at the present moment our allies are engaged in a desperate endeavor to effect the transition from a war to a peace basis. Their problem in this regard is infinitely greater than our own, because, unlike ourselves, they depended upon other nations during the war for peace-time necessities and transferred practically their entire industrial strength to manufacturing the munitions of war. It will take at least two years to place the factories of England, France and Italy in the same position for peace-time production which obtained before the war.

This, then, is the picture which every American manufacturer should have before his eyes when he considers developing his trade in the allied countries. Practically untouched by the war, he is in a position to undersell the industries of the Allies in their own markets. If he were permitted to go freely into these markets and compete without restriction, it would mean the temporary, if not the permanent, destruction of Europe's industries. Continuing, Mr. Coster said:

> I do not believe that any intelligent American business man would desire to see such a situation created. We have built up our domestic trade on the theory that the manufacturer's best interests are served when his customers are prosperous. We cannot build up our international trade by ignoring the best interests of our foreign customers.
>
> I am very firmly of the opinion that nothing could be worse for the future of America's foreign trade than the permission to enter into unrestricted competition with the manufacturers of England, France and Italy in their home markets.
>
> England, France and Italy are now working out plans for their domestic salvation. In these plans they should have our assistance rather than our interference. They know better than we do what is necessary for the restoration of their industries. Our first and most important duty is to give them full assurance that we understand their problems, sympathize with their difficulties and stand ready to supply them with what they need rather than what we want to give them.
>
> This does not mean that we shall not have an export trade with the Allies—quite the contrary. Those things which they cannot make themselves must be secured from us. Just as food and certain raw materials are now flowing in a steady stream from this country to the other side, so in an ever-increasing volume will go those manufactured articles which these countries need for the restoration of their industries and for the development of their business.
>
> Furthermore, while the European countries are restoring their domestic affairs, the demand of the rest of the world for our products will be greater than ever before. What we lose in Europe by taking the large-minded view will in a measure be compensated for by the increased opportunities presented by those countries which formerly drew the greater part of their imports from Europe.
>
> Europe, I am firmly convinced, will not be in a position for many years to meet the requirements of South and Central America and the Orient. These are the fields to which the American manufacturer should direct his energies with almost certain promise of profitable and increasing trade.

Mr. Coster then turned to a consideration of the conditions that will prevail when Europe at last becomes normal and expressed the belief that there will be greater opportunity for the American exporter than ever before.

In the first place, he will no longer be confronted with the obstacle of cheap European labor. The leaders of thought on the other side are convinced that the present effort to raise the standards of European wages more nearly to the level with American standards will be successful, and there are evidences on every hand that the organized labor of Europe is determined to secure the recognition which can only come through higher wages.

In the second place, Mr. Coster continued, the standard of living in the allied countries has been raised.

These two factors, higher standards of wages and of living, mean that in years to come the manufacturers of this country will find better markets abroad for American products than they ever had before the war.

"We may go out of European competition for a while, but in the long run the changes brought about by the war will, I think, be favorable rather than unfavorable to this country's European trade," said Mr. Coster in conclusion. "The important thing at the present moment is that we shall do nothing which shall cause our friends across the ocean to lose confidence in our friendship or our good faith. We must make it clear that, while we are business men, we believe that there is something more than profit taking in international trade. Alone of the great producing nations, we are in a position to play a tremendous part in the salvaging of Europe's commercial structure, and the more generously and intelligently we perform our part, the greater the prospect there will be for a permanent and gratifying expansion of our future European business."

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Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 927 of this number.

Cleveland (Ohio) Electrical League.—Harold T. Clark told some of his experiences at the peace conference to the league members on April 24.

Arkansas Utilities Association.—May 20, 21 and 22 are the dates set for the annual convention of the Arkansas Utilities Association, which is to be held in Fort Smith, Ark.

A. I. and S. E. E., New Section Formed.—The Birmingham Section of the Association of Iron and Steel Electrical Engineers has been organized and will hold its first regular meeting to-day to elect officers.

Annual Meeting of the S. E. D.—The Society for Electrical Development, Inc., will hold its annual meeting at 10.30 o'clock on the morning of May 13 at the society's offices in the Engineering Societies Building, New York City.

Institute of Radio Engineers.—A meeting of the Institute of Radio Engineers is to be held on May 7 in the Engineering Societies Building, New York City. "The Detecting Efficiency of the Thermionic Detector" is the title of a paper which will be presented by Dr. H. J. van der Bijl of the Western Electric Company. This paper describes convenient methods for measuring absolutely or by comparison the true detecting efficiency of vacuum tubes.

I. E. S., May Meeting.—"Marine Camouflage" will be the subject discussed at the May 8 meeting of the Illuminating Engineering Society, which is to be held in the Engineering Societies Building, New York City. These papers will be presented: "The Growth of Marine Camouflage," by Lieut. Harold Van Buskirk, U. S. N.; "The Science of Marine Camouflage Design," by Lieut. Everett S. Warner, U. S. N., and "The Low-Visibility Phase of Marine Camouflage," by Dr. Lloyd A. Jones, Eastman Kodak Company.

Ohio Electric Light Association.—Committee meetings of the Ohio Electric Light Association were held at Dayton on April 17 and 18. The transmission and distribution committee heard the following papers: "High-Tension Transmission-Line Operation," by Frank Howard, general superintendent Wheeling (W. Va.) Electric Company, and "Type and Rupturing Capacity of Oil Switches for Substation and Transmission Lines," by J. B. MacNeill, East Pittsburgh, Pa. The program of the meter conference included papers by A. H. Bryant, Cleveland (Ohio) Electric Illuminating Company, on "Scheduling Service Tests of Small-Capacity Meters," and by J. L. Wright, Toledo Railways & Light Company, on "Training Men for Meter Work."

Baltimore Get-Together Meeting.—A meeting of contractor-dealers in conjunction with the jobbers, manufacturers and central-station men was held in Baltimore, Md., April 15.

Massachusetts State Association of Electrical Contractors and Dealers.—The monthly meeting for the Boston district of the Massachusetts State Association of Electrical Contractors and Dealers was held March 20.

Electrical Men to Meet in Portland, Ore.—A meeting of jobbers, contractors, dealers, central-station men and manufacturers to stimulate business in the electrical industry will be held at Portland, Ore., on May 21 and 22.

Engineers' Club of Trenton, N. J.—J. F. Lincoln, vice-president of the Lincoln Electric Company, Cleveland, Ohio, gave an illustrated talk on "Electric Arc Welding as Applied to Present-Day Commercial Manufacturing and Repairs" before a recent meeting of the Engineers' Club of Trenton, N. J.

Engineers' Society of Milwaukee.—The monthly meeting of the society was held under the auspices of the Milwaukee Section of the American Institute of Electrical Engineers on April 29. A. A. Oswald of the Western Electric Company gave an illustrated talk on "Wireless Telephony and Telegraphy in War."

New York Electrical Society.—The 373d meeting of the society was held on April 24. Charles E. Clarke of the United States Employment Service gave an address on "How the Government Is Meeting the Unemployment Situation," and Dr. Gilman Thompson lectured on "The Functional Reëducation of the Soldier and the Civilian."

Southwestern Electrical and Gas Association.—At the "Victory" convention of the Southwestern Electrical and Gas Association, to be held in Galveston, Tex., on May 12, 13 and 14, there will be two special sessions each for the gas, the electric light and power, and the street and interurban railway sections. There will be a "round-the-table" discussion at every session. Two general sessions will also be held.

American Institute of Electrical Engineers

Denver Section.—Paul M. Lincoln, past-president of the American Institute of Electrical Engineers, addressed the meeting held on April 19, his subject being "The History of Power Transmission."

Philadelphia Section.—The April 14 meeting of the section was devoted to a discussion of the work of the committee on development. F. L. Hutchinson, J. F. Stevens and Dr. William McClellan were the principal speakers.

Detroit-Ann Arbor Section.—On April 11 Prof. John C. Parker, University of Michigan, led a "round-table talk" on "Direct-Current Motors," discussing the speed and torque characteristics in reference to the adaptation of the various types to specific load applications. Prof. B. F. Bailey, University of Michigan and consulting engineer for the Howell Motor Company, gave a "round-table talk" on "Induction-Motor Characteristics" at the April 25 meeting.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Discount on Bonds Sold.—In authorizing the Commonwealth Edison Company of Chicago to issue $4,000,000 bonds to discharge short-time loans and reimburse the treasury for capital expenditures the Illinois Public Utilities Commission provided that the bonds should be sold to net 90 and interest and that the sales expenses should be amortized from income or charged to profit and loss.

Increase in Rates in California.—The Western States Gas & Electric Company has been authorized to increase its rates for gas and electricity in the Stockton district, the Railroad Commission having found that the rates fixed for gas last June and the electric rates fixed last November fail to yield a reasonable return to the company. This is due to added cost of oil and material, labor and taxes. The new rates for electricity are still ordered in the shape of a surcharge, the principal change being made in the flat rate for commercial lighting, which is increased from a 5 per cent to a 10 per cent addition to the monthly bill. The surcharge for energy sold for power service is increased from 1 mill a kilowatt-hour to 1½ mills a kilowatt-hour, and the surcharge for railway power and for energy sold other utilities is made 1 mill a kilowatt-hour, an increase of 0.5 mill. There is no change in the surcharge of 5 mills a kilowatt-hour for energy sold for domestic, commercial and municipal metered lighting other than street lighting. The new rates went into effect March 20. The company's estimates were accepted as reasonable by the commission, excepting the claim for taxes. This the commissioners cut from $30,641 to $23,846, holding to the view expressed in a previous Western States rate case, that federal war taxes should not be passed on to the consumer but should be borne by the utilities.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Metric System Urged.—The World Trade Club, San Francisco, has issued a booklet urging that messages be sent to American and British authorities asking the adoption of the metric system of weights and measures in the United States and in Great Britain and her dependencies.

Members for Society of Electrical Development.—J. M. Wakeman, general manager Society for Electrical Development, has written to members inclosing booklets to interest men in the industry "who should be supporting the society but who are not doing so. There are thousands of concerns all over the country reaping the benefit of the society's work and contributing nothing to the expense entailed. The larger the membership the more effective will be the work of the society. The cost of membership is small, and the work is absolutely necessary to the industry."

Popular Demand for Street Lighting Again.—In some matters newspaper editorial comment can be said to reflect generally the sentiments of the locality from which the paper comes. Because this is usually true the following editorial from a Grand Rapids (Mich.) paper is interesting as indicating the trend of the popular mind on the subject of street lighting: "We cheerfully submitted to privations and to dim lighting during the war, but that conflict's over now and we ought to give signs that we're prosperous and assume a 'front' even if we haven't one. But we know that we are advancing fast in every way. Don't let us hide our light under a bushel any longer."

Far-Reaching Rate Increase in Illinois.—In an application for authority to increase rates for electric service in 148 communities served by the Central Illinois Public Service Company, Mattoon, an agreement was reached between the company and the communities in which rates were advanced 0.5 cent per kilowatt-hour. In opposing the increase attorneys representing the 148 communities filed objections to the service rendered, and the commission's order in the case directs the company to make a general survey of its property as to its transmission system, the source from which it receives its power, the capacity of its lines, the character of the switching and lightning protection apparatus employed, the adequacy of the installation of the system and the nature of interruptions to the system and the causes therefor, and to report the findings to the commission within one year from the receipt of this order.

Knox County Electric Company.—Effective April 1, 1919, the name of the Rockland, Thomaston & Camden Street Railway, Rockland, Me., was changed to "Knox County Electric Company." All directors and officers of the corporation will remain the same, the name only undergoing any change. Its affairs will be managed and carried along as previously, but under the new name.

Electrical Smelting for the Dutch East Indies.—Considerable study has been made by the Dutch engineers as to the working of the iron fields in the Middle Celebes, in what is known as the lake district of Netherlands India. It appears that two methods are open, the smelting of the ore by the carbonization of coals, the coals of Ombilin and Lematan being quite well adapted for carbonization, or by electrical smelting. The latter method is preferred, as it is believed there is sufficient water power in the neighborhood of the ore beds and electrical machinery for the purpose can be established at a low cost. An examination of the water-power possibilities is now being made. The reduction expedient, wood coal, which is necessary for electrical smelting, can be obtained in abundance near the ore fields.

Consolidation of Massachusetts Commission Reported in Bill.—A bill providing for the consolidation of the Public Service Commission and the Gas and Electric Light Commission of Massachusetts was reported last week by the special committee on commissions of the Massachusetts Legislature. The bill creates a Department of Public Utilities under the direction and charge of a Commission on Public Utilities, to consist of five persons appointed for five-year terms, except that the initial appointments range from one to five years. The Governor is to designate the chairman of the commission, and the departments will embrace all public utilities. The chairman, with the approval of the Governor and Council, is annually to designate two members of the commission to act with himself as a board to administer the laws relating to railroad, railway, telephone and telegraph companies—this to include all matters now coming within the jurisdiction of the Public Service Commission—and two members to act with himself as a board to administer the laws relating to gas, electric and water companies; *i.e.*, all matters now within the jurisdiction of the Gas and Electric Light Commission. Each of these boards is to elect its own chairman and respectively exercise all the powers now vested in the commissions at present existing. All employees of the existing commissions, as temporary employees, would continue under the bill to perform their usual duties until removed, appointed to positions under the act or transferred to other departments.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Contract for Power to Operate City Street Railway.—A contract for electric power to operate the street-railway system acquired by city of Seattle, payment to be made from revenues derived from the system, has been held by the Supreme Court of Washington to be within power of the City Council (179 P. 127).

Injury to a Servant.—In a case where the floor of a building was several feet above an opening from an alley into a dark elevator shaft, a servant fifteen years of age, who saw another servant on a ledge at the bottom of an opening into the alley attempting to open a door for purposes of ventilation and, without invitation and without looking, ran and jumped into shaft to aid him, thinking elevator was on level with ledge, was guilty of contributory negligence, according to a decision handed down by the Supreme Court of Missouri (209 S. W. 931).

Power to Make Contracts.—Where articles of a corporation formed by the consolidation of pre-existing corporations chartered under special acts in no way restricted the powers which the old corporations possessed, and further declared that the new corporation might guarantee any dividends and make contracts for the furthering of its business, it was held by the Supreme Court of Alabama (815 S. 4) that the corporation which was engaged in the street-railroad business, as well as furnishing of electricity, etc., might contract to pay a manufacturing company a sum of money on its removal of its plant from one point and reconstruction of the same on the corporation's right-of-way, etc.

Basis for Review of Commission's Orders.—The Supreme Court of Illinois has held that under the public utilities act, Section 68, it is not sufficient to justify a reversal of a reasonable order of the Public Utilities Commission, made in lawful exercise of its powers, that the court of review should be of the opinion that the order was unwise or inexpedient, but to justify a reversal on ground that the order was unreasonable it must be arbitrary action not resting on a reasonable basis for exercise of discretionary powers. The court reviewing an order of the Public Utilities Commission will examine facts upon which it is based, and, if there is substantial evidence to sustain the order, not a mere scintilla of proof, the order will be sustained (122 N.E. 478).

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M. F. Bonham, formerly assistant manager of the Southwestern Gas & Electric Company at Texarkana, Tex., has been made manager of the Arkansas Light & Power Company. Newport, Ark.

R. E. Thompson has been appointed manager of the Deming Ice & Electric Company, Deming, N. M., to succeed M. E. De France, who has gone to Trinidad, Col., as superintendent of power for the Trinidad Electric Transmission Railway & Gas Company.

Dr. William McClellan, a well-known engineer who was appointed dean of the Wharton School of Finance and Commerce of the University of Pennsylvania in 1916, has resigned to resume his former relations in the firm of McClellan & Champion, with engineering offices in New York and Philadephia.

E. A. Bechstein, for the last two years second vice-president of the Sandusky (Ohio) Gas & Electric Company and for a number of years before that general manager, has resigned to become associated with a new electrical supply company with headquarters in Sandusky. Mr. Bechstein is well known in the Middle West, having been continuously associated for the past twenty years with the Sandusky Gas & Electric Company and active in the public utility affairs of his state. During 1916-17 he served as president of the Ohio Electric Light Association.

George E. Quinan now holds the position of chief electrical engineer for the Puget Sound Traction, Light & Power Company, Seattle, Wash., a post which is new for that company. Mr. Quinan has heretofore been electrical engineer of the Seattle division, and previous to that he was made superintendent of light and power as successor to W. J. Grambs when the latter was promoted to the position of assistant to the president in the early part of 1914. S. C. Lindsay, who has been assistant engineer of the Seattle division, succeeds Mr. Quinan as electrical engineer of that division.

George W. Hubley has recently terminated his office as administrative engineer and chief of conservation of the United States Fuel Administration of Kentucky and opened an office in Louisville as a consulting and advisory engineer and also to furnish service as a power-plant specialist. Previously Mr. Hubley was general manager of the Badenhausen Company of Philadelphia and New York City, and prior to that he had been general manager and chief engineer of the Merchants' Heat & Light Company of Indianapolis, Ind. Subsequent to his employment with the Westinghouse Electric & Manufacturing Company and with the Citizens' Traction Company of Pittsburgh, Pa., he was for twenty years chief engineer and superintendent of the old Louisville (Ky.) Lighting Company and its successor, the Louisville Gas & Electric Company. He resigned from this company to join the electrical engineering staff of the Jones & Laughlin Steel Company of Pittsburgh, from which he resigned in 1916 to become associated with the Merchants' Heat & Light Company of Indianapolis.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

W. J. Grambs, heretofore assistant to the president of the Puget Sound Traction, Light & Power Company, Seattle, Wash., has been made manager of auxiliary operations under a new reorganization plan of the personnel

W. J. GRAMBS

of that company. The auxiliary operations department includes the following subsidiary companies: Diamond Ice Company, Renton Coal Company and Washington Auto Bus Company. The position Mr. Grambs now holds has been lately created. Until recently he had served as supervisor of the Sea Training Bureau of the United States Shipping Board for the Pacific Northwest. Mr. Grambs' entrance into the electrical field dates back to the spring of 1888, when he established the Northwest Electric Supply & Construction Company. This company installed the first incandescent electric lighting plant in the Northwest and represented a number of prominent electrical manufacturing companies. In 1899 Mr. Grambs resigned from the company to become purchasing agent for the Seattle Electric Company. In 1905 he was appointed contract agent for the company and two years later sales manager. In 1911 he was made superintendent of light and power and advanced to the position of assistant to the president of the company in the early part of 1914.

Obituary

Charles H. Stevens, for the past fifteen years head of the power sales department of the Lynn (Mass.) Gas & Electric Company, died at his residence in Lynn on April 26. He was born at Fort Fairfield, Me., fifty-three years ago and was widely known in New England central-station circles. He was actively interested in the work of the New England Section, N. E. L. A.

Welcome I. Capen, vice-president of the Postal Telegraph Company since 1912, died April 17 at his home in Mount Vernon, N. Y., at the age of sixty-five. Mr. Capen was first associated with the Vermont, Boston & Montreal Telegraph Company at Brattleboro, Vt. When the Postal Company was formed in 1885 he took charge of its Cincinnati office and later became general superintendent of the Western division. In 1909 he went to New York as general superintendent of construction and was made vice-president in 1912.

Samuel E. P. Smith, formerly general manager of the Reading Transit & Light Company, Reading, Pa., died on March 24 at his home in Reading after an illness of several months. Early last November Mr. Smith was appointed general manager of the Mobile Light & Railroad Company, Mobile, Ala. On Nov. 23 he was taken ill and soon returned to Reading. For more than ten years Mr. Smith was associated with the Reading Transit & Light Company, and in later years in the capacity of general manager. He was forty-two years old.

A. D. Juilliard, one of the pioneers in electric lighting in New York City, died of pneumonia on April 25, at the age of seventy. He was of French extraction, born at Canton, Ohio, and a father of the dry-goods commission business in New York, in which he was a leading figure up to the time of his death. He was actively connected with the introduction and development of the Brush and Swan electric lighting systems in New York City in the early eighties, having among his associates George W. Stockler and W. L. Strong, afterward Mayor of the city. He was vice-president and director of both the old Brush Electric Illuminating Company of New York and the Brush-Swan Electric Light Company of New England. Although immersed in insurance and railway affairs and in Republican politics, he gave a great deal of time and attention to these companies and other electrical interests, which later became merged into the great public utility, the New York Edison Company, now serving Manhattan Island as a whole. To Mr. Juilliard, a man of most engaging personality, high public spirit and a culture manifested in his long and generous support of opera in New York, the electrical industry owes not a little for his far-sighted financial support at a time when it was but a weak and struggling enterprise.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

JOBBERS PROTEST AGAINST SHORT DISCOUNTS ON DEVICES

While Most Sales Are Now Direct, Still Many Eastern Houses Stock and Catalog Soldering Irons, Particularly, Which They May Discontinue

Electrical supply jobbers, particularly in the big industrial centers in the East, disapprove of the recent action of short-listing industrial heating devices, reported in last week's issue of the ELECTRICAL WORLD. The 10 per cent margin, it was pretty generally felt, was insufficient to warrant the jobbers stocking the devices, cataloging them or otherwise trying to interest buyers. It was stated by a number of jobbers that if no greater margin were allowed they would cease to handle these lines. Some took the position that the volume of business handled was too small to justify any serious objections.

It is recognized by the jobbers that the bulk of these articles are sold direct by the manufacturer. However, there are many jobbers who stock these goods and catalog them, particularly soldering devices. One Pittsburgh jobber states that he regards soldering irons as standard shelf goods which have been stocked for immediate delivery from the warehouse.

A Syracuse jobber says: "Our sales of these devices have been substantial, and considerable sales effort has been placed by us in the past on these lines, but, on the basis of the profit now allowed us, we will have to discontinue absolutely taking any initiative in pushing them.

"Out of Syracuse alone, with a population of 150,000, approximately thirty-five electrical salesmen go continuously and call with regularity on the other classes of purchasers who would buy such articles as are in the mentioned schedule, and it seems to us that this activity alone, which cannot be duplicated by the manufacturer, is worth more than the profit now provided."

Jobbers in New York City and New Jersey have been quite a factor in the distribution of soldering irons in the past year or so. Orders from jobbers for twenty-five soldering irons for stock have not been infrequent.

One large New England house estimates that its annual sale of soldering irons, glue pots and small industrial heating devices is from $2,000 to $3,000 per year; another good-sized house estimates $1,000 as an outside figure, and the smaller houses run downward to under $500. Heaters over 660 watts, and notably hotel toasters, are not carried in sizable stocks, as the business in such equipment is generally special as to requirements. One house carries one hotel toaster largely for emergencies, and another carries one large combination toaster and broiler for hotel service.

Despite the foregoing fact the jobbers are of the opinion that the field for commercial exploitation in industrial heating devices is very large and should be cultivated with the coöperation of manufacturer and jobber on a basis which will yield the latter a reasonable profit on his outlay and efforts. The sale of small hot plates to industrial plants for warming employees' lunches, etc., is increasing very rapidly, owing to a recent Massachusetts law requiring such installations. The automobile trade is becoming interested in electric soldering irons, one concern recently having purchased thirteen on one order from a Boston jobber.

In soldering irons, particularly, there are reasons to believe that the elimination of the jobbers by not allowing a larger discount will result in smaller sales than would otherwise be obtained. The jobbers have representatives going to industrial plants much more frequently than the manufacturers could expect to visit there, besides having a point of contact through long and satisfactory business relationship.

THE MARKET FOR RADIO SUPPLIES IS AWAKENING

Considerable Development Made in Past Two Years— Existing Conditions Point to a Greatly Increased Demand

Restrictions were removed on April 15 by the Navy Department from amateur, technical and experimental receiving stations. Commercial stations, however, are not free yet to receive messages.

By this action there is immediately opened a market for small wireless sets. This market will be greatly increased as soon as the ban on sending is removed. Already the buying has become large. In 1914 the sale of wireless material amounted to $672,575. Since the spring of 1917 virtually the entire sale of this material has been on government account. Much of this material during the war was made by factories that had not previously been in this field. These factories are now in a position to enter the commercial field provided that a satisfactory demand arises.

On this point it would be reasonable to expect a larger commercial demand than ever before. The ranks of amateurs have been greatly increased by the men who have learned radio work while in service. Air transportation is now virtually assured, and the air and ground requirements in this connection will not be small. Technical schools, with the start gained during the war, are undoubtedly going to take more interest in radio work than they did five years ago. Besides all of these there are the commercial and government wireless stations, of which the number is rapidly growing.

Since the war a great many developments have been made in apparatus. Prices of sets and accessories have advanced 10 to 15 per cent over pre-war prices.

SCHEDULE MATERIAL OUTPUT 60 PER CENT OF NORMAL

Both Jobbers and Manufacturers Disinclined to Stock Heavily, Although Latter Are Building Up Stocks to Meet Demands for Immediate Shipments

Inquiry among representative manufacturers of schedule material indicates that about 60 per cent of the normal output is being produced at the factory at present. Jobbers are quite generally content to let the manufacturer do the principal stocking up. Makers of wiring devices are largely of the opinion that prices will remain firm for months to come, probably well into the fall at least. They do not share the opinion expressed in some jobbing circles that prices do not warrant buying for stock, and in some cases are not slow to affirm that if any considerable expansion in building occurs, some of the jobbers will lose more through holding back on purchases than they will gain by waiting.

Increased buying for stock by the jobbers would tend to stabilize production conditions at the factories, and it

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is believed that a reasonably wide distribution of finished material can be accomplished without overloading the jobber. The contractors are getting more work now, and house-wiring campaigns are running at full blast among the progressive central stations. New building operations are far from being at a standstill, though nothing like a boom is yet apparent. The natural demands of public consumption are responsible for a very fair volume of business, which seems likely to increase rather than to diminish.

Jobbers' stocks, so far as can be learned, are ample to meet immediate requirements, with perhaps enough surplus to carry their customers along for a very few weeks, and the question as to which interest shall maintain the principal stocks is unsettled. It looks as if the jobber would do well to see to it that his stock is complete and ample to meet daily anticipated demands, that hesitation on account of prices will get him nowhere, but that, on the other hand, he can reasonably count upon the manufacturer to supply the excess needs of the year without much danger of unsatisfactory deliveries. Manufacturers' stocks are being gradually built up to meet demands for immediate shipment of standard lines, and it is significant that many of these shipments are being made by express to the jobbing houses, although the freight embargoes are a memory. If the jobber is disinclined to overstock. the manufacturer is equally opposed to heavy accumulations of finished material at this time.

METAL MARKET SITUATION

Extreme Dullness Prevails in All Metals—Copper Slightly Higher

Less copper was purchased in April than in March. The past week's sales were very low, but there is still a confident feeling prevailing among producing interests. Slight increases of ⅛ cent in Prime Lake and electrolytic have had no effect on the buying because the consumer is not at present interested in prices. Wire mills are about the only buyers of copper just now.

Government stocks are causing no apprehension, as their division among producers has been of such a nature as to place no great burden on any of them.

Director-General Hines has accepted the offer of the Industrial Board to bring together representatives of the Railroad Administration and the steel producers again to discuss the price stabilization plan.

The whole metal situation is quiet. Antimony and aluminum are slightly higher in price but non-active. The used metal market showed a small business this past week, but prices remained fixed. Large offerings of government material are added to large accumulations of surplus stocks of rolling mills and brass works.

NEW YORK METAL MARKET PRICES

	April 22	April 29
Copper:	£ s d	£ s d
London, standard spot	76 10 0	76 15 0
	Cents per Pound	Cents per Poun
Prime Lake	15.50	15.62½
Electrolytic	15.25	15.37½
Casting	15.00	15.00
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.00	5.00
Antimony	6.75	7.00
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.40	6.42½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	31.00	31.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 13.75	13.50 to 13.75
Brass, heavy	7.50 to 8.00	7.50 to 8.00
Brass, light	6.50 to 7.00	6.50 to 7.00
Lead, heavy	4.00 to 4.25	4.00 to 4.25
Zinc, old scrap	4.25 to 4.50	4.25 to 4.50

THE WEEK
IN TRADE

REPORTS of an increasing volume of business from virtually all sources come from almost all parts of the country. Apparatus sales, particularly in the East, are better. Motors are in greater demand and in many instances cheaper. More lines are going up, and inquiries are now in the market for equipment for a couple of 100-mile lines, one in the East and the other located on the Pacific Coast.

It is interesting to note that one prominent manufacturing concern is quoting prices on large waterwheels around one dollar per horsepower lower than pre-war prices.

Sales of surplus electrical equipment by the War Department up to April 11 amounted to $198,285.

Certain factors, such as uncertainty over iron and steel prices, the Victory Liberty Loan and the wait until peace shall be signed, are proving to be substantial handicaps to building and business generally. As soon as these are disposed of an excellent volume of business is expected to follow.

Labor is becoming scarce in certain regions, particularly the automobile centers and the farm country of the South and Northwest. Non-employment is generally decreasing and wage disputes are fewer.

NEW YORK

There is a continued steady but slow increase in business. This is not restricted to any one class of electrical material but is general. Power cable is showing increased activity for street-lighting and power work. This implies no boom but a resumption in the use of power. Motor activity is on the increase. Practically every line of material is running just a little bit better than heretofore.

Jobbers find business holding well. No big bursts of buying have been reported. Much of the buying is small in value, although the number of orders is rather high. Prices are steady with no evidence of marked decline. Deliveries are good and jobbers' stocks are ample to care for immediate needs. Collections from retailers are continuing satisfactory, and some are close to thirty days. Longer time is required to clear up many contractors' accounts as some of the latter wait for their own payments before settling with the jobbers.

Building activity is increasing in the Queens district with the projection of several large industrials. Housing plans call for many dwellings. The home-building and house-wiring campaigns are bringing results in many sections of the East.

SCHEDULE MATERIAL.—Jobbers' stocks are in good shape. The demand shows a slight increase, much of which is for house wiring in the suburbs. The market also continues fair in the making over of private houses into small apartment dwellings.

POWER CABLE.—Many inquiries are being received and orders are gradually increasing to the extent that manufacturers who have found hard sledding this spring are beginning to see daylight ahead.

MOTORS.—In the fractional sizes and up to 5 hp. the market has been found quite active. Some manufacturers are having difficulty in keeping deliveries up to required demand for appliance use. Low-speed motors for sewing-machine group drive have been reported active following the settlement of labor conditions in the garment industries. Several new factories about to be built in the metropolitan district will offer an outlet for a thousand or two horsepower in the large sizes.

STEEL POLES.—Some activity has been reported in the market for steel poles for street lighting and for trans-

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mission lines. One type of pole decreased in price about $7 per ton with the drop in steel prices five weeks ago.

INSULATORS.—The market for transmission-line insulators is picking up.

STORAGE BATTERIES.—Factories are still working practically to capacity taking care of back orders and catching up on new business brought in through automobile and farm-lighting activities. Large stocks of raw materials are being carried and deliveries are being made according to schedule.

RUBBER-COVERED WIRE.—One producer has changed from 22-cent to 20-cent base, bringing the average base just under 20 cents. One producer is on 18 cents, one on 19 cents, eight on 20 cents, one on 22 cents and one is quoting on a cost basis.

WATERWHEELS.—Quotations received within the past few days on a large wheel ranged from $5 to $8 per horsepower. The lower figure is under the previous price, while the higher figure is slightly above the current market. The successful bidder quoted between $6.50 and $7 per horsepower. This figure is lower than October quotations.

CHICAGO

Export trade has been a live subject in Chicago business circles this week. Two factors have contributed to this interest. One is the meeting of the National Foreign Trade Council, and the other is an announcement by the members of the banking committee of the Mississippi Valley Association to the effect that the details of a banking institution to be operated by the organization are being planned.

There is somewhat of a feeling of depression in local utility circles because the Public Utilities Commission of Illinois refused to grant an increased fare to the Chicago surface lines. The decision handed down April 26 holds the fare at 5 cents.

Jobbers report that business in appliances continues good and that building materials are beginning to move. Building permits for the week ended April 19 totaled ninety-three, covering 123 buildings, with a total value of $1,261,400. For the week ended April 26 155 building permits were issued, valued at $1,703,900.

SOCKETS.—Jobbers have made a reduction of about 20 per cent on their prices for sockets, although there has been no decrease in the manufacturers' price to the jobber on these devices.

CONDUIT FITTINGS.—The market is beginning to show signs of life again.

MOTORS.—One manufacturer of direct-current motors running from ½ hp. to 25 hp. in size reports that his business now is practically as good as it was in war time. His factory is still working at full production.

COPPER WIRE.—Rubber-covered and weatherproof copper wire still remain on a 20-cent base. Prices of $9 per 1000 ft. are being quoted on large quantities.

CONDUIT.—The market is a trifle more active than it was last week.

DOMESTIC APPLIANCES.—In reviewing the general market situation on domestic appliances since the first of the year, one manufacturer said that 1919 bids fair to surpass any year in the history of the business. The Commonwealth Edison Company's retail stores are showing a nice increase over previous records, the jobbing accounts are more active, and the central stations in some of the surrounding states are busy with merchandising endeavors. The activity includes practically all lines of heating devices. Stocks of the retail stores were very badly depleted by the big Christmas business, and there has been considerable buying to replenish these stocks. It may be said that the business is better from a wholesale standpoint than from a retail standpoint, except in Chicago. As this manufacturer sees the price situation, there will be no real change in the level of prices before September.

INSTRUMENTS.—One manufacturer of electrical instruments reports that the volume of his business for the first week in April exceeded the total volume of business for the entire month of April last year. The majority of sales are being made to central-station customers.

POLES.—Cedar-pole producers are receiving orders in satisfactory volume.

BOSTON

Trade was still considerably unsettled last week by the prolongation of the telephone strike until Monday afternoon and by a general holiday Friday in honor of the parade of the Twenty-sixth Division in this city. Business was resumed last Monday in fair volume. The demand for washing machines and vacuum cleaners continues to increase, and some factory representatives report that production is on a day and night basis. The shortage of armored flexible conduit shows signs of passing. Prices are running about even with last week's quotations, although some weakness is reported on dry batteries under close competition. Stocks are rather uneven, and a good deal of hand-to-mouth buying is still in evidence. The demand for electrical accessories for automobile use is remarkably good. Deliveries are very satisfactory. Collections are a little slow, with small prospect of improvement until the Victory Liberty Loan is completed. Building projects are still slow in materializing, although a good deal of small betterment work is under way.

MOTORS.—Interest is quickening somewhat and stocks are in good shape for prompt deliveries. A better tone has been noted in the market during the past fortnight. Prices are a little unsteady, though no marked changes are predicted in the trade for the immediate future. A 10 per cent reduction on Wagner single-phase motors has been reported.

FARM-LIGHTING SETS.—The first quarter of 1919 exceeded the corresponding period of 1918 in the volume of business done by one large distributer. Inquiries are coming in well and an excellent year's sales is expected. Prices are expected to remain steady throughout 1919. The demand from Connecticut and from the Canadian Provinces is said to be gratifying at this time. The increased price of these sets compared with a year or two ago does not seem to deter buyers seriously.

LAMPS.—Trade holds up better than ordinarily would be expected. Jobbers' stocks reflect improved deliveries in the smaller sizes, which hitherto have been somewhat behindhand in production.

PORTABLE LAMPS.—A surprisingly steady trade has been handled by retailers, and this business is fast developing into a year-round type. Very little price cutting has been required to move these products, even after the holiday trade ceased.

WIRE.—The feeling is strong that prices will advance before long. There is a fair demand at present for galvanized iron and steel guy wire for small construction jobs in the telephone field. Some purchases are also going through for fire-alarm circuit use.

INSULATORS.—Glass insulators show some tendency to weaken in price. Procelain insulators hold firm, and only a moderate amount of construction work on central-station lines is in sight at the moment. At the present price of copper it would seem that central stations might relax their conservatism more generally as regards extensions.

SCHEDULE MATERIAL.—Stocks are well prepared for an increased volume of trade. Barring numerous small jobs and occasional larger ones, the contractors are not in the market at the present time for a normal amount of material.

STORAGE BATTERIES.—Sales for automobile starting and lighting service are in excellent volume.

WASHING MACHINES.—The New England market is absorbing these products about as fast as they can be shipped in. It is expected that sales of the larger jobbing houses will run into six-figure totals this year.

HOT PLATES.—A heavy demand is noted for factory service.

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ATLANTA

Trade in the wholesale and retail lines is better than at any time since the armistice. The textile situation, which affects this section, is now better than it has been in months. Following the recent improvement, this week brought news of a highly encouraging nature, and there is unanimity of opinion that the gain will continue. A number of new textile mills are being organized in Georgia, North and South Carolina, calling for considerable quantities of electrical equipment. Atlanta voted this week against a municipal electric plant.

APPARATUS.—After a protracted period of dullness following the armistice, heavy equipment is again beginning to pick up. Manufacturers report increasing inquiries and numerous proposals are being made. The outlook for turbine business is especially bright. The small central stations and municipal plants are getting ready to install more generating capacity. This is evidenced by the fact that actual orders show a decided gain and that the municipalities are getting in better shape financially to consider enlargements and improvements. Then, too, there is a potential business in the larger central-station field awaiting the end of the present period of financial difficulties. A larger business is also expected from industrial sources as soon as production conditions approach more nearly to normal ones. No change in turbine prices has been noted since the January adjustment. Better promises of shipment are being made and deliveries are reasonable.

CONDUIT.—The demand for the black and white rigid products compared with last week shows little change, excepting an increase in scattered purchases from jobbers for industrial work. Stocks in general are in good shape and prompt factory shipments can be made for substantial requirements. Dealers and contractors anticipate a large volume of business from now on, when construction under way advances. Prices are steady and no weakness is evident. Favored jobbers, however, buying in large quantities, are receiving the benefit of an extra 5 per cent discount.

MOTORS.—A big improvement is noted in the number of inquiries received and orders actually placed. Capacities up to 50 hp. are moving briskly, and the larger capacities between 50 hp. and 100 hp. show marked gains over the previous weeks. Activity is accounted for to some extent by better central-station conditions, and rate increases are reflected in an improved financial outlook. Industrials are gradually returning to a normal working basis. There have been no price changes lately; stocks are ample and factory deliveries good.

PANELBOARDS.—These have shown little life this week, registering a decline in sales over the past two weeks. This condition is spotty, however, as one manufacturer reports a number of inquiries which will materialize in a satisfactory volume of orders within a few days. The class of buildings that stimulate this item is being rapidly pushed, and a good trade is looked for. Local stocks are in poor condition, and factory facilities, while improving, are far from normal. Prices remain firm.

FLEXIBLE-STEEL CONDUIT.—Eastern shipments are excellent, and stocks on hand appear to be ample to take care of the increasing demand. Manufacturers and jobbers report a brisk movement to all points and steady prices.

SEATTLE—PORTLAND

Big business interests report some revival of activity in various branches of industry during the past week. This is notably true of the building industry as reflected by the large increase in the number of permits issued for both business structures and residences. The great majority of Northwestern cities record gains in building over the previous month and many for the year to date over the same period last year. Seattle has not entirely recovered from the effects of the seven weeks' shipyard strike, but evidences are accumulating that the summer is to be an active period. The smaller cities in eastern Washington and throughout Oregon will from present indications experience a year in building similar to some of the best years previous to the war. Seattle jobbers report the volume of business as slow and sluggish. During the week sales to shipyards and industrials were light.

Domestic-science business showed a slight increase. Inquiries for electrical equipment for lumber mills in the Puget Sound district continue to come in but orders are not following. The Railroad Administration has placed orders with Northwestern lumber mills for 2,000,000 ties, valued at $1,750,000. The Puget Sound Navy Yard reports receipt of a contract for a three-million-dollar repair ship, work to begin immediately. Construction of the Skagit River power plant by the city of Seattle along lines suggested by City Engineer A. H. Dimeck has been declared feasible by consulting engineers. The cost of the project is estimated at $30,000,000 with a capacity of 300,000 hp. The cost of the first unit, for which bonds have been sold, is estimated at $500,000.

Portland electrical jobbers and manufacturers report business for the past week as exceptionally light. A small increase in all copper wire is noted. Other prices show no change. A number of mills in Coos Bay region are expecting to electrify shortly or to add additional electrical equipment. A decided increase in construction during the past month has been noted, permits varying from medium-priced residences to substantial brick and concrete garages. Portland has been making steady improvement along building lines since the first of the year.

SAN FRANCISCO

This is Pacific Coast convention week at Santa Barbara, where the National Electric Light Association, contractor-dealers' and jobbers' associations of this district meet. It is expected that business will show a further temporary stagnancy because of the Victory Liberty Loan campaign.

The effort of San Francisco to improve her foreign trade is reflected in the securing of the 1920 convention of foreign trade delegates for this city.

TRANSFORMERS.—Commercial sizes of standard transformers have recently advanced 10 per cent. Deliveries are fair, but great quantities will be required if the range campaign now being inaugurated is successful. It is recalled in this connection that a similar campaign several years ago was ruined by inability to secure transformers.

LINE MATERIAL.—Barring a 10 per cent advance in certain bolts and braces about two months ago, there has been no recent change; stocks are good. Observers predict that needed new construction and extensions must surely be made this year—now that the power companies have the money and load to carry them out—which will restore the business on this class of material to the standing that it had about five years ago.

VIBRATORS.—The demand is still very heavy. Deliveries are poor.

SEWING MACHINES.—Deliveries are still a little slow on certain makes. Extensive national advertising is resulting in the booking of advance orders.

WIRE AND CABLE.—Rubber-covered wire in the standard commercial sizes has been unusually steady during the last few weeks, there having occurred only a nominal increase. Lamp cord, on the contrary, has decreased all along the line by an average of 10 per cent, a considerable drop bearing in mind the comparatively small part that the copper factor plays in its price. Demands in both these staples have been light, although a boom in lamp cord, especially, is predicted. Lead-covered cable, on the contrary, has jumped 20 per cent in the regular wiring sizes, such as Nos. 14 and 12.

BELLS AND BUZZERS.—Because of the labor cost, bells and buzzers have recently advanced 10 per cent. The demand is average and the stocks high.

CONDUIT AND FITTINGS.—Several fairly large inquiries are reported for municipal and government work. Eastern shipments maintain their schedules fairly well. Flexible steel-armored conductor has increased 15 per cent.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅛	250	$5.00
¼	250	7.50
⅜	100	10.00
½	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00	$18.00	$16.00
¼-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00–26.50
¼-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$7.00 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$31.00—$36.00
Coil to 1000 ft	24.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–36%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	5%
1/5 to std. pkg	15%
Std. pkg	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to list
1/5 to std. pkg	+5% to 10%
Std. pkg	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39–$0.41
No. 18, full spools	.35– .37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.62–$20.00	$13.00–$15.00	$11.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$24.00–$29.25
25 to 50 lb	24.00– 25.25
50 to 100 lb	23.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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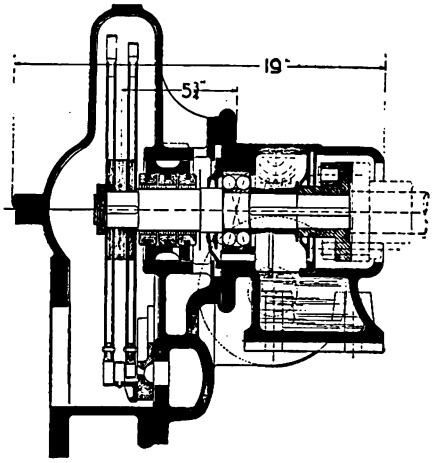
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

One-Bearing Steam Turbine

The outstanding feature of the "steam motor" manufactured by the Steam Motors Company, Springfield,



MOUNTED IN PLACE OF ONE BEARING OF DRIVEN UNIT

Mass., is that it is not a complete turbine in itself, but when connected to its driven member becomes an integral part of the complete unit, making possible a compact two-bearing unit with any standard design of driven apparatus. It consists of an overhung wheel supported by one S. K. F. ball bearing arranged so that it can be mounted in place of one bearing of the driven unit, such as a pump, blower, generator, etc., and attached to it by a rigid coupling. By this arrangement the weight of the overhung wheel balances the load on the driven unit shaft and allows a minimum deflection for each. A great saving in floor space and elimination of faulty alignment is thus effected.

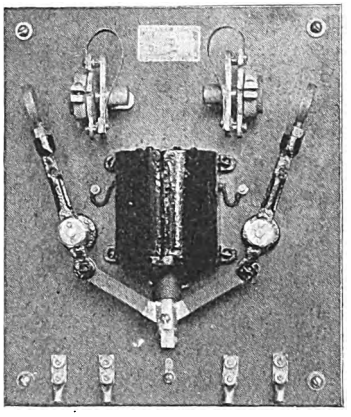
The principle of operation of the turbine proper is the straight two-row velocity-stage impulse turbine. Double labyrinth glands prevent an escape of steam and eliminate the necessity of adjustment or renewal of any soft packing. For generator drive and other applications when constant speed is required the motor is fitted with a centrifugal governor of the Pickering type, driven by gearing from the main shaft. An emergency governor can also be used if desired.

Asbestos Insulation

Consisting of long fibrous white asbestos free from such impurities as lime, iron and alumina and cemented together with a special chemically neutral cement, "Rockbestos," a fire-resisting insulation for wires is announced by the Marlin-Rockwell Corporation of New Haven, Conn. Being mineral in its composition, it is said that disintegration, deterioration, drying-out or decay do not take place even after long service, while varying degrees of heat and cold do not affect it. In the form of a roving this insulation is evenly applied to the conductor in such a manner as to insure an adhesive, uniform homogeneous body of high insulating and dielectric strength. This insulation is said to possess great flexibility, mechanical strength and tenacity and to be proof against acid, alkali and moisture, in addition to its fire-repelling qualities.

Two-Pole-Magnet Line Contactor

Particularly intended for elevator service or for frequent intermittent service where arcing conditions would quickly reduce the carrying capacity



USEFUL FOR ELEVATOR SERVICE

even of carefully constructed copper-to-copper contacts, the type SSAC-2-50 two-pole-magnet line contactor for 50-amp. service has been produced by the Automatic Switch Company of 4 White Street, New York City. It may be employed in the construction of controlling devices for polyphase motors, both as a line contactor and as a resistance bridging contactor in automatic starting devices.

Bowls and Shades for Fixtures

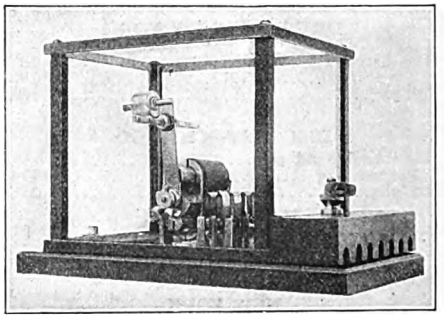
Bowls in popular sizes with shades to match, as well as lantern forms for use in halls, vestibules, etc., are included in a line of glassware for lighting fixtures recently brought out by the Beardslee Chandelier Manufacturing Company, 223 South Jefferson Street, Chicago. "Magnolia" white glass, with an external satin finish, is used in the manufacture of these designs.

Wood-Boring Tool

A wood-boring tool that may be used in bit braces, breast drills or pneumatically and electrically driven machines will shortly be obtainable from the W. A. Ives Manufacturing Company, Wallingford, Conn. It is especially useful in electrical work to bore holes in timber for wires and conduits.

Multiple-Circuit Sensitive Relay

A relay that operates on very small currents and yet has contacts that carry sufficient current to operate remote-control oil circuit breakers, field circuit breakers and blower motor-circuit breakers is being manufactured by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago It is mounted on a slate base and is operated by the rotative action of two electromagnets upon an armature mounted between the two poles. Mounted upon the same shaft with the armature is an arm carrying an insulated contact-making rod which closes the control circuits when the relay operates. This arm is weighted in such a way that normally the weight is slightly beyond center so that very little energy is necessary to carry it past center and allow it to fall into the multiple contacts mounted on the slate base. The position of the weight is adjustable, thereby making the relay adaptable to a large range of operating currents. The insulated contact-making rod merely bridges the pair of contacts as it falls into position.



OPERATED BY ROTATIVE ACTION OF TWO ELECTROMAGNETS

The relay may also be used to protect generators and transformers of large rating. Arrangements are made

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so that the glass cover with which the relay is provided can be locked in position over the outside terminals.

Electric Lead-Burning Set

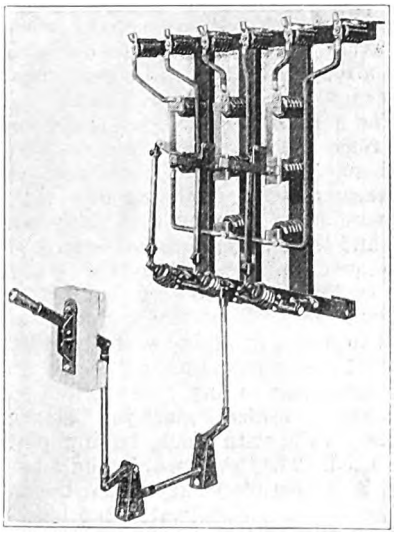
The electric lead-burning set recently placed on the market by the Spence Electric Company, 136 Liberty Street, New York City, was developed for particular use in garage and battery repair stations for burning the straps and posts on storage batteries and for other lead-burning work.

It can be connected to a 110-volt alternating-current lighting circuit through a socket and is operated in a manner similar to that of an electric soldering iron. Any degree of heat may be obtained, it is said, and perfect control is afforded by varying the pressure at the point of contact. An advantage of this electric set is that skill in operation is not required as when gas-flame outfits are used, and in addition there are no gas fumes to contend with. The energy consumption of the set is approximately equal to that of a 300-watt lamp. The outfit is portable, weighing 30 lb. (13.6 kg.) and having dimensions of 8 in. (20 cm.) by 7 in. (18 cm.).

Switching Arrangement for Electric Furnaces

To obtain two voltages on the secondary side of electric furnace transformers, the switching combination illustrated has been designed by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. The variation in secondary voltage is secured by changing the high-tension side of the transformers from delta to star in order to secure the lower secondary voltage and from star to delta when a high voltage is desired.

The switch for making these changes

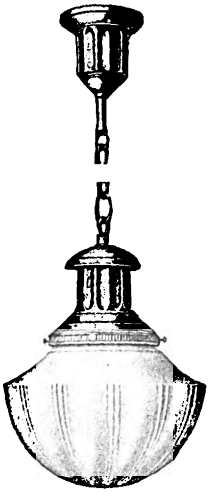


INSURES VARIATION IN SECONDARY VOLTAGE OF FURNACE

consists of two single-pole double-throw elements and one single-pole single-throw element, all interlocked and simultaneously operated by means of a common shaft and controlled by a handle mounted on the switchboard. This handle is adjacent to the oil-switch handle, the two being interlocked so that the disconnecting switches cannot open until the oil switch is in open position, and the latter cannot close until the disconnecting switch is secured in either up or down position.

Fixture of Doric Design for Commerical Illumination

Designed to utilize the efficiency of the smaller sizes of type C gas-filled lamps a lighting fixture, known as "Lightolier" No. 8544, is now manufactured by the Lightolier Company, 569 Broadway, New York City. It is intended for commercial illumination and has a Doric design canopy and fitter, together with a translucent glass globe. The over-all length of the fixture is 36 in. (91 cm.), the depth of the bowl is 8 in. (20 cm.), and its diameter is 11½ in. (28 cm.). Gas-filled lamps up to and including 200 watts may be used.



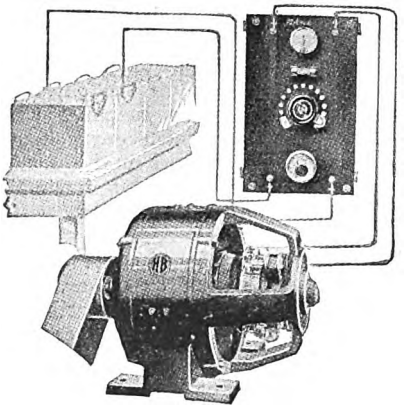
ADAPTED FOR LAMPS OF 200 WATTS OR LESS

Receding Pipe Threader with Quickly Releasing Chasers

Two special advantages are claimed for the receding pipe threader recently added to the line of tools made by the Greenfield Tap & Die Corporation, Greenfield, Mass. One is the quick releasing of the chasers at the end of the cut and the other is the quick resetting to cutting size. After the tool has been wound on the pipe and a thread of proper size cut, the threader may be pulled straight off. No unwinding is necessary to return the thread to its original cutting position, as it is only necessary to release the lead screw, lift the head, reset the trigger and begin another cut. The chasers used in this tool are interchangeable and can be replaced singly in case of breakage. These chasers travel along the pipe parallel to the thread they are cutting and not parallel to the pipe's axis, in this way reducing considerable friction, it is said. A non-slipping, three-jawed universal chuck guide is provided on the tool. Adjustment can be made for cutting both shallow and deep threads.

Lighting and Battery-Charging Outfit

With the lighting and battery-charging set recently developed by the Hobart Brothers Company of Troy, Ohio,



CHARGES BATTERIES AND LIGHTS LAMPS AT SAME TIME

a garage not having energy available from other sources can make its own electric light and at the same time have power on hand to recharge automobile storage batteries. The generator used in this set is a specially wound machine rated at 110 volts, direct current, and a speed of 1800 r.p.m. It weighs 300 lb. (136 kg.) and operates from a line shaft or an engine, requiring 4 hp. at full load. The maker states that from one to six 6-volt automobile storage batteries or their equivalent can be charged at one time.

This set is furnished complete, ready to connect to the engine, and includes the generator, base tracks, field rheostat, charging panel and a pulley with a 6-in. (15-cm.) diameter and a 4-in. (10-cm.) face. Outfits can also be furnished with 60-75-volt windings for industrial tractor recharging and with 60-volt windings where 60-volt lamps are to be used.

Arc Protective Equipment for Drum Controllers

By adding the arc master equipment which the Union Electric Manufacturing Company, Milwaukee, Wis., is manufacturing to reversing or non-reversing weatherproof-type drum controllers it is said that the following advantages are obtained: The human element of carelessness or inexperience in operation is nullified, the controller is made arcless, all arcing circuits are broken on contacts, low-voltage protection is provided, and, if desired, overload protection can be secured.

The equipment consists of the arc master, mounted on the head of the

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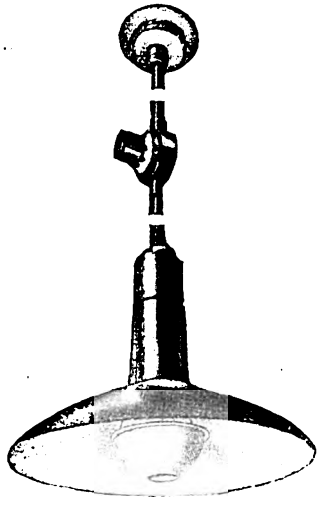
controller and operated by the motion of the standard controller handle and a solenoid switch. Three wires for a pilot circuit run from the arc master to the solenoid switch. This switch is a magnetic blow-out type designed for continuous duty and is mounted on a slate panel which can be conveniently attached in any position.

With the arc master equipment the operator can advance the motor speed only as the motor is capable of picking up the load. If he accelerates too rapidly, he loses his circuit and must commence all over. He cannot draw long-burning arcs and he cannot reverse too rapidly.

All circuits breaking heavy currents have the arc broken on the solenoid switch designed for this purpose. The resistance circuits, which carry very little current, are broken in the drum. These arcs are practically infinitesimal, owing to the blow-out coils incorporated in the standard drum. A slight reverse motion of the controller handle causes the circuit to be opened by the solenoid switch, thus eliminating the possibility of an arc being established when the controller is moved to the "off" position.

Glareless Industrial Lighting Fixture

For giving even and well-diffused illumination without glare in factories and other industrial plants "Factorylite" No. 700 has been developed by the Henkel & Best Company, Chicago, and is being distributed by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago. This fixture is intended for use with lamps of 100 watts and 200 watts and gives best results when installed with spacings not more than one and a quarter times the mounting height above the lighted plane. A feature of this fixture is the opal-glass eye shield which fits around the bottom of the bulb, it being suspended by a holder. The metal reflector is furnished with a fitter for a ½-in. (1.3-cm.) stem and with a porcelain socket. A condulet on the stem supports a pull-chain switch.



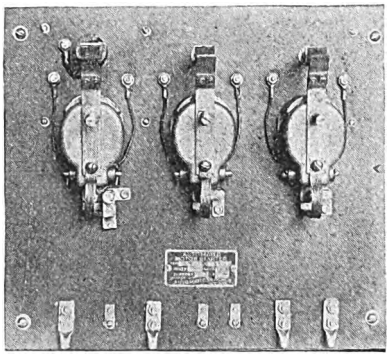
BALL SWITCH IS MOUNTED ON STEM OF FIXTURE

Quick-Break Entrance Switch

Combination switch No. 5741 for two-pole, 30-amp., 125-volt service has been announced by the Trumbull Electric Manufacturing Company, Plainville, Conn. This switch is practically the same as style No. 5641, using fuse plugs, but does not have the safety interlocking features of that model. It is externally operated and meets most requirements for entrance work where a switch is rarely opened. Quick-break switch mechanism is used and is contained in a sixteen-gage steel box. The handle rod extends across the interior of the box and is held firmly to the side. When the box is opened the overlap rests on the top of the box so that the cover stays open, thus making for convenience in replacing fuse plugs and other work on the switch mechanism. Provision is made for locking the cover with either one or two padlocks.

Current-Limiting Counter-Emf. Starter

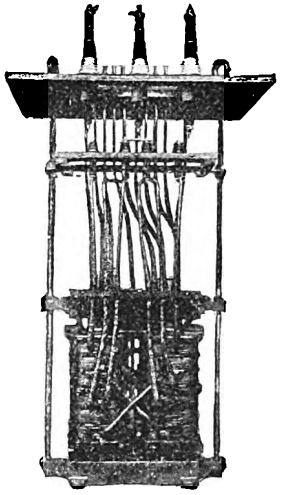
For use on board ship the type "O" current-limiting counter-emf. starter for direct current has been developed by the Automatic Switch Company, 4 White Street, New York City. It comprises a magnet line contactor and two resistance-bridging magnets, specially finished in copper throughout, with waterproof resistance, copper-plated frame, etc., the coils being impregnated to prevent injury from moisture. In this type of control the magnets are said to be unaffected by the widely varying angle of mounting used on board ship.



FOR DIRECT-CURRENT SERVICE ON BOARD SHIP

Core-Type Transformers for Furnace Control

The electric furnace owes its growing acceptance as a desirable medium both for heat-treating steel and melting non-ferrous metals chiefly to the exacting control it offers over temperature conditions. As a link in the control equipment of its Baily electric furnaces, the Electric Furnace Company, Alliance, Ohio, is building special transformers of the core type with a 400-kva. rating. The high-tension side of these transformers is fitted with the customary voltage taps and wound for 22,000 volts, and the low-tension side has ten special voltage taps to meet the particular voltage requirements of the furnace. Each transformer is single-phase, and for small furnaces, requiring 100 kw. or less, one transformer is said to be sufficient. Three-phase current is taken care of by two transformers fitted with a Scott connection. By means of the special low-tension voltage taps any desired current input may be delivered to the furnace through the selective oil-break switches that are a part of each installation. With furnace current under control, any furnace temperatures may be steadily maintained.



ANY DESIRED CURRENT CAN BE DELIVERED TO FURNACE

Engineless Farm-Lighting Plants

Storage batteries, a generator and switchboard compose the farm-lighting plant manufactured by the Superior Engineering Company, Jenkins Arcade, Pittsburgh, Pa. No driving unit is furnished because the company wishes to avoid duplication on farms which are already equipped with some means of generating mechanical power.

The generator of this set is designed for rough service and has a commutator with small segments to insure a smooth, flickerless light. A sliding base makes it possible to take up belt slack readily, and the bearings are said to require infrequent oiling. Standard pulleys are customarily furnished, but flywheel pulleys can be obtained which are said to assist in giving a steadier light when the current is used directly from the generator to any great extent.

Sixteen sealed glass-jar storage-battery cells with thick, lasting plates are used. They are mounted on a rack, and it is possible easily to see the condition of the plates, watch the level of the electrolyte and determine whether each cell is receiving a charge. The switchboards are furnished with a voltmeter and a double-reading ammeter which shows both charge and discharge. There is a rheostat for controlling the rate of charge, an automatic circuit

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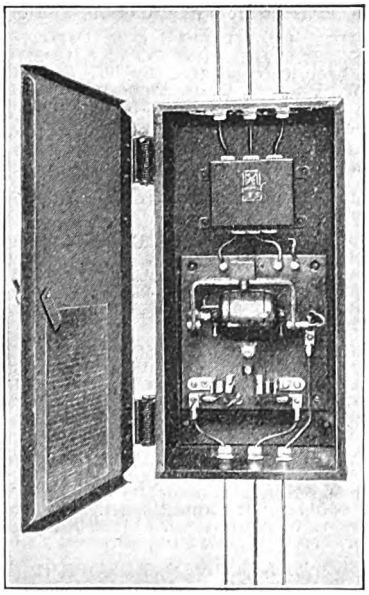
breaker and the necessary switches and cartridge fuses. These sets are supplied in sizes from the twenty-five, forty and fifty-light plants with 32-volt batteries up to 10-kw. and 24-kw., 110-volt plants.

Ratchet Receding Pipe Threader for Limited Space

To perform pipe-threading operations in places where space is limited a ratchet receding pipe threader has been developed by the Greenfield Tap & Die Corporation of Greenfield, Mass. The ratchet mechanism of this device represents the only change from the receding pipe threader made by this company and is incorporated directly in the die stock instead of being made an attachment. The head is so designed that the pulling strain of the handles comes directly back of and in line with the chasers, thus minimizing the pull and preventing danger of trouble caused by twisting strains. The threader is made with two-handle lugs, two handles being furnished with the tool. When it is to be used with the ratchet mechanism one of these handles is taken off and the tool will then swing in a 14-in. (35-cm.) circle; but it is equally feasible to disengage the ratchet, screw the second handle into place in its lug, and use this tool just as the regular receding pipe threader is operated.

Reverse-Phase Protective Relay

For installation where a reversal of phase may result in a serious accident. Schweitzer & Conrad, Inc., 4431 Ravenswood Avenue, Chicago, are now manufacturing a device known as a reverse-phase protective relay. It includes an arrangement for operating two stationary contacts and a moving contact which bridges the two stationary ones when it falls into position. The moving contact is held in the normal position by cams mounted on the end of the shaft of the operating mechanism. The entire relay is mounted in an approved sheet-iron box.



AN ARRANGEMENT OF TWO STATIONARY AND ONE MOVING CONTACT

The operating element is connected through a small transformer to the terminals of the motor being protected, and the three short-circuiting contacts are connected to the load side of the fuses protecting the motor. The operating element connections are made so that as long as the motor rotates in the proper direction the retaining cam holds the moving contact in the normal or open position. If a reversal of the supply wires occurs, the operating element rotates the retaining cam approximately 90 deg. and releases the moving contact. Since these three contacts are directly connected to the load side of the fuses protecting the motor, these fuses will be blown. This disconnects the motor and prevents its further use until the trouble has been investigated and corrected. This reverse-phase relay can be furnished in 100-amp. and 200-amp. sizes, the smaller size being suitable for any motor that requires fuses up to 100-amp. and the larger size for motors requiring between 100-amp. and 200-amp. fuses.

Notes on Recent Appliances

Show-Window Lighting System

"Ready-to-install" lighting systems for show windows are being made by Frederick A. Watkins, 565 West Washington Street, Chicago.

Semi-Indirect Lighting Fixture

The Wheeler Reflector Company, 156 Pearl Street, Boston, Mass., has made several improvements in its "Mellowlight" semi-indirect lighting fixture.

Induction Motor Rotors with Cast Windings

Cast squirrel-cage windings are now used for the rotors of induction motors made by the General Electric Company of Schenectady, N. Y.

Ammeters and Voltmeters

Two types of ammeters and voltmeters have been placed on the market by the Dongan Electric Manufacturing Company, 745 Franklin Street, Detroit, Mich.

Pendent or Ceiling-type Fixtuer

The "Reth-Lite," a commercial lighting fixture of the pendent or ceiling type, is being manufactured by the Retherford Brothers Company, Muncie, Ind.

Continuous Recuperative Annealing

For the annealing of alloy steel bars and wires the Electric Furnace Company, Alliance, Ohio, has produced a continuous recuperative annealing furnace.

Automatic Light and Power Plant

Self-contained electric lighting and power plants for farms and isolated dwellings are now marketed by R. M. Owens & Company, 722 South Michigan Avenue, Chicago, Ill.

Welding Apparatus for Alternating Current

The Arcwell Corporation, 42 Broadway, New York, has just placed on the market an electric welding machine built for operation on alternating current of any specified voltage or frequency.

Attachment Plug

One piece, fuseless attachment plugs are being sold by the Stuart Products Corporation, 440 South Green Street, Chicago, Ill.

Domestic Flatiron

Electric flatirons with two points for domestic use are now manufactured by the Central Flatiron Manufacturing Company, Johnson City, N. Y.

Electrical Tool, Cutter and Surface Grinders

The Saphil Manufacturing Company, 147 West Austin Avenue, Chicago, has developed a portable electrically driven tool, cutter and surface grinder.

Dome-Reflector Sockets

Standard dome-reflector sockets, known as "RLM," are being made by the Benjamin Electric Manufacturing Company, 120 South Sangamon Street, Chicago.

Automatic Egg Boiler

Automatic electric egg boilers for 110-volt circuits have been developed by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City.

Prophylactic Cabinet

To operate pressure sprays for treating the teeth a prophylactic cabinet containing an inclosed motor-driven air compressor is being marketed by Reid & Pancoast, 313 Vine Street, Philadelphia.

Knife Switch

Renewable fuses are a part of the knife blades in the "Navy" type switch being marketed by the Metropolitan Electric Manufacturing Company, Fourteenth Street and East Avenue, Long Island City, N. Y.

Copper Nuts

The Mutual Electric & Machine Company, Detroit, Mich., is now manufacturing copper nuts by a new copper-flowing process which eliminates machining on the outside of the nut. The threads are, of course, drilled and tapped.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A commercial agent in France (No. 29,120) desires to secure an agency for the sale of electrical goods. Correspondence may be in English.

A man in Switzerland (No. 29,115) desires to secure an agency for the sale of electrical apparatus such as dynamos or electric locomotives. Correspondence may be in English.

A company in Spain (No. 29,126) desires to purchase and secure an agency for the sale of electrical goods. Cash will be paid as per arrangements. Correspondence should be in Spanish.

A machinery dealer in France (No. 29,134) desires to purchase electrical apparatus. Correspondence should be in French. Descriptive literature and quotations are solicited.

An American firm (No. 29,124) which has recently been appointed as representative of a company in New Zealand desires to secure agencies for the sale of electrical goods. Quotations should be given f.o.b. New York or San Francisco. Payment will be by established letter of credit or sight draft.

A company in Australia (No. 29,158) desires to receive catalogs of machinery for the manufacture and distribution of compressed air, fans and blowers for both air and gas, insulating materials for electricity and heat, electric furnaces, factory lighting, boilers, centrifugal and reciprocating pumps, fire tiles and firebricks.

A firm in this country (No. 29,153) with a branch in Italy, and also proposing to open offices in other European countries, desires to secure agencies for the sale of electrical railway equipment, metal goods and other electrical supplies, and especially insulated wires, cables, rubber goods and all the machinery and materials for their manufacture.

COYNE SCHOOLS DESIRE CATALOGS AND SAMPLES.—Manufacturers' and jobbers' catalogs of electrical goods, as well as samples of all kinds, are desired by the electrical department of the Coyne Trade and Engineering Schools, Chicago.

FEDERAL TRADE COMMISSION ACTIONS.—Formal complaint has been filed against the Universal Battery Service Company, Chicago, alleging false and misleading advertising. Complaint against the Victor Electric Corporation, Chicago, has been dismissed.

BALL-BEARING MANUFACTURERS COMBINE.—The S K F Administrative Company, 5 Nassau Street, New York City, just announces a reorganization, effective May 1, whereby the products of the Hess-Bright Manufacturing Company, the S K F Ball Bearing Company, the Atlas Ball Company and the Hubbard Machine Company will be sold through one central organization. The new company—S K F Industries, Inc.—will be under the direction of B. G. Prytz, president, W. L. Batt, vice-president, J. P. Walsh, comptroller, and S. B. Taylor, sales manager. The principal office will be at 165 Broadway, New York City, with branches at Boston, Philadelphia, Atlanta, Buffalo, Cleveland, Detroit, Cincinnati, Chicago and San Francisco.

THE HUTCHINSON STORAGE BATTERY COMPANY, Trenton, N. J., manufacturer of storage batteries, has completed plans for the construction of a new one-story addition to its plant on South Warren Street, to cost $15,000.

F. C. MYERS, formerly with the Society for Electrical Development, and more recently with the W. R. C. Smith Publishing Company, has been appointed district manager of the Baker R. & L. Company, manufacturer of electric vehicles, for the South.

C. J. HOLSLAG sailed for England on March 28 for a stay of several months, during which time he will assist in forming an English factory branch of the Electric Arc Cutting & Welding Company, Newark, N. J., manufacturer of portable cutting and welding devices.

THE WIRELESS SPECIALTY APPARATUS COMPANY, Albany, N. Y., has increased its capital to $700,000.

W. H. GREEN has been appointed Pacific Coast manager of the Chicago Fuse Manufacturing Company, with headquarters in San Francisco.

H. M. NEWKIRK, formerly mechanical engineer of the Hygrade Lamp Company, Salem, Mass., has resigned to enter private business in Boston.

THE STAR ELECTRODE WORKS, Niagara Falls, N. Y., have commenced the erection of a new one-story plant addition, about 25 ft. by 70 ft., for increased output.

THE ELECTRO STEAM RADIATOR COMPANY has moved its offices to 22 West Monroe Street, Chicago, and has moved its factory to 147th and State Streets, Harvey, Ill.

THE WIRELESS SPECIALTY APPARATUS COMPANY, Albany, N. Y., manufacturer of wireless apparatus and special equipment, has filed notice of an increase in capital to $700,000, for expansion.

CHAS. F. AMES & COMPANY, LTD., 90 West Street, New York, has been appointed to act as the New York sales department of the Platt Iron Works, Dayton, Ohio, manufacturers of pumping and power plant equipment.

C. D. SMITH, formerly manager of the Great Falls Electric Supply Company, Great Falls, Mont., has organized the firm known as the Cascade Electric Supply Company, with offices at 504 Central Avenue, Great Falls, Mont.

THE O. K. BATTERY COMPANY, Gary, Ind., will soon begin building a large plant in that city, one wing of the plant to be erected at a time. A site has been secured. It is planned to have the O. K. batteries on the market shortly.

J. McDONALD SMITH, formerly chief engineer of the Triumph Electric & Ice Machine Company, Cincinnati, has left that company to represent the Australian interests of the Texas Oil Company with headquarters at Sydney, Australia.

THE J. & M. ELECTRIC COMPANY, Utica, N. Y., has filed notice with the Secretary of State of an increase in its capital from $60,000 to $100,000. It is understood that the increase will be used to provide for extensions and general expansion.

THE LIBERTY STORAGE BATTERY COMPANY, Chicago, will purchase the factory building formerly occupied by the plant of the Brazil Stamping & Manufacturing Company at Brazil, Ind. The manufacturing will be removed from Chicago to Brazil.

THE STATES ELECTRIC SERVICE COMPANY announces the opening of its business at 1011 Farnam Street, Omaha, Neb., to engage in the repair of electrical equipment and the installation of light and power plants. C. W. Parker is manager.

BITTMAN & BATTEE, INC., manufacturers' agents, 84 Second Street, San Francisco, have been appointed representatives of the Hazard Manufacturing Company of Wilkes-Barre, Pa., manufacturer of steel and wire rope, electric wires and cables, etc.

THE ADJUSTABLE FIXTURE COMPANY, Manufacturers' Home Building, Milwaukee, Wis., manufacturer of distribution material, is reported to have increased its capital stock from $25,000 to $50,000, preparatory to increasing its facilities and output.

THE STANDARD ENGINEERING COMPANY, Mount Carmel, Pa., has been formed by M. J. Flynn, Frank McLoughlin and J. R. Cunningham. The company will carry on a general engineering business, electrical, mechanical and civil, besides attending to construction, repairing, appraisals and valuations.

THE MOHAWK ELECTRICAL SUPPLY COMPANY, Syracuse, N. Y., established a home appliance department in Syracuse a year ago to sell at retail in that city only. In this first year the department sold $33,000 worth of washers, ironers and cleaners, and this year it expects to sell not less than $50,000 worth of these appliances. This statement is from A. M. Little, president, in the March number of *The Mohawk Trail.*

Trade Publications

GRAPHIC INSTRUMENTS.—In a new booklet the Esterline Company, Indianapolis, Ind., tells about its latest-type graphic efficiency instruments.

ELECTRIC RADIATOR.—The Electro Steam Radiator Company, 125 South Wells Street, Chicago, has issued an envelope stuffer showing three styles of its electro steam radiators.

LAVA.—The American Lava Company, Chattanooga, Tenn., has prepared a booklet about lava for mechanical and electrical purposes. Illustrations are included showing many articles of this material.

DISHWASHING MACHINES. — Two models of the Crescent electrically driven glass and dish washer are described and illustrated in a leaflet from the Bromley-Merseles Manufacturing Company, 837 Larrabee Street, Chicago.

WASHING MACHINES. — The Voss Brothers Manufacturing Company, Davenport, Iowa, has issued a booklet in which it presents about twenty advertisements which washing-machine merchants can use in advertising to their local trade.

NIGHT LIGHT.—"Baby Light," a new porcelain night lamp equipped with a transformer for reducing current from an ordinary lighting circuit to 6 volts, is the subject of a leaflet from the St. Louis Brass Manufacturing Company, St. Louis, Mo.

INDUSTRIAL LIGHTING.—The Henkel-Best Company, 122 South Michigan Avenue, Chicago, has issued a booklet on "Industrial Lighting and Production." Heavy-duty reflectors, shade-holder reflectors and two types of "Fac rylites" are described.

LIGHTING FIXTURES.—R. Williamson & Company, Washington and Jefferson Streets, Chicago, have issued a thirty-two-page catalog illustrating lighting fixtures grouped in sets to assist in selecting the right fixtures for each room in both town and country homes. The catalog also contains a few pages on electrical supplies and domestic appliances.

New Incorporations

THE CAMPTON (N. H.) ELECTRIC LIGHT COMPANY has been chartered with a capital stock of $2,000 by Moody G. Dole, Erastus Dole of Campton, and others.

THE STAMPING GROUND (KY.) ELECTRIC LIGHT & POWER COMPANY has been incorporated by W. D. Adams, J. W. Palmer, C. B. Roberts and others. The company is capitalized at $6,000.

THE CLERMONT SUBURBAN POWER & LIGHT COMPANY of Amelia, Ohio, has been chartered with a capital stock of $2,000 by Frank C. Williams, J. M. Cook, C. B. Kergan, G. W. Hartwell and L. V. K. Keister.

THE MUTUAL POWER & LIGHT COMPANY of Burlington N. C., has been incorporated with a capital stock of $125,000 by Eugene Holt, James N. Williamson, Jr., of Burlington, and Lynn B. Williamson of Graham.

THE MINNESOTA STORAGE BATTERY COMPANY, 191 West Sixth Street, St. Paul, Minn., has been incorporated with a capital stock of $50,000. Ferris Price is president. O. W. Hart vice-president, and W. E. Lean secretary and treasurer.

THE HI-GLO COMPANY of Wheeling, W. Va., has been incorporated by Carl O. Schmidt, Henry L. and Herman L. Arbenz. The company is capitalized at $50,000 and proposes to manufacture electric signs and other metal illuminating displays.

THE TRI-COUNTY ELECTRIC COMPANY of Pompton Lakes, N. J., has been incorporated by E. V. and Samuel W. McElroy and Henry G. Hershfield. The company is capitalized at $25,000 and proposes to construct and operate an electric light plant in Pompton Lakes.

THE MILLING & LIGHTING COMPANY of Brasher Falls, N. Y., has been incorporated by R. Hefferman, T. D. Rochford and M. A. Hallahan of Brasher Falls, N. Y. The company is capitalized at $60,000 and proposes to generate and distribute electricity for lamps, heaters and motors.

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New England States

NASHUA, N. H.—The Nashua Manufacturing Company is planning a hydroelectric development at Mine Falls to furnish energy to operate its cotton mills. The proposed plans include the erection of a large power station and raising the present dam 13 ft.

RUTLAND, VT.—The Rutland Railroad Company is reported to be considering the installation of a number of electrically operated tools at its local repair shop and car repair works.

CAMPELLO, MASS.—Contracts, it is reported, will soon be awarded by the A. E. Keith Company, for the construction of power plant, 64 ft. by 71 ft., to cost about $56,000. Jenks & Ballon, Grosvenor Building, Providence, R. I., are engineers.

HOLDEN, MASS.—At a recent town meeting extensions were authorized to the municipal electric lighting service involving an expenditure of over $4,000.

HOLYOKE, MASS.—The Board of Public Works has requested the Gas and Electric Department to extend the High Street lighting system south to Cabot Street.

HOLYOKE, MASS.—Some contracts have been awarded by the Cortz Manufacturing Company of Holyoke for an addition to a manufacturing building, and to power house, to cost about $60,000.

IPSWICH, MASS.—An extension of the municipal electric lighting system to Linebrook Parish and an appropriation of $6,000 to pay for same was authorized by the voters at a recent town meeting.

NORTH KINGSTON, R. I.—Permission has been granted to the Wickford (R I.) Light & Water Company to erect and maintain electric transmission lines on several highways in the town. The Town Council has been authorized to enter into a contract with the company for 170 street lamps for a period of one year.

Middle Atlantic States

DUNKIRK, N. Y.—Arrangements are being made by the City Council for the installation of a new ornamental lighting system throughout the principal business thoroughfares of the city.

EAST ROCHESTER, N. Y.—The Rochester Railway & Light Company is planning to erect a distributing station at East Rochester to supply electricity in Eastern Monroe and adjoining territory.

HUDSON, N. Y.—Bids will be received by the city clerk, Hudson, until May 15, for lighting the streets and public buildings of the city of Hudson with electricity for a period of five years, beginning Sept. 1, 1919.

TARRYTOWN, N. Y.—Contract has been awarded by the Chevrolet Motor Company, 112 East Fifty-seventh Street, New York City, to the White Fireproof Construction Company, 286 Fifth Avenue, for the construction of its plant at Tarrytown, to cost about $500,000.

CAMDEN, N. J.—The Camden Motor Company is planning to erect a new plant, to be located on the White Horse Pike, Collinswood, which with equipment will cost more than $$500,000. D. M. Davis, Temple Building, Camden, is interested in the company.

EAST ORANGE, N. J.—Arrangements have been completed by the Water Department for alterations and improvements in the municipal pumping station located at Millburn. Roswell M. Roper, 436 Main Street, East Orange, is engineer.

WANAQUE, N. J.—Steps, it is reported, have been taken by local men to organize a company to erect an electric transmission line from Pompton Lakes to Wanaque to transmit electricity from the Pompton Lakes power plant to supply energy in Wanaque and surrounding country.

ERIE, PA.—Negotiations are under way between the city officials and the Erie County Electric Company for removing the overhead electric wires on State Street and placing them in underground conduits.

ERIE, PA.—Bids will be received by the board of education, Erie, until May 12 for general work, heating, plumbing, electric work, clocks, bells and telephones and vacuum-cleaning system for the new East Side High School building. Plans and specifications may be secured from R. S. Scobell, business manager, board of school directors, Erie. For details see Searchlight section.

McKEE'S HALF FALLS, PA.—Steps have been taken to organize a company to be known as the Susquehanna Power Company, to construct a hydroelectric power plant at McKee's Half Falls to supply electricity in this town, Port Trevorton, Selinsgrove and adjacent teritory. E. C. Williams, F. A. Bingaman, T. M. Vanzandt of Port Trevorton and George C. Wagenseller of Selinsgrove are interested in the project.

MEADVILLE, PA.—Plans have been prepared for the erection of a new pumping plant, to cost about $11,000, to be used for municipal service. F. Ellsworth is superintendent of waterworks.

PHILADELPHIA, PA.—Contract has been awarded by the Department of City Transit to the North American Railway Construction Company, Chicago, Ill., for construction of the proposed surface railway line to extend from Oxford Avenue, Frankford section, to the city farms at Byberry, a distance of 10 miles, of which it is planned to build 6 miles, as far as Bustleton, for initial operation.

PITTSBURGH, PA. — The West Penn Traction Company, it is reported, is contemplating the erection of machine repair shops at South Warwood, W. Va.

PITTSBURGH, PA.—A portion of the plant of the Electric Manufacturing & Repair Company, First Avenue, was recently damaged by fire. The company, it is understood, will rebuild at once.

NORFOLK, VA. — R. E. Sparks, St. George Hotel, Norfolk, is contemplating the installation of an electric welding machine, motor-generator and switchboard.

WASHINGTON, D. C.—The Potomac Electric Power Company has petitioned the Public Utilities Commission for permission to issue $1,750,000 in bonds to cover additions to its plant at Benning.

North Central States

DETROIT, MICH.—Plans are being prepared by the Detroit Seamless Steel Tube Company, 841 West Jefferson Avenue, for the erection of a new factory on Wyoming and West Warren Avenues, to cost with equipment about $1,700,000. A. A. Templeton is president.

HIGHLAND PARK, MICH.—Bids will be received by the city of Highland Park at the office of the city clerk, 20 Gerald Avenue, until May 12 for general work, heating, plumbing, electric work, lighting fixtures, refrigeration, sterilizers, laundry machinery, cooking apparatus, etc., for a four-story basement and sub-basement hospital building, a two-story power house and laundry and connecting tunnel for the city of Highland. Separate bids will be received for each, all or any number of the above items. Plans and specifications may be obtained upon application to L. C. Whitsit, city engineer, 28 Gerald Avenue, Highland Park, for which a deposit of $25 will be required.

CLEVELAND, OHIO.—A six-story power block will be erected on East Eighteenth Street by the Paul Brothers Company, in which quarters will be provided for light manufacturing purposes.

CLEVELAND, OHIO.—Plans are under consideration by G. W. Hale, Leader-News Building, for the construction of a garage on East Ninth Street and Bolivar Road, to cost about $250,000..

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of the division of purchases and supplies, City Hall, Cleveland, until May 9 for auto trucks for the Division of Light and Heat. Specifications may be obtained upon application to Room 204, City Hall.

DAMASCUS, OHIO.—The establishment of a municipal electric light plant in Damascus is under consideration.

EATON, OHIO.—The Eaton Lighting Company is negotiating with the Greenville (Ohio) Electric Light & Power Company for energy to operate its local system.

LEBANON, OHIO.—Improvements to the municipal electric light plant, to cost about $14,000, are under consideration.

MANSFIELD, OHIO.—The Kenney Company is considering the installation of new electrical machinery and new equipment for machine shop. Jacob Cousins is treasurer.

DECATUR, IND. — The Public Service Commission has granted the Farmers' Light & Power Company and the Preble (Ind.) Light & Power Company permission to erect their electric transmission line to furnish electrical service east of the city and to the residents of Preble. Both companies will secure electricity from the Decatur Light & Power Company.

EVANSVILLE, IND.—The erection of a new engine house with shop facilities, to cost about $125,000, is under consideration by the Louisville & Nashville Railroad Company of Louisville, Ky.

FRANKLIN, IND.—The Hatfield Electric Company of Indianapolis has been awarded the contract for electrical fixtures for the new dormitory at the Masonic Home, to be erected at a cost of $42,500.

PERU, IND.—The American Gas & Electric Company, 30 Church Street, New York, N. Y., has submitted a proposal to the City Council to supply electricity for the local system from its plant in Marion. It is proposed to erect a high-tension transmission line from Marion to Peru and connect with the switchboard at the municipal plant. O. M. Drischell is general manager of the Marion Light & Heating Company.

ALVIN, ILL.—The Public Utilities Commission has granted the Rossville Electric Light Company permission to erect an electric transmission line from Alvin to Bismarck and to furnish electrical service in Bismarck, and also to residents along the line.

ELDORADO, ILL.—The installation of a municipal electric light plant in Eldorado is under consideration.

HILLSDALE, ILL. — The Public Utility Commission has granted the Rock River Valley Light & Power Company a franchise to erect an electric transmission line from Silvis to Hillsdale and also to install and operate distribution systems in Barstow, Joplin and Hillsdale. The company has also been given authority to issue $20,000 in capital stock.

LENA, ILL.—The Lena Electric Light & Power Company has taken over the property of the Warren Light & Power Company, including the service wires to Apple River. The erection of an electric transmission line from Lena to Warren is contemplated by the Lena company and also furnishing electrical service to intervening towns.

PLEASANT PLAINS, ILL.—The Abbott Light & Power Company has been granted permission to install and operate an electric distribution system in Pleasant Plains.

SPRINGFIELD, ILL. — The Board of Public Works has authorized the installation of a new lighting system in Reservoir Park.

WOODSTOCK, ILL.—The installation of a new engine in the municipal electric light plant is under consideration.

FOND DU LAC, WIS.—The City Commission has adopted an ordinance requiring all overhead wires placed in underground conduits in the downtown business district within sixty days.

MENASHA, WIS.—Bids will soon be awarded by the Peerless Paper Products Company for the erection of an addition to its mill and an extension to the boiler house and transformer station. The cost including equipment is estimated at about $75,000. L. A. DeGuere of Grand Rapids is consulting engineer.

MILWAUKEE, WIS.—Contracts aggregating $580,000 will be awarded this year in connection with the municipal electric lighting system. The work for installing the system will amount to $180,000, and the material to be used will cost approximately $400,000. The lowest bids for the work were submitted by the Cummings Company of Chicago, Ill., at $176,000, and the Dean Construction Company of Milwaukee, at $180,000. To date the city has appropriated $1,500,000 for the installation of the system.

STURGEON BAY, WIS.—The Universal Shipbuilding Company is planning to build an addition to its power plant, to cost about $30,000.

WAUPACA, WIS.—Preliminary plans, it is reported, have been prepared by E. Orbison, engineer, Appleton, for the construction of a hydroelectric power plant on Little Wolf River to develop about 150 hp. The cost is estimated at $200,000. F. H. Josslyn, Algoma Block, Oshkosh, is interested.

HASTINGS, MINN.—The Legislature has made an appropriation of $25,000 for a power plant for the Hastings State Hospital, the money to be available July 31, 1919; also $5,000 for power-plant repairs. An appropriation of $125,000 was also made for completion of power plant, the money to be available July 31, 1920.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

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RED CLOUD, MINN.—The municipal electric light plant was recently damaged by fire.

DUBUQUE, IOWA.—A petition has been presented to the City Council requesting that an election be called to submit to the voters the proposal to establish a municipal electric light and power plant.

STORY CITY, IOWA.—The proposal to issue bonds for rebuilding the municipal electric light plant will be submitted to the voters. The cost is estimated at about $50,000.

TRAER, IOWA.—The town officials are considering establishing a municipal electric light plant and contemplate either purchasing the equipment of the local company or building a new plant.

ST. LOUIS, MO.—A report submitted to the Board of Public Service by Ralph Toensfeldt, engineer of the Department of Public Utilities, estimates the cost of installing municipal street lighting at $1,260,400. The plan provides for the use of the city's conduits, which are now used for carrying the wires of the police and municipal telephone wires.

FARGO, N. D.—Bonds to the amount of $150,000 have been voted for the installation of a municipal electric light plant.

HANKINSON, N. D.—The Richland Power & Light Company, recently incorporated with a capital stock of $50,000, proposes to erect an electric transmission line from Wahpeton to Moorston, where it will connect with the transmission system of the Otter Tail Power Company.

JAMESTOWN, N. D.—At an election held recently the proposal to issue bonds for the installation of a municipal electric light plant was carried.

GREGORY, S. D.—At an election held recently the proposal to issue bonds for the installation of a municipal electric light plant was carried.

VERMILION, S. D.—An election will be called to submit to the voters the proposal to issue $60,000 in bonds to construct a municipal electric light plant in Vermilion.

TRUMBULL, NEB.—At an election held recently $6,000 in electric light bonds were voted.

YORK, NEB.—Plans are being prepared by W. F. Gernandt, architect, Keeline Building, Omaha, for a power house, to cost about $12,000, and an addition to the Lutheran Hospital, to cost about $40,000.

NEODESHA, KAN.—Bids will be received by the city of Neodesha until May 7 for the installation of an ornamental lighting system. Specifications may be obtained from F. O. Williams, chairman.

PITTSBURG, KAN.—The State Legislature has made an appropriation of $10,000, to be available after July 1, for new equipment for the power plant at the State Normal School at Pittsburg, including the installation of a 125-hp. tubular boiler, etc. J. A. Kimball, State House, Topeka, is business manager.

ST. JOHN, KAN.—Bonds to the amount of $45,000 have been voted for improvements to the municipal electric light plant and waterworks system.

Southern States

BRIDGEWATER, N. C.—The Southern Power Company of Charlotte, it is reported, has made arrangements with the Rinchart & Dennis Company of Charlottesville, Va., to take over and complete the Sydo hydroelectric development, including the construction of dams and power house. The cost is estimated at about $400,000.

HENDERSONVILLE, N. C.—The Blue Ridge Power Company is contemplating the construction of a hydroelectric power plant with steam-power equipment for emergencies. The cost of the project is estimated at about $1,000,000, which will include a dam with 300-ft. fall, railroad bridge and a 300-acre lake. John A. Law, of Spartanburg, S. C., is secretary.

SPARTANBURG, S. C.—The City Council has awarded the South Carolina Light, Power & Railways Company a contract for lighting the city for a period of ten years, beginning October, 1919. Under the terms of the new contract the company will install an ornamental lighting system in the business district.

LYONS, GA.—The Council is considering issuing bonds for improvements to the municipal electric light plant.

REIDSVILLE, GA.—The City Council has awarded a contract for the installation of an electric light plant in Reidsville to the J. B. McCrary Company of Atlanta, at $12,000.

BRADENTOWN, FLA.—Bids will be received by the city of Bradentown, until May 30 for complete electrical equipment for opening a bascule bridge. Plans and specifications may be obtained on application to the Scherzer Rolling Lift Bridge Company of Chicago, Ill. Harry Wadham is commissioner of public works.

TALLAHASSEE, FLA. — Preparations are being made by the city of Jacksonville to rebuild the municipal electric light and power plant, recently destroyed by fire. The loss is estimated at $75,000. The waterworks pumping station (electrically driven) was also put out of commission. Gasoline-driven engines will be installed at the waterworks.

COALFIELD, TENN.—The Coalfield Company, it is reported, is planning to rebuild its power plant, recently destroyed by fire. The cost is estimated at about $5,000.

FAIRFIELD, ALA.—A large section of the works of the Tennessee Coal, Iron & Railroad Company was recently destroyed by fire, including machine shop, forge and blacksmith shop, carpenter and woodworking shop, rigger shop and electric substation. The loss is estimated at about $65,000. The buildings, it is understood, will be rebuilt.

CLARKSDALE, MISS.—At an election to be held May 12 the proposal to issue $300,000 for improvements to the water and electric light systems, construction of sewers, paving, etc., will be submitted to the voters. The plans include the installation of turbine, boiler, feed pump, transformer, boiler, construction of reservoir, laying additional mains, etc.

GURDON, ARK.—M. B. Morgan, owner of the local electric light plant, is negotiating with the City Council of Prescott to secure electricity from the Prescott municipal electric plant. Mr. Morgan proposes to erect a high-tension transmission line from Gurdon to Prescott.

SPRINGDALE, ARK.—The installation of a municipal electric light plant is under consideration by the City Council. W. L. Winters, 700 South Twentieth Street, Fort Smith, is engineer.

DONALDSON, LA.—Plans are under consideration to extend the municipal electric light and power system beyond the corporate limits of the city, to include the whole of what is known as the Faubourg La Pipe. Joseph W. Byrnes is manager.

COMMERCE, OKLA.—Arrangements have been made for erecting street lamps in the business section on Commerce Street. Electric lamps will probably be erected on other business streets, although definite plans have not been made.

EL RENO, OKLA.—The W. E. Bible Storage Battery Manufacturing Company is planning to establish a plant for the manufacture of storage batteries. The cost of the equipment is estimated at about $50,000.

GROVE, OKLA.—Preparations are being made for improvements to the municipal electric light plant and waterworks system.

HANNA, OKLA.—Arrangements are being made by the Commercial Club for the installation of a new electric plant in Hanna.

TAHLEQUAH, OKLA.—The installation of an electric light and power plant is under consideration by the City Council. The cost is estimated at about $65,000.

TULSA, OKLA.—Plans are being considered for extensions to the street-lighting system on Fifteenth Street to Terrace Drive. Additional lamps will also be erected in West Tulsa.

ABILENE, TEX.—The electric light and power and waterworks plants of the American Public Service Corporation at Abilene, recently destroyed by fire, will be rebuilt as soon as machinery and material can be obtained. The new plants will cost about $300,000.

CLIFTON, TEX.—The Waco Mill & Elevator Company of Clifton is planning to erect a grain elevator of 75,000 bushels capacity, to be equipped with electrically driven machinery.

FORT WORTH, TEX.—Work will soon begin on the survey of the proposed electric railway to run between Fort Worth and Mineral City. Right-of-way for the first 45 miles out of Fort Worth has been secured. Richard Feris and H. E. Robison of Fort Worth are promoters.

FORT WORTH, TEX.—The Alexander Lumber Company has awarded contract to Miller Brothers of Fort Worth for all electrical work in connection with its proposed new plant. The company proposes to manufacture portable buildings for use principally in oil fields and for export trade.

STEPHENVILLE, TEX.—The installation of an electric light plant at the John Tarlton Agricultural and Mechanical College, to cost about $40,000, is under consideration.

WACO, TEX.—J. F. Strickland, president of the Texas Power & Light Company, has advised the City Commission of Waco that the company will build an addition to its plant, to cost $200,000, in Waco, provided the city will grant the company a new franchise to run until 1939. No action has been taken on the proposition.

Pacific and Mountain States

SEATTLE, WASH.—The City Council has passed an ordinance authorizing the purchase of a 100-kw. motor-generator set for the lighting department.

SEATTLE, WASH.—An estimate has been submitted to the City Council by Thomas F. Murphine, superintendent of the public utilities, having control of street-car operations and betterments, of the cost of extensions, improvements and construction work contemplated for the municipal street-railway system, the total of which is $536,300.

FLORENCE, ORE.—The City Council is negotiating with G. G. Bushman, owner of the local electric light plant, for the purchase of the system, consisting of a steam electric generating station, street-lighting and distributing system for private consumers in Florence and in Grenada.

HOLLISTER, CAL.—The Board of Supervisors has granted the Coast Counties Gas & Electric Company of Santa Cruz a franchise to erect and operate electric transmission lines on the county roads and public highways.

MARE ISLAND, CAL.—Improvements have been authorized by the Bureau of Yards and Docks, Navy Department, Washington, D. C., to the Mare Island Navy Yard including slips and piers, doubling the capacity of power plant, new buildings, oil tanks and railway through Vallejo causeway to connect with the Southern Pacific Railway. The cost is estimated at about $2,500,000.

MONTEREY, CAL.—The Del Monte Light & Power Company, recently incorporated, has petitioned the State Railroad Commission for permission to issue $25,000 in capital stock for the purpose of purchasing from the Pacific Improvement Company its electric transmission system in Monterey County. The line has been appraised at $26,967. The Del Monte company proposes to purchase energy from the Coast Valleys Gas & Electric Company. H. Tiedmann is president of the Del Monte company.

SALMON, IDAHO.—The Harmony Mines Company is planning to erect an electric transmission line to connect with the Salmon River power plant. E. F. Nieman is general superintendent of the company.

MILLVILLE, UTAH.—Bonds have been authorized by the voters for the erection of an electric transmission line to secure electricity for lighting the town.

Canada

VICTORIA, B. C.—The British Columbia Electric Railway is planning to lay a submarine cable across Victoria Harbor to supply electricity for industrial purposes on the Songhees Indian Reserve.

WINNIPEG, MAN.—Tenders will be received by the chairman of committee on fire, water, light and power, at the office of the city clerk, Winnipeg, until May 5 for a quantity of medium hard-drawn stranded copper cable, soft-drawn copper tie wire and copper jointing sleeves. Bids will also be received at the same time and place for 3000 more or less high-voltage porcelain insulators. Specifications, etc., may be obtained at the office of the City Light and Power Department, 54 King Street. C. J. Brown is city clerk.

MILLTOWN, N. B.—The Canadian Cottons, Ltd., has petitioned the International Joint Commission for permission to divert the St. Croix River and erect a power house on the river opposite Milltown, N. B. Improvements and additions are contemplated by the company involving an expenditure which is estimated at more than $500,000.

CLARKE HARBOR, N. S.—The Town Council is considering the installation of an electric lighting plant.

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GALLETTA, ONT.—The Galletta Electric Power Company is considering the erection of an electric transmission line to Arnprior. E. R. Lock is engineer of the company.

PETERBOROUGH, ONT.—The construction of an electric railway from the junction of the Irondale & Bancroft Railway with the Grand Trunk Railway, running from Lindsay to Haliburton and extending this line through the townships of Galway, Harvey and Smith, to the old Cobourg & Chemong Railway at Chemong Lake, is under consideration by the Ontario Hydro-Electric Power Commission.

ST. CATHARINES, ONT.—Formal request to the Dominion government has been made by the Ontario Hydro-Electric Power Commission for an order in council authorizing immediate beginning of construction work on two hydro radials, one from Toronto to Bridgeburg, the other from Toronto to London. The two roads will have a total mileage of 250 miles and will cost about $26,000,000.

ST. RAPHAEL EAST, QUE.—Plans are being prepared by Gauvin & Lessard, civil engineers, 147 Côté de la Montagne, Que., for a 2000-hp. water development at St. Raphael on Rivière du Sud for La Compagnie Electrique de Montmagny. Bids, it is understood, will be asked in June for water turbines, generators and penstocks.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS UTILITIES ASSOCIATION. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark., May 20-22.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF MUNICIPAL ELECTRICAL ENGINEERS OF ONTARIO. Secretary R. A. Clement, 190 University Ave., Toronto, Ont., Can. Annual convention, Niagara Falls, Ont., June.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy, 900 15th St., Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 110 West 40th St., New York City. Annual meeting, White Sulphur Springs, May 1-3.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegeman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Annual meeting, Hot Springs, Va., June 11-12.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, George E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB, Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago,

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa.

JOVIAN ORDER. Jupiter (president), J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary and treasurer, Meyer Barnest, St. Paul, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary-treasurer, L. D. Gordon, Jackson Light & Traction Co., Jackson, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo. Annual meeting, June 5-7, Excelsior Springs, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania, Tennessee and Wisconsin. Annual meeting, Milwaukee, Wis., July 16-18.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass. Annual meeting, Springfield, Mass., Oct. 13 and 14.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City. Annual convention, Atlantic City, N. J., May 19.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 15-17.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 152 Beach St., Yonkers, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex. Annual meeting, Galveston, Tex., May 12-14.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., June 17-19.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

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Record of Electrical Patents

Notes on United States Patents

(Issued April 1, 1919)

1,299,336. ELECTRIC FURNACE APPARATUS FOR ORES OR MINERALS; Ingenuin Hechenbleikner, Charlotte, N. C. App. filed Dec. 29, 1917.

1,299,337. METHOD OF TREATING GASES; Ingenuin Hechenbleikner, Charlotte, N. C. App. filed Dec. 29, 1917. Useful in preparing fertilizing material.

1,299,356. APPARATUS FOR USE IN RADIO-COMMUNICATION; Lee De Forest, New York, N. Y. App. filed Dec. 11, 1916. Electrodes of audion detector are not inclosed in evacuated vessel.

1,299,361. DIRECTION SIGNAL; Hyman Lieberman, Marinette, Wis. App. filed May 29, 1918. For automobiles.

1,299,376. AUTOMATIC STOVE LIGHTER; William J. Mulvaney, Lisle, Ill. App. filed Oct. 20, 1917. Electric circuit combined with thermostat automatically completes circuit and relights wick.

1,299,387. FUSE DEVICE; Edmund O. Schweitzer and Nicholas J. Conrad, Chicago, Ill. App. filed Dec. 31, 1914. For high potentials.

(Issued April 8, 1919)

14,631 (reissue). SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed Feb. 22, 1916. Immediate contact between switch plates and busbars.

1,299,414. ELECTROLYTIC REFINING OF METALLIC ZINC-BEARING MATERIALS; Charles H. Aldrich and John K. Bryan, Baltimore, Md. App. filed July 26, 1916.

1,299,427. RECORDING INSTRUMENT; Charles F. Chapman, Philadelphia, Pa. App. filed Aug. 29, 1916. Effective needle-deflecting means.

1,299,457. CONTACTOR; David E. Gray, Chicago, Ill. App. filed Feb. 12, 1917. Engages stationary contact, sticking being avoided.

1,299,485. PROCESS FOR MAKING HYDROGEN PEROXIDE; David Levin, Buffalo, N. Y. App. filed Feb. 3, 1916.

1,299,509. MECHANISM FOR CONTROLLING MOVEMENT; Jean A. Rey, Paris, France. App. filed Nov. 30, 1914. Of guns on board ship.

1,299,519. METHOD OF HANDLING ANODES IN ELECTROLYTIC BATHS; Heber M. Stuart, Baltimore, Md. App. filed July 26, 1916.

1,299,526. DAMPER-OPERATING MOTOR; Everett H. White, St. Paul, Minn. App. filed Jan. 10, 1916. Stops shaft when it arrives at predetermined position.

1,299,558. CALL-DISTRIBUTING SYSTEM; Gerald Deakin and Lipa Polinkowsky, London, Eng. App. filed March 24, 1917.

1,299,565. PROCESS OF ELECTRICALLY PREPARING CATALYSTS FOR HYDROGENATION; Carleton Ellis, Montclair, N. J. App. filed Nov. 14, 1916.

1,299,590. METHOD OF AND MEANS FOR SEPARATING WATER FROM HEAVY-OIL EMULSIONS; Charles W. McKibben, Houston, Tex. App. filed Oct. 24, 1918.

1,299,592. METHOD AND APPARATUS FOR IGNITING THE CHARGE IN INTERNAL-COMBUSTION ENGINES; Charles T. Mason, Sumter, S. C. App. filed Nov. 9, 1917.

1,299,602. SERVICE SWITCH; Granville E. Palmer, Brookline, Mass. App. filed April 23, 1913. Fuses are accessible upon the opening doors of safety switch.

1,299,606. CALL-DISTRIBUTING SYSTEM; Lipa Polinkowsky, London, Eng. App. filed March 24, 1917. Calls are automatically extended.

1,299,608. SELECTIVE SIGNALING APPARATUS; Louis M. Potts, Baltimore, Md. App. filed Oct. 11, 1913. Employs single transmitting contact.

1,299,617. ELECTRIC SWITCH; William H. Ripley, Orange, N. J. App. filed April 9, 1917. Quick opening action prevents arcing.

1,299,624. APPARATUS FOR ELECTROPLATING; Harry O. Schuessler, Peru, Ill. App. filed Jan. 28, 1918.

1,299,632. METERING SYSTEM; Ralph B. Stitzer and Harry E. Sovereign, Brooklyn, N. Y. App. filed May 7, 1914. Enables the reading of consumers' and station meter at same time.

1,299,646. COMBINED TYPEWRITING AND COMPUTING MACHINE; Alfred J. Wood, Brooklyn, N. Y. App. filed May 27, 1916.

1,299,649. HUMIDIFYING DEVICE FOR OVENS; Daniel H. Young and William L. Cass, Manchester, Iowa. App. filed June 13, 1918.

1,299,664. ELECTRIC FURNACE AND TRANSFORMER FOR USE THEREWITH; Frederick E. Berry, Hayes, Eng. App. filed Jan. 19, 1918. Distributes heat in three-phase furnaces.

1,299,693. STORAGE BATTERY; Thomas A. Edison, Llewellyn Park, West Orange, N. J. App. filed Aug. 10, 1914. Capacity increased.

1,299,736. ELECTRICAL MEASURING INSTRUMENT; John A. Knight, Hamilton, Ont., Can. App. filed June 6, 1916. Highly accurate wattmeter.

1,299,770. IGNITION MECHANISM FOR INTERNAL-COMBUSTION ENGINES; George F. Paldani, Waukegan, Ill. App. filed July 20, 1917.

1,299,813. CONNECTION WITH DRY BATTERIES; Edouard Armelin, South Woodford, Eng. App. filed Sept. 14, 1918. Rigidly connects flashlight cells.

1,299,839. SAFETY LIMIT SWITCH; David R. Knapp, Pottsville, Pa. App. filed Dec. 28, 1917. Automatically stops electric hoist.

1,299,846. MOLDED ELECTRIC CONDUCTOR AND PROCESS OF MAKING THE SAME; James P. A. McCoy, Wilkinsburg, Pa. App. filed Oct. 9, 1915.

1,299,891. KNIFE-BLADE SWITCH; Frederick B. Adams, St. Louis, Mo. App. filed April 29, 1918. Handle attached to tapped socket in blade.

1,299,908. BATTERY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed March 1, 1916. Protects the lamp from fracture because of too much pressure on its base.

1,299,909. BATTERY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed March 1, 1916. Protects lamp against accidental lighting.

1,299,910. BATTERY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed March 24, 1917. Accidental lighting avoided.

1,299,911. BATTFRY HAND LAMP; Charles F. Burgess, Madison, Wis. App. filed March 24, 1917.

1,299,924. MOTOR-CONTROL SYSTEM; John Eaton, Schenectady, N. Y. App. filed April 23, 1915. Plainly marked portable controller for planers to be carried in hand.

1,299,926. COMBINED ELECTRIC PLUG AND SWITCH; David M. Edwards, London, Eng. App. filed Sept. 27, 1917. Switch not "on" until the plug is pushed home nor "off" before the plug is withdrawn.

1,299,931. METAL-HEATING DEVICE; Henry Geisenhoner, Schenectady, N. Y. App. filed Aug. 13, 1918. Heats long objects uniformly.

1,299,947. ELECTROLYSIS OF FUSED ELECTROLYTES; Henry C. M. Ingeberg App. filed Oct. 30, 1917.

1,299,953. STATIONARY INDUCTION APPARATUS; Svend E. Johannesen, Pittsfield, Mass. App. filed May 2, 1917. Core material within windings of transformers is smaller than the cross area of each yoke.

1,299,965. ELECTROMAGNETIC DEVICE; Richard C. Leake, Rochester, N. Y. App. filed March 28, 1916. Rotary electric motor relay acting independently of the armature.

1,299,994. TELEGRAPH INSTRUMENT; Joseph S. Newman, Cleveland, Ohio. App. filed Sept. 15, 1916. Toy.

1,300,022. RELAY FOR TELEPHONE CENTRALS, ETC.; Morten B. Richter, Copenhagen, Denmark. App. filed Feb. 6, 1917.

1,300,062. SUBMARINE SIGNALING DEVICE; George H. Walker, Willow Grove, Pa. App. filed May 2, 1917.

1,300,068. WELDING ELECTRODE; James M. Weed, Schenectady, N. Y. App. filed May 7, 1918. Provided with separable caps.

1,300,074. SYSTEM OF ELECTRICAL DISTRIBUTION; Max A. Whiting, Schenectady, N. Y. App. filed June 6, 1917. Equalizer set for steel mills, etc.

1,300,094. ELECTRICALLY OPERATED VEHICLE BRAKE; Charles Adler, Jr., Baltimore, Md. App. filed June 16, 1917.

1,300,117. METHOD OF AND APPARATUS FOR WELDING; Charles A. Cadwell, Cleveland, Ohio. App. filed June 19, 1915. Current of high voltage utilized.

1,300,126. ELECTRIC SWITCH; William F. Craddick, Salt Lake City, Utah. App. filed Jan. 17, 1918. Multiple resistance connections.

1,300,127. PROTECTIVE DEVICE; Elmer E. F. Creighton, Schenectady, N. Y. App. filed July 21, 1916. Needle-point discharge gap.

1,300,150. AUTOMOBILE-THEFT PREVENTER; St. George Evans and Edward B. Birkenbeuel, Portland, Ore. App. filed March 5, 1918.

1,300,156. RADIOTELEGRAPHY; Leonard F. Fuller, San Francisco, Cal. App. filed March 27, 1916. Means for producing signals.

1,300,157. RADIOTELEGRAPHY; Leonard F. Fuller, San Francisco, Cal. App. filed March 27, 1916. Signaling system for high-powered transmission stations.

1,300,172. RADIATOR; William R. Jones, Summitville, Ind. App. filed June 21, 1918. Moistened air driven over heating coils.

1,300,176. ELECTRIC WATT-HOUR METER; Otto A. Knopp, Oakland, Cal. App. filed Nov. 20, 1916. No under-registration on overloads.

1,300,191. RECORDING APPARATUS; George D. Pogue, St. Louis, Mo. App. filed Nov. 7, 1917. Maximum-demand meter.

1,300,213. JUNCTION BOX FOR CABLE SLICES; Harry G. Freeman, Atlantic City, N. J. App. filed Nov. 10, 1916. Simple connection.

1,300,215. THERMO-ELECTRIC REGULATOR; William G. Hartwig, Chicago, Ill. App. filed July 16, 1917. For street cars.

(Issued April 15, 1919)

1,300,238. MOTOR-CONTROL SYSTEM; Howard L. Beach, Edgewood Park, Pa. App. filed Feb. 3, 1915. Patented April 15, 1919. Operated at uniform speeds under varying loads.

1,300,239. COMMUTATOR BRUSH; Charles B. Berst, Pittsburgh, Pa. App. filed March 25, 1916. For electrical measuring instruments.

1,300,242. SERIES-TYPE DISTRIBUTING SYSTEM; Howard D. Braley, Pittsburgh, Pa. App. filed July 28, 1917. Load circuits maintained at low voltage.

1,300,243. DYNAMO-ELECTRIC MACHINE; Aubrey L. Broomall, Wilkinsburg, Pa. App. filed Feb. 3, 1916. Prevents foreign matter from going through ventilators.

1,300,249. FUSE FOR HIGH-TENSION ELECTRICAL CIRCUITS; Leslie N. Crichton, Salt Lake City, Utah. App. filed Jan. 25, 1913. Outdoor expulsion type.

1,300,251. VAPOR CONVERTER; David C. Davis, Wilkinsburg, Pa. App. filed June 16, 1916. Prevents short-circuiting and reverse arcing.

1,300,265. TUBULAR ELECTRICAL CONDUCTOR; William Handley, Providence, R. I. App. filed Aug. 1, 1916. Seamless woven tube with contained return conductor.

1,300,270. ELECTRIC PLUG RECEPTACLE; William Ile, Toronto, Ont., Can. App. filed Feb. 19, 1917. Rigid double-outlet device.

1,300,277. ELECTRIC RECIPROCATING DEVICE; Greenhow Johnston, Richmond, Va. App. filed April 16, 1917. Readily controlled.

1,300,283. MEASURING INSTRUMENT; Paul M. Lincoln, Pittsburgh, Pa. App. filed April 5, 1917. Maximum-demand meter.

1,300,286. ELECTRICAL FITTING CONNECTION; John A. McKay, Toronto, Ont., Can. App. filed July 1, 1918. May be wired separately.

1,300,293. SYSTEM OF CONTROL; Laurence M. Perkins, Wilkinsburg, Pa. App. filed April 4, 1916. Generated current inherently maintained.

1,300,296. METHOD OF PRODUCING IRON SHEETS BY ELECTRICAL DEPOSITION; Joseph H. Procter, Wilkinsburg, Pa. App. filed Sept. 7, 1917.

1,300,300. SYSTEM OF CONTROL; Karl A. Simmon, Edgewood Park, Pa. App. filed March 4, 1916. Disconnects motor from line automatically.

1,300,303. TROLLEY WHEEL; Antoni Tomaszak, Cohoes, N. Y. App. filed Oct. 20, 1917.

1,300,308. ELECTRICAL CONVERTER; Miles Walker, Manchester, Eng. App. filed Dec. 23, 1916. For polyphase to single-phase current.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 — New York, Saturday, May 10, 1919 — *Number* 19

An Engineer at Last

WHILE the Governor of the State of New York may not have had in mind any distinct tribute to the engineering profession, his appointment of Lewis Nixon as head of the Public Service Commission, First District, and his desire to make William Barclay Parsons responsible for the construction functions of the commission constitute a notable recognition of the engineer in public affairs. Both men have reached a position of eminence in their respective professions, and the fact that Mr. Parsons has declined to serve merely shifts the regulatory and construction burdens on to the shoulders of Mr. Nixon. To engineers as well as the general public Mr. Nixon's appointment will commend itself. He is a graduate of Annapolis, a famous shipbuilder and designer, a captain of industry and was Commissioner of Public Works of the State of New York at the time of his appointment. Whether or not he is skilled in the particular branches of engineering with which public service commissions are mostly concerned matters not. It suffices that he is an engineer with experience in governmental work. Without reflecting in the least on the public service commissioners who have previously served the State of New York, we are inclined to the belief that an engineer rather than a lawyer can give the more excellent and satisfactory account of his stewardship.

The advocates of government ownership are astonished at the lamentable failure of the wire and rail operations; but what else is to be expected? Would experience and modern history indicate any other results?

Agreement with Labor

IF LABOR is a factor which must be dealt with on an industrial basis, the sooner employers understand labor the better. Certainly there is a new spirit toward labor manifesting itself throughout the world, and labor for its part is beginning to appreciate that its interests and those of employers are identical. But if they remain apart mutual understanding is impossible and maximum coöperation is not attained. A long step toward eradicating labor misunderstandings has been taken by the Conference Club and the International Brotherhood of Electrical Workers. Representatives of both organizations have mingled in conference out of which has been evolved a declaration of purposes tantamount to a national agreement, mutually satisfactory to both sides and of advantage to the electrical industry and the general public. If this code of principles is finally adopted by the International Brotherhood of Electrical Workers and the electrical contractors, there will be no stoppage of work unless one side or the other becomes dishonest. Mistakes, of course, are liable to happen in all organizations through honest intentions, but a means of adjudicating these differences will be provided without cessation of work and without inconvenience to the general public. Therein lies the advantage of the agreement. If both parties to the understanding are honest with each other and mutual confidence can be maintained, the result is bound to be beneficial. The rest of the electrical industry will watch with interest the working out of this copartnership between the electrical contractors and the International Brotherhood of Electrical Workers, of which much that is excellent is expected.

Commercial men in large numbers are to be found at almost every convention, but employers will reap rewards as great if not greater if they encourage their engineers to go as well. The latter need the broadening influence which comes from contact with men more than do the former.

A Historic Case

THE Supreme Court of the United States this week sat in a case involving two great public utilities which is destined to become historic. "Can the federal government take from the states the control of rates charged for public utilities in their territory?" This, in brief, is the issue in the case of thirty-eight states at bar as appellants against the United States Post Office Department and the United States Railroad Administration as respondents. The contention is that interstate commerce alone is within federal jurisdiction and that meddling with wire rates and railroad tariffs within a state contravenes the police powers of that state. The government holds that executive departments are exempt from court determination of the legality of what they may do and that no suit against the government is possible without its consent. It remains, however, for the Supreme Court to say if in a government of laws there is no remedy for the unsatisfactory condition now existing in our communication and railroad systems. The public is little interested in the Postmaster-General or the Director General of Railroads as individuals, but is vitally concerned in the kind of telegraph, telephone and railroad service it is to receive, the price it has to pay for that service, and the character and development of the communication and railroad interests in the future. If government ownership of these corporations had been a manifest success, the demand for government ownership would have been so strong that it could not be resisted. But there has been no such success. Instead, we have indifferent service at increased rates, and in the case of the Railroad Administration the country faces a yearly

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deficit of more than half a billion dollars. On the outcome of the case will depend whether or not our present system of public regulation is to prevail or go entirely to smash. When thirty-eight states are moved to seek a remedy from the Supreme Court the situation must be serious.

The nation is confronted with an enormous war debt, but it has been estimated that a thorough interconnection of electric utilities in New England and the electrification of railways and industries would effect savings amounting to many billions yearly. Such a saving is certainly worth while making.

The City of Electric Service

A FEW years ago word came from Switzerland of an enterprising little village among the mountains, renowned as a health resort, in which the progressive people had abolished the use of fuel and the whole service of the community had been turned over to electricity, clearing away the last trace of smoke from the weary traveler's contemplation and leaving him free from at least some of the evils of civilization while possessing all its benefits. New York City has just seen the opening to public convenience of an electrically served community on a vastly larger scale, truly a roofed-in city in its magnitude. The Hotel Pennsylvania, the largest hostelry in the world, is especially notable for the wonderful completeness of its electrical equipment and for the fact that it is served by an external heating plant and a distant power station adequate to meet its entire needs. The fundamental principle carried out in the equipment of this immense addition to the accommodation of the traveler was that the whole building should be cleared of the trouble of a localized heating equipment and should be provided with an electric service as near to absolute reliability as is humanly possible.

The requirements of the building are truly enormous. For heating purposes it is estimated that nearly a quarter of a billion pounds of steam will be required annually and somewhere around 5,000,000 kw.-hr. of electrical energy—more than the output required for many a small city. To find an adequate source for these supplies outside the building was no easy matter. There was not a little to be said for the construction of an independent isolated steam and power plant; for a hotel load, with its relatively long hours of service and its great requirement for steam outside of prime movers, affords an unusually favorable opportunity for economic generation of power. The local central station could not furnish the necessary steam, and there was a question whether it would be able to furnish electricity at a rate which would in the long run prove profitable. In the final resort both steam and electricity were purchased from the Pennsylvania Railroad, the electricity from the great Long Island City generating station, the live steam from the Pennsylvania Terminal across the way. Inasmuch as large amounts of steam are required at all times for heating purposes and the live steam supply must in any event be reduced in pressure for heating, this supply was utilized as an independent source of electric power, a 500-kw. engine-driven generator being installed as a reducing valve.

This equipment is big enough to furnish emergency lighting for the hotel and can be run practically at full load in cold weather and effectively utilized in connection with the transmitted supply of power at all times. This latter is delivered to the sub-basement substation at 11,000 volts, three-phase, 60 cycles. The substation contains two sets of transformers, one for the regular lighting service, the other for three synchronous converters, feeding the motor equipment requiring a special speed control. These rotaries are operated in parallel with the engine-driven generator, dividing the load unit as conditions require.

Care has been taken with the lighting distribution to insure adequate emergency lighting. The various lighting circuits are distributed among the three phases in approximate balance, but some of the corridor lamps and lamps at other important points are fed from each of the three phases, so that nothing short of a complete failure of the alternating-current supply can put them out of service, and in that case they can be immediately transferred to the direct-current supply. The illumination of the public portions of the building is most effectively designed. We know of no building in which the electrical equipment has been carried out more thoroughly and effectively than here and the whole plan of the installation does credit to this most notable addition to the hotel accommodations of the metropolis.

In some cases closer operating relations between central electric stations in nearby cities or districts will be developed through interconnection; in other cases consolidation of the physical assets of the companies will be arranged. Either form of operating unification will mean economy, which is conservation and is in the ultimate interest of the communities.

The 60,000-Kw. Interborough Generator

IN THIS issue details of operation are given of the 60,000-kw. three-cylinder, cross-compound turbo-generator in the Seventy-fourth Street station of the Interborough Rapid Transit Company by W. S. Finlay, Jr., the superintendent of motive power. The cross-compound turbo-generator is now comparatively familiar. Three of this class, of 30,000 kw. rating, have already for several years been in use in the Interborough power station. These were, however, two-cylinder units, so called, consisting of two turbines, one high-pressure and one low-pressure, the former exhausting into the latter, operated without mechanical connection, through electrical coupling of the generator ends. These earlier units were designed for different rotative speed in the two cylinders, the high-pressure units operating at 1500 r.p.m., the low-pressure ones at 750 r.p.m. The new 60,000-kw. turbine is somewhat different in arrangement and very different in some of the details. It consists of one high-pressure and two low-pressure turbines, each of the same rated capacity and arranged so that the high-pressure unit exhausts into both the low-pressure cylinders. All three are of the same rotative speed, 1500 r.p.m., and are of the pure reaction type of turbine, a construction which lends itself particularly to the design on account of the very large quantities of steam to be handled.

The high-pressure cylinder is of the ordinary single-flow construction, the steam entering at one end and leaving at the other, while the low-pressure cylinders are arranged for modified double flow, with the steam entering near the center, flowing as a whole through

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part of the blading, and then dividing in opposite directions through the rest of the unit to the condensers. The high-pressure cylinder takes steam at 205 lb. per square inch (14.35 kg. per sq.cm.) gage pressure, superheated 150 deg. Fahr. (83 deg. C.), while the condensers are arranged for 29-in. (736-mm.) vacuum. Each cylinder is connected to its own generator of 20,000-kw. continuous capacity, three-phase, 11,000 volts and 25 cycles. Each element has its own busbars with separate feeders and reactance coils between the busbars to limit the current flowing between the generators. The connections are so arranged that each element can be operated separately or any necessary combination can be made. In practice the three generator switches are closed in starting, and the unit is brought up to speed as a whole. The total continuous capacity of the combined unit is 60,000 kw. for continuous service, or 70,000 kw. for two hours' operation.

Perhaps of even greater interest than the size and structure of this huge machine are some of the details of construction and operation. The matter of foundations alone was one which required serious thought. The foundation for each element was structurally isolated from the others, and the surrounding floor merely rests on the foundations without solid fastening. The very great amount of steam to be dealt with considerably complicated the matter of proper piping both to take care of expansion and to eliminate interference with proper facilities of operation and inspection or to reduce or remove the piping from the working area. For instance, the high-pressure steam piping was divided into two separate and individual lines, and the circulating-water piping was laid in trenches filled with concrete, but flexibility as regards its slight but measurable expansion and contraction was secured by wrapping the pipes with heavy paper before filling in, while the joints were left in pockets filled with coal tar and afterward flowed over with cement. There is thus left a considerable degree of plastic flexibility combined with the resisting power of the concrete filling. An absolutely unique feature of this type of engineering was substitution of jacketed steel and rubber expansion joints on the turbine exhaust, dispensing with the ordinary copper joint.

Perhaps the most ingenious feature of the whole installation is the automatic governing for the three cylinders. This is carried out with extraordinary completeness in spite of the fact that there are the usual means for manually handling the elements. If the high-pressure element is for any cause suddenly shut down, the two low-pressure cylinders automatically get steam direct from the boilers and hold up the load. Similarly, if the low-pressure elements are shut down from any cause not affecting the high-pressure cylinder, the latter will continue working and exhaust into the atmosphere, while if only one low-pressure cylinder goes out of service the high-pressure turbine will exhaust into the remaining low-pressure one. Each unit has an overspeed stop governor to cut off the steam when the load is lost. The regular high-pressure governor is adjusted for close speed control, about 3 per cent for the total range, and the governors of the low-pressure cylinders are arranged to be subordinated to the general governor system so that they will not tend to interfere or hunt. The details of the governor system are particularly instructive because they show to what extent the operation of a three-unit turbine can be made substantially automatic. So thoroughly has the scheme of governing been worked out that every ordinary contingency of service seems to be provided for by the mechanism with almost human intelligence. The advantage of these great multiple cylinder turbines over entirely independent units is considerable. The design is on the whole not complicated; the steam economy is quite as good as if the units were mechanically coupled and materially greater than if three entirely independent units were provided, while the electrical flexibility of the system certainly leaves very little to be desired.

Modern achievements of wireless telephony should recommend its use to many transmission companies. Storms which are violent enough to bring down heavy transmission circuits usually carry away the telephone circuits also, but with wireless telephony operators and linemen can communicate with headquarters and service can be quickly restored.

The Pull-Together in California

IT WAS a victory convention that the Pacific Coast Section of the National Electric Light Association and other branches of the industry held last week at Coronado, Cal. It had the consciousness of industry service to the nation in the time of peril, of an ever-growing obligation to meet the requirements which fall upon the electric utility, and of the need for substantial enlargement of plant facilities to provide for the future. The tendency was to look well ahead in forecast and to prepare for the big-scale development which is clearly foreseen during the years to come. California is progressive. Its survey of the growth of the industry in the post-war era is optimistic. Based on the tremendous development of the past, the spirit of enterprise sees new opportunity for large service in the years of upbuilding which lie just ahead. In every way the Western Coast companies have tried to weld all branches of the industry together to work for the greatest measure of this assured development. It is an evidence of this that is shown by the third joint convention of representatives of central station, manufacturer, jobber and contractor-dealer. Not only have all branches of the industry got together but each one had a share in the plans. By following this course the Pacific Coast industries have secured a superior degree of harmony and coöperation.

Another feature of the convention was the presence of representatives of various state commissions and officials whose work touches the regulation or operation of the electric utilities. Participation in the discussion by President Edgerton of the California Railroad Commission introduced a new element in the far coast convention. His message was a warning of the prospect that utilities will be owned by the public unless new ideals are established. This warning found, as it is right that it should find, a ready and responsive audience. We believe that the disposition and purpose of the industry are to keep their service better in quality and cheaper in price than any corresponding service can be given by public authorities under the conditions of political life in America to-day. The ideal of service is indeed being made paramount. It is a notable indication of the thought of the times that the leaders of the industry on the Coast pledge President Edgerton their best effort to establish and maintain a fixed and a steadfast policy of service before profit.

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Three-Cylinder, 60,000-Kw. Turbine Installation

Operating Details of the Largest Turbo-Generator Yet Built and the First Three-Cylinder Unit in America—Automatic Control Enables Any Two Elements to Do the Work of Three in Case of Trouble

BY W. S. FINLAY, JR.
Superintendent Motive Power, Interborough Rapid Transit Company, New York City

ON OCT. 9, 1918, there was placed in service at the Seventy-fourth Street station of the Interborough Rapid Transit Company, New York City, the third element of a Westinghouse 60,000-kw., three-cylinder, cross-compound, 25-cycle turbo-generator. This is the fourth cross-compound unit installed by this company since the latter part of 1914. The three units installed first were of the Westinghouse two-cylinder, cross-compound, reactance design, rated at 30,000 kw. maximum each, having a point of highest efficiency at 25,000 kw. when operating at 205 lb. steam pressure (14.35 kg. per sq.cm.), 150 deg. Fahr (83 deg. C.) superheat and 29-in. (736 mm.) vacuum.

The new unit, besides being the first three-cylinder turbine to be placed in operation, is the largest yet designed. Its maximum continuous rating is 60,000 kw.

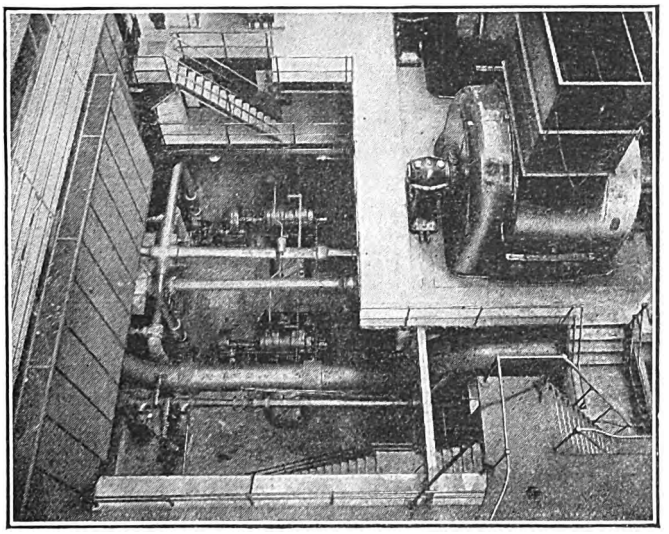

FIG. 1—VIEW OF PUMP ROOM DIRECTLY UNDER THE 60,000-KW. TURBO-GENERATOR, LOOKING DOWN FROM A CRANE; SHOWING ACCESSIBILITY OF AUXILIARY APPARATUS

and 70,000 kw. for two hours. It occupies a floor space of 52 ft. by 50 ft. (7.6 m. by 15.2 m.), and its maximum load requires 826,000 lb. (375,000 kg.) of steam per hour. This unit is designed to operate with steam at 205 lb. per square inch (14.35 kg. per sq.cm.) gage pressure, superheated 150 deg. Fahr (83 deg. C.) and to exhaust at a temperature of 540 deg. Fahr. (282 deg. C.) at a vacuum of 29 in. (736 mm.) of mercury. At the load of 40,000 kw., which is the point of best economy of this unit, the high-pressure element will receive its steam at a pressure of 211 lb. per square inch (14.7 kg. per sq.cm.) absolute and a temperature of 538 deg. Fahr. (262.9 deg. C.). It will exhaust into the low-pressure elements at a pressure of 29.7 lb. per square inch (2.07 kg. per sq.cm.) absolute and a temperature of 250 deg. Fahr. (121.1 deg. C.), in which elements it is further expanded down to the pressure in the condenser, which is one inch of mercury absolute and a temperature of 79 deg. Fahr. (26.1 deg. C.).

Like the original two-cylinder machines, the new unit is built on the cross-compound principle and consists of one high-pressure turbine and two low-pressure turbines, each being coupled direct to its generator and all three elements when in normal operation tied together electrically. The steam path is such that all the steam passes through the high-pressure element, then divides equally and flows through the two low-pressure elements. This principle of design, by dividing the work done into separate cylinders, allows smaller individual elements which are inherently stronger than large cylinders; it makes possible an outlet considerably more flexible than a single large unit, and more reliable, because the turbines are smaller and there is less temperature difference in any one cylinder; and commercially common materials with moderate speeds and stresses can be used.

Each turbine runs at a speed of 1500 r.p.m. and is connected to a generator of 20,000 kw. continuous rating and 23,500 kw. for two hours, which delivers three-phase, 25-cycle energy at 11,000 volts.

CONNECTIONS FOR THE THREE 20,000-KW. GENERATORS

From an electrical point of view the connections of the new 60,000-kw. unit were adapted to the general scheme used with the 30,000-kw. units already in operation. Each generator has a separate oil switch connecting it to a short generator bus. From this bus the current can be led to each of two main bus sections through oil switches or to the transfer bus through another oil switch. It is possible by this form of construction to operate each element separately or in any combination desired. In practice, however, the three generator switches are closed and the whole unit is brought up to speed as one, the snychronizing being done through one of the oil switches leading to the main bus sections or transfer bus. The proper disconnecting switches were placed in series with the oil switches, some of them being remotely controlled. Suitable current transformers and potential transformers with their proper instruments were installed so as to measure the output of each generator separately, there being in addition a large totalizing transformer by which the combined loads of the unit can be metered on one instrument.

Reactance coils of 5 per cent value were inserted between the generator bus and the two sections of the main bus, and another of 2 per cent value between the generator bus and the transfer bus. The percentage values are 5 per cent and 2 per cent of the star voltage when carrying one-half load. Each generator is protected by a relay system devised by the late H. G. Stott, which is a modification of the Merz-Price system. Should a burn-out occur in the windings of any generator, the unbalanced currents will operate a relay which in turn will open the oil switch, disconnecting the generator from the line.

The reactance coils permit only a limited amount of

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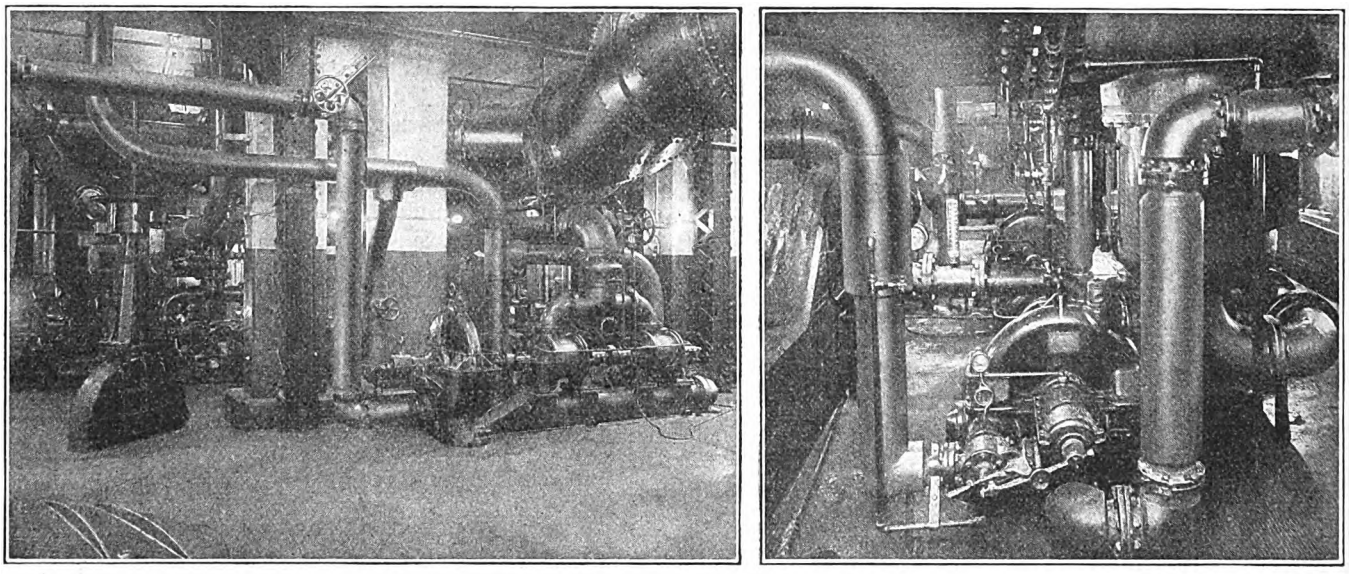
current to flow between the generators. Any tendency for an abnormal flow in current causes a circuit breaker to open the circuit. This is done for the purpose of insuring the continuous operation of the remaining elements should a short circuit develop in the feeder system of any one of the three elements.

Although this 60,000-kw. unit consists of three separate elements, the method of starting the elements from rest preparatory to synchronizing is essentially the same as for single-shaft units. First, the field current of all three generators is applied, then the throttle valve on the high-pressure element is partially opened. As soon as the high-pressure rotor starts revolving it will, through the applied field current, start the rotors of the two low-pressure elements revolving. This causes all three elements to come up to speed together and in correct phase with each other, so that when synchronized with the system they can be connected to the main busbars by closing a single circuit breaker.

By the use of an ingenious governing arrangement means have been provided that will permit uninterrupted operation of each individual element, should one or the other two elements be taken out of service by tripping the automatic stop from any cause not affecting all three elements. For example, if the high-pressure element be shut down, each low-pressure element will automatically receive high-pressure steam direct from the boilers through its own individual high-pressure steam system, whereas in normal operation the low-pressure elements do not receive any high-pressure steam direct. Vice versa, if the two low-pressure elements be shut down from any cause not affecting the high-pressure element, the high-pressure element will continue operating and automatically exhaust its steam into the atmosphere, but should only one low-pressure element be removed from service, the high-pressure element will exhaust into the remaining low-pressure element. All this governing arrangement, as before stated, is entirely automatic. Such flexibility, needless to state, is not possible with turbines employing a single generator unless they be of as small capacity as one of the elements.

Since the governing mechanism must control three units, not only when operating together but when operating separately, it involves several features novel in steam-turbine practice. Each unit is provided with an overspeed stop governor which will immediately shut off the steam from that unit if the speed rises above a predetermined amount. Each unit is also equipped with a speed-regulating governor, of which that on the high-pressure unit is of the customary form. The speed-regulating governors on the low-pressure units are somewhat more complicated.

A butterfly valve capable of automatic operation is provided in each connection between the high-pressure and low-pressure units, which will be automatically closed should the low-pressure turbine speed exceed the predetermined limit. This is tripped shut first by the speed-regulating governor, should it go to the outer position, and, in event of its failing, then by the automatic stop governor. The high-pressure turbine is provided with another exhaust having a back-pressure valve, so that when necessary the exhaust from the high-pressure turbine may pass to atmosphere and the high-pressure turbine continue to carry its load.



FIGS. 2 AND 3—VACUUM AIR PUMPS AND CONTROL VALVES ARE SHOWN AT THE LEFT AND THE HOT-WELL PUMPS FOR THE UNIT AT THE RIGHT

Similarly, should the high-pressure element lose its load, its governor will cut off steam to the whole system. If the governor does not control the turbines and its speed reaches the predetermined limit, then the stop governor on the high-pressure element will close the automatic throttle, similarly cutting off steam from the whole system. The whole system will then slow down until it reaches a predetermined speed lower than normal, when the governors on the low-pressure turbines will cause live steam to be admitted directly to them.

The high-pressure turbine governor is adjusted for close regulation, say 3 per cent for its total range. It is necessary, of course, that the system operate from no load to full load—that is, be subjected to the speed variation in this 3 per cent range—without the low-pressure governors performing any of their functions, admitting live steam to the low-pressure turbines, on the one hand, or closing the connection between the high and low, on the other. Hence the travel of the low-pressure governors may be said to be divided into three zones—the outer position of the governor weights operating the butterfly valves and admitting steam to the low-pressure element—the inner position of the

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weights controlling and regulating the admission of high-pressure steam to the low-pressure turbines. Between the outer and inner position is a portion of the governor travel which is called "neutral," and when the governor is within this portion of its travel it has no effect on any of the control apparatus.

There is a butterfly valve in the low-pressure line which is controlled from the governor of the corresponding low-pressure turbine. Each valve is operated by a differential piston, to both sides of which steam pressure is admitted. One end of this cylinder is connected to a valve-trip mechanism at the low-pressure governor and so arranged that when the governor reaches a prescribed position a valve will be tripped open, thus releasing steam from that side of the differential position. Steam pressure in the other side will then quickly force the butterfly valve closed. If the turbine is to be shut

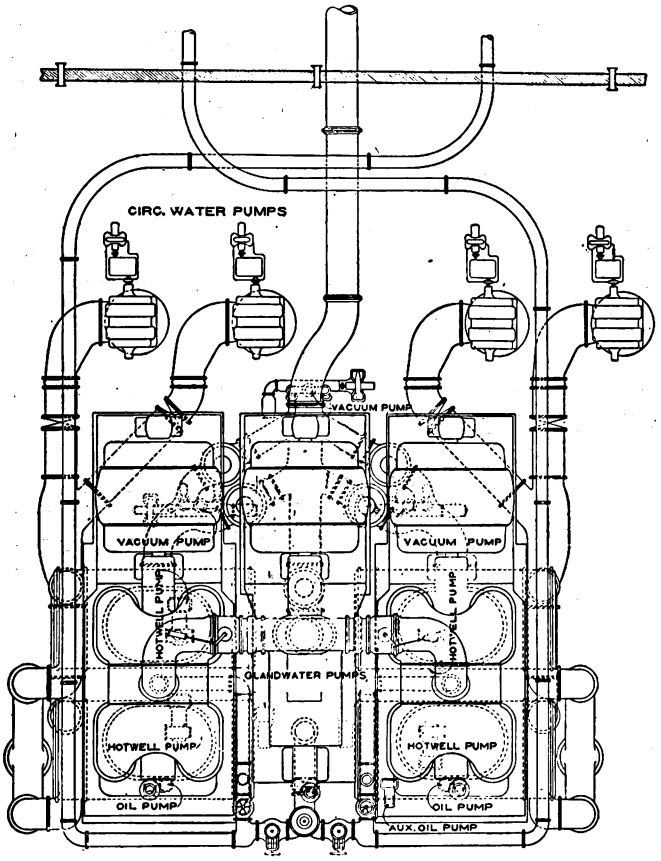

FIG. 4—LAYOUT OF THE 60,000-KW. TURBO-GENERATOR ELEMENTS AND ARRANGEMENT OF STEAM LINES, ATMOSPHERIC EXHAUST AND CIRCULATING WATER PIPING UNDER UNIT

down, the gate valve is then closed by hand. The butterfly valve may be opened or closed also by a hand-controlled valve. The valve controlling live steam direct to the low-pressure turbine will begin to open when the low-pressure governor reaches a prescribed position. This valve mechanism does not differ in principle from the main high-pressure valve controlling steam in the system and is in conformity with ordinary practice.

The overspeed stop governor on the high-pressure turbine will close the main throttle valve and the main regulating valve, while that on the low-pressure turbine will bring about the closing of the butterfly valve and the governor and throttle valves admitting high-pressure steam to the low-pressure turbines.

As part of the throttle valves there is a switch which when closed will open the main circuit breaker. Should some accident happen to one of the turbine elements, it may be instantly cut out by operating the emergency stop, which will cause the immediate closing of the automatic throttle. This in turn causes the closing of the switch, which opens the circuit breaker.

The operation of this apparatus may be further described by the following examples:

1. If on account of some electrical trouble the circuit breaker opens between the generator of a low-pressure turbine and the bus, this turbine will then be relieved of load and will speed up 3 per cent (provided that the governor has been maintained in the central position). Before it has speeded up 4 per cent the low-pressure butterfly valve will have dosed. In the meantime the steam is still going into the high-pressure turbine. The exhaust pressure of the high-pressure element will then rise, if the load be great enough, until the back-pressure valve on the exhaust opens, permitting the high-pressure turbine to continue operating, a fraction of its steam exhausting into the atmosphere, the remainder passing to the low-pressure turbine which is in operation.

Upon closing the butterfly valve, the low-pressure turbine, receiving no steam, will commence to slow down, and when it has reached 3 per cent below normal the governor valve admitting high-pressure steam to the low-pressure element will commence to open, and unless some adjustment is made, it will remain at that speed under the control of its governor.

2. If an accident happens to a low-pressure turbine making it desirable to take it out of service quickly, the operator can trip the emergency stop as he would on any turbine, which will cause the closing of the butterfly valve, then admitting low-pressure steam, and the throttle valve, which later would admit live steam to the low-pressure. The throttle valve, being automatically closed by the emergency stop, will close the switch, which will open the circuit breaker, when the low-pressure turbine will come to rest.

3. On a disturbance to the electrical system which will cause the opening of the circuit breaker on the generator of the high-pressure turbine, the high-pressure turbine, being relieved of load, will speed up an amount corresponding to the regulating characteristics of the high-pressure governor, cutting off nearly all the steam supply to the whole system, only enough steam passing through the high-pressure element to maintain it at speed.

If there are enough units operating on the system to take the load that has been dropped by this unit, the low-pressure turbines will continue in service but carry practically no load. If, however, there are not enough units in the system to carry the load, then the frequency of the whole system will fall 3 per cent (provided that the low-pressure governor has been maintained in its central position), when high-pressure steam will begin to be admitted direct to the low-pressure turbine and a further fall of 3 per cent will give complete opening to this governor valve, admitting high-pressure steam.

Should it then be found that the exigencies of the system demand that the low-pressure turbine continue carrying the load, the switchboard operator may by his distant control of the governor tighten the governor spring by means of the motor until he brings the speed of the unit (and system) to normal, when the low-pressure turbines may continue operating indefinitely, carrying any load within their capacity with the governor regulating the high-pressure valve opening.

4. In case of an accident to the high-pressure turbine its emergency stop may be tripped, which will bring about the automatic closing of the main throttle valve. This valve, when automatically closed, will close the switch that is on the throttle valve, which in turn will open the main circuit breaker on the high-pressure turbine, after which the operation will be the same as in case 3.

Since each low-pressure turbine has its independent governor, it is obvious that either or both will operate indefinitely if the high-pressure turbine has been put out of service as indicated in either 3 or 4 above.

If the throttle valve be manipulated by hand in the usual way, it will have no effect on the switch that is on the throttle valve. This switch will only be closed when the throttle valves are operated by the emergency stop.

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The Continuous-Rated Motor and Its Application

Reasons for Adopting 50-Deg. Temperature Rise for Motor Rating—Development of Motor Design and Amelioration of Hot Spots Make It Possible to Get the Maximum Out of Motor Material

BY L. F. ADAMS
Power and Mining Engineering Department, General Electric Company

THE industrial world has come to realize the benefits of standardization, and during the first part of this century manufacturers began to place their production on a quantity basis, thus lowering overhead charges, reducing stocks, simplifying factory methods, tending toward interchangeability of working parts and, most important, giving better service to the purchaser. The individualistic method of standardization, however, resulted in each manufacturer working out his own standards without due regard to those of others, and naturally the outcome was as many standards as there were manufacturers.

These methods, coupled with the keen competition of recent years, created a general desire on the part of all for a common standard. The individualistic method of standardization gave way to collective effort. In the electrical field this latter idea is embodied in the Standardization Rules* of the American Institute of Electrical Engineers.

The Institute rules make certain definite recommendations covering electric machinery and apparatus. The following discussion will be confined to an interpretation of these standards as applied to motors and to motor applications.

Motor Design Becomes More Exact

During the past few years many important improvements have been introduced in motor construction, such as the addition of commutating poles in direct-current machines to improve commutation, better methods of insulating the windings to resist puncture, elimination of excessive hot spots by the use of internal directive ventilation, etc. These improvements have assured a uniformity of product which formerly would not have been considered within practical limits.

Similar advances have been achieved in the application of motors and the use of the control best suited for any particular purpose. In the pioneer days motors were usually substituted for other forms of power with but one thought in mind—to have the motor large enough. The vast amount of data now available as to the power requirements of various machines, the large number of well-trained men now engaged in the application of motors and the unusual desire to do things better to-day than yesterday mean that motors must now be selected and applied with a greater degree of accuracy than was considered essential in the early days.

It is better to have a motor underloaded than so heavily loaded that it cannot operate successfully. On the other hand, there is no real advantage in selecting a size and type of motor which is unduly large or expensive for the work. The selection of an unduly large motor means a larger outlay in first cost and a higher yearly charge for power because of the lower average operating efficiency. In the case of alternating-current motors over-motoring lowers the power factor, requires a more expensive transmission line and larger generators, and causes poor regulation and greater line losses. Finally, the unused capacity of the motor is without resulting benefit to any one.

What are the requirements for a successful operating motor? A motor produces torque and speed, the two elements required to drive any load. The load requirements have certain variations in the relations of torque, speed and time. Consideration must also be given to the operating temperature. We therefore define a successfully operating motor as one of such size and design as will readily start and accelerate any reasonable load which the driven machine may be called upon to sustain, carry any reasonable overload that may be imposed on the machine, and be capable of carrying the normal load for the period of time required without exceeding a temperature of 90 deg. C. as measured by thermometer.

Procedure in Selecting Motors

The first point to consider in the selection of a motor is the starting and accelerating torque. For convenience the starting torque or turning movement of a motor is frequently spoken of in terms of full-load torque. For greater accuracy it is obviously better to use the actual torque developed by the motor at standstill expressed in pound-feet. After the starting torque requirements of the driven machine have been determined the ratio of starting torque to normal torque should be noted. The ratio, if relatively large, indicates that a compound-wound or series-wound direct-current motor will be preferable to a shunt-wound machine, or that a slip-ring or high-resistance rotor alternating-current motor should be selected in preference to the standard squirrel-cage motor. Substantially the same method may be used for services requiring very frequent starting. Careful consideration of the starting and accelerating torques frequently permits the selection of a motor of smaller horsepower rating than would otherwise be employed.

The next question is one of peak load. This is usually expressed as a percentage of full-load torque. Here, too, it is better to express this torque in pounds at one-foot radius as this expression eliminates the full-load speed, which is a variable. Ample margin must be allowed between the requirements of the driven machine and the maximum torque developed by the motor. The maximum running torque which the motor will deliver without undue drop in speed is usually of greater importance than the maximum horsepower output, because in many applications a slight drop in speed on the peaks is advantageous, for the inertia or flywheel effect in the driven machines assists in carrying the load over that peak.

Another point of interest in the selection of a motor is the horsepower rating. This will be largely a measure of the motor's ability to do the required work for

*Latest edition, revised 1918.

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the specified period without exceeding the safe heating limits or violating other requirements of successful operation, such as good commutation.

DISCUSSION OF LIMITING TEMPERATURE

Heating in motors is primarily of interest only as it affects the life of insulation. The heating standard must be in the form of a limiting temperature, this limit to be sufficiently low to insure that insulation continuously subjected thereto will not deteriorate in so far as its insulating qualities are concerned. Evidently the logical upper limit should be based on the ultimate temperature at which the motor is to be operated, since it is above this that the insulation begins to weaken. After careful investigation, supported by tests and in the light of practical experience, the American Institute of Electrical Engineers has set a temperature 5 deg. C. above that of boiling water, *i.e.*, 105 deg. C—as a conservative and safe limit for the temperature at which treated fibrous insulation can be used without deterioration. The question arises: Would insulation last longer at a lower temperature? Experience indicates a negative answer. This is to be expected, because even the highest permitted temperature is well below the danger zone. The American Institute of Electrical Engineers in its Standardization Rules, Section 302, states:

"There does not appear to be any advantage in operating at lower temperatures than the safe limits, so far as the life of the insulation is concerned. Insulation may break down from various causes, and when these breakdowns occur it is not usually due to the temperature at which the insulation has been operated, provided the safe limits have not been exceeded."

Having established a suitable upper limit, the next step was the selection of a conservative standard for the cooling medium, or surrounding air temperature, or, as it is called in the Institute rules, the "ambient temperature." The value settled upon by the Institute is 40 deg. C. In a building this represents an extraordinarily hot day or a very highly heated room for ordinary industrial purposes. It is a temperature approached in all parts of the temperate zone at some time during the year. It is improbable that the average standard motor will normally be required to operate in temperatures as high as 40 deg. C. for any considerable period of time. For all except the hot days of summer 21 deg. C. very closely represents the average mean room temperature. Therefore, under normal conditions, motors will seldom operate under so high an ambient temperature as has been proposed, and the value selected is consequently very conservative. Incidentally, in the international conferences on standardization previous to 1914, practically all other electrical societies agreed in recommending 40 deg. C. as the ambient temperature, but two countries of northern Europe held out for the less conservative ambient temperature of 35 deg. C.

From what has preceded it is evident that the motor manufacturer in following the Institute standards can design his motor for any temperature rise which, based on an ambient temperature of 40 deg. C., will not exceed 105 deg. C., *i.e.*, 65 deg. rise. It should be borne in mind, however, that the temperatures so far used are the external or observable temperatures of the motor and no allowance has been made for the greater heating of the interior and inaccessible parts. It is very difficult to measure internal temperature by ordinary thermometers, and thus the ultimate temperature of motors, or the actual temperature rise, is arrived at by assuming that the hottest spot in any part of a well-designed motor will have a temperature not more than a certain definite number of degrees above that of the observable temperature of the same part. The Institute's allowance for the difference is 15 deg. C. for open-type motors. This would apply to thermometer readings for ultimate as well as for temperature rises. In other words, the ultimate observable temperature is 90 deg. C. for treated fibrous materials, or a temperature rise of 50 deg. C. above ambient temperature. On totally inclosed motors there is less difference between the hottest spot and the observable temperature, so that 10 deg. C. is a fair allowance for inclosed motors. Therefore the observable temperature rise permitted for open motors is 50 deg. C., and for totally inclosed motors 55 deg. C. While in some designs the permissible temperature rise is decidedly the limiting feature, in other designs the requirements of other conditions will result in a lower temperature rise.

INSULATION SAFE AT 50-DEG. RISE

It might appear that a motor which has a temperature rise of 40 deg. C. will have a longer life than one designed for 50 deg. C. As previously pointed out, this is not true, because the limit adopted by the Institute for the ultimate temperature is well below that point at which deterioration of the insulation will take place. The situation in this case is roughly analogous to the amount of heat required to produce steam. If the quantity of heat is such that the temperature of water never exceeds 90 deg. C. no matter how long it is applied, no steam will result because the water has not reached the boiling point. In a like manner deterioration in insulation will not occur until its critical point, analogous to the 100 deg. C. for boiling water, is reached.

In case the ambient temperature is under 40 deg. C.—say 20 deg.—it might seem that the motor could be operated at a greater temperature rise. This is possible in some cases, but a very dangerous policy, and the Institute's rules do not sanction such loads as shall occasion in the insulation a temperature rise in excess of 50 deg. C. This is a matter of such importance as to justify reproducing from the Institute rules the text of section 305A, which follows:

"Whatever may be the ambient temperature when the machine is in service, the limits of the maximum observable temperature or of temperature rise specified in the rules should not be exceeded in service; for, if the maximum temperature be exceeded, the insulation may be endangered, and if the rise be exceeded, the excess load may lead to injury by exceeding limits other than those of temperature, such as commutation, stalling load and mechanical strength. For similar reasons, loads in excess of the rating should not be taken from a machine.

With reference to horsepower rating, the Institute has adopted two distinct ratings—one a continuous rating,* the other a short-time rating. The meaning of the first is self-evident. The second will be reviewed. It is, briefly, the equivalent output which a motor can deliver for a specified time, such as during 5, 10, 15, 30, 60 or 120 minutes without exceeding a temperature rise

*Throughout the remainder of this article, "continuous rating" will mean a motor that will operate continuously without exceeding a temperature rise of 50 deg. C.

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of 50 deg. C., provided that after each run and before starting on the next run the motor be allowed to cool to within 5 deg. of the ambient temperature. It is also understood that the motor must operate without violating the requirements of successful operation, such as commutation, sufficient starting and maximum torque, suitable mechanical strength, etc. The short-time rating is primarily a method of expressing a thermal equivalent. For example, motors built to operate valves frequently receive a five-minute short-time horsepower rating because the operations are normally intermittent and the principal requirements are with reference to mechanical strength, torque and commutation. Crane motors are similarly rated on an equivalent thirty-minute basis—since crane motors are operated for longer periods of time than valve motors, although somewhat similar torque characteristics are required. Machine tools, compressors, etc., are frequently rated on a 60-minute or 120-minute basis, as the period of operation and the duty cycle of the load are such as to make this a close heating equivalent. A machine tool, for example, might be operated for a longer period than specified, but the periods of heavy load and light load must be such that the ultimate heating of the motor will be closely equivalent to the rated horsepower for the time stated.

Limitations Other than Temperature Rise

It sometimes happens that some certain requirements may prove a limiting factor in rating a motor, with the result that all the other factors have an unnecessary margin between these values and those recognized as safe standards. Where heating is the limiting factor in the rating or selection of a motor, the horsepower rating may be said to represent simply the equivalent load which produces the same heating as would accrue under full normal load in continuous operation. Under these conditions, a 10-hp. motor will develop 10 hp. for the period of time specified without exceeding the predetermined safe heating limits, or it will carry a varying load which will result in the same or lower ultimate temperature for the period in question. As an example consider a 10-hp. continuous-rated motor. Suppose a duty cycle of 9.5 hp. 90 per cent of the time is to be imposed on this motor, the other 10 per cent to consist of momentary loads of 13 hp. and underloads of 3 hp. to 7 hp. The heating effect on the motor due to this duty cycle would be about the same as if 10 hp. were delivered continuously. It should be borne in mind, however, that the variations of current, rather than the actual variations of mechanical load, must be used in determining the heating equivalent. It should also be noted that while a 10-hp. continuous-rated motor would meet the heating limitations, it would not be satisfactory unless the starting and maximum running torque available were ample to meet the starting and running overloads imposed on the motor, and that successful commutation should not be exceeded.

The capacity and rating of the machine, although frequently used interchangeably, are not synonymous terms, according to the Institute. The capacity of the machine is the maximum output which it can successfully deliver for a stated period. The rating of the machine is the output stamped on the name plate. The maximum limit for this rating is the capacity of the machine. There is no minimum limit.

The purchaser is usually interested in knowing all the facts about the possibilities of the machine that he is buying; *i.e.*, the capacity of the machine consistent with the requirements of starting torque, maximum running torque and similar factors. This logically means that the name-plate rating stated in the accepted even ratings should closely correspond with the capacity rating. Such a rating has been referred to as a continuous or 50-deg. rating. Possibly the term " capacity rating," within the limits above specified, is the most descriptive.

It is obvious that the system which has been widely followed in the past, of giving a normal continuous rating with 25 per cent overload for two hours, is not a capacity but a fractional rating, and that it represents but one form of duty cycle. Under this method of rating, a 10-hp. motor will carry 10 hp. continuously with a temperature rise of 40 deg. C., and at any time during such operation will carry 12½ hp. for two hours with a temperature rise of 55 deg. The temperature rise in these few hours is only a few degrees less than the ultimate temperature which will be attained in eight or ten hours. Consequently, the capacity of such a machine (provided that the rating does not understate or overstate the possibility of the machine) would be about 11⅜ hp. continuously, or a short-time rating for thirty minutes of approximately 15 hp. This example illustrates that a continuous-rated or capacity-rated motor is classed conservatively with reference to heating since the temperature rise for such an open motor is limited to 50 deg. C., whereas the temperature rise on a 25 per cent overloaded motor is 5 degrees higher, *i.e.*, 55 deg. C.

It must not be overlooked, however, that the intent of the Institute rules is not to require a 50-deg. rise but to fix it as a limit for good engineering practice. Designing engineers have long recognized that a temperature rise of 35 deg. in itself is absurdly low, but the object in operating at such low temperature, measured on a part of the motor accessible for the application of a thermometer, was simply to protect the motor in the hot spots where the temperature could not be measured. It became the fashion to call for motors of 35-deg. rise, and no doubt the users never knew the real meaning of such low temperatures. Improvements in insulating material, more modern methods of preparing and applying the insulation, together with the knowledge of hot spots gained from tests and experience, have contributed to the Institute's recognizing 50 deg. as being the safe upper limit. The rules do not, however, require the motors to be so designed as actually to have this temperature rise. Without doubt, designing engineers will retain a safe margin below 50-deg. rise in the continuous-rated motors.

Motors Commonly Too Large

Other factors will also enter to increase this margin of safety. Usually the ambient temperature will be below 40 deg. C., thereby insuring additional safety. Many motors are running to-day shamefully underloaded, and it is to be expected that numerous applications in the future may be at less than the rated load of the motor, although it is hoped that the universal disposition to underload will be overcome to a great extent in applying continuous-rated motors. Analyses made by various power companies have indicated that motors are from 20 to 25 per cent larger than necessary, causing the installation of excess transformer capacity and running

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up investment costs. Numerous motors are driving a number of machines each having its own duty cycle (such as a machine shop), and investigations have shown that in most applications of group drive, as well as in some cases of individual drive, the demand factor is less than 100 per cent. Evidently such operation will also increase the margin of safety.

Compare the factor of safety of a motor rated in the old way with that of a motor rated in the new. Was the purchaser any better off? No; because the intended margin was not sufficiently definite. A motor of a certain rating with a certain overload guarantee gives much less idea what can be obtained from the machine than a motor rated on the continuous basis. By the old method a motor was capable of carrying 25 per cent overload. If the load is steady and there is no overload, 25 per cent of the possible output of the motor is wasted and the motor is larger than necessary. If it happens that the average load, equal to the rated load, fluctuates up or down 10 per cent, there still remains an unnecessary margin of 15 per cent. If the load varies 50 or 100 per cent, the margin of 25 per cent is worthless and the motor would in all probability burn out. To drive a load requires a certain maximum horsepower output. Under the old method of determining the size of a motor it was customary to deduct 25 per cent from the maximum output required by the machine the motor was to drive and thus arrive at the normal rating of the motor. The new method of rating simplifies the determination by omitting the 25 per cent overload, which is not really overload, and merely stating that the maximum load is so much and therefore the motor is rated at that load.

This new and simplified method of rating places on the purchaser the burden of determining the appropriate margin to be provided. The industry is far enough advanced for the users to be capable of selecting their own margin. The application engineers of to-day are fully conversant with the diversified requirements of the industry, so that they will have no difficulty in selecting the proper motor for each specific case. There is no excuse for guessing at the duty a motor must fulfill. Twenty years of education should have taught the user how to make allowance for the conditions he has to meet. The new method of rating assists both the seller and the buyer by defining more completely the capability of the motor.

Some confusion exists due to the impression that continuous-rated motors will not stand any overload. The motors are guaranteed to stand 50 per cent momentary overload, but they are not guaranteed for any overloads which in heating effect are equivalent to more than their rated output; *i.e.*, that will cause the motor to exceed a 50-deg. C. rise at any time. In case a motor is subjected to peak loads in excess of the ordinary load and the peak endures for more than a short time, it must be included in the rating. If, however, the peak load lasts for brief periods only, the rating must be sufficiently above the ordinary load to give a continuous thermal equivalent to that required on the brief peak loads without exceeding the permissible temperature limits. From the explanation of the short-time rating it is obvious that the machine will actually carry overloads within the maximum torque capacity of the machine, but the heating equivalent must be within the limits specified or the motor will not be used within the conditions specified in the guarantees.

It is common practice to rate generators on a continuous basis. During the last ten years such generators, particularly those for connection to steam or water turbines or gas engines, have been purchased very generally on the basis of a 50-deg. C. rise. The tendency is to rate the machine at the highest point it can be operated at safely in continuous service, thus getting the maximum output possible from the investment. In case a margin for overload is desired, it is necessary to increase the rating of the machine so that the name-plate rating equals the maximum load desired. However, transactions arise where it is necessary to rate the generators on a 40-deg. C. basis, and in these instances the rating is taken as 83⅓ per cent of the rating as a continuous-rated machine.

Question of Name-Plate Marking

In this same manner it will be possible to tell the capabilities of a continuous-rated motor operating on a 40-deg. C. basis. For example, a 10-hp. continuous-rated motor will without change operate as successfully as a 8.33-hp., 40-deg. C. motor and as such will be capable of sustaining an overload up to 10 hp. with 50-deg. C. rise. This is a scientifically correct method, and the only equitable one for obtaining a 40-deg. C. rating from a continuous-rated motor. The objection is that when applied to the continuous-rated motor in standard ratings it gives odd ratings instead of the even ratings to which we are accustomed. However, it is not necessary to place the odd rating on the name plate. All motors sold to-day have a name-plate showing, among other factors, the horsepower and corresponding temperature rise. Therefore, mark all name plates with the continuous rating, and let it be universally understood that the 40-deg. C. rating is 83⅓ per cent of the name-plate rating of a continuous-rated motor.

Another method of obtaining the 40-deg. C. rating from the continuous-rated motor is to "derate" to the next even rating. This means that a 10-hp. continuous-rated motor becomes a 7½-hp., 40-deg. C. motor. Following this method through the line of even ratings gives ratios of 66, 75, 80 or 83 per cent. It is quite evident that this is not the right method of procedure, as at a 40-deg. C. rating the motor contains more material than is necessary to justify the designated rating. Such a system of rating is entirely wrong as it is a direct blow at the conservation of material—recently a very important matter.

Getting the Most Out of Motor Material

Under the continuous-rating system the purchaser will know exactly what he is getting and pay for that only. Just a little thought will enable the purchaser, his engineers, or the application engineer, to select the proper size and type of motor. In the transition period, however, it should be realized when applying these motors that it is particularly unwise to assume that because a 10-hp. motor with 25 per cent overload for two hours did the work, a motor of the same continuous capacity will do the same work. It may or may not do so, depending entirely upon the starting and maximum load requirements and the heating equivalent of the cycle of duty; but it should be fully realized that the motor will carry its rated load continuously with as great a factor of safety as will a motor guaranteed to carry 25 per cent overload for two hours, and it will have equally long life and be equally reliable.

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Electric Service in World's Largest Hotel—I

All Necessities, Conveniences and Comforts So Depend on Electricity that Reliability of Service Was All-Important—How It Was Obtained Economically—Features of the Electrical Equipment of Hotel

HOTEL PENNSYLVANIA, the largest hotel in the world, which was recently opened in New York City with accommodations for 3500 registered guests, is not only interesting because of its magnitude and excellent appointments but because of the many conveniences which have been made possible by electricity. Besides, the electrical equipment—including lighting, electric cooking, signaling and communicating apparatus, motor-driven applications and provisions for using electric service—represents the latest word in the hotel world. While in the hotel appointments too great plainness has been avoided, little can be seen of an extremely ornate kind or suggestive of lavish expense, so that many of the practices, arrangements and electrical applications can be copied to good advantage in hotels of a smaller sort both physically and financially. The conditions which made it practicable to supply electric service in the manner adopted are not, of course, duplicated everywhere, but nevertheless the factors taken into account are well worth the consideration of all engineers.

From an illumination point of view, the lobby, ballroom and dining room are particularly attractive, while the lighting of the guest rooms, corridors and service rooms is economical yet ornamental enough for other hotels to follow. The elevator service has been very effectively worked out, there being twenty-seven electric elevators, including an automobile lift, dumbwaiters and freight hoists. In the kitchens are electric warming ovens, ranges and motor-driven kitchen appliances. Being really a small city in itself, the hotel has been equipped to be independent of most outside agencies such as hospitals, restaurants, barber shops, machine, carpenter and other shops and laundries, and almost every known application of electricity can be found somewhere in the hotel. The laundry is the largest electrically driven one in the world. Electric signaling and communication have been extensively applied, there being 260 trunk telephone lines, 3340 extensions and 23 operators in the hotel, besides 200 telautographs, an electric clock and time-stamp system and a fire and watchman signaling system. Some idea of the magnitude of the electrical equipment may be gained from the fact that there are more than 2,000,000 ft. (600,000 m.) of No. 14 to 2,000,000-circ.mil conductor installed, besides 635,000 ft. (195,000 m.) of ½-in. to 4-in. (1.25-cm. to 10-cm.) conduit, 240 distribution panels, controlling about 2250 kw. in lighting, to say nothing of the thousands of sockets and receptacles, switches and lighting fixtures.

Since service is the outstanding requirement of a hotel, one of the fundamental conditions laid down by the consulting engineer for the hotel was that a failure of the electric service must be practically impossible, and this end was attained by providing two independent sources of supply; namely, from the main power station of the Pennsylvania Railroad at Long Island City and from a generator in the hotel operated by steam purchased from the Pennsylvania Terminal. The first source can take care of all the requirements of the hotel, while the generator is able to provide enough energy for emergency lighting and power purposes.

Before these sources of supply were decided on, however, other methods were carefully considered, among them being a private and independent isolated plant in the building and central-station service with heating service from an isolated plant near by. The problem of securing steam* for heating and other purposes was necessarily as important as obtaining electric service, and therefore the two were considered jointly.

The New York Edison Company was handicapped in giving the service desired by the difficulty of providing the steam. A heating plant in the hotel was not desirable because it would involve handling coal and ashes around the hotel—one of the chief things that were to be avoided by central-station service.

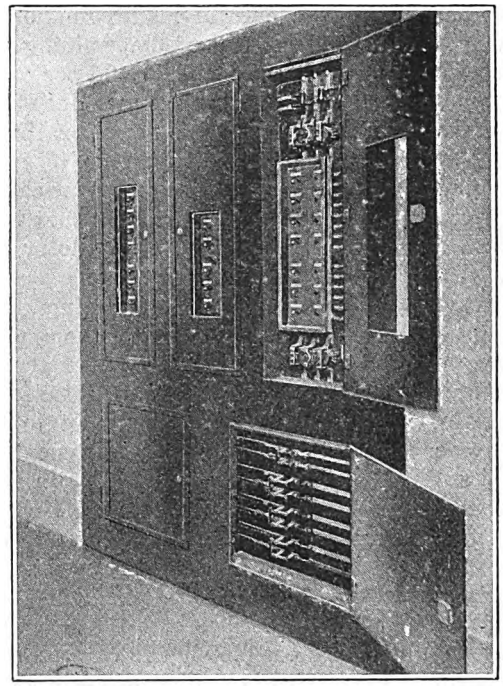

FIG. 1—DEAD-FRONT PANELBOARD WITH LIVE PARTS ACCESSIBLE ONLY TO AUTHORIZED PERSONS

The choice, therefore, lay between a private plant and the purchase of steam and electricity from the Pennsylvania Railroad. As the railroad company is the owner of the property, it was naturally anxious to give the hotel operating company as favorable a rate as possible. For this reason, and because it was not desirable to handle coal and ashes or to use valuable space in the hotel for boilers, it was finally decided that electricity and steam be purchased from the Pennsylvania Railroad. Since the live steam furnished by the Pennsylvania Terminal would have to be reduced in pressure before it could be used for heating, it was decided to install a single engine-driven generator rated at 500 kw. which

*It is estimated that 225,000,000 lb. of steam and 5,000,000 kw.-hr. of electricity will be needed each year in the completed hotel.

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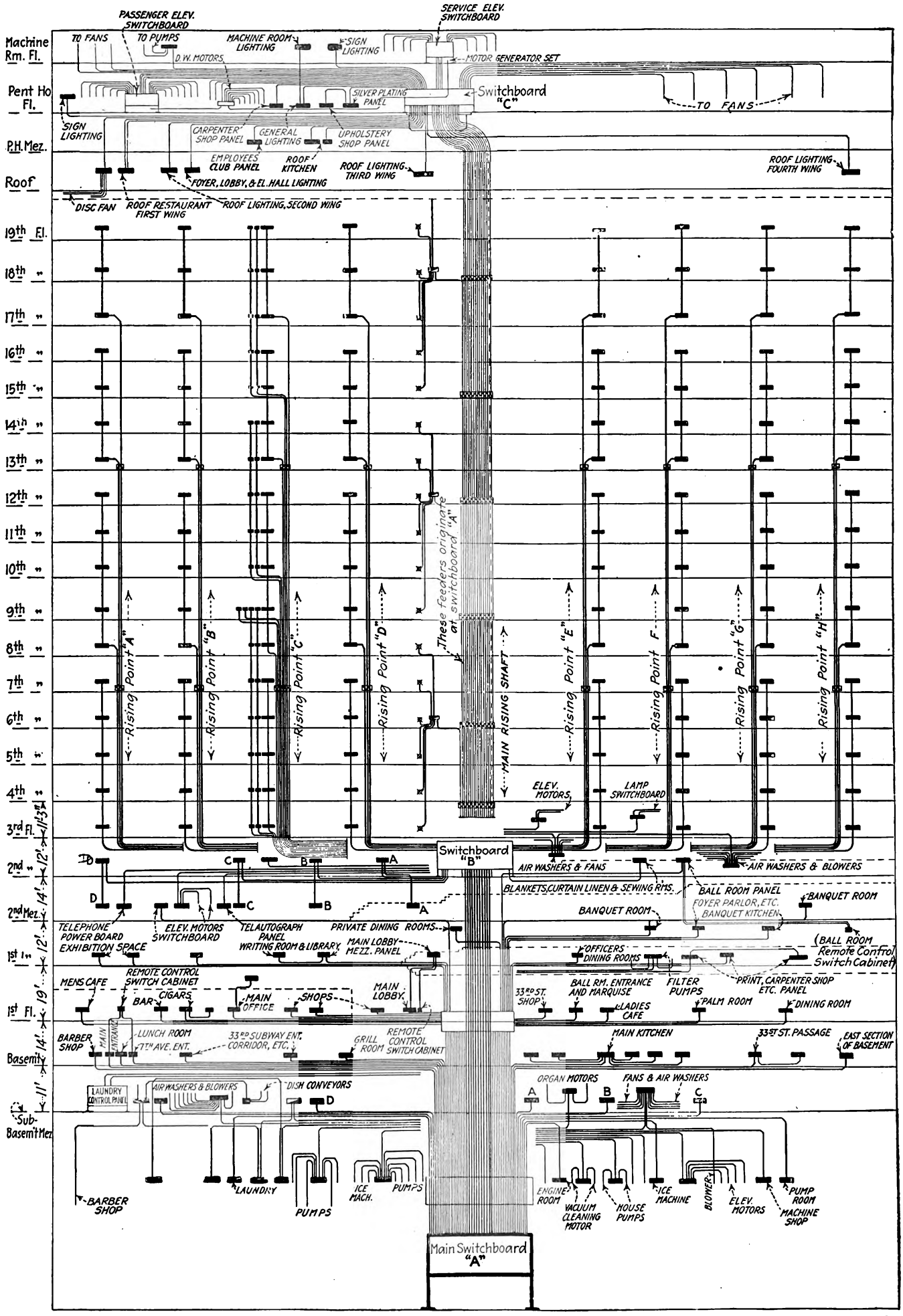

FIG. 2—FEEDERS IN RISER SHAFTS EXTENDING FROM BASEMENT TO ROOF

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would serve as a very efficient reducing valve. During the cold weather it can be run to generate electricity, and the exhaust steam from it and the steam-driven refrigerating plant, air compressors and so forth can be used for heating by radiation and for hot water. The load on the generator can be adjusted so as to supply just the amount of exhaust steam required. On very cold days it can be loaded almost to rating, and on warm days the load can be reduced an amount depending on how nearly the steam requirements compare with the exhaust from the other steam-driven apparatus.

Electrical requirements in addition to the amount of energy which can be furnished by the generator operating in this way during the cold season and all of the energy supply required at other times are met by using electricity purchased from the Long Island City station of the Pennsylvania Railroad. By this arrangement steam and electricity can be secured at a minimum cost without installing boiler equipment and a generating plant large enough to supply the entire electrical load in the hotel.

Electricity from the Long Island City plant is received in the form of 11,000-volt, 60-cycle, three-phase alternating energy through a tunnel which terminates at a transformer room in the sub-basement of the hotel. This room is a small compartment completely shut off from the remainder of the building. It contains two sets of transformers, one of which supplies three rotary converters, while the other supplies the lighting system and small motors. The rotaries are for supplying energy to the elevators, ventilating fans, laundry machines, auxiliary house pumps and sump pumps, which require speed control. The transformers for the converters consist of three banks of three units, each of which is rated at 187 kva. and has two secondary taps, 58 volts for starting and 188 volts for running. The lighting transformers, which are rated at 250 kva., are arranged in two banks of three each and energize 240--120-volt, three-wire lighting circuits. The high-tension circuits are controlled by type B-2 oil circuit breakers, disconnecting switches being provided so that some of the transformers can be thrown out of service without interfering with the operation of the rest.

The rotaries are rated at 500 kva. and supply direct current for 230-115-volt, three-wire circuits. Each has a starting switch mounted on a panel beside it. Two rotaries will be able to handle the power load, leaving the third as a spare.

The generator previously mentioned is driven by a 24-in. by 32-in. (61-cm. by 81-cm.) Corliss engine that runs at the very low speed of 120 r.p.m. so as to insure quiet operation. It operates in parallel with the rotaries.

Switchboards and Distribution.—There are two switchboards in the engine room, the power board and the main distributing board. The power board handles the direct-current circuits from the rotaries and the two main lighting circuits (one from each transformer bank) and carries the meters, relays and other instruments for the high-tension side of the line. Both the rotary circuits and the lighting circuits pass from this board to the main distributing board, which is divided into three main sections—the power-receiving section, the power-distribution section and the lighting-distribution section. The power-distribution section controls the power circuits for the lower floors. A kilowatt-hour meter is mounted on each panel. The busbars are so arranged that direct-current power can be supplied from the generator to any rotary or any combination of these four machines. In case of failure of the alternating-current supply, direct current can be used for lighting the corridor and other emergency lamps. The lighting-distribution section, which receives current from either or both banks of transformers, controls all the lighting circuits in the hotel. The various circuits are distributed among the phases so that an approximate balance is secured. Some of the lights in each corridor and at other emergency points are operated from each of the three phases, so that the failure of one or even two phases will not put any portion of the building in complete darkness. Each phase, as well as the main line, is provided with a kilowatt-hour meter.

As all the elevator motors are installed in two penthouses on the roof, the energy supply for these motors is carried by feeders from the main switchboard in the sub-basement to a power switchboard on the roof floor. From this power switchboard the feeders are extended to separate distributing boards, one in the passenger elevator penthouse and a second in the service elevator penthouse. A switch is provided on the roof-floor switchboard so that the feeders supplying the passenger and service elevators may be tied together electrically. By taking advantage of the diversity factor resulting from the operation of two banks of elevators the combined carrying capacity of the two sets of feeders is utilized to better advantage.

In the design of the feeder system for lighting the size and arrangement of the feeders were determined with a view to reducing the amount of copper required to a minimum and at the same time avoiding the possibility of having such variation in voltage as would seriously affect the candlepower of the lamps. The consulting engineer engaged by the hotel operating company had a large amount of data on the demand factors of feeders of various hotels which were used in conjunction with the connected loads in this hotel to determine the size of feeders necessary. As the variation in candlepower is much more rapid that the variation in voltage, it is obvious that if too great a loss were permitted in the feeders, the resultant reduction in light produced in the lamps might cause complaints from guests and an increase in the size of the lamp would be made necessary. On the other hand, good engineering required that no more copper be used than was necessary to obtain proper results. Economy was also obtained in the branch-circuit wiring by putting as many as ten to twelve outlets on a circuit. This is permissible in a hotel for the reason that all of the outlets are very seldom used at the same time in the bedroom portion of hotels.

*Illumination.**—The main feature in the way of illumination is the lighting of the lobby. There the ceiling is of glass arranged in an attractive design, supported on steel framework. Special glass in two colors is used, and in the space above the glass are a number of lamps with efficient reflectors, arranged for control in three groups. The lighting effect is very attractive and is obtained with an unusually small expenditure of energy for this type of lighting. Standard floor lamps are also provided in the lobby for use in connection with the lighting above the glass ceiling.

Charles E. Knox was consulting engineer for the hotel and was responsible for the design of the electrical and

*Other features of the illuminations will be discussed in the next installment of this article.

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elevator equipment of the hotel. Tenney & Ohmes were the heating, ventilating and refrigerating engineers. L. K. Comstock & Company, Inc., handled the entire electrical construction work, O. Chevalier acting as superintendent of the work. The American Laundry was furnished by the Otis Elevator Company, electric cooking and warming equipment was supplied by the Duparquet, Huot & Moneuse Company, the electrically operated dishwashers by F. G. Street, and motor-driven food mixers by the Hobart Manufacturing Company.

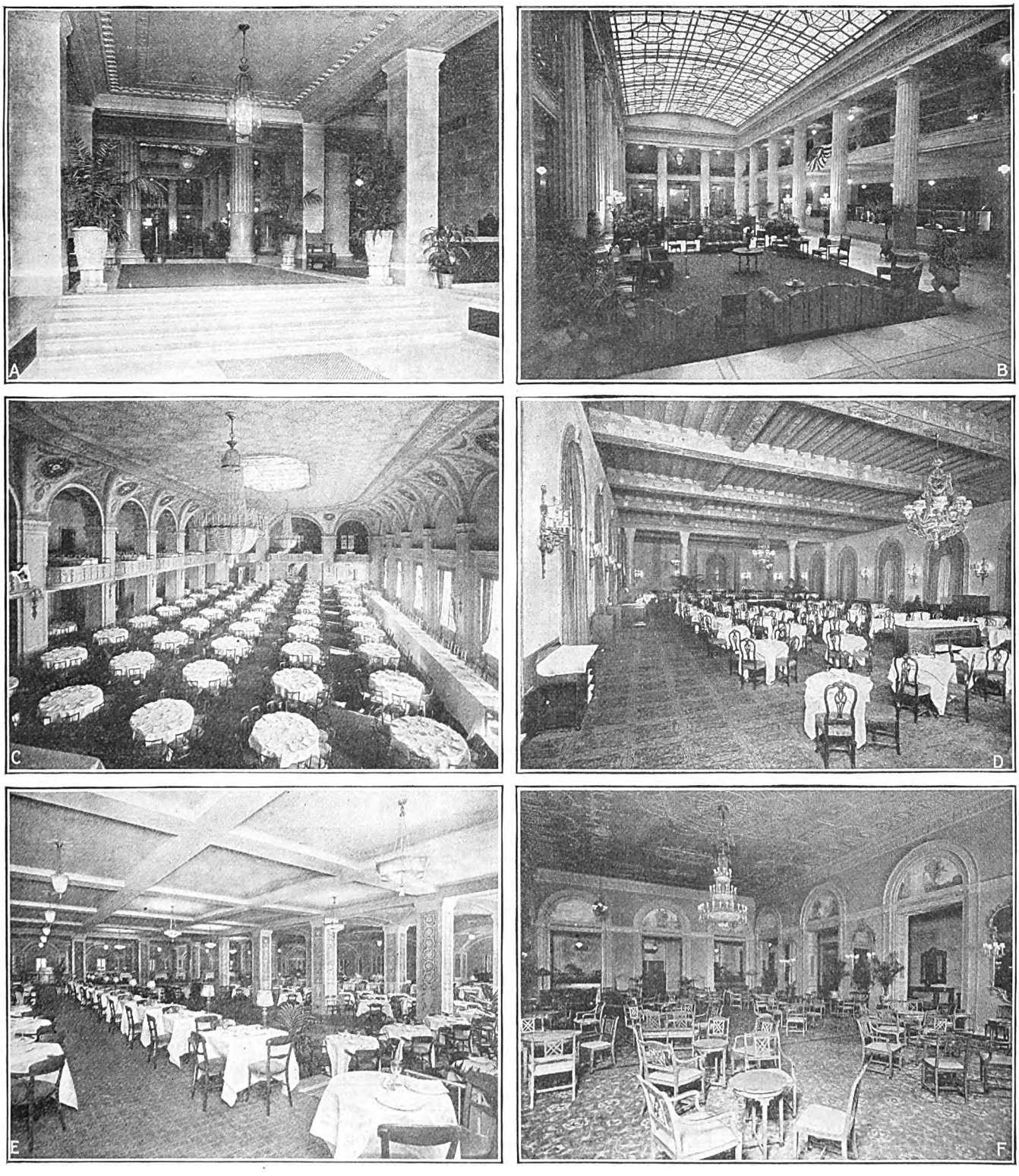

FIG. 3—ILLUMINATION FEATURES OF PUBLIC ROOMS

A—Entrance to lobby lighted by one large fixture. B—Main lobby illuminated by lighting units behind glass roof. C—Ballroom illuminated by two large fixtures and side lamps. D—Main dining room with concentrated illumination. E—Grill room illuminated with ornamental fixtures. F—Palm garden adjoining main lobby.

Machine Company equipped the laundry. Watt-hour meters were furnished by the Sangamo Electric Company, and sockets, receptacles, etc., were supplied by the Bryant Electric Company. The elevator equipment The Westinghouse Electric & Manufacturing Company furnished about all the rest of the electrical equipment—power-plant equipment, motors, panelboards, etc. The George A. Fuller Company built the hotel.

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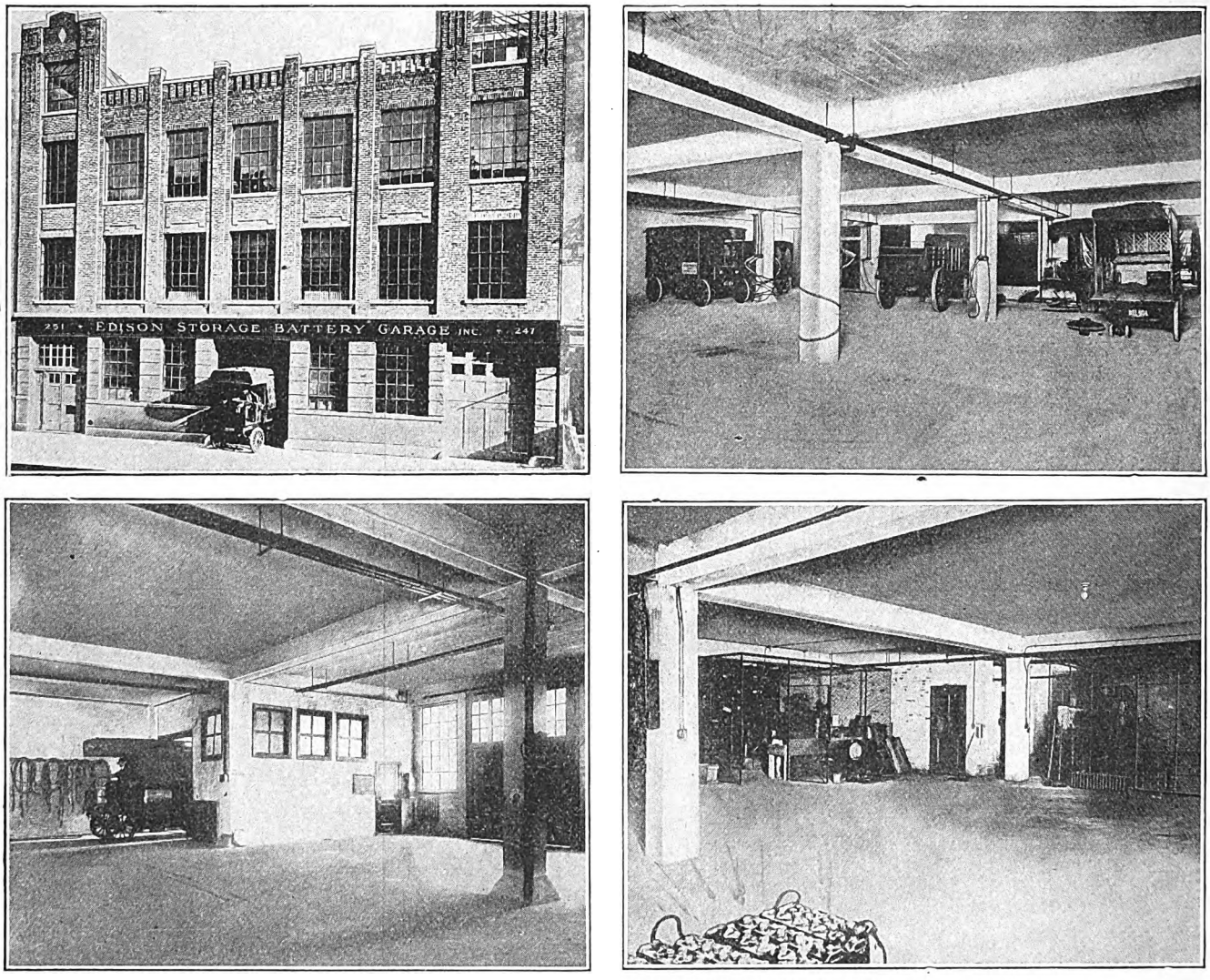
A 110-Truck Electric Garage

Description of Three-Story Building Designed to Keep Trucks in the Maximum Length of Service by Giving Proper Attention to Battery Charging and Truck Maintenance

WHENEVER central-station men meet to discuss the promotion of electric street trucks and delivery wagons there appears to be a unanimity of opinion that the successful operation of commercial electric vehicles in any community is predicated on there being the right kind of a garage operated by or under the auspices of the local electric light company. There are certain instances of electric light companies operating electric garages. In the following paragraphs a garage put up by one of the prominent manufacturers of storage batteries solely for electric street trucks is described.

This garage has been separately incorporated and is known as the Edison Storage Battery Garage, Inc., and it is situated at 247-251 West Thirty-fifth Street, New York City. The building is three stories high and has a basement. It is constructed of reinforced concrete and is 69 ft. (21 m.) wide by 98 ft. 9 in. (30 m.) deep. Each of the three stories is devoted to regular garaging purposes, while in the basement there is a repair plant. A 7-ton elevator serves to take trucks from the ground floor to other floors. On each floor there are six supporting concrete columns, and on each of these are double charging plugs from which current of any desired amperage may be had. There is also a washstand on each floor where soap and warm water for washing the trucks are provided.

In the basement a locker for each driver is provided. There is an additional panelboard with provisions for battery discharging. A small repair shop has been set up, in which are a drill press, a gear press, a power emery wheel and a lathe. With the equipment on hand it is stated that all repairs on cars as well as on batteries can be made. A stock room for batteries and battery parts has been installed. In a small fireproof room all oils and greases are kept. Along a portion of



VIEW OF OUTSIDE AND SOME OF THE FLOORS OF THE GARAGE

The charging panel is in the room next to the elevator on the ground floor, lower left hand. The upper right-hand cut shows charging plugs and part of repair floor. Lower right-hand cut shows machine shop and one corner of battery repair department.

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one side of the basement there is a battery room where all battery overhauling, solution changing and minor repairing is done. In this room there is a small charging bench for small batteries. Space is provided in the basement also for storing solution drums and battery trays. A 5-gal.-per-hour still has been installed to provide distilled water as required. There are also an automatic water heater and a steam producer. All battery cleaning is done with steam.

Contracts are based on three different rates, as follow:

1. Dead storage. The rates per month in this case are as follows: 750-lb. vehicle, $17.50; 1000-lb. vehicle, $20; 2000-lb. vehicle, $22.50; 4000-lb. vehicle, $25; 7000-lb. vehicle, $27.50; 10,000-lb. vehicle, $30. This rate includes housing only. Energy for charging will be supplied upon written request at 8 cents per kilowatt-hour, including watering of battery. Other services and supplies will be furnished, upon written request, at transient rates.

2. Full service, including charging. Rates per month are: 750-lb. vehicle, $43; 1000-lb. vehicle, $48; 2000-lb. vehicle, $53; 4000-lb. vehicle, $65; 7000-lb. vehicle, $75; 10,000-lb. vehicle, $85. This rate includes housing, washing and polishing, oiling and greasing, monthly inspection of vehicle and battery, watering and regular charging of battery. It does not include repairs to vehicle or battery nor other services of any kind. Repairs will be made only on the written orders of the owner.

3. Full service, charging extra. Rates per month are: 750-lb., 1000-lb. and 2000-lb. vehicles, $25; 4000-lb. vehicle, $30; 7000-lb. and 10,000-lb. vehicles, $35, plus 5 cents per kilowatt-hour for energy consumed in charging. This rate includes everything included in rate No. 2 except that charging is extra, according to the actual energy consumption.

There is a contract rider covering emergency repairs which authorizes the garage to make emergency repairs without formal orders, but not to exceed $25 in cost for any single job.

On the back of each contract appear the following terms and conditions:

1. This agreement shall not be binding upon the garage company until accepted in writing by its proper officer or duly authorized agent.

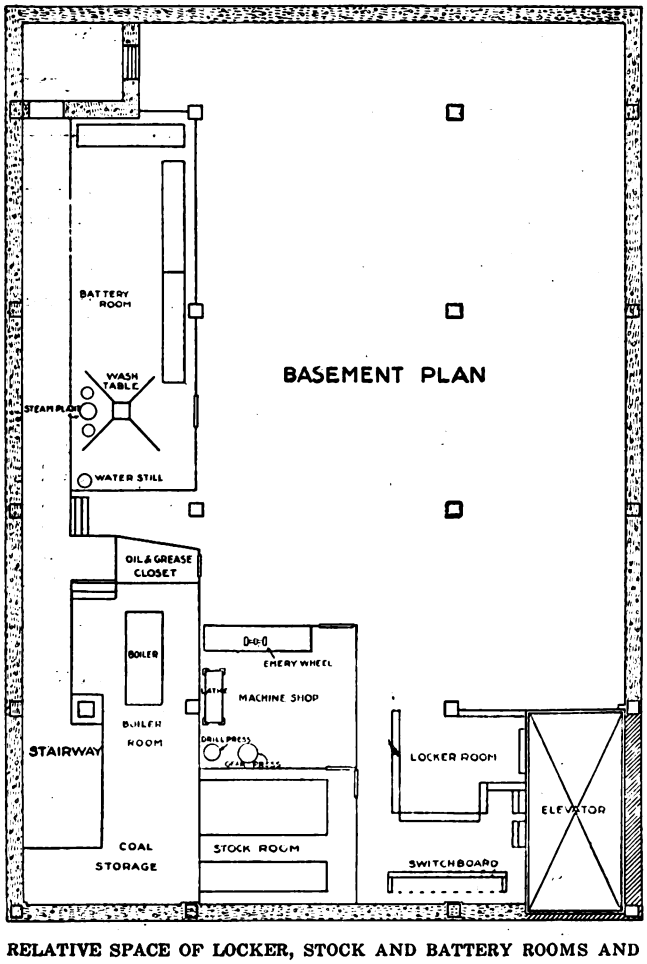
2. The garage company will endeavor to have the battery in the vehicle fully charged by 7 o'clock each morning (except Sundays and holidays unless especially requested in writing) but does not assume responsibility for failure to have the battery so charged.

3. The garage company shall not be responsible for damage by fire and shall not be responsible for any other damage unless caused solely by the negligence of its agents or employees.

4. The garage company shall not be responsible for damage to or the loss or theft of articles or goods left in the vehicle or the garage.

5. The garage company will furnish at the garage for the use of the vehicle owner or his agents or employees during the life of this agreement a locker provided with lock and key, for the sum of $1 per year or fraction thereof, but assumes no responsibility for the safety of articles therein.

6. The garage company will from time to time make such rules and regulations as may be found necessary for the proper operation of the garage, and the vehicle owner agrees for himself, his agents and employees to be bound by them during the life of this agreement.



RELATIVE SPACE OF LOCKER, STOCK AND BATTERY ROOMS AND MACHINE SHOP

G1711F-1C-119

Contract No. F.....

ELECTRIC VEHICLE GARAGE AGREEMENT

Edison Storage Battery Garage, Inc.

Main Office, Orange, N. J.

Garage, 247-251 West 35th Street, New York City

New York,.....19....

The undersigned requests the Edison Storage Battery Garage, Inc. (hereinafter called the "Garage Company") to furnish garage service, as indicated below, for.....vehicle, capacity.....lbs. Owner's No....., Mfrs. (MAKE) No....., equipped with.....(MAKE) battery containing .....cells, type....., and, subject to the terms and conditions endorsed hereon, and made a part hereof, agrees: To be bound by this agreement until terminated as herein provided; to pay for such service monthly upon presentation of the bill; that the service shall include only the service indicated below and shall be charged for at the rate indicated below:

RATE F—Full Service, Including charging.

750 lb. vehicle	$43.00	per month
1,000 " "	48.00	"
2,000 " "	53.00	"
4,000 " "	65.00	"
7,000 " "	75.00	"
10,000 " "	85.00	"

This rate includes housing; washing and polishing; oiling and greasing; monthly inspection of vehicle and battery; watering and regular charging of battery. It does not include repairs to vehicle or battery nor other service of any kind. Repairs will be made only on written order of owner.

In case of any question regarding vehicle call Mr.....

Phone....., No....., or Mr.....

Phone....., No.....

Signed.....

By.....

Title.....

Accepted.....19.... (Address for Bills)

EDISON STORAGE BATTERY GARAGE, Inc.

By..... (Address for other Communications)

ALL SERVICES USE THE SAME CONTRACT FORM EXCEPT FOR THE RATE PANEL

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7. This agreement may be terminated by either party at any time by one week's notice in writing to the other party. The garage company reserves the right to terminate this agreement forthwith in case of arrears in payments due from the vehicle owner, or in case of failure on the part of the vehicle owner, his agents or employees to observe the rules and regulations of the gagage.

8. This agreement shall not be binding on the garage company if the form or rates are altered in any way, unless with the written consent of an officer of the garage company.

An interesting feature of the operation of the garage is the daily time card. Each driver must punch the time clock on his card each time he takes his truck out and brings it in. The amount of charge or boost is recorded on the card. On the reverse side space is ruled off for such details of maintenance as flushing battery inspection, battery repairing, washing and polishing, oiling and greasing, vehicle inspection and vehicle repairing. At any time these daily cards will show at a glance the history of each vehicle using the garage service. After a few months they will also provide some interesting statistics of operation. On the first floor there is walled off in a small room a six-panel Cutler-Hammer charging board. Each circuit is plainly marked, and any desired charging current may be obtained. No circuit is rated at less than 100 amp. and the heaviest circuit is rated at 270 amp. A daily charging record is kept of each circuit.

EDISON STORAGE BATTERY CO. 247-251 W. 35TH STREET, NEW YORK

DAILY TIME CARD

VEHICLE NO.....

BATTERY.....CELLS, TYPE.....

DRIVER..... DATE.....19....

SB 1707-15M-1118

	ODOMETER		AMP.-HR. METER	TIME
TRIP No. 1		OUT		
		IN		
CHARGE OR BOOST	CIRCUIT No.___ ___Amp.	ON		
		OFF		
TRIP No. 2		OUT		
		IN		
CHARGE OR BOOST	CIRCUIT No.___ ___Amp.	ON		
		OFF		
TRIP No. 3		OUT		
		IN		
CHARGE OR BOOST	CIRCUIT No.___ ___Amp.	ON		
		OFF		

		REPORT No.	TIME
FLUSHING	START		
By___	FINISH		
BATTERY INSPECTION	START		
By___	FINISH	No.___	
BATTERY REPAIRING	START		
By___	FINISH	No.___	
WASHING AND POLISHING	START		
By___	FINISH		
OILING AND GREASING	START		
By___	FINISH		
VEHICLE INSPECTION	START		
By___	FINISH	No.___	
VEHICLE REPAIRING	START		
By___	FINISH	No.___	

FRONT AND REAR OF DAILY TIME CARD

There is room in the garage for 110 trucks. Already, after about four months of operation, seventy trucks are utilizing this service.

The same conditions have existed in New York that obtain elsewhere. Gas-car interests operate the garages, and in them the electric car does not receive the required attention. Batteries cannot be charged in the same manner that a gasoline tank is filled. Batteries should be charged at a certain rate. If panels are not large, as seems to be the case in gas garages, proper charging does not result. Instances of charging a 45-amp. cell at a 15-amp. rate from a 30-amp. board are not uncommon. Cars must be kept in condition if they are to be of service to their owners. It is this fact that causes the statement that central stations must conduct the electric garages if electric commercial transportation is to be a local success.

The garage described was built to better the conditions of electric transportation in New York City by giving a better service to the operator of large fleets and to provide a place where the prospective user of one or two electric trucks will be assured that his trucks will be cared for properly. This service embodies many new features and ideas which are the outcome of years of observation of the many deficiencies of service that have retarded the growth of the electric vehicle industry.

WIRELESS TELEPHONY AND TELEGRAPHY IN THE WAR

Engineer Believes Commercial Applications of Radio Development Accelerated by War Will Lie Only in Field Unreached by Wire Lines

A. A. Oswald, Western Electric Company, New York City, speaking before a joint meeting of the Chicago Section, A. I. E. E., and the Electrical Section, Western Society of Engineers, at Chicago, April 28, described much of the radio apparatus and organization utilized by the military establishment of the United States in the recent war. The speaker showed lantern slides of the equipment used by all sections of the army and the navy for both aircraft and ground uses. He showed how the ground telegraph, using earth waves instead of atmospheric waves, made it possible to utilize radio communication even in the forward areas of a battle zone where it was impossible to keep aërials from being shot down by the enemy. He also showed how the messages received from these ground telegraph sets were communicated to the back areas by aërial-radio communicating sets established at regimental, brigade and division headquarters.

A particularly interesting section of the speaker's address was devoted to anecdotes on radio camouflage. To show the workings of this peculiar art he first described the method by which air craft, equipped with radio sets, can utilize the waves sent out from sending stations as direction finders. It appears that the Germans were using this method of guiding their Zeppelins in the night air raids on London. These enemy air craft would tune to certain stations in London which were sending continuously and would then use the waves coming out from these stations to guide them to the British capital. When the Allied armies discovered this procedure they took pains to learn when the next Zeppelin raid was to be put on and to learn what station in London was to be the "beacon" station. On the night of the raid this station was shut down and a station in France was tuned to send out waves which would be mistaken by the Zeppelin commander for those coming from the British station. By thus leading the Zeppelins astray it was possible for the Allied armies to trap them and to destroy all five of the raiders.

In commenting on the possible commercial application of recent radio developments Mr. Oswald expressed the belief that unless some vitally new principle was discovered in connection with radio it would not come to be a serious competitor with wire lines. It will be used for communication between ships at sea, between ships and the land, between aircraft and between sections of isolated country over which it is difficult to lay wire lines. It will find use wherever there is a demand for telegraph or telephone service and where wire lines are not available.

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Third Joint Convention on Pacific Coast

Progress of Co-operative Campaign, Preparation of Industry for Standardizing Steam-Railroad Electrification Methods, Interconnection, Commercial Conditions and Plan for Reorganization of the N. E. L. A. Are Discussed

This report supplements an article printed in last week's issue of the ELECTRICAL WORLD. It gives details of later sessions of the joint convention at Coronado, Cal., last week by the Pacific Coast Section of the National Electric Light Association, the Pacific division of the Electrical Supply Jobbers' Association and the California Association of Electrical Contractors and Dealers.

SUPPLEMENTING last week's account of the joint electrical conference at Coronado, Cal., details of later sessions have been received. Participation in conference affairs by members of the Railroad Commission, the Industrial Accident Commission, the water committee and others made for comprehensiveness and breadth of view in discussions. Economic questions sometimes crept in, as when the president of the Railroad Commission volunteered some unofficial comments in the engineering session. Authoritative expression was the rule on all matters considered, because practically all California companies were represented by their leading men.

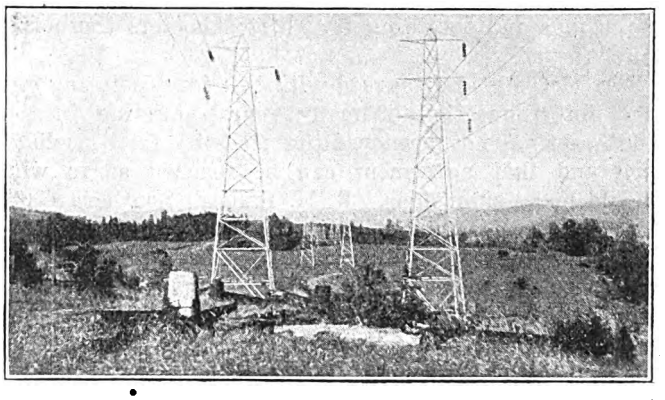
There was much praise from all quarters for the co-operative campaign, which has been steadily expanding and now has four field men at work in an effective plan for increasing the sale and use of electrical appliances. Some of the suggestions made by Samuel Kahn, president of the California Section of the National Electric Light Association, were that membership in classes D and E should be made more attractive, that companies should offer to make consumers "financial partners," that more attention should be given to publicity, and that a study be made of busbar interconnections that would improve the prospects for serving railroad electrification projects. He stated clearly that he would rather see the powers of the Railroad Commission broadened than curtailed and mentioned the desirability of putting municipally owned utilities under its jurisdiction.

STANISLAUS FLUME, SIERRA & SAN FRANCISCO POWER COMPANY

Reports by the secretary and the treasurer showed the section to have weathered the war in excellent condition. Two particularly creditable developments of war times were the salvage bureau planned as an equipment clearing house and the personnel bureau as a clearing house for men. The satisfactory membership condition despite enlistments is due to its active coöperation in getting in new members, a shining example being the total of 329 class B members secured in one company as the result of concentrated effort and team work.

ENGINEERING COMMITTEE DISCUSSIONS

In reporting for the engineering committee at the general session H. A. Barre, Southern California Edison Company, chairman, said that the committee's most important work will be in preparing the industry for standardizing steam-railroad electrification methods. Although this is a national question, it will be a particularly live one in the Southwestern States. It is very desirable to have power systems so built that they can be utilized effectively in the electrification of railroads. Four interests are involved—railroads, power companies, manufacturers and regulatory powers.



TOWER LINES NEAR VALLECITO, SIERRA & SAN FRANCISCO POWER COMPANY

The engineering sessions began Thursday afternoon, the first report to be considered being that of the committee on insulators. C. O. Poole, Southern Sierras Power Company, said that, out of 10,000 insulators in service, 98 per cent of the failures were between pin and cap. He suggested the continuation of engineering committee tests, using insulators of modern design. It was also suggested that particular care be taken in recording the type and location of failures with respect to metal parts.

J. P. Jollyman, Pacific Gas & Electric Company, referred to the great need for better field-test methods. Insulators shown to be doubtlul under megger tests would often be shown by laboratory methods to be still fit for many years' service.

C. P. Osborne, Portland Railway Light & Power Company, said that advice from high authority had been to remove all insulators testing below 2000 megohms. This seemed too expensive a plan, so the limit was reduced to 200 megohms, and with this standard there were practically no failures in two years. The subject brought out prolonged discussion, experience with different designs and makes being exchanged and the latest word from manufacturers' representatives being listened to with interest.

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Others who contributed to the discussion were E. B. Snyder, Ohio Brass Company; H. L. Garbutt, Westinghouse Electric & Manufacturing Company; R. J. McClelland, Electric Bond & Share Company; J. A. Lighthipe, Southern California Edison Company; J. E. Woodbridge, Sierras & San Francisco Power Company; D. J. Butts, Western Electric Company; John Koontz. Great Western Power Company, and R. S. Masson, Arizona Power Company.

The committee on transformer standards suggested that subtractive polarity of transformers be made standard for all types and that three-phase transformers be provided for distribution service.

Discussing the paper by G. R. Kenny, San Joaquin Light & Power Company, on the interchange of power between that company and the Los Angeles system, E. O. Edgerton, president California Railroad Commission, suggested that a possibility now faced is the consolidation of companies as a means of avoiding difficulty over extensions and obtaining for all stockholders the maximum return.

Mr. McClelland disagreed with this idea, pointing out that interconnection of many years' standing in the Southeast has not developed the necessity for consolidation and that agreement can be reached as to who should make extensions. R. H. Ballard, Southern California Edison Company, cited as an obstacle to consolidation outstanding capitalization and the time required to apportion this satisfactorily.

Edward Whaley, Northern California Power Company, pointed out that the chief problems of consolidation are on the financial side and that physical interconnection, which can be effected much more quickly, secures the same benefits so far as service to the public is concerned. A difficulty of interconnection is that line troubles are carried over into other systems. Mention was made of the desirability of interconnection at more than one point, or assigning one or more generators exclusively to the system with which power is to be exchanged. The next sudden increase in power demand was likely to be for the electrification of railroads.

Others who expressed views on the question were Perry O. Crawford, California-Oregon Power Company; D. D. Morgan and J. R. C. Wood, Southern California Edison Company.

The engineering committee did not approve of applying on the Pacific Coast the line safety code of the United States Bureau of Standards. A code better suited to local needs had therefore been prepared and submitted to the Railroad Commission with the recommendation that it be adopted as California's standard. L. S. Ready, California Railroad Commission, said that the matter was being studied. His opinion was that a code prepared locally would be of greater value than any code issued by the Bureau of Standards, because the latter would have to be complex to be applicable to so large a territory.

Relay Protective Systems and Other Topics

At the afternoon session, in discussing the paper by G. E. Armstrong, Southern California Edison Company, on relay protective systems, there was difference of opinion as to whether any possible combination of relay switches now made would meet all requirements on Western systems. It was urged that relays depending on the amount of voltage or current be avoided in favor of those operative on relative values of current.

Several companies had developed equipment that suited their needs better than standard apparatus, and it was pointed out that Western engineers must frequently design their own apparatus to meet requirements previously unknown. Mr. Woodbridge suggested that relays "should not be taken too seriously" as heavy short circuits will run through anyway. On the Southern California system short-circuit charges are plotted on a distribution system map to enable a study of the nature and extent of the currents that run over the lines at such times to be made.

R. H. Halpenny, Southern Sierras Power Company, showed how the importance of relay protection has grown as system networks have extended. Several speakers thought the manufacturer should give more attention to the relay protection field.

The paper on automatic inductor-generator plants by E. A. Quinn, San Joaquin Light & Power Corporation, brought out general agreement that automatic substations require a reasonable amount of intelligent attention. Paul Lincoln, Westinghouse Electric & Manufacturing Company, pointed out that this attention increases with the size of the installation, approaching a limit in large plants, where constant attention would probably be economical.

John Hood, General Electric Company, showed that operating expense is the one charge on which there remains a field for considerable economy increases. Because they affect this charge, automatic substations will influence as they increase in size the comparative studies of the proposed steam and hydroelectric plants in the matter of fixed and operating charges which are being made. Mr. Hood expects to see an increase toward larger automatic substation sizes.

Other papers discussed at this session were on connecting a steam plant to stand-by operation, by L. M. Klauber, San Diego Consolidated Gas & Electric Company, and on the meaning of kilowatt-hours per barrel of oil, by S. J. Lisberger, Pacific Gas & Electric Company.

At the Friday afternoon session there was an interesting demonstration of noise-proof telephone transmitters, and Mr. Lighthipe suggested these would be very useful means of communication for power-station operators, enabling them to talk from the switchboards instead of going to sound-proof booths. Mr. Barre said the investigation of the same principle as a means of mitigating inductive interference should be carefully followed. In discussing the paper on powdered fuel by C. H. Delaney, Pacific Gas & Electric Company, R. J. C. Wood, Southern California Edison Company, brought out the need for considering the dust problem in comparing coal and oil fuels. The high sulphur content of pulverized California coal should be considered in relation to its sulphuric-acid action on boiler tubes.

Paul M. Donning, Pacific Gas & Electric Company, felt that more complete tests of pulverized fuel on a large scale are needed. Mr. Lisberger spoke of the large first cost necessary in equipping plants to use this fuel and the storage dangers involved. Comment was also made by H. E. Linden of the Beckman-Linden Corporation and J. A. Buell, Lone Coal Mine Company.

Brief discussion of the paper on extending the accuracy range of watt-hour meters by O. A. Knopp, Pacific Gas & Electric Company, was followed by the paper on electric welding by John Hood, General Electric Company. F. A. Anderson, United States Shipping Board,

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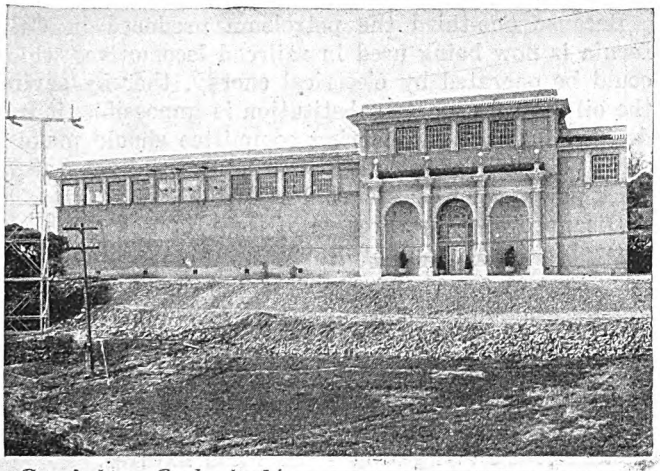
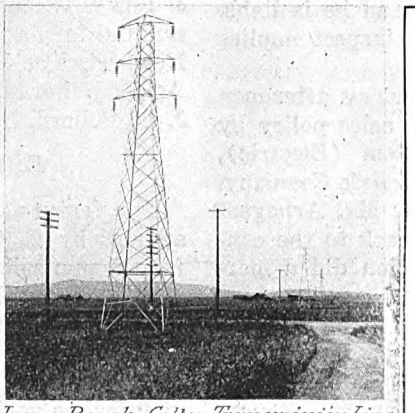
called attention particularly to the metallic theory involved. W. B. Sawyer, United States Steel Products Company, pointed out that no one specification of electrode material could meet all requirements. The three considerations in proper electrode combinations are character of material, chemical composition and physical structure. Further discussion was followed by a visit to the electric welding apparatus brought by Mr. Hood, which was used to illustrate welds which were homogeneous and well connected to the parent metal.



Cordelia Substation, Napa District, Pacific Gas & Electric Co.

Wise Power House, Pacific Gas & Electric Co.

Colton Substation, Southern California Edison Co.



Long Beach-Colton Transmission Line Southern California Edison Co.

COMMERCIAL SESSIONS

Reporting for the commercial committee, A. W. Childs, Southern California Edison Company, chairman, referred briefly to recent extensive changes in conditions. During the war most companies found it unnecessary to solicit business. Many isolated plants were voluntarily shut down and central-station service was substituted. Now an era of unprecedented development of resources is faced, and the companies must set their house in order as it were, giving careful attention to the sales personnel, interesting the architect in providing suitable arrangements for electrical needs and in other ways preparing to meet new conditions.

At the first commercial session on Thursday morning the paper on proper training of the sales personnel by L. H. Newbert, Pacific Gas & Electric Company, was discussed by John A. Britton, Pacific Gas & Electric Company, who said that the primary qualification of a salesman is ability to approach prospective customers with convincing presentation. Closer contact between the salesmen and executives of the company was urged. Every salesman should know the company policy and should learn it from the boss.

K. E. Van Kuran, Westinghouse Electric & Manufacturing Company, made the point that the all-important feature of any business, particularly the electrical trade, is service, and this can only be rendered through the properly coördinated efforts of every person and department. An understanding of human nature is the first consideration in the selection of salesmen. One who meets this requirement can be expected to learn the other essentials. Mr. Van Kuran emphasized the need of leaders who can develop a spirit of loyalty in employees. Employees render loyalty in the same measure as they receive it. Others who commented on the subject were Mr. Ballard, E. B. Criddle, Southern Sierras Power Company, and Glenn D. Smith, Ontario Power Company.

A paper on how the electrical industry can assist the architect in serving his clients by J. O. Case, General Electric Company, was heartily approved as an aid in much-needed progress. Mr. Eltringham of the State Accident Commission stated that a standard code which had been considered for two years would soon be submitted. He requested coöperation. Glen Arbogast, of the F. E. Newberry Company, said that about 5 per cent of the cost in building construction now goes for electrical work and that this percentage could be doubled by proper coöperation with the architects.

The paper on problems of electric cooking and heating by B. M. Maddox, Southern California Edison Company, was the center of as much interest as any paper before the convention. A. B. Wollaber, Southern California

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Edison Company, said this company now has more than 3000 electric ranges installed and working. His experience indicated that ordinarily there was no more trouble with ranges than with motors and other apparatus. Written discussion from J. J. Gibson, Westinghouse Electric & Manufacturing Company, suggested that it is for the ultimate good of the entire industry that range rates be profitable. Electric heating of water can be made profitable to all concerned, he thought.

P. H. Booth, Hotpoint Electric Company, predicted a great increase of range business this year and pointed out that there must always be enough different styles to suit the fancy of the purchasers, usually women. Hotel, restaurant and bake-oven business has been increasing by leaps and bounds, he said. E. H. Richardson, Edison Electric Appliance Company, thought that keeping the number of models to a minimum would hold the cost down.

Others who spoke on this subject were Glen D. Smith, M. A. Delew, electrical contractor, and R. C. W. Libbey, Simplex Electric Heating Company. There was also appreciative and general discussion on the paper by H. L. Harper entitled "Selling the Idea" and that by John C. Rendler entitled "The Contractor-Dealer of the Future."

"THE MAN IN THE STREET"

At a general session Thursday afternoon a paper entitled "The Man in the Street" was read by S. M. Kennedy, Southern California Edison Company. Some of the points made in this paper were as follows: If there is any class of business which is at all times on trial before the great court of public opinion, it is that of the public utility. The utility, however, cannot select its jurors; they are selected by the destiny that groups men together in cities and communities. The man in the street is a many-sided individual, but in the main he will be found reasonable, tractable and not unfriendly. He judges the company somewhat by the manner in which it maintains its property. An open, accessible office invites him to inspect, and he is liable to say to himself that an invitation to inspect implies that there is nothing to conceal.

The concluding commercial session Friday afternoon had two items—the paper on appliance sales policy by Tracy W. Simpson, Federal Sign System (Electric), and a talk by W. L. Goodwin, General Electric Company. In commenting on Mr. Simpson's paper Mr. Arbogast warned against any tendency to drift back to the conditions obtaining when the central station did a merchandising business on unethical lines.

Brief comment was also made by A. M. Smith, General Electric Company, and Mr. Booth, the former stating that he hoped to see a display room for samples maintained by the central station but sales of appliances made only by retail merchants. In reviewing the comment Mr. Simpson cited experience in one Coast city where no sales effort is made by the central station and where appliances used are exceptionally low and dealers are not prosperous.

Mr. Goodwin explained why the electrical business is unique and, in his opinion, must ultimately consist of a single organization, including all present branches of the industry, if the best results are to accrue. The first need is an educational campaign, he said. He highly commended the spirit manifested at this convention. The campaign of publicity must be national, and it is particularly desirable that the example of the Pacific Coast be reported to other sections not so far advanced.

A final joint session for resolutions and elections was held late Friday afternoon. The public policy committee report was made at this session by John A. Britton, Pacific Gas & Electric Company.

Among actions taken by the convention were the following:

Because one-third the petroleum produced in California is now being used in railroad locomotives which could be operated by electrical energy, thereby saving the oil for uses where substitution is impossible, it was decided that the engineering committee should make a study of railroad electrification and the preparatory work power companies should undertake.

Disapproval was expressed of the proposed establishment by the Bureau of Standards at Washington of standards of ethics for application in the West, where capable commissions already exercise jurisdiction.

All branches of the industry were "invited to cooperate in an educational campaign to inform the public, and particularly architects, as to the need of installing receptacles for appliances, rather than to depend on makeshift use of lighting sockets and fixtures."

A plan for reorganizing and decentralizing the N. E. L. A. which was presented by the executive committee and indorsed by the general session proposed the financial independence of each geographical section. At some later date representatives of the sections should meet, it was suggested, and determine the proper allotment for maintaining a national association, the plan being to keep the expenses of the national office at a minimum and to send communications to members solely through the geographic sections. The plan also proposed the elimination of national conventions, in lieu of which annual section meetings should be held from which delegates would be sent to a general executive committee meeting.

The election of officers for the ensuing year resulted as follows: President, A. G. Wishon, San Joaquin Light & Power Company; vice-president, E. R. Davis, Southern California Edison Company; vice-president, L. H. Newbert, Pacific Gas & Electric Company; secretary, A. H. Halloran, *Journal of Electricity*, and treasurer, J. F. Pollard, Sierra & San Francisco Power Company.

ENTERTAINMENT AND BANQUET

The feature of the banquet Friday evening was the address by E. O. Edgerton, president California Railroad Commission. He sounded a sharp note of warning regarding public ownership of utilities unless new ideals were established. Americans have demonstrated their habit of themselves undertaking that which others do not do to their satisfaction. It will be so with the utilities, he said. Unless the quality of service is truly the first and chief consideration the opportunity to serve will be taken away. Moreover, the public will be the sole judge as to whether that service is satisfactory. If there is any feeling that experience with federal control of railroads and telephones has killed the municipal ownership tendency, that idea should be dismissed at once. The public ownership idea will never be killed, Mr. Edgerton said, and if consumers find a difference between a utility operated for profit and one operated for service, there will be a demand for the latter. A monopoly is economically right, he said, and if the private utility dominates, it will be because the ideal of service is put above the ideal of profit.

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

IMPROVING THE LIGHTING FROM STREET LANTERNS

Method That Permits Use of Ornamental Fixture and at the Same Time Gives Better Light Distribution

BY F. BRUEGGEMAN

Street-lighting installations in which lantern-type fixtures are mounted on post standards ordinarily give distribution of light like that shown in Fig. 2 (above) because the rays from the lamp are reflected uniformly in a circular area and as a rule are uncontrolled. Experimental work which has been carried on in connection with one of the larger installations of lantern-type street lighting has shown that it is possible to modify certain fixtures in order to secure better distribution of light like that shown in Fig. 2 (below). The result is accomplished by collecting the upward and downward rays from the incandescent lamp and reflecting them into useful directions, preferably parallel with the street or drive.

The apparatus which was used in this experimental work has been operated on city streets. It is shown both assembled and disassembled in Fig. 1. In this photograph *A* is the upper reflector, which, when the unit is assembled, sits closely over the series tungsten lamp *B* and reflects all direct rays, as well as reflected rays from the lower reflector *C*, into useful directions. The lower

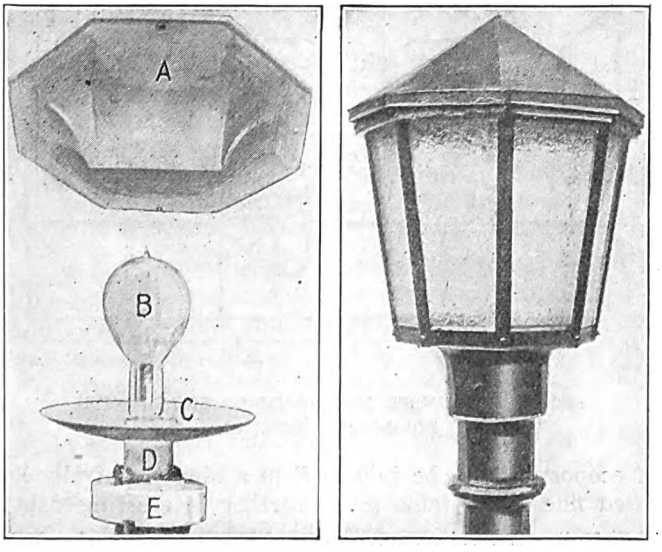

FIG. 1—UPPER REFLECTOR *A* SITS CLOSELY OVER LAMP *B* IN LANTERN ON RIGHT. *C* REFLECTS RAYS VERTICALLY AGAINST *A*

reflector *C* is parabolic and is designed to reflect vertically against reflector *A* all rays that strike it. *D* is a porcelain series socket of standard manufacture which fits into a specially designed porcelain combination cable terminal and receptacle *E*. The lead-covered cables terminate in this specially designed receptacle to make a safe and lasting installation. The complete lantern is constructed entirely of cast iron and glass, including the reflectors, which are white, fire-enameled and not affected by heat or rough usage. Chipped glass

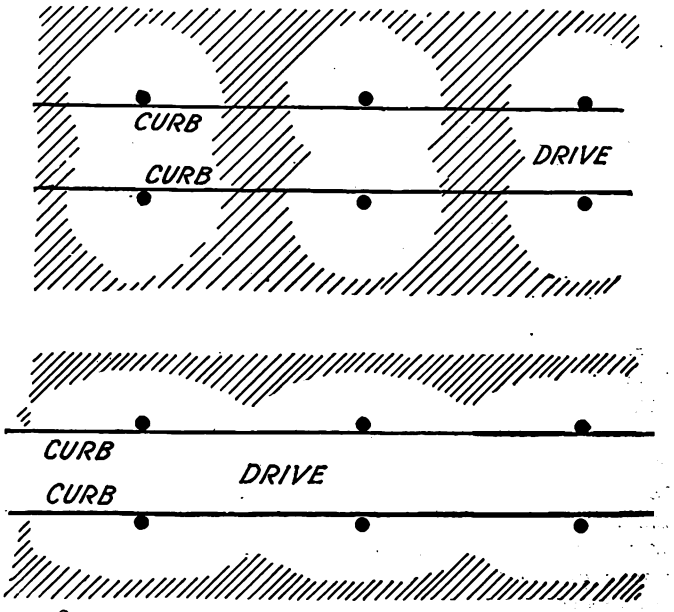

FIG. 2—REFLECTOR CHANGES LIGHT DISTRIBUTION OF STREET LANTERN FROM UPPER TO LOWER CURVE

is used in the lantern because it eliminates glare and does not offer much resistance to the rays. A broken-glass panel in lanterns of this design may be readily replaced by merely tipping over the hinged top, pulling out the broken glass and sliding the new panel into place.

SAFETY MEASURES FOR PROTECTION OF LINEMEN

Central Station Discards Rubber-Hose Insulation on Primary-Pole Connections in Favor of Specially Insulated Stranded Wire

One of the largest utilities in the Mississippi Valley has discontinued the practice of insulating 4000-volt primary-pole connections with rubber hose. It was found that in about a year the rubber deteriorates and becomes so porous that the fabric absorbs moisture. The hose then gives no protection where some is expected and may become an unexpected source of danger to linemen. To overcome this hazard No. 6 stranded wire insulated with Kerite $\frac{5}{32}$ in. (4 mm.) thick and covered with a seine twine braid impregnated with Kerite compound will be used. This insulation is impervious to the weather, to acids and to gases. Wire insulated in this manner will be used for all 4000-volt primary pole connections, including vertical transformer risers and connections to primary pole switches, fuses, etc.

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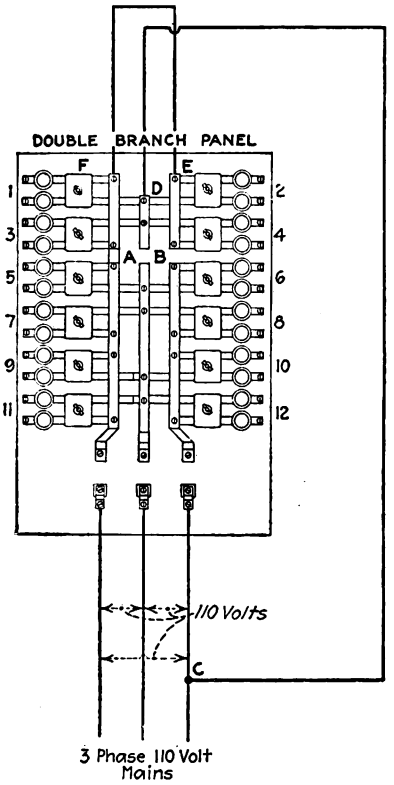
SINGLE-PHASE PANELS CHANGED TO THREE-PHASE

Inexpensive Way of Reconnecting Single-Phase, Three-Wire Lighting Panels for Balancing Load on Three-Phase, Three-Wire System

BY H. L. CORNELISON
Electrical Equipment Engineer, Austin Company, Cleveland, Ohio

It became necessary to place all electric lighting and power lines under ground when the business section of Jacksonville, Fla., became congested with overhead lines and poles. A balanced three-phase, 60-cycle system con-



SINGLE-PHASE, THREE-WIRE LIGHTING PANEL RECONNECTED TO GIVE BALANCED LOAD ON THREE-PHASE, THREE-WIRE SYSTEM

nected in closed delta had been used for power, and the incandescent lighting load in each building had been connected three-wire, 100/220-volt, single-phase. When the underground system was installed it was deemed advisable to supply three-phase, 110-volt energy to the 15-amp. or larger single-phase, three-wire lighting panels in each building as a balanced condition was desired throughout the system. The engineers were therefore confronted with the problem of working out the most economical method of changing the existing three-wire single-phase lighting panels for balanced three-phase operation without making the front of each panel unsightly.

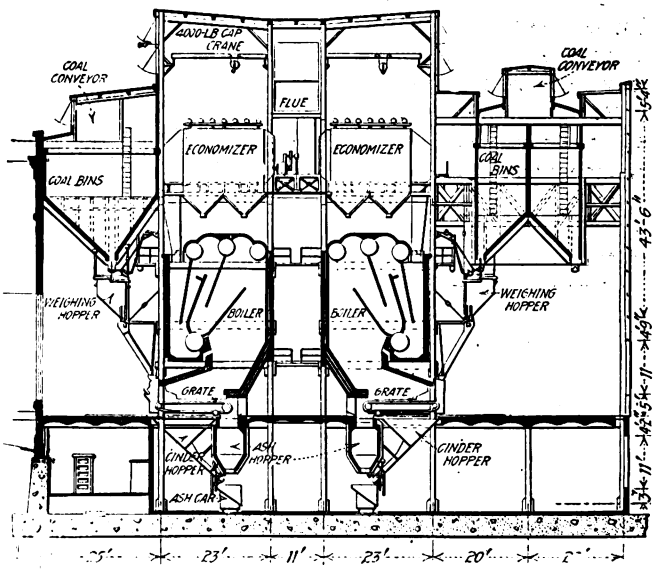
It was found that all of the panels could be most easily changed to operate on the three-phase system in a manner similar to that described for the twelve-circuit panel shown in the accompanying illustration. It will be noted that circuits Nos. 5, 7, 9 and 11 are already connected across phase No. 1 and that circuits Nos. 6, 8, 10 and 12 are connected across phase No. 2. To balance the system it is then only necessary to connect circuits Nos. 1, 2, 3 and 4 across phase No. 3. This was accomplished by cutting two of the buses at points *A* and *B* and connecting point *C* to point *D* with a jumper of the same capacity as the line. Point *F* was also connected to point *E*. The result was that the four top circuits were connected across phase No. 3, and it was only necessary to remove the cabinet door and trim the panel to accomplish this work. No special copper strips and no extra drilling were necessary. This made the change very inexpensive.

After all the panels had been changed to operate on three-phase in this manner it was found that the values of the secondary current were the same in each phase to within 10 amp. or 20 amp. under normal load conditions.

NEW BOILER SETTING

Development Made by Cleveland Company to Get Desired Gas Flow Puts Stoker Under Mud Drum

In that section of the Lake Shore station of the Cleveland (Ohio) Electric Illuminating Company known as the 1918 addition a new furnace design has been worked out. Its essential features are shown in cross-section on the drawing published here. The chain-grate stokers, instead of being placed in the usual way under the front of the boiler, are installed at the rear under the mud drum. An igniting arch extends under the mud drum, which sits rather high, its center line being 15 ft. 8 in. (4.8 m.) above the floor line. The boiler baffling is of the type known as "four-pass baffling." The gases, in passing through a boiler so arranged, enter the first bank of tubes at the top instead of the bottom. This puts the uptake also at the rear of the boiler and permits the gases that have passed through the two banks



STOKER SET UNDER MUD DRUM OF BOILER WITH FOUR-PASS BAFFLING

of economizers to be taken off in a single centrally located flue. The table gives further interesting data:

Type of boilers	Stirling, water tube, class M-25
Type of stokers	Green, chain-grate, type L
Boiler rating in square feet of heating surface	6,864
Size of stokers	13 ft. long by 12 ft. wide
Grate area in square feet	156
Ratio of grate area to heating surface	1 to 44
Content of furnace in cubic feet	3,000
Cubic feet of furnace, volume per square feet of grate area	19

From the data presented in the table it will be observed that the furnace volume is higher than in many older installations. This is thought to be in line with the modern tendency of boiler setting design.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

SAME COMPANY SELLS BOTH GAS AND ELECTRIC RANGES

Louisville Company Has Adopted Policy of Supplying Electric Cooking Service in the Territory Not Covered by Gas Mains

While the Louisville Gas & Electric Company sells high-grade natural gas for 35 cents per 1000 cu.ft. in the territory covered by the gas mains, it also sells electric ranges in the territory which these gas mains do not reach. In this territory there is a population of about 25,000 and there are about 1000 electric service customers. The company expects to place 160 ranges this year.

SOME METHODS FOR BETTERING METER-DEPARTMENT EFFICIENCY

Rules Relating to Height of Meters, Pass Keys, Filling Orders, Disconnection, Etc., as Brought Out at Meeting of Texas Employees

There came from the first efficiency meeting of the Texas Power & Light Company, held at Paris, a number of details relating to meter-department operation, some of which are set down here.

Meters, it was decided, should be set not higher than 6½ ft. from the floor. Higher than this they cannot be considered accessible to the meter reader or the meterman in case a test is required. The company will move meters down lower on the wall without charge if the customer will pay for the wiring.

A pass key must never be used for any place where there is furniture, with the exception of lodges, churches and picture shows.

In signing orders of any kind the employee doing so is to use his last name and never the initials only.

Orders received in the morning should be filled in the afternoon; orders taken in the afternoon should be filled the next morning, and if taken before 4 o'clock may possibly be filled that afternoon if the case is urgent. No connect order will be taken after 4 o'clock with a promise of being filled before the next morning. The office should put the number of the meter on disconnect orders where there are several meters in the same house. Meters should be tagged in a house where there are several meters and a change is made.

It will be the work of the office force to do all in its power to get the customer to come to the office to sign an application, and the work of the service men to get meters set in accessible places not exposed to the weather.

If a disconnect notice is written for a house which is to be reoccupied within a week, the distribution department should get the reading and open the switch, but leave the meter in the house. If the house is not to be occupied for some time, the meter should be brought in so that it may be cleaned and tested. Where the meter is left in a vacated house the meter card should say, "Meter left in," and it should also show the work order number when the meter is removed. It is preferable to disconnect at the pole where the meter is to be left in a house, except in apartment houses.

It was decided to leave the reading on a disconnected meter as it stands, rather than run the meter back to zero. If the customer objects, it is then explained that the company has a record of the reading in the office and knows exactly where to begin using it.

SELLING ENERGY TO COAL MINES FOR MOTOR SERVICE

Characteristics of the Load Make It a Desirable One for Central Stations, and Changing Attitude of Mine Owners Makes Selling Easier

BY H. W. YOUNG
President Delta-Star Electric Company, Chicago

During the past two years there has been a great increase in the number of coal mines using power supplied by central stations. Some transmission companies have built generating stations to supply power exclusively to mines. Other central stations have materially increased their distribution systems in new mining districts. These extensions in connection with the low-cost outdoor substations make it possible to supply power economically for both small mines and large mines.

One example of this sort of central-station development which is especially interesting comes from a transmission company in the Middle West. This company serves twenty-one mines from thirteen outdoor 33,000-volt, three-phase, 60-cycle substations. The aggregate transformer rating of these stations is 5375 kw. In addition to this coal-mining load, the same generating station also has connected load aggregating approximately 1800 kw., coming from eight small towns which the company serves.

During the month of March, 1918, the demand from the mining load totaled 2239 kw. and the energy sold to the mines amounted to 184,185 kw.-hr. These data show that the mining load alone operated at a demand factor of 41 per cent and a monthly load factor of 11 per cent. During the same month the average number of mine working days was twenty. The system peak for the month was 4258 kw., the diversity between the mining and other loads being favorable. The characteristics of the minng load from a central-staton standpoint are further improved, because there is a more or less constant demand for power regardless of the coal production of a mine. While a mine may be closed as far as mining or hoisting is concerned, pumps, fans

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and small power devices are continually operated every day and at every hour of the day.

Central stations in many instances have not fully developed the coal-mining load, feeling that it was often a hard problem to convince the mine operator that power could be purchased at less cost than it could be generated for at the mine. At old mines having their own plant the central-station opportunity will come when it is found necessary to expand and enlarge the capacity. This is a good place to put in a motor-generator, running it in parallel with the coal-mine plant. The mine owner will quickly see that with this auxiliary central-station power he can shut down his generating plant on days when he is not mining coal. Other savings can be effected by banking fires and laying off all labor during the night shift. In one case a steam hoist was changed over by putting a gear wheel on the sheaves and gearing to a motor. By starting sales operations in this way the old mines can be gradually won over and will eventually take more power or all of it from the transmission lines. In many cases the possibility can be pointed out of further development than would have been considered if the mine owner had to enlarge or rebuild the steam plant.

Very little trouble will be experienced by the central station in selling power to the new mine, as coal operators now realize that isolated plants cost money, that depreciation costs run into considerable figures, and that by securing energy through the substation their power problems can be transferred to the organization best equipped to handle them. In a new district opened recently the transmission company is supplying power to a mine which expects to get out 6500 tons of coal per day. The 600-hp. direct-connected hoist at this mine receives energy through a synchronous motor-generator set. All energy is sold on a demand basis using the average of the highest three fifteen-minute integrated peaks each month. Other mines are being opened in this district and power will be supplied through outdoor substations.

PROFITS FOR CONSUMERS IN LARGE POWER CONTRACTS

War-Time Costs Gave Substantial Asset Value to Contracts Made Under Pre-War Conditions—Policy for the Future

Many companies have had striking instances of the value of power contracts to large industrial consumers under the high cost conditions which developed unexpectedly as a result of war shortage and demand. Such contracts, based on the pre-war status of operating cost, became assets of real value to consumers. Advance in the cost of fuel alone made a radical difference to the consumer. In addition to the financial advantage offered by a contract of this character, the general consumer was more likely to be protected in his power supply than if he tried to provide it himself. His contract with a central station relieved him of both labor and coal difficulties. The acuteness of both of these difficulties is thoroughly appreciated and needs no other emphasis than simple mention.

As bearing on the worth of power contracts made at a period antedating the war costs a report by the receiver of a manufacturing company may be cited. In this case a special master in chancery, reporting to the court, said that "the rates and service provided for in the contracts as written and in force at the time of filing this application are more favorable than could be obtained under present conditions and should be an asset of value" to the patron of the central-station company. Another case may be mentioned where an industrial consumer, ill advised for its own welfare, canceled a power contract with a central-station company at the height of the war-time demand under the impression that it could replace the equivalent service of power without extra expense. The outcome was that the contract, which had been made originally under conditions particularly favorable for the consumer, was renewed but at a rate several times the figure stated in the original document.

It is not the function of central stations to make contracts for power with consumers which, by reason of abnormal changes in operating cost, become great assets or great liabilities to either of the two contracting parties. By the chance of war it has happened that many consumers have benefited substantially from economic changes that could not well have been foreseen. By checks and safeguards, by coal clauses, by continued study of the factors which make up operating cost, the tendency in future will be to keep contracts for large blocks of electrical energy close to a basis of cost plus profit.

This policy will be in accord with the spirit of fair play as between different classes of consumers and with the laws and the rulings of regulating commissions.

PLACE OF ELECTRICITY IN THE AUTOMOBILE "TRAILS"

Use of Energy in Lighting and Building These Well-Advertised Highways of Pleasure and Commerce Offers Possibilities

Automobile "trails" attract much attention and are thoroughly advertised. The use of electrical energy in lighting them as well as in construction presents possibilities which up to the present have not been thoroughly developed.

W. F. Raber, vice-president and general manager of the Arkansas Valley Railway, Light & Power Company, Pueblo, Ark., claims credit for his company as the first to supply electricity to be used exclusively in road building. The Pueblo *Chieftain* of April 13 contained a long article concerning the work which is being done on the Santa Fé trail. The following paragraphs from the article serve to emphasize the part played by electricity in the connection under notice:

Electricity is now playing a very active part in road construction in Pueblo County. In addition to the motorized vehicles for hauling road-building materials and the motorized machinery for grading and surfacing the roads, electricity is being used to drive the stationary machinery which prepares the materials for the road foundations and the surface. Perhaps no other county in the state is quite so favored with a combination of gravel, stone and electric service as is Pueblo County. Especially is this the case between Pueblo and Fowler, where gravel beds abound every few miles, rock is within easy haul and the high-tension electric wires of the Arkansas Valley Railway, Light & Power Company follow along the Santa Fé trail down the valley.

This electric energy is being utilized in building this Santa Fé trail into a highway boulevard from Pueblo to Fowler, or to the East Pueblo county line.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Commissioning Alternators.—C. W. MARSHALL.—Drying-out, pressure tests, phase sequence, synchroscope connections, phase rotation and subsidiary tests are discussed in this article.—London *Electrical Review*, March 21, 1919.

Maximum Power of Electrical Machines for Given Temperature Limits.—H. LAJUS.—The title gives the object of this theoretical study, which the author holds can have a practical application in conducting the tests of a continuous-current machine, alternator or transformer.—*Revue Générale de l'Electricité*, March 29, 1919.

A 60,000-kw. Transformer.—A static transformer of this capacity has been supplied by the A. E. G. company in Berlin to a Rhineland central station. The pressure is stepped up to 110,000 volts from 6250 volts primary. The complete transformer weighs 116 tons, of which the core accounts for 66 tons, the casing for 15 tons and the insulating coils for 35 tons. The over-all height is 17 ft. 3 in. (5.8 m.) and the floor space occupied is 18 ft. by 18 ft. 4 in. (5.48 m. by 5.58 m.). The four low-tension coils for 6250 volts are normally connected in parallel but may be placed in series to work with a primary tension of 25,000 volts. The transformer is insulated with a material specially manufactured by the A. E. C. company for high-tension purposes. The oil is cooled while circulated within the transformer casing, and a coil is immersed in a water tank by a pump which delivers 495 gal. (1873 l.) of oil per hour and is kept under a higher pressure than the water to prevent any leakage of water being absorbed, as this would damage the insulation. Tests showed a loss of 126 kw. in the iron core and 434 kw. by radiation from the aluminum coil—that is, a total loss of 560 kw. —which corresponds to an over-all efficiency of 99.07 per cent.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Zeitschrift des Vereines Deutscher Ingenieure*, Feb. 1, 1919.)

Lamps and Lighting

Some Special Problems in the Lighting of Laboratories and Technical Institutions.—At a technical or engineering college the lighting should be done scientifically if the student is to get fundamental ideas of illumination. Lecture theaters, chemical laboratories, electrical and physical laboratories are discussed in regard to lighting.—London *Illuminating Engineer*, January, 1919.

Modern Practice in Office Lighting.—A. WISE.—Choice of methods of lighting and applications to various types of offices are discussed, and typical examples of installations are given. The importance of periodically cleansing lamps and lighting units is also shown. Charts showing the reduction in light due to the accumulation of dust on the several kinds of units described are then produced.—London *Illuminating Engineer*, February, 1919.

Generation, Transmission and Distribution

Calculation and Design of Direct-Current Circuits.—TERRELL CROFT.—A discussion of the elementary calculations for electric light and power circuits plentifully illustrated with diagrams and typical examples.—*National Engineer*, March, 1919.

Transforming Direct Current Into Alternating, or Vice Versa, Without Commutators.—O. LI GOTTI.—The author explains a new method which makes this transformation possible by producing variations of flux with the aid of an apparatus that varies the reactance and obviates the need of the commutators hitherto employed. —*Revue Générale de l'Electricité*, March 29, 1919.

Utilizing the Power of the Tides.—R. GOUEDARD.—As a result of his researches into the feasibility of using the waste power of the tides for the manufacture of energy, the author indorses the favorable conclusions of M. Maynard in previous articles on the subject and joins with him in urging on capitalists and the public authorities the speedy undertaking of an experimental plant.—*Revue Générale de l'Electricité*, March 29, 1919.

Plate Valves Versus Stop Valves.—E. CLAASSEN.—The considerable pressure drop in an ordinary stop valve represents waste of fuel, small at a single valve but important when all the valves in the country are considered. The author recommends the use of plate valves, even in ships or other comparatively small installations where small plate valves have not been much used in the past owing to their tendency to leak, particularly with superheated steam. A new type of plate valve is illustrated comprising two plates with an intermediate keypiece. The spindle has an internal thread, the position of the valve being indicated by a wheel worm geared to the spindle. The plate closing the steam inlet is ground but the other plate is not. There is no rubbing of the "closing" surfaces, and a "warming valve" is provided to bypass steam and, by warming the body of the valve, prevent jamming due to differences in thermal expansion.—*Science Abstracts*, February, 1919. (Abstracted from *Zeits. V. D. I.*, Nov. 2, 1918.)

Use of Electricity in Agriculture in Germany.—In a paper read before the Royal Society of Arts Dr. J. F. Crowley discussed this subject. He said that the mistrust of the farmer had almost completely disappeared in Germany before the war. Cheap production of electric power in central stations and its transmission to various parts of the country gave the German farmer an opportunity of advantageously introducing electricity into his farmyard, field and buildings. The three-phase system was almost invariably adopted, as it permitted the use of squirrel-cage motors, which were ideal for agricultural work. Particulars are given of the lamps, fittings, wiring, etc., used for lighting installations, and

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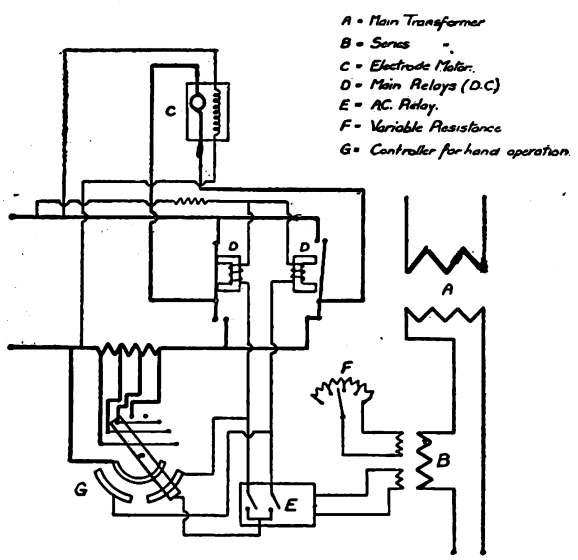
a calculation is made of the cost of electricity compared with other forms of lighting. Before the war the cost of energy for lighting in rural districts was 40 pfennigs per unit, and 0.2 pfennig was sufficient to add to cover the cost of the metal-filament lamp. In the case of a farm of about 92 acres eleven incandescent lamps were installed in the dwelling house and eleven in the working places. The cost of the lighting plant, apart from the power plant, was 390 marks, and the energy consumption during one year for lighting was 77 kw.-hr., which at 40 pfennigs came to 70.80 marks. (The pre-war value of a pfennig was about ¼ cent and of a mark approximately 25 cents.)—London *Electrician*, Feb. 28, 1919.

Control of Electric Furnaces.—FRANK E. HILL and A. P. M. FLEMING.—In this article attention is paid only to those properties which are supplied from an alternating-current source, the power usually being available at a voltage which must be transformed before it can be applied directly to the furnace. Under "Methods of Control," variation of voltage and variation of current are discussed and the methods of variation of voltage are outlined. These methods are alteration of the ratio of the main transformer by tappings, alteration of the ratio of the main transformer by an auxiliary winding, use of a primary booster transformer, use of a secondary transformer and control of a motor-generator. Under "Current Control," hand-



ELECTRODES RAISED OR LOWERED BY MEANS OF SHUNT-WOUND MOTOR

operated movement of electrodes, movement of electrodes by electrical or hydraulic power under manual control and automatically controlled motors are discussed. The control by current regulation is accomplished by raising or lowering the electrodes, thus varying the input to the furnace. This method may be used in place of or as an auxiliary to one of the beforementioned methods of voltage control. Regulation by moving the electrodes is employed principally in the case of furnaces used for steel smelting, although there are a considerable number of examples of this type of control equipment employed in furnaces used for the production of calcium carbide, abrasives, etc. In the case of small furnaces the raising and lowering of electrodes may be performed by a hand-operated winch, but in large furnaces it is usual for this to be done either by hydraulic power or automatically by means of an electric motor operating through hauling mechanism. In the accompanying illustration a regulator of the relay type shows the general arrangement of the machine or Routin regulator. The electrode is raised or lowered by means of a shunt-wound motor operating through suitable gearing. The armature of the motor is connected in series with two main interlocked relays which control the direction of current through the armature according to whichever relay is in operation. The main relays are excited from a third relay, which is operated through a series transformer inserted in the secondary circuit of the main transformer supplying the service. This relay is in a neutral position when the current supplied to the furnace is at a predetermined value, but when the current increases or diminishes it comes into operation and excites the appropriate main relay. In order to set the relay to respond to a predetermining value of the furnace current the series transformer has an auxiliary secondary winding which is short-circuited through a variable resistance.—*Transactions* of the Faraday Society, January, 1919.

Installations, Systems and Appliances

Electrical Welding; Its Theory, Practice, Application and Economics.—H. S. MARQUAND.—In this, the introductory article of a series, the author gives a general survey of welding and refers briefly to soft soldering, brazing, thermit welding, riveting, blowpipe welding and electric welding.—London *Electrician*, March 21, 1919.

Electrostatic Precipitation.—O. H. ESCHOLZ.—A diagram of the precipitator or treater circuit for this system is given, together with a list of apparatus used. The two main systems and other minor systems used in the process are described, with the advantages and disadvantages of each. Transformation, rectification, suppression of treater short circuits, treater voltage, operating voltage, electrode vibration and treater problems are discussed in full. The commercialization of the electrostatic precipitation process has pivoted about the development of transformers. The synchronous contact maker or mechanical rectifier, besides converting high-tension alternating current to high-tension direct current, serves to (a) suppress treater short-circuits and (b) sustain treater voltage, thereby permitting operation within a few per cent of the critical voltage of the treater, while also maintaining a practically constant voltage, resulting in high recovery of suspended substances.—Paper presented before the Colorado Meeting of the American Institute of Mining Engineers, September, 1918.

Electrode Manufacture.—The demand for special steel which followed the outbreak of the war resulted in a large addition to the number of electric furnaces in operation in Great Britain. The shortage of electrodes made it necessary to develop processes for their manufacture in that country. It is said that most of the carbon electrodes are cheaper than graphite electrodes, although the amorphous carbon electrodes cost now more than $200 per ton. Although the electrode consumption of modern steel furnaces is usually given as about 10 lb. (4.5 kg.) per ton of steel, the average consumption including breakages is well over double that figure. It is said that the manufacture of amorphous carbon electrodes has presented some difficulties. The work calls for uniform temperature varying from 450

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deg. to 600 deg., but it is possible to meet these requirements of temperature by the use of gaseous fuel. The writer describes a furnace for the manufacture of carbon electrodes 20 in. (51 cm.) in diameter, the output of which exceeds 30,000 tons of steel per annum. Details of the gas and air supply follow.—*Electrical Times*, Feb. 27, 1919.

Electricity in Household Service; the Central Station.—H. C. HOYT.—In undertaking a discussion of the relation of the central station to electric service in households, the writer gives an idea of the growth in central-station systems. It has been estimated that fully 70 per cent of the population of the country is in some way affected by the use of electrical energy. The following table gives some idea of the extraordinary growth of these electrical systems in the fifteen years extending from 1902 to 1917:

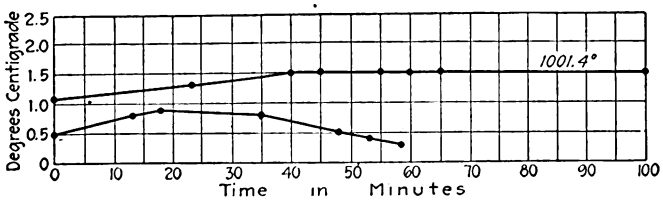
	1902	1907	1912	1917
Total number central stations....	3,620	4,714	5,221	5,500
Investment in construction and equipment.....	$504,740,000	$1,096,914,000	$2,175,678,000	$3,000,000,000
Total number of employees.....	30,326	47,632	79,335	125,000
Total gross income	$85,701,000	$175,642,000	$302,116,000	$550,000,000
Total income from electric service..	$84,187,000	$169,615,000	$286,981,000	$500,000,000
Total generator capacity in kilowatts.....	1,212,000	2,709,000	5,135,000	9,000,000
Total kilowatt-hour output....	2,507,051,000	5,862,276,000	11,532,963,000	28,000,000,000

—*General Electric Review*, March, 1919.

Electrochemistry and Batteries

Melting Points of Chemical Elements and Other Standard Temperatures.—Centigrade and Fahrenheit melting points for the chemical elements are given in tables.—*Bureau of Standards Circular No. 35* (third edition), July 15, 1918.

Temperature Uniformity in an Electric Furnace.—JOHN B. FERGUSON.—The problem of obtaining uniform temperature in an electric furnace used for investigational work at high temperatures is one of importance. The writer describes designs of furnaces giving uniform temperature from end to end over ranges of 620 to 1190



TEMPERATURE CONSTANCY

The upper curve shows the fluctuations in the furnace temperature with time in part of a four-and-a-half-hour run with a furnace at 1001.4 deg. The lower curve shows the fluctuations in the furnace temperature with time in a run with a furnace at approximately 1190 deg.

deg. In addition to the heating coils in the end plugs there are three independent heaters which are used to control the temperature. The use of alternate layers of insulating and conducting materials not only reduces the total amount of insulation necessary but eliminates the effect of temperature fluctuations due to the surrounding air.—*Chemical and Metallurgical Engineering*, March 15, 1919.

Pocket Battery Lamps.—H. LUX.—A description is given of the methods of manufacturing pocket battery lamps in Germany during the war, with particular reference to the difficulties presented by lack of the raw materials required. The success that was attained is due to the drawing up of standardizing regulations and the introduction of reliable methods of testing the internal electromotive force, internal resistance, depolarization, capacity and powers of withstanding deterioration during storage.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Elektrot. Zeits.*, Jan. 9, 1919.)

The Future of Electrolytic Chlorine.—A. H. HOOPER.—Discussion of the development of the electrolytic chlorine industry and its bearing on the future of the millitary defensive policy of the United States.—Paper presented before Oct. 1, 1918, meeting of the Electrochemical Society.

Telegraphy, Telephony and Signaling

Improvements in Multiple Telegraphy.—This paper describes three methods of multiple telegraphy based on the employment of Hughes apparatus. In the first arrangement division of line time and the duplex balance are used to get two independent channels in each direction (double duplex). By a system of bevel gears the chariots of two Hughes instruments are coupled to a common axis carrying the speed regulator and a rotating crown-wheel commutator. The line is alternately connected to the two transmitting levers through the medium of the commutator, and one lever is arranged to send positive, the other negative, impulses to line when it is operated. The signals are received on two polarized relays oppositely connected so that one responds to positive and the other to negative currents only. This system is stated to have worked satisfactorily on a 5-mm. iron wire 400 km. in length, using a battery of 220 volts. The second system is substantially the same as the first. Each transmitting apparatus has its own commutator, which is coupled to the main shaft for one revolution when a transmitting key is depressed. Signal impulses are twice as long as those of the first plan, and it has been found possible to work over distances of 500 km. to 600 km. The third arrangement depends upon synchronously run distributers between the two terminals. One of the distributers is arranged to be held against making a second revolution until a releasing current is sent from the distant station. The release current is automatically sent once per revolution, and if the receiving distributer is run slightly faster it will be positively held at the end of one revolution and start the next revolution correctly in phase.—*Science Abstracts*, Section B, February, 1919. (Abstracted from *Elektrot. u. Maschinenbau.* Dec. 1, 1918.)

Miscellaneous

Electrical Vehicle Progress in New Zealand.—Rapid advances have been made in the use of electric vehicles for city service and other purposes in New Zealand. Particulars are given of the economical use of electric wagons by a coöperative dairy company.—*Electric Vehicle*, December, 1918.

Storage of Coal and Spontaneous Combustion.—S. H. PUDNEY.—As a result of many years' practical experience, the writer attributes most cases of spontaneous combustion to the presence of sulphur in scale and bone coal, and he advocates proper ventilation for the prevention of these fires.—Paper read before the Canadian Railway Club, February, 1919.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

EDISON MEDAL AWARDED TO BENJAMIN G. LAMME

Presentation of Trophy and Exhibition of Weaver Memorial Tablet Will Take Place in New York on May 16

The annual business meeting of the American Institute of Electrical Engineers will be held on Friday, May 16, in the auditorium of the Engineering Societies Building, New York, at 8:30 p.m. The board of directors will make its annual report, including a financial statement for the year ended April 30, 1919. The report of the tellers will also be presented, giving the results of the election of officers for the ensuing administrative year.

Weaver Memorial Tablet to Be Exhibited

The Weaver memorial tablet, which is to be erected in the headquarters of the Institute "in acknowledgment of the services rendered to the Institute and to the electrical engineering profession by William D. Weaver," will be exhibited at this meeting.

Immediately following the business meeting will take place the ceremony of the presentation of the Edison medal. This medal was founded by the Edison Medal Association, composed of associates and friends of Thomas A. Edison, and is awarded annually by the Institute "for meritorious achievement in electrical science, electrical engineering or the electric arts."

The Edison medal has been awarded this year to Benjamin G. Lamme "for invention and development of electrical machinery," and the presentation ceremonies will be as follows:

1. "The Edison Medal," by Carl Hering, chairman Edison medal committee.
2. "Achievements of Benjamin G. Lamme," by B. A. Behrend.
3. Presentation of the medal, by William B. Jackson, vice-president A. I. E. E.
4. Response, by Benjamin G. Lamme.

Non-members of the Institute are cordially invited to attend this meeting. Ladies are welcome.

Professional Activities of Mr. Lamme

Benjamin G. Lamme was born in Springfield, Ohio, in 1864 and was graduated from the Ohio State University as a mechanical engineer in 1888. The subjects in which he is particularly interested are analytical, such as mathematical and mechanical problems.

He entered the testing department of the Westinghouse Electric & Manufacturing Company on May 1, 1889. The company was then engaged almost exclusively in the manufacture of high-frequency alternating apparatus for incandescent lighting. The development of practically all types of polyphase alternating-current apparatus and railway generators and motors was a matter of the future in which Mr. Lamme took a leading part. He has invented and designed much of the apparatus and many of the systems and methods which are now in general use. He has about 140 patents, many of which are of fundamental importance and cover inventions which have contributed very largely to the present methods of generating, transmitting and using electrical power.

In 1900 he was made assistant chief engineer and since 1903 he has been chief engineer of the company. Aside from his personal engineering activities, he acts in an advisory capacity to the whole engineering interests of the company. He is chairman of the company's committee which passes upon new inventions and appliances.

Mr. Lamme is the author of many technical papers presented before engineering societies, some of which

B. G. LAMME

are regarded as classics. A paper on the induction motor published eighteen years ago is used in many schools, and permission has recently been given for including it in the textbooks of the Naval Academy at Annapolis. His inventions and writings have made him well known among electrical engineers in Europe as well as in America.

Mr. Lamme has been an acknowledged leader during the past twenty-five years in the engineering work of the Westinghouse company, and many advances in the general use of electricity are due to his ingenuity and ability and discriminating judgment in directing and passing upon the engineering work performed by others.

In 1915 Mr. Lamme was, upon nomination by the American Institute of Electrical Engineers, appointed by the Secretary of the Navy to membership on the Naval Consulting Board, and his services as a member of the board during the war have been of great value to the country.

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NOMINEES FOR OFFICE IN THE A. I. E. E., 1919-20

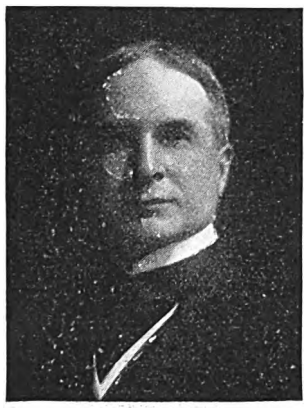
Calvert Townley Named for President in the Ensuing Institute Year— Other Nominees on the Official Ballot

The nominees for officers of the American Institute of Electrical Engineers for the ensuing year are as follows:

For president—*Calvert Townley, New York; †J. Franklin Stevens, Philadelphia.

For vice-presidents (six to be elected)—*C. E. Skinner, East Pittsburgh; *John B. Fisken, Spokane, Wash.; *N. A. Carle, Newark, N. J.; J. B. Whitehead, Baltimore; *L. R. Jorgensen, San Francisco; *Wills Maclachlan, Toronto; *A. M. Schoen, Atlanta.

For managers—*L. E. Imlay, Niagara Falls, N. Y.; L. F. Morehouse, New York; F. F. Fowle, Chicago.



CALVERT TOWNLEY

For treasurer—George A. Hamilton, Elizabeth, N. J.

The ballots have been cast in accordance with the constitution, and the result of the election of officers will be announced at the annual business meeting of the Institute to be held in New York on May 16.

Calvert Townley, whose election as president of the Institute for the ensuing year is assured, is assistant to the president of the Westinghouse Electric & Manufacturing Company. He served as an active official of the New York, New Haven & Hartford Railroad in connection with the electrification of the New York terminal zone of that property and is an accepted authority on railroad electrification.

*Directors' nominees.
†Candidate requested, prior to nomination, that his name be withdrawn.

PROGRESS MADE IN A. I. E. E. DEVELOPMENT COMMITTEE WORK

At Meeting of the Executive Committee Many Suggestions from All Parts of the Country Are Compiled for Report to General Committee

A meeting of the executive committee of the development committee of the American Institute of Electrical Engineers was held in New York on May 2. Progress was made in the work of preparation for the report, which it is expected will be submitted at the annual Institute meeting at Lake Placid, N. Y., June 24.

The executive committee of the development committee will resubmit to the members of the development committee throughout the country a compilation of the information and suggestions received. A large number of suggestions from all parts of the country were before the executive committee at the meeting last week. The main features of these suggestions were compiled in the form in which they were to be resubmitted to the members of the general committee. It was stated that the compilation of the suggestions, presenting rather the broad policies under consideration than the details of methods proposed, was to be sent during the current week to members of the general committee.

Members of the executive committee said that they did not feel at liberty to give publicity to the results of the correspondence, but that the executive committee will meet again in June to receive the additional comments which are expected from all sections. The membership at large is taking great interest in the matter, and the suggestions made are being sent to the general committee in the letter, which is in the form of a report by the executive committee.

ONE-MAN SUBSTITUTE FOR NEW YORK CITY COMMISSION

Lewis Nixon Made Regulatory Public Service Commissioner in New York City Under New State Law, Superseding Larger Body

Under legislation enacted by the last Legislature the New York Public Service Commission, First District, is superseded by one or two single-headed commissions. Separate bills were passed providing for, respectively, a regulatory Public Service Commissioner and a construction Public Service Commissioner. The bill providing for the regulatory commissioner has been signed by Governor Smith, who on May 3 appointed Lewis Nixon to the office which it created. Col. William Barclay Parsons is said to have declined the office of construction Public Service Commissioner.

By the appointment of Mr. Nixon, a Democrat, three remaining members of the old commission, Republicans, are legislated out of office. They are Travis H. Whitney, F. J. H. Kracke and Charles S. Hervey. Mr. Whitney announced that he will be associated with W. J. Norton and associates, for whom he will act as counsel.

Mr. Nixon has been State Superintendent of Public Works since Jan. 1. He was the leader of Tammany for a short time and had held many public offices. He was born in Leesburg, Va., in 1861, and was graduated as a naval cadet at Annapolis in 1882. He designed the battleships Oregon, Indiana and Massachusetts and established the Crescent Shipyards at Elizabeth, N. J.

The salary of the regulatory commissioner is $15,000 a year. Under the law three deputies are to be appointed at $7,500 a year each.

Travis H. Whitney, in speaking of the work of the superseded commission, said in part:

The relationship between the utility companies and the public has been recognized and improved. The public has the advantage of greatly increased facilities and of lower electric rates to the extent of several million dollars yearly.

It may be that rates and service were pushed too far in favor of the public, particularly with the war conditions, and it may be the pendulum will need to swing back. At any rate the public evidently desired a change in the administration of public service matters.

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JUDGES ANNOUNCED FOR N. E. L. A. PRIZE CONTEST

E. W. Lloyd, Paul Spencer and C. J. Russell Selected to Make Awards of Victory Liberty Bonds for Articles on Exhibi s

In a letter to exhibitors at the annual meeting of the National Electric Light Association at Atlantic City, beginning on May 19, J. W. Perry, chairman of the exhibition committee, announces the selection of judges for the prize contest which is to be a feature of the convention. The men chosen to pass on the papers are E. W. Lloyd of the Commonwealth Edison Company, Chicago; Paul Spencer, United Gas Improvement Company, Philadelphia, and C. J. Russell, Philadelphia Electric Company.

Mr. Perry emphasizes the importance of the prize contest as a means of stimulating interest in the exhibits. The delegates will have more than the usual incentive to study the exhibits carefully, as they will have to be thoroughly familiar with them in order to take part in the contest. This, he feels, should stimulate exhibitors to put forth their best efforts since they will be assured of the interested attention of the delegates. The contest will bring the Class B members of the association into closer touch than ever with exhibitors and will give the latter an unequaled opportunity to tell their story to an appreciative audience. The contest is open only to Class B members, but advertising and publicity men are barred from participation.

Mr. Perry suggests in his letter that exhibitors impress upon their convention representatives the necessity of being "on the job" at all times when the convention is open, since those taking part in the contest will doubtless choose the hours when there are few visitors on the floor, say, early in the day.

As stated in the ELECTRICAL WORLD of April 19, prizes for the best articles giving the impressions of delegates on the exhibition as a whole are to be awarded as follows: First prize, $150 in Victory Liberty bonds; second prize, $100 in Victory Liberty bonds; third prize, $50 in Victory Liberty bonds.

N. E. L. A. EXHIBITS AS SEEN BY EXHIBITION COMMITTEE

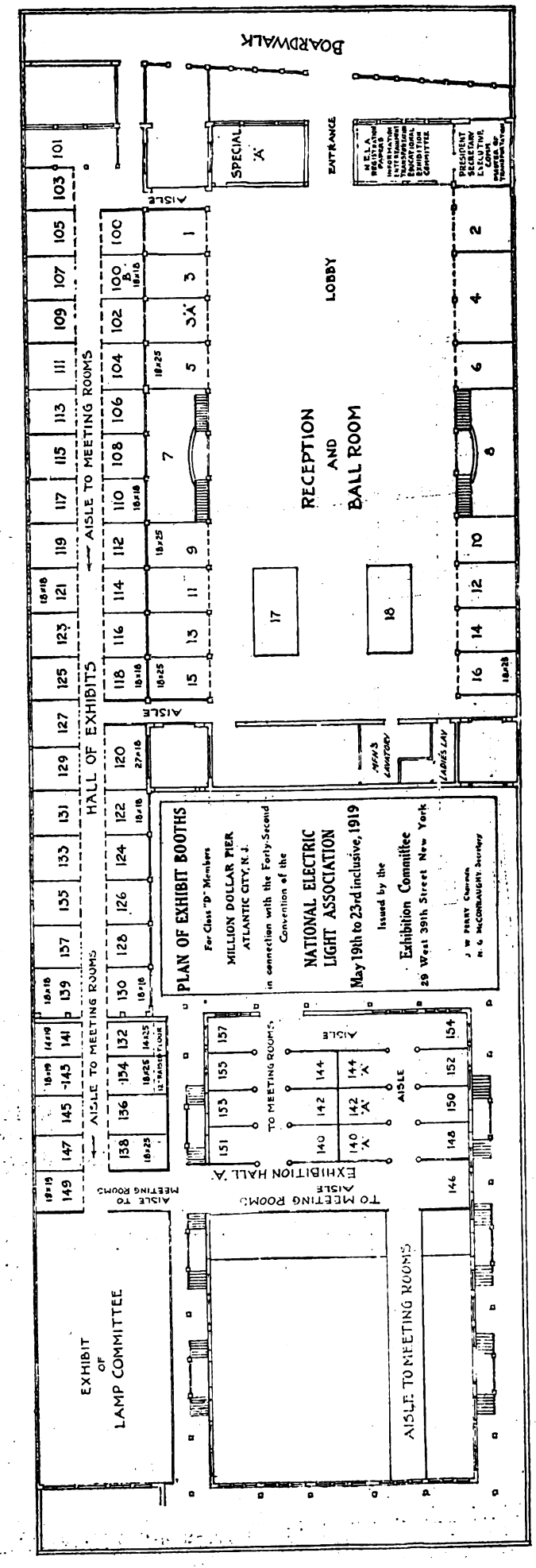
More Exhibition Space Could Be Used After Addition to the Original Allotment—Lighting and Transformation of the Scene

From the point of view of the exhibition committee of the National Electric Light Association the exhibits at the Atlantic City Convention beginning on May 19 will offer the following advantages to delegates:

Five acres of combination ballroom, hotel lobby, dance saloon and exhibition hall, all under one roof—same to be moored off the Atlantic Coast, within easy reach of land.

It should here be written into this program, as of historic interest, that this convention occupies the largest home in the history of the association, and more remarkable is the fact that with all its size it could still use more exhibition space, even after the addition of 3000 square feet to the original 20,000 square feet allotted it. Despite this addition, it was impossible to accommodate all applicants.

"All under one roof" has always been the spirit of N. E. L. A. conventions, no matter what the actual geography of the respective convening places has been. This year your convention is literally "all under one roof" and to the convenience and pleasure of all.



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The great ballroom is flanked with pergolas as a foreground *pia vista* of Italian gardens, which in turn are the setting in which exhibitors will display their interesting and diversified products. Then there are more garden paths flanked by more exhibits along the way that leads from the exhibition hall to the meeting auditorium.

This is an electric lighting convention, so logically lighting will play an important rôle—not only the workaday science, service, selling side, which will be shown in abundance, but lighting in mask and wig, lighting with the make-up on—playing to your eye and to your sense of the beautiful. Lighting at this convention will count you not only as a craftsman in electricity but also as a lover of the beautiful and of the artistic.

Lighting will entertain you. The great hall itself, through lighting, will appear in new guise day after day and night after night, for your entertainment and pleasure.

The ballroom will hardly be recognizable as between morning, afternoon and evening—what with its complete change in dress-up for business convention, exhibition hall, tea room, theater and finally dance saloon.

So that in the same expanse where in the morning you browse around among the exhibits that are so important from your business point of view you will in the afternoon be entertained in a seemingly different place. You will be refreshed at a tea table and dance or laugh three hours later on the same spot where that table stood.

All under one roof—for the N. E. L. A.—for business, fellowship and pleasure. This you will agree is the thought that the exhibit hall will leave with you as a "souvenir" of the 1919 convention.

VARIED ENTERTAINMENT AT N. E. L. A. CONVENTION

T. I. Jones Announces Some Details of the Revised Program—Grand Carnival for Wednesday —Aeronautical and Wireless Exhibits

Final arrangements for the entertainment at the Atlantic City convention of the National Electric Light Association are being made by T. I. Jones, Brooklyn Edison Company, chairman of the entertainment committee. The program will begin Monday, May 19, at 10 a.m., with the opening of the exhibitions under the auspices of the Class D members. The reception of the president will come at 9.30 p.m. in the ballroom of the Million-Dollar Pier, the receiving line being stationed at the east end of the room. Dancing will follow the reception.

On Tuesday from 12.30 to 1.30 p.m. and from 4 to 5 p. m. there will be a demonstration of wireless telephony between the end of the Steel Pier and an airplane exhibit. A tea and musicale for the ladies will take up the hours from 4 p.m. to 6 p.m. In the evening comes the public policy session, followed by dancing, open to all the guests of the convention.

Wednesday morning and afternoon will be given over to a second exhibition of wireless telephony and to a display of aëronautical skill.

The feature of Wednesday's program is to be a grand carnival and ball in which effects of music, light and color, rather than fancy dress, are to be stressed. The carnival will begin promptly at 9.30 p.m. and will continue until 10.45 p.m., when there will be an illumination and dance spectacle. Lights of seventeen colors will be used. Bassett Jones will supervise the staging and scenario.

The entertainment committee will have headquarters on the ground floor of the Million-Dollar Pier, where H. S. Giellerup will be in charge. Delegates should wear their badges to participate in the privileges of the convention.

LAMP COMMITTEE HEAD EMPHASIZES THE EXHIBIT

Frank W. Smith Calls Display at Atlantic City of Specially Great Value--Make-up of the Committee

Frank W. Smith, chairman of the lamp committee of the National Electric Light Association, has issued a letter and leaflet in which he calls special attention to the committee's exhibit at the Atlantic City convention, beginning on May 19. Mr. Smith says:

"This exhibit will present a working machine shop, a life-size shop window and a home interior, equipped with numerous systems of illumination for demonstration and comparative test. There will be a great deal of practical value in it."

The members of the lamp committee are: Frank W. Smith, chairman; Douglas Burnett, Walter Cary, E. R. Davenport, W. W. Freeman, W. H. Johnson, G. F. Morrison, J. T. Mountain, J. P. McSweeney and F. S. Terry.

The sub-committees are composed as follows:

Standardization of Voltage—F. S. Terry, chairman; S. E. Doane, A. H. Moore, C. Renshaw, H. B. Rogers and W. H. Rolinson.

Standardization of Colored Lamps—W. A. Durgin, chairman; Louis Bell, Robert Ely, C. L. Law and P. S. Millar.

Exhibit—S. E. Doane, chairman; P. S. Millar, H. B. Rogers, W. H. Rolinson, L. C. Kent and R. B. Grove.

Lighting Sales Bureau—C. L. Law, chairman; O. R. Hogue, C. G. Durfee, E. A. Mills, W. A. Durgin, G. Bertram Regar, H. H. Magdsick, C. W. Johnson and Ward Harrison.

Portrait of Mr. Doherty

A portrait of Henry L. Doherty has been presented to the organization in New York on behalf of all the members by a committee of several of the leading officials. It was presented as a tribute of respect to the head of the organization. The portrait will be in the New York general offices. It was painted by Joannes de Taby.

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CONFERENCE CLUB PLANS AGREEMENT WITH LABOR

Assistant Secretary of Labor and Acting President of International Brotherhood of Electrical Workers Take Active Part in Meeting

A national labor agreement formed the chief topic of discussion at the meeting of the Conference Club at White Sulphur Springs, W. Va., May 1, 2 and 3. The advantages of coöperating with organized labor had already been discussed at a previous meeting held in Pittsburgh last November, at which time it was agreed that no question could arise between employer and employee which could not be successfully settled at a conference table by the application of common sense and honest intentions. A joint meeting of representatives of the Conference Club and the International Brotherhood of Electrical Workers was provided for at that time, and as a result of the work of the committee a declaration of purpose by the International Brotherhood of Electrical Workers and the Conference Club was drawn up for submission to the club and for final action by the National Association of Electrical Contractors and Dealers and the International Brotherhood of Electrical Workers.

In the agreement it was pointed out that the vital interests of the public and of the employee and employer in industry are inseparably bound together. All will benefit by a continuously peaceful operation of industrial processes and the devotion of the means of production to the common good.

The declaration in substance embodies the following:

That each group in the industry should confine its efforts to developing its legitimate function to the end that controversy and wasteful competition resulting from the overlapping of function may be eliminated.

Close contact and mutually sympathetic interest between employee and employer will develop a better working system, stimulate production and improve relationships not only between employer and employee but between both and the community.

Strikes and lockouts being detrimental to the interests of all should be avoided.

A tribunal should be created with power to decide questions that might result in interruption of work, loss of wages and of capital and loss and inconvenience to the public.

Agreements or understandings which obstruct free trade development or grant special privileges are subversive of public interest, limit rights and opportunities, and should be condemned.

Public interest is conserved, hazards are reduced and standards of work are improved by fixing an adequate minimum of qualifications as a requirement to the right of any individual to engage in electrical construction work and by rigid inspection of such work.

Public welfare and interest of the trade demand that electrical work be done by the electrical industry.

Coöperation between employer and employee acquires constructive power as both become more completely organized.

The right of both employees and employers of local groups to establish wage scales and working rules is recognized.

In order that the above principles may be put into practice, it is necessary to create agencies for coöperation between the public and employees and employers. As a first step in that direction the agreement provides that the International Brotherhood of Electrical Workers and the National Association of Electrical Contractors and Dealers shall form a national executive council consisting of five representatives of each association. The council shall elect a chairman, a vice-chairman, a secretary and such officers as may be decided on and shall meet four times a year or more frequently as the need may arise. All meetings shall be open to the public. Rules for procedure and the necessary provisions for transaction of business shall be supplied by the council, and provision is made for the appointment of committees of ways and means, legislation, public information, industrial relations and such others as may be considered advantageous in promoting the objects of the declaration and the welfare of the public and the industry. A majority of the representatives of each organization shall constitute a quorum and the body may appoint one alternate to take the place of an absent representative. A permanent board of mediation or investigation, consisting of an equal number of representatives of employees and employers and of the public, will be created by the council, which will prescribe the rules of procedure.

James P. Noonan, acting president of the International Brotherhood of Electrical Workers, spoke of the desirability of such an agreement from the viewpoint of the employees, and L. K. Comstock and other members of the Conference Club spoke of the advantages which would accrue to the contracting industry if some such agreement were in existence. Mr. Noonan pledged his coöperation in getting the International Brotherhood of Electrical Workers to accept the agreement, stating that this would involve considerable time owing to the size of the brotherhood and to the necessity of getting action on the declaration especially by those particular branches of the brotherhood interested. The Conference Club will recommend the declaration of purpose to the National Association of Electrical Contractors and Dealers for action at its convention in July. Both the representatives of labor and those of employers thought the effect of such an agreement would be far-reaching and that no one would want to be without it after seeing the benefits of its operation, especially as regards harmony and peace in business.

L. F. Post, Assistant Secretary of Labor, made a stirring address on the labor outlook, and there was considerable discussion by the members present on expanding the functions of the Conference Club so as to increase its value to the industry and to the general public. No definite action was, however, taken.

MEETINGS OF SECTIONS OF ASSOCIATED MANUFACTURERS

Meetings of the Various Sections to Be Held at New London, on June 16 to 18—Governors and Trade Committee Also to Meet

General Secretary Charles E. Dustin of the Associated Manufacturers of Electrical Supplies has notified members of the completion of arrangements for holding the summer section meetings at the Hotel Griswold, Eastern Point, New London, Conn., on Monday, Tuesday and Wednesday, June 16, 17 and 18. The board of governors and the international trade committee will also hold meetings on some one of these days.

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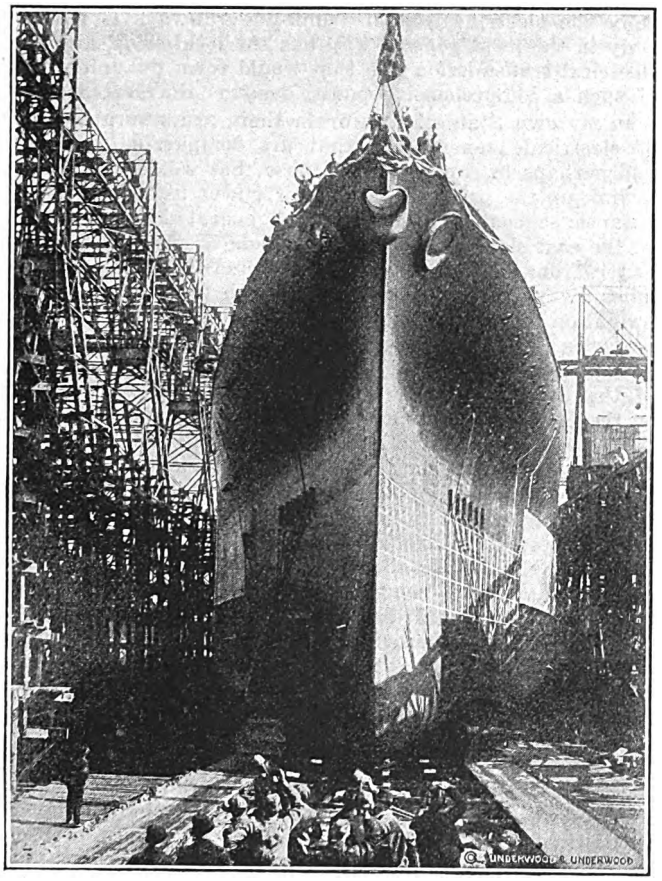
As the Tennessee Slid Down the Ways



As stated in last week's issue of the ELECTRICAL WORLD, the superdreadnought Tennessee was launched on April 30 at the Brooklyn Navy Yard. The construction of the giant fighting ship embodies all lessons taught by the war, especially in safeguards against torpedo attacks. The ship mounts twelve 14-in. guns as the main battery, with an effective range of more than 13 miles. It is an oil burner with electric drive and has a speed of 21 knots. It is 624 ft. long with a beam of 97 ft. Its displacement is 32,600 tons. The keel was laid May 14, 1917. This Tennessee is the fifth warship of that name to serve in the American Navy.

WILL INFORM THE PUBLIC ON UTILITIES CONDITIONS

Illinois Committee to Give Information About Post-War Utility Situation to Those Responsible for Well Being of Utilities

The public utilities of Illinois, including electric, gas, traction, water and telephone companies, have combined in an effort to place their after-the-war case directly in the hands of the persons to whom they are responsible, that is, their customers. The agency through which this work will be handled is the Illinois Committee on Public Utility Information, 203 South Dearborn Street, Chicago. This committee has been organized under the auspices of the Illinois Gas Association, the Illinois State Electric Association and the Illinois Electric Railway Association. The committee, which is a permanent one, is in charge of Bernard J. Mullaney, director.

In a statement issued by the committee belief is expressed that "the present delicate situation in which the utilities find themselves calls for sane, scientific and non-political, just treatment such as will enable them to perform the services which their customers have a right to demand. The utilities would be in no danger if the economic facts about them were well known. The Illinois utility managers believe it is their duty to customers, investors, employees and the entire public in this reconstruction time to bring this about."

A 40,000-KW. HYDRO PLANT NEAR CHICAGO PROBABLE

Sanitary District Behind Legislation to Get Right to Bid on Power to Be Created as By-product from State's Transportation Canal

The waterway scheme which has passed the Senate of the Legislature of Illinois, and which will provide a transportation waterway from Chicago to downstate and Mississippi River points, contemplates the removal of a dam in the Desplaines River at Joliet and the construction of a modern 40,000-kw. power plant about 4 miles further south at a site known as Brandon's Road. At the same time, there is in the Legislature a bill which will enable the Sanitary District of Chicago to bid on the power from this site either developed or undeveloped. This latter bill, presented by Senator Clark, is being held up by Senator Kissinger for amendment. Should the bill pass in its present form, it would enable the Sanitary District to bid not only on the new power at Brandon's Road but also on the power from the old site which has been the cause of so much court action in which the Economy Light & Power Company was an interested party.

The Jackson Street dam in the Desplaines River at Joliet is controlled by the Illinois and Michigan canal commissioners. They have been leasing this water power since 1855 and for it have received an aggregate of about $2,000,000. The lease of the Economy Light & Power Company expired July 17, 1916. This company had been paying $10,457 a year. The commissioners asked for bids. There were two, from the Chicago Sanitary District and A. J. Cooke. The district offered $15.01 per horsepower a year. Mr. Cooke offered $3 per horsepower per year. The Sanitary District trustees paid the state $41,000 for certain structural changes which the canal commissioners deemed advisable and then appropriated $600,000 for the new construction and development. Then John W. Yeadon, a taxpayer, questioned the authority of the district to make such a lease. The State Supreme Court agreed with the taxpayer and the lease was annulled. Since then the Economy Light & Power Company has been taking the energy from the dam presumably on a month to month basis.

ILLUMINATING ENGINEERING SOCIETY 1919-20 NOMINEES

S. E. Doane Named by the Board of Nomination for President for the Ensuing Year—Other Nominees of the Board

The board of nomination of the Illuminating Engineering Society has announced the following nominees for officers for 1919-20: President, S. E. Doane; vice-president from New York Section, W. J. Clark; general secretary, Clarence L. Law; treasurer, L. B. Marks; directors, E. C. Crittenden, F. E. Cady, R. B. Ely, Walton Forstall, R. H. Maurer and F. A. Vaughn.

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SECRETARY LANE ON PLAN FOR POWER RESOURCE SURVEY

Head of Interior Department to Renew Request to Congress for Appropriations to Study Power Situation and Conservation

(From an article by Edgar Mels in the New York *Commercial*, April 29, 1919.)

When the new Congress meets in special session, it will receive a communication from Franklin K. Lane, Secretary of the Interior, which, if his suggestions are followed, is likely to have a far-reaching effect on American industries and, through them, on American business. The Secretary's letter will be a request for two appropriations—one of $50,000, the other of $200,000. Small as this total is, the last Congress refused the request because of the filibustering tactics employed to kill friendless bills.

The request for $50,000 is to make a survey of the undeveloped water power of the United States, estimated at some 35,000,000 hp. The $200,000 is requested to investigate and to survey existing power plants in the great industrial region between Boston and the city of Washington. The latter survey has for its ultimate purpose the erection of steel-tower transmission lines to be constructed from Boston westward to Worcester and Springfield, crossing the Hudson River near Newburgh or Poughkeepsie and then swinging eastward to northern New Jersey and across the Delaware, near Easton, crossing southeastern Pennsylvania near Philadelphia, striking the Susquehanna River below York and extending south to Washington.

The proposed system would connect with existing power stations in Boston, Worcester, Springfield, Hartford, Poughkeepsie, New York, Newark, Paterson, Trenton, South Bethlehem, Philadelphia, Wilmington, Harrisburg, Lancaster, York, Baltimore and Washington. In the region involved there is power-producing machinery capable of 8,500,000 hp., equally divided between industrial and public service plants. This equipment is being augmented annually at the rate of from 500,000 hp. to 1,000,000 hp.

Mr. Lane believes that any pending and projected additions to existing lines and plants should be made in accordance with the bigger projects now in contemplation. In discussing these projects Mr. Lane revealed a systematic and comprehensive plan. He said to the writer:

In selecting this field for a special investigation it was not intended to ignore the needs of other sections or to suggest that there were not in other sections similar opportunities for improvement in methods of power supply. But our experience during the war had shown that in the area mentioned there were perhaps the largest opportunities for usefulness and especially that there generally existed along the North Atlantic coast a potential, if not an actual, deficiency of facilities for power development and for transportation that might prove a serious handicap to American industrial progress.

Mr. Lane's plan is best told in a letter he sent to the chairmen of the appropriations committees of the last Congress. [This letter was published in the ELECTRICAL WORLD of Feb. 8, 1919, page 282.—EDS.]

In discussing this letter Mr. Lane made it clear that his department had no definite plans worked out as yet. He said:

The fact that such an investigation as the one for which I asked funds is proposed makes it clear that the engineers of the department have at this time no specific plan to offer. They have not determined as yet what water-power sites may be advantageously developed. They have formed no opinions as to where mine-mouth power plants might best be located. The data are not available to indicate how fully the electrification of trunk-line railways is feasible. Only in the most general way has the location of a master electrical transmission line that would form the spinal cord of such a comprehensive power system been sketched.

In my own State of California there are several systems of electrical transmission that are comparable in length and perhaps in capacity with those that would be required to link up the principal centers of power use of the North Atlantic seaboard. Electric power generated by one stream on the east slope of the Sierra Nevada is used to pump the water from the mines at Goldfield and Tonopah and, 300 miles away, to lift water from beneath the surface for the irrigation of orange groves near Riverside. The extreme tentacles of this system of interconnected power plants now have a reach of nearly 500 miles. In the northern part of the State it is now possible to send power generated on the Rogue River in southern Oregon into San Francisco, 300 miles away. These distances compare with those from Scranton to Portsmouth, N. H., or Altoona to Norfolk. I can conceive of a similar great interstate electrical carrier that would start somewhere near Boston, would extend westward through Massachusetts, past Worcester and Springfield, into the State of New York and would cross the Hudson near Poughkeepsie, sending branches north to Albany and down the river to the metropolitan district. It would then extend southwestward across northern New Jersey into eastern Pennsylvania, crossing the Delaware River near Easton, receiving in this vicinity feeders from power plants in the anthracite region.

The Lebanon Valley furnishes a natural route for the line across eastern Pennsylvania, and it would doubtless reach the Susquehanna River in the vicinity of the large water-power sites south of York. Its extension southward to Baltimore and Washington, and possibly even to Richmond, would be across open country and without any serious obstacles. Near Washington the line could be connected with the proposed electric power plant at the Great Falls of the Potomac.

I feel confident that the development of such a system would make possible the more economical use of coal supplies. If the trunk-line railroads are electrified, their coal requirements will be greatly reduced, and several million tons could undobtedly be saved annually by the operation of electric rather than steam locomotives. A large amount of coal could be saved by the substitution of water power for power now generated by fuels. A large saving of coal can unquestionably be effected if the power needed by these communities is produced in large central stations situated either at tidewater or near the mines in the coal regions, but here too our information is incomplete. It is conceivable, however, that the present power requirements of this region can be met by the use of from 25 to 50 per cent less coal if the power is generated in large central stations either in the coal-mining regions or at tidewater.

The development of water power would not only give employment to hundreds of thousands for a period extending over a number of years, but it would help to solve many an industrial and manufacturing problem. Secretary Lane, however, thinks that there is still another side to cheap electric power and light. In discussing this side, Mr. Lane said:

The topic of electricity on the farm opens up an attractive vista, but why should not this promise of better industrial conditions on our farms and ranches be followed to its logical conclusion? Electricity in the house to furnish both light and motive power means real help to the farmer's wife, while such a coöperative undertaking as a community cold-storage plant, made possible by cheap electric power, in turn makes possible economic holding of farm products in hands of producers during the season of oversupply.

The automotive tractor and electric machinery together will make agriculture more of a manufacturing business. The greater and more varied the use of electric power, the cheaper it can be sold.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Missouri Association of Public Utilities.—The annual convention of the Missouri Association of Public Utilities will be held on June 5, 6 and 7 at Excelsior Springs, Mo.

Mississippi Electrical Association.—This association, which is affiliated with the National Electric Light Association, held its annual convention in Gulfport, Miss., on April 15-17.

Brooklyn Industrial Exhibit.—The Brooklyn (N. Y.) Engineers' Club recently held an industrial exposition, the electrical division being in charge of the Brooklyn Electrical Contractor-Dealers' Association.

Electrical Credit Association of the Pacific Coast.—The fourteenth annual meeting of this association was held on April 3. C. C. Hillis and Frederic P. Vose, president and secretary of the National Electrical Credit Association, were among the speakers.

Colorado Engineering Council to Be Formed.—Representatives of the nine engineering societies in the state are to compose a new body known as the Colorado Engineering Council. H. S. Sands has been appointed to represent the Denver Section of the American Institute of Electrical Engineers.

Toledo Joint Company Section.—On account of the increased membership of the Toledo (Ohio) Joint Company Section, which now numbers more than 1300, a permanent secretary has been found necessary and David H. Shapiro has been appointed to that position. An entertainment was held by the section on April 28.

Mining and Metallurgical Engineers to Meet in Chicago.—The American Institute of Mining and Metallurgical Engineers will hold its convention in Chicago, Sept. 22 to 26. In addition to the technical talks a social program is being arranged and excursions are planned to the steel mills at Gary, the oil refineries at Whiting, metallurgical plants at East Chicago and North Chicago, and to the La Salle district, where the cement, coal and zinc industries are represented.

New York Electrical League.—At the New York Electrical League luncheon held on April 29 Major David A. L'Esperance of the 369th Infantry, U. S. A., told of the war-time accomplishments of this regiment and Dr. Charles T. Baylis spoke of his experiences in France and Belgium. Victory Liberty Loan notes were sold at the meeting, $25,000 being bought by members of the league. James H. McGraw, president of the McGraw-Hill Company, publisher of the ELECTRICAL WORLD, subscribed a like amount.

Jovian Electric League, Los Angeles.—Sylvester Weaver spoke on "Boosting" at the April 23 meeting of the league. Other speakers were H. N. Sessions and Paul Burke.

I. E. S., Annual Convention. — The 1919 convention of the Illuminating Engineering Society is scheduled to be held in Chicago early in October. The program of this meeting will be announced later.

Ontario Association of Municipal Engineers.—This association purposes holding its next convention at Niagara Falls, Ontario, on June 19, 20 and 21, according to S. R. A. Clement of Toronto, its secretary.

I. E. S., Philadelphia Section.—"Some Practical Measurements of Daylight in Modern Factory Buildings" was the title of a paper given by E. G. Perrot at the April 23 meeting of the Philadelphia Section, Illuminating Engineering Society.

American Association of Engineers.—At the annual convention of this association, to be held in Hotel La Salle, Chicago, on May 13 and 14, Col. Walter Dill Scott, in charge of personnel classification for the United States Army, will give an address on "Fitting the Engineer to His Job." C. E. Drayer, 29 South La Salle Street, Chicago, is secretary of the association.

Associated Engineering Societies of St. Louis.—H. W. Eales, chief electrical engineer Union Electric Light & Power Company, gave an illustrated talk on "Present Practice in Substation Design" at a joint meeting of the Associated Engineering Societies of St. Louis held on April 30 under the auspices of the local section of the American Institute of Electrical Engineers.

American Institute of Electrical Engineers

Milwaukee Section.—On April 16 George A. Laurentz, president of the Louis Laurentz Aeroplane Company, Chicago, gave an illustrated talk on "Aëroplane Construction."

Panama Section.—A paper by William R. O'Connell entitled "Testing of Hydraulic Turbines" was presented at the meeting of March 30. The annual business meeting for the election of officers will be held on May 23.

Schenectady Section.—A special meeting participated in by representatives of the American Institute of Electrical Engineers, American Societies of Civil and Mechanical Engineers, National Electric Light Association, American Chemical Society and Society of Engineers of Eastern New York was held on April 23 to discuss the development of local and national society affairs.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Minimum Charge.—A decision has been rendered by the New York Public Service Commission, First District, on the lawfulness and reasonableness of a minimum charge for electric service by the Bronx Gas & Electric Company. A part of this decision reads as follows: "The provision in the new rate schedules of the Bronx Gas & Electric Company for a minimum charge of $1 in connection with the statutory maximum of 12 cents per kilowatt-hour, and the admitted action of the company in demanding and collecting such a minimum charge, is contrary to and in violation of law, and it is the duty of the commission to prohibit and prevent the continuance of such an exaction. A hearing thereon having been held before the commission, its exaction and collection should now be prohibited, and an appropriate order to that effect should be entered. If the company does not defer to this ruling and withdraw this minimum charge, appropriate proceedings by mandamus or injunction should be instituted."

Where Margin Between Income and Outgo Is Narrow.—The Illinois Public Utilities Commission has issued an order on the petition of the Farina Electric Company for authority to increase street-lighting rates. It says in part: "The margin between the revenues received and actual money paid out for the operation of the property is so narrow that the question of the reasonableness of the expense items and the value of the property cannot materially affect the issue. The commission believes that it would be improper to charge street-lighting service in Farina with more than its justly proportionate share of the expense of operation or to expect the village of Farina through its street-lighting service to make up the losses and deficiencies occasioned by the residential and business lighting consumers. However, it appears that this will not result from the rates as proposed herein. At the hearing some question was raised as to the ability of the village to pay the increased amount proposed for street-lighting service, and the commission in its order hereinafter will care for this phase of the situation. The commission finds that the rates as proposed should be permitted to become effective as of Jan. 1, 1919, provided that the funds in the fire and light appropriation of the village of Farina are sufficient to pay the increased amount without a reduction in the number of street lights."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Lighting Department Not Affected in Chattanooga Receivership. — Pending further court proceedings, John S. Graham, Philadelphia, and Percy Warner, Nashville, who have been appointed temporary receivers of the Chattanooga Railway & Light Company, are limited in their activities. The receivership covers the street railway property and property used in connection therewith, but does not cover the lighting department, and the question of a receivership over the lighting department was reserved for further consideration by the court.

Occupations in Electrical Manufacturing Industries for Men Disabled in the Service.—The Federal Board for Vocational Education has prepared a monograph, No. 25 in the vocational rehabilitation series, on "Occupations in the Electrical Manufacturing Industries" for disabled soldiers, sailors and marines, to aid them in choosing a vocation. The subjects covered are engineering and drafting, coil winding and taping, coil impregnating and painting, coil placing and connecting, assembling, inspection and repair and testing. The booklet is issued by the board in coöperation with the office of the Surgeon-General, War Department, and the Bureau of Medicine and Surgery, Navy Department.

Water Power in Scandinavia.—Notes on Scandinavian power developments have been sent by United States Commercial Attaché Erwin W. Thompson from Copenhagen, Denmark. Transmission of electric power to the city of Stockholm from the new power station near Untran is just beginning. It will deliver about 14,000 kw., which is only about half of what the power station can produce, but this alone will save the city coal to the value of $4,000,000. Nordsjællands Elektricitets of Sporvejs Aktieselskab of Copenhagen will increase its capital stock from $2,010,000 to $2,680,000. This company was incorporated in 1902 with a capital of $402,000 to take over and extend an interurban electric car line north of Copenhagen and to supply light and power to the country districts and villages. The capital stock was increased in 1907 and 1911 up to $1,340,000, and in 1912 a contract was made with the Sydsvenska Kraftaktiebolaget for the delivery of 1000 hp. of electricity (to be increased later to 5000 hp.) from several hydroelectric plants in south Sweden. The current was conducted under the sound from Helsingborg, Sweden, to Helsingør, Denmark, through a nine-strand cable 3¼ miles long with a voltage of 25,000. Shortage of coal in Denmark intensified the demand for electricity, but the impossibility of obtaining cables and other apparatus during the blockade has prevented further developments. It is supposed that the present increase of capital is primarily intended to provide for more electrical transmissions from Sweden.

Financing California Development.—Under the terms of the order issued by the California Railroad Commission in the matter of the application of the Great Western Power Company of California for authority to issue $7,500,000 of stocks and bonds to finance hydroelectric development, the Great Western Power Company and the City Electric Company, both of which will be taken over by the Great Western of California, are authorized to issue bonds as follows: Great Western company, $2,407,000; City company, $1,564,000. These bonds, however, are not to be sold, but are to be delivered to the trustee under the one-hundred-and-fifty-million-dollar mortgage provided for in the financial plan submitted to the commission. The trustee is to hold the bonds as collateral security. The bonds of the old companies are not included in the six-million-dollar issue authorized by the commission, the proceeds of which, together with the returns from the sale of $1,500,000 of 7 per cent preferred stock, are to be used (except $350,000) to finance the company's development plans. The $350,000 is to be used to pay a note. The commission stipulates that the $6,000,000 bonds shall be sold for not less than 88 and the preferred stock at not less than 90.

Utility Rate Cases in Illinois.—The first annual report of the Department of Trade and Commerce, Division of Public Utilities, covering the period July 1, 1917, to June 30, 1918, shows that within that period the Public Utilities Commission of Illinois received applications for permission to increase rates as follows: Electric, 94; gas, 58; heating, 21; water, 25; total, 198. Each of these applications represents the appeal of one company, and the figures given do not show the number of communities affected. Between Jan. 1, 1918, and July 1, 1918, 1957 electric schedules were filed with the commission. These figures count the schedule for each community as one. The report states further that on June 30, 1918, out of the ninety-four cases involving increase in electric rates, the commission had approved sixty-five, disapproved five and twenty-four were pending. Of the fifty-eight gas cases, twenty-six were approved, none was disapproved and thirty-two were pending. Of the twenty-one heating cases, six were approved, two disapproved and thirteen were pending, all of which were nearly ready for orders. Of the twenty-five water cases, six were approved and nineteen were pending.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Assumption of Risk by Crane Operator.—In an action for the death of a workman killed while operating a crane, after his complaint of its dangerous condition and assurances that repairs had been made, the Supreme Court of Pennsylvania has held on the evidence that its dangerous condition on the day of the accident was not such that an ordinarily prudent man would undertake its operation, so that assumption of risk was for the jury. It was also held by the court that a servant acting in an emergency to save the life of others is not charged with the consequences of errors in judgment resulting from excitement and confusion of the moment (106 A. 102).

Commission Cannot Increase Rates Fixed by Statute.—Although the city of New York was not a party to a proceeding by Public Service Commission, First District, against the Brooklyn Borough Gas Company to fix gas rates, the Supreme Court of New York has held that the city could intervene and has vacated an order which the court was without power to make, although entered with consent of all parties legally interested. If the Laws of 1906, Chapter 125, fixing gas rates at $1, are still in force, the order of Public Service Commission and a judgment of the court fixing the rate at $1.10 is void, although made and entered upon consent of all parties legally interested (175 N. Y. S. 28).

Installation of Underground and Overhead Lines.—An ordinance of St. Louis, Mo., establishing the district where electric wires are required to be laid in conduits authorized and required applications for permits under the ordinance to be filed within ninety days. It also required acceptances of provisions of the Ordinances of 1895, granting the privilege to place wires along streets and alleys and public places within the time provided by the ordinance, to be filed, any time limit previously existing having been brought down to the date of the ordinance. In a case in which these regulations were involved the St. Louis Court of Appeals has held that a power company, by acceptance of terms prescribed by the ordinance within the time therein prescribed and by compliance with the provisions of Revised Code of Ordinances of 1895 within the time designated in the ordinance, obtained authority to erect poles and string overhead electric wires in the district proposed outside of the restricted underground district established by the ordinance (210 S. W. 90).

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Lieut.-Col. W. R. Thompson, manager of construction and engineering of H. M. Byllesby & Company, Chicago, landed in New York from overseas recently. Colonel Thompson has been in uniform since completion of the second officers' training camp at Fort Sheridan, from which he was sent as an instructor to Deming, N. M., commissioned as captain. Later he was made a major and sent to France with the 109th Engineers. About the time the armistice was signed he was promoted to the rank of lieutenant-colonel in the same regiment.

Lewis Nixon, State Superintendent of Public Works of New York, has been appointed Public Service Commissioner by Governor Smith for the First District of New York (Greater New York) in charge of regulation. Mr. Nixon was born at Leesburg, Va., fifty-eight years ago and was graduated from the Naval Academy in 1882. He served on the staff of the chief constructor of the navy, being detailed to Cramps, Philadelphia, and to the Navy Yard in New York. He afterward operated his own yard at Elizabeth, N. J. As a naval constructor he designed the Oregon, the Indiana and the Massachusetts. Mr. Nixon won national fame as the man who built the first really big battleship of the American navy, the Oregon.

H. E. Brandli, who has recently been elected president of the Mississippi Section of the National Electric Light Association, is vice-president and general manager of the Meridian (Miss.) Light & Railway Company. Mr. Brandli became associated with that company in the summer of 1917. He was at one time superintendent of lighting of the Ottumwa (Iowa) Railway & Light Company, leaving that position in the summer of 1912 to become manager of the Consumers' Power Company at Minot, N. D. A year later he was made general manager of the Citizens' Gas, Electric & Heating Company at Mount Vernon, Ill., and when that property was sold by H. L. Doherty & Company to the Frye interests he resigned to take up the management of the Meridian company.

C. J. Berry, electrical engineer with the National Lamp Works at Cleveland, has resigned to take up engineering work with the firm of Brandt et Fouilleret at Paris, France. Mr. Berry has been with the National Lamp Works for six years, becoming connected with that firm after being graduated from the electrical engineering course at the Massachusetts Institute of Technology in 1913. During 1918 Mr. Berry served as a first lieutenant in the United States Air Service in France, where he undertook radio and aviation lighting work. While with the National Lamp Works he has been the inventor of several electrical devices for use on lighting distribution systems. Mr. Berry is an associate member both of the American Institute of Electrical Engineers and of the Illuminating Engineering Society.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Stephen C. Pohe, who for the last year has been general manager of the Penn Public Service Company at Clearfield, Pa., has been appointed vice-president of the operating companies controlled by the Pennsylvania Electric Company of New York City and having offices at Clearfield, Somerset and Johnstown, Pa. Mr. Pohe's headquarters will be at Johnstown, where general offices of the companies have recently been established. He will

STEPHEN C. POHE

direct the operating department of the system from that point. Mr. Pohe resigned as manager of the Columbia & Montour Electric Company and of the Northumberland Gas & Electric Company at Bloomsburg, Pa., in 1918 to become general manager of the Penn Public Service Company, from which position he has been advanced. Since entering the central-station field directly after graduating from the Potts Business College in 1902, Mr. Pohe has been associated with companies operating in the section in which he now resides. He has been active in the work of the Pennsylvania Electric Association and was elected president of that organization in 1915.

John F. Vaughan, whose resignation as district manager of the Emergency Fleet Corporation for the New England district has been accepted, to take effect on May 1, will resume his engineering practice. While employed in the government service since January, 1918, his engineering office at 185 Devonshire Street, Boston, has been in charge of his principal assistant, E. A. Ekern. Before taking up consulting work Mr. Vaughan had been associated with the Stone & Webster Engineering Corporation of Boston for about fifteen years, paying special attention to electrical transmission and hydraulic engineering problems. Before that he was associated with the late Col N. H. Heft in the early electrification work of the New Haven & Hartford Railroad on the Nantasket Beach and other lines. He is the inventor of the Vaughan flowmeter and has served as a member of committees on prime movers of the N. E. L. A.

Ralph Frost, who recently returned from France after service with Company A, Twenty-seventh Engineers, has been appointed superintendent of the electrical branch of the municipal lighting plant at Wakefield, Mass.

Major John L. Retallack has been appointed by the government of British Columbia public utilities commissioner for the province under the new public utilities act. Major Retallack is a returned soldier, having gone overseas as quartermaster of the Forty-eighth battalion. Later he was transport officer in the railway corps. He is a mining engineer and a member of the Canadian Mining Institute.

P. J. Morrissey, for a number of years general manager of the Citizens' Light, Heat & Power Company of Pennsylvania and the Penn Electric Service Company, with headquarters at Johnstown, Pa., has been made vice-president in charge of the generating, mining and power departments of all the operating companies of that section which are under the control of the Pennsylvania Electric Company of New York City.

William A. Sullivan has resigned as manager for the Shreveport La.) Railways to accept the position of general manager of the Gulfport & Mississippi Coast Traction Company, which controls city, interurban and electric lighting companies in and between Pass Christian and Biloxi, Miss. Mr. Sullivan has been manager of the Shreveport Railways for the last nine years. He was formerly with Ford, Bacon & Davis at Birmingham, Ala., and Little Rock, Ark.

Obituary

Charles H. Stevens, for the past fifteen years head of the power sales department of the Lynn (Mass.) Gas & Electric Company, died at his home in Lynn on April 26, after a two weeks' illness following a severe attack of influenza.

Edward B. Sturges, formerly president of the Lackawanna Electric Power Company and organizer of the Suburban Electric Light Company, now a part of the Scranton (Pa.) Electric Company, died on April 8 at his residence in that city. Mr. Sturges was a prominent promoter of electrical and railway properties in Scranton in the early days of electric service. He was seventy-four years of age.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

LIFTING OF BLACKLIST TO HELP ELECTRICAL EXPORTS

Enemy-Controlled Electric Light and Railway Interests Greatly in Need of Equipment and Supplies

Action of the War Trade Board wiping out its blacklist on April 29 should be reflected in the exports of electrical goods, especially to South America. Included in the lists were a number of electric lighting plants and electric railways besides a number of electrical trading concerns. In the past the properties and concerns purchased, because of their relations, electrical equipment of German make.

For more than four years there have been no German imports into South America, and the stocks on hand in the summer of 1914 were quickly absorbed. A belief in the statement that victory was near for Germany kept these plants out of the market pretty much for some time. But for the last year and a half or more they have been on the Allied blacklist and so could not buy from the principals.

Now Germany cannot supply their needs and their needs are many. There is an opportunity therefore for American electrical goods.

European neutrals also offer, through this action of the War Trade Board, a greater outlet for electrical goods.

NO DECLINE EXPECTED IN SCHEDULE MATERIAL PRICES

Accumulations of High-Priced Copper and Other Metals and Increases in Certain Raw Materials Preclude Any Drop on This Score

The price question is the chief interest in the schedule material market at present. Considering the drop in copper, the buyer may ask why prices should not reflect this. The answer lies, according to the manufacturer, in the following considerations: Assuming selling price at 100 per cent, the cost of labor for small wiring devices might be taken as 25 to 30 per cent; raw material, 30 to 35 per cent; selling expense and overhead, 20 per cent; profit, 20 per cent. A maximum fall in the price of copper of, say, 33⅓ per cent would not permit a reduction of more than 10 or 12 per cent in selling price if the manufacturer immediately began to use the lowest-priced raw material; and where he was heavily stocked on raw material purchased at war prices it would be out of the question to expect any substantial reduction in sales price until the high-cost supply had been largely worked out.

One representative manufacturer had $500,000 worth of high-priced copper on hand on Jan. 1 (eight months' supply), and by the middle of April had received practically no copper bought around the lower quotations. Price advances in porcelain—say 40 or 50 per cent toward the close of the war—further tend to reduce the benefits of lower-priced copper, and, finally, it is believed in manufacturing circles that copper prices will not remain long at present levels but will tend to increase materially with increasing demand. On the heavier and simpler material, like knife switches of large size, the labor cost might run as low as from one-half to one-third the material cost.

By and large, there appears to be small ground to expect lower prices on wiring devices for some time, and it is significant that one manufacturer recently accompanied his bid with a guarantee to bear the cost of any shrinkage in prices below the quotation made during 1919. A better selection of labor is now feasible, and increased efficiency is being studied.

Reductions in the price of steel as thus far obtained have practically no effect on the cost of switch boxes. The volume of orders is well maintained, but the amount of money involved is probably a third or more less than at the height of the war.

INDUSTRIAL ELECTRIC TRUCK MARKET QUIET

Outlook, However, Is Promising, with No Indication of Extensive Decrease in Prices—Many Propositions Being Analyzed

On account of the transition period through which manufacturing industries are passing in many localities, the sales of industrial electric trucks appear to be somewhat below normal just at present. That this condition is merely temporary is apparent from the most cursory survey of the achievements of this class of equipment during the war, and long before it, in the saving of labor and time in internal industrial transportation. It is not the practice of distributers to carry large local stocks of trucks for immediate shipment, but factory deliveries are in good shape and the absence of embargoes assures reasonably prompt transit in most cases. A good many propositions are being analyzed, and the number of quotations shows that as soon as intensive production can be established in manufacturing plants on the basis of sound business conditions throughout the country numerous installations can be made to advantage. Government truck business is expected to show a decided improvement as soon as Congress meets and passes the necessary naval appropriations. It is unlikely that prices will fall off to any great extent for some time in these equipments. The present is an unusually desirable time for manufacturers and forwarders to investigate the possibilities of these efficient speeding-up devices, and purchases made in time to anticipate expansion of production are likely to be money earners for truck buyers.

STEEL PRICES AGAIN UP FOR CONSIDERATION

Prevailing Uncertainty in This Connection Has Prevented the Electrical Market from Showing a Greater Volume of Sales

That business is not greater to-day by a considerable volume is because of the stabilized steel price fiasco. Evidence is found in many places that buying and building construction are being held up not so much because prices are high as because of the uncertainty of the steel-price situation. Iron and steel are so fundamental in business progress that uncertainty in steel is reflected by duller conditions in other markets. The copper market, for instance, is stagnant solely as a result of the steel-price uncertainty.

The domestic electrical market feels this condition very much. While business is better than it was, it is by no means so large as it should be. All kinds of wiring de-

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vices and supplies should show evidences of better demand once the steel-price situation is cleared up. Transmission-line construction is not so much dependent on steel. In fact, this work should be going ahead now with great rapidity because line materials are, generally speaking, about as low as they will be for some time.

Representatives of the steel producers and the Railroad Administration are scheduled to meet late this week. Even if the stablized price program is adhered to, it is doubtful whether any prices, except rail, perhaps, will be lowered. A great many people are urging the discontinuance of such prices and the return to a free and open market. This latter plan seems best. Buyers know what to expect. Fixed prices are fair neither to the buyer nor to the seller.

There are indications that a free and open market for steel would momentarily bring lower prices. As soon, however, as sufficient buying had been stimulated increases would probably follow.

METAL MARKET SITUATION

Light Copper Demand Not Affected by Price at Which Metal Is Offered

There is little of especial interest in the present copper market. Prices are holding firm. The price at which copper is offered to consumers appears to have no effect on the volume of buying. A possible purchaser with little outlet for his wares is not interested in copper at any price within reason. So with the light demand the volume of business is light.

It is estimated that present domestic consumption of copper is at the rate of 45,000,000 lb. for the month, while total domestic shipments for April were in the neighborhood of 30,000,000 lb. Average production in the United States has been given as 60 per cent of capacity. There is talk of production being cut to 50 per cent, but a cut to this figure would bring the cost of production relatively considerably higher than at present, and where this ratio of production has been reached by some companies the cost of producing has been found to be above the selling price.

Prices in the London market are £1 easier than last week. It is becoming more difficult to make sales to British consumers now that Japan and Australia are active competitors in copper.

Spelter has decreased to 6.35 cents, and considerable trading for export is the result. The final plans for the disposal of government stocks have not yet been perfected.

Scrap metals are quiet. Old scrap zinc is off ¼ cent. Scrap brass and copper have a small measure of sales. Government material in rather large quantities is still offered for sale.

NEW YORK METAL MARKET PRICES

	April 29	May 6
Copper:	£ s d	£ s d
London, standard spot	76 15 0	75 15 0
	Cents per Pound	Cents per Pound
Prime Lake	15.62½	15.62½
Electrolytic	15.37½	15.37½
Casting	15.00	14 90
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.00	5.00
Antimony	7.00	7.12½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.42½	6.35
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	31.00 to 33.00	31.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 13.75	13.50 to 14.00
Brass, heavy	7.50 to 8.00	7.50 to 8.00
Brass, light	6.50 to 7.00	6.50 to 7.00
Lead, heavy	4.00 to 4.25	4.00 to 4.25
Zinc, old scrap	4.25 to 4.50	4.00 to 4.25

THE WEEK
IN TRADE

THE volume of sales booked seems to be getting larger right along. Because of the decreasing amount of unfilled back orders sales billed by manufacturers are not so favorable. However, the outlook is very favorable, and the fall months of 1919 should find the electrical industry running at pretty near top speed.

Exports are developing very satisfactorily. During March last there was exported from the port of New York alone, according to the National City Bank of New York, $409,325 worth of batteries and $957,628 worth of insulated wire.

Reports on equipment in A. E. F. depots show an increase in the stock of copper wire and cable on hand. As of March 1, there was on hand 114,000,000 ft., an increase over Nov. 1 of 22,700,000 ft. Both motor and generator stocks are lower, 350 motors and 230 generators being on hand March 1.

A shortage in certain lines, particularly flexible armored conductor, is reported. Lamps, on the other hand, are reported to be overstocked. Heavy demand on domestic socket appliance stocks continues.

NEW YORK

Market conditions for electrical apparatus all over the State of New York are steadily becoming better. This is the attitude expressed by a prominent jobber on his return from a tour of the state. Motors in sizes up to about 20 hp. enjoy the same sales up-state as they do in the lower sections. The same is true of vacuum cleaners and washing machines. On the other hand, wiring devices have a quiet market up-state and down-state. Conditions are not localized but general in this territory, and the tendency is steadily upward in an encouraging way.

April has been reported a good jobbing month, and May is starting out in an encouraging manner. Industrial collections are holding well; those from retailers are likewise good. The only long collections reported in the jobbing trade are from some contractors. The whole class of contractors suffers to some extent on this account and probably will continue to do so until those who carry their credit system under their hats are brought to realize that they owe an obligation to the responsible members of their trade.

WIRELESS.—In the last two weeks sales of wireless-telegraph instruments, accessories and supplies have increased considerably. Deliveries are practically from stock. Development of wireless-telephone sets for commercial use is under way, and one manufacturer expects to have transmitters on the market in about eight weeks. These will have a radius of approximately 30 miles and will sell in the neighborhood of $120. The source of electrical supply will be the commercial alternating-current lighting circuit

FLEXIBLE ARMORED CONDUCTOR.—The heavy demand is causing a shortage in supply, according to reports from jobbers. Although the demand in the metropolitan district is not so high as that in the West and Middle West, the supply in this section is nevertheless affected.

SCHEDULE MATERIAL.—Notwithstanding the amount of wire used, the demand on wiring devices in general hardly seems to be up to expectation. Price cutting is being indulged in by jobbers in order to obtain the business which is going through.

FUSES.—Orders are in the nature of 100 boxes when formerly they were for 1000 boxes. These orders seem to be of normal volume in number but each one smaller in number of units, and in general they are resales.

FANS.—Sales to retailers are opening up and stocks are being shipped. Some jobbers are ordering additional

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stocks. The recent warm days were a small reminder of what may follow.

INSULATORS.—An increase of 5 per cent on high-voltage porcelain guy insulators has been reported. Shipments can be made from the factory in two weeks.

WOOD CROSS-ARMS.—Sales are reported to be on the increase. Deliveries are from stock.

RUBBER-COVERED WIRE.—No changes in base have been reported. House-wiring campaigns throughout the country are causing considerable movement in wire, although the New York section is not so active in this respect as are some other sections.

CHICAGO

While there are no large strikes of a spectacular character in the Middle West at the present time, there appear to be a large number of smaller disturbances. One electrical manufacturer reports that his business in farm plants has been hampered by a strike at the factory. Orders are rolling in, but there is no way to fill them. Another manufacturer of electrical specialties in Wisconsin is reported to have closed his plant definitely and made arrangements for producing his output elsewhere because 400 of his 600 employees voted against accepting the wage advance offered them, they considering it not enough. The manufacturer has stated that the plant will not be reopened. The closing was caused by the demands made by the machinists and polishers. The machinists asked a 10 to 20 per cent increase, and the polishers asked an increase from 67½ to 80 cents an hour. The company was willing to give the polishers 70 cents an hour.

Such labor troubles as these and the fact that the Victory loan is lagging seriously in the Chicago district are causing a slacking of business. This situation is reflected this week in the building permit record, which dropped to $710,400, or about half the amount it had been running weekly. Banks are not loaning freely because they feel they must wait until they learn how much they must take of the Victory loan.

In the jobbing trade business is reported about the same. Prices are steady except for some slight decreases, which are due more to competitive conditions than to market changes.

COPPER WIRE.—Both weatherproof and rubber-covered copper wire are holding firm on the 20-cent base.

CONDUIT.—While building operations are apparently going ahead, according to building permit records, the jobs are mostly small, and, coming into the electrical jobbing houses in such small quantities, conduit does not appear to be moving. When the situation is analyzed, however, it is realized that a considerable quantity of this material is being sold for construction projects of minor character.

SCHEDULE MATERIAL.—Some of the jobbers who have reduced their prices to the trade on standard items of schedule material figure that it is merely a situation brought about by competitive conditions.

32-VOLT APPLIANCES.—These items are finding ready sale as the spring permits the farm-plant agent to become more active in his field canvassing.

INDUSTRIAL HEATING DEVICES.—While some of the jobbers in Chicago do not object to the recent change in discounts on industrial heating devices, there apparently has been some objection to this on the part of other jobbers, who are basing their objections on the priciples involved. They contend that if the differential on the regular line of heating devices were higher, they would not object so much to this policy in connection with the industrial devices, in which they do not deal largely.

SMALL MOTORS.—There apparently is no let-up in the extraordinary demand for small motors. Manufacturers of devices such as washing machines, vacuum cleaners, etc., are finding it very difficult to secure an adequate supply.

FANS.—Middle Western fan manufacturers report that this field is now beginning to show considerable activity.

FUSES.—Industrial conditions do not seem to have had any immediate effect on the fuse market, as some Middle Western manufacturers are finding it difficult to catch up with the orders that are coming in.

TRANSFORMERS.—Foreign business is occupying the attention of a number of transformer manufacturers, the majority of this coming from Norway and Switzerland.

LAMPS.—The problem in the lamp field now is to reduce consigned stock. It is reported by one company that some of its distributers have as much as a year's supply on hand.

BOSTON

Jobbers report a better feeling in the trade, with a fair volume of orders for maintenance and reconstruction work. Little gain can be seen in building operations this week. but as soon as the Victory loan is out of the way and the peace treaty signed a substantial expansion is anticipated. Deliveries are good in most lines, though shortages are reported of wire of No. 6 and smaller sizes and armored flexible conduit is scarce. A price reduction of 20 per cent was announced on a prominent make of electric flashlight this week. Other prices are holding steady around last week's levels. Central-station house-wiring campaigns are continuing with good results. Household appliances continue to show great activity. Manufacturers' agents report an increasing volume of inquiries. Collections are a little slow, and stocks are somewhat "spotty." Little speculative buying is to be seen at this time, and many jobbers are buying from hand to mouth. On the other hand, recent buying of wire by contractors for delivery over a period of six months reflects activity of a desirable kind. Labor conditions in the electrical field are unusually quiet.

MOTORS.—Inquiries are rapidly increasing, and one distributer remarked Monday that if he could "cash in" upon one-third of these he would be doing a splendid business. Stocks are in excellent shape, with occasional exceptions. A scarcity of small direct-current motors is noted.

SCHEDULE MATERIAL.—Orders are well maintained and a large amount of betterment work is under way in factories. Stocks are well in hand.

WIRE.—Steady prices are reported, with many predictions of a later increase. Some ordering for delivery over fairly long periods is noted. Central-station line extension and betterments are absorbing a fair quantity of wire. Bare wire is quoted this week at 18 cents base, rubber-covered at 20 and weatherproof at 19. Considerable wiring of old houses is under way in different parts of New England. Flexible metallic conduit and wire in sizes below No. 5 are scarce.

FLASHLAMPS.—A reduction of 20 per cent in the price of "Ever-ready" flash lamps was announced Monday. Jobbers are preparing for the vacation trade.

FANS.—Dealers are buying very cautiously. The public is holding off for lower prices, but a hot wave will start the fan trade along so fast that it is doubtful if stocks will be equal to the demand.

WASHING MACHINES.—These outfits continue among the season's "best sellers." The servant problem continues acute and electrical labor-saving devices for the home are in great demand.

ELECTRIC RANGES.—A prominent New England manufacturer is running full time and is quoting two weeks' delivery. Prices are firm and seem likely to hold so. A two-carload order for California is about to be started from the Simplex factory at Cambridge.

INDUSTRIAL ELECTRIC TRUCKS.—Sales are rather quiet at the moment, but a fair volume of inquiries is being handled, and a solid growth of business in these labor-saving equipments is anticipated this year. If general business increases as it should following the peace treaty, manufacturers will be hard pressed to meet the demands.

VACUUM CLEANERS.—A brisk trade is being handled, and some intensive central-station campaign work is being conducted with great effectiveness, notably on the Central Maine Power Company's system.

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ATLANTA

Reports coming in from Birmingham, New Orleans and Jacksonville, combined with information secured in the Carolinas and Georgia, indicate that business in general is well maintained by numerous orders of comparatively small amounts but which in the total show a substantial aggregate. Jobbers are doing a good business and appear to be very well pleased with the present conditions. At the same time their purchases from the manufacturers are made in smaller lots for quick turn-overs. Retail sales are excellent and well ahead of the corresponding period last year. The much-looked-for building movement has started in the Southeast. Building operations at Atlanta for April are 100 per cent above 1917, and construction for the first quarter of 1919 shows an increase of 55 per cent over the first quarter of 1918.

FANS.—Jobbers have registered a lively trade this week through anticipation of dealers covering their early summer requirements. The movement of large shipments to points further south has about ceased.

STORAGE BATTERIES.—Dealers report a brisk trade as an outcome of the increasing automobile demand. The volume of sales so far this year exceeds expectations, and while shipments are improving daily some difficulty is experienced in meeting insistent calls. Prices have stiffened.

METERS.—The volume of sales is satisfactory, and the surprising feature is the steady influx of orders from the small central stations for residence type. The demand for meters of other types has lessened considerably. Prices remain firm. Local stocks are holding up and deliveries are normal.

CABLE.—A few jobbers state that the requirements from industrial sources are growing. Lead and cambric-covered cables have been active. Weatherproof is moving rapidly. A substantial order for immediate delivery was placed late this week at a shade off market.

TRANSFORMERS.—Business in the larger power type shows signs of a revival. This condition is spotty, however, and nothing in the nature of a general improvement can be looked for until the larger electric utilities become more active in going after power business. Following closely the trend of 5-amp. and 10-amp. meters, 2300-volt distributing-type transformers enjoy a fairly active market. Stocks are normal.

ORNAMENTAL LIGHTING.—Manufacturers and dealers in post and ornamental fixtures are optimistic. Inquiries are becoming more numerous, and quite a good business is developing in the way of profitable orders. There is a big field for these as evidenced by the desire of small municipalities to make such improvements.

STREET LIGHTING.—A lively market is opening up for all types of fixtures. In replacement work the old arc lamps are being discarded for incandescent units, and standardization of equipment has stimulated this demand. No price change has been recorded in some time. Factory deliveries are getting better.

LAMPS.—The shortage in 75-watt and 100-watt lamps has disappeared. A sag in the general volume of transactions is noted.

SEATTLE—PORTLAND

Seattle jobbers and dealers report that the condition of sales is low and business is lagging. This condition is attributed primarily to the Victory loan drive. Many business men are throwing aside personal interests to work for the loan. With the uncertainty over existing contracts and the prospects for new ones more or less indefinite, shipyard owners refuse to stock in excess of needs. Both jobbers and dealers report a healthy movement of domestic appliances, particularly washing machines and ranges. Sales of flat-irons during the week showed a noticeable increase. Every jobber in this district, according to first-class authority, is well stocked in every line carried by jobbers; in fact, many of them are overstocked. There has been no decrease in prices noted recently. Wire, which has dropped three times since Jan. 1, has held firm for the past six weeks. Collections are keeping pace with sales, but the loan drive is affecting both. Very few new credits are being placed.

Manufacturers' agents and jobbers in electrical lines in the Portland district report last month's business as only fair. A decrease is shown over that of March and a considerable decrease over April last year. Retail electrical business is reported to be in good condition, gross sales being appreciably greater than for April, 1918, as well as greater than for March of this year.

Permits issued for building construction cover a total expenditure of 90 per cent more for the first four months of this year than for the similar period last year. The increase for April this year over April of last year was 160 per cent. Building activity seems to be along two definite lines, public garages and dwellings. Collections are reported as only fair.

Industrial activities, particularly lumbering and logging, are growing, and prospects are that conditions will continue to improve.

Poles and pole-line materials sales, which have been dragging heavily for a considerable time, received a fresh impetus when an unexpected order for poles, wire, cross-arms, etc., developed for maintenance and some new extensions to rural transmission lines in western Washington. This order is the first of several long anticipated.

SAN FRANCISCO

During the past week there has been a great deal of agitation over the threatened cancellation of Pacific Coast shipbuilding contracts. Chairman Hurley of the Shipping Board, however, has just advised Pacific Coast shipbuilders that their contracts will remain intact, although it is possible that ships of new designs will be substituted in some cases. This news is highly welcome to Pacific Coast interests, for in the San Francisco Bay district alone shipyards give employment to 75,000 people.

Another one of California's industries is threatened, and there seems to be no remedy—the grape industry. The fruit season is progressing nicely, and all crops look to be close to the record. California mines are operating at only about 50 per cent capacity. Nevada mines are in the midst of the biggest boom in ten years, and Tonopah and Goldfield are seeing a revival of their best days.

Collections are fairly good, although there is a constantly increasing tendency to extend the time of payment, probably because of the dealers' entry into the high-priced device business, such as washing machines and the like. Ninety days' time is rather the rule than thirty days' time.

TELEPHONES.—Eastern factories are now making good deliveries, and rural lines especially are showing more extension and improvement work than they have for years.

MOTORS.—Several large export orders were reported during the past month. Sales of this material are running below last year, especially for irrigation.

RANGES.—The Pacific Gas & Electric Company is developing a plan whereby it hopes to place several thousand ranges on its line within a few years. The scheme, although not yet fully completed, will depend upon the dealers' co-operation, and liberal inducements in the way of carrying customers and wiring allowances have been made dealers and consumers respectively. Range prices have recently increased slightly because of the application of a revised freight rate.

LINE MATERIAL.—Only needed extensions are being made, but several of these are reported, covering bolts, cross-arm braces, pins, cross-arms and a very few poles.

HEATING DEVICES.—The market for small devices is rather quiet, although solicitors are now being placed in definite zones which they will work over for dealers who have made applications for their services. An especial drive will be made on such devices as percolators and chafing dishes, as all feel that these have not yet been worked to their capacity.

INSULATING MATERIAL.—The market is fairly steady. Stocks are good, but the demand in general is considerably lighter than that of last year.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges or account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft.	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft.	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft.	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft.	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to List
1/5 to std. pkg.	+5% to 20%
Std. pkg.	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12.	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12.	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅛	250	$5.00
¼	250	7.50
⅜	100	10.00
½	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¾	.06	1¼	.33
¾	.09	1½	.40
⅞	.12	1¾	.47
1	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00	$18.00	$16.00
¾-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00–26.50
¾-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$7.00 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00—$36.00
Coil to 1000 ft	21.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-qmp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 10%
Std. pkg	8% to 23%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39–$0.41
No. 18, full spools	.35– .37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33 12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$17.50–$20.00	$9.50–$15.00	$9.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$24.00–$29.25
25 to 50 lb	24.00– 25.25
50 to 100 lb	23.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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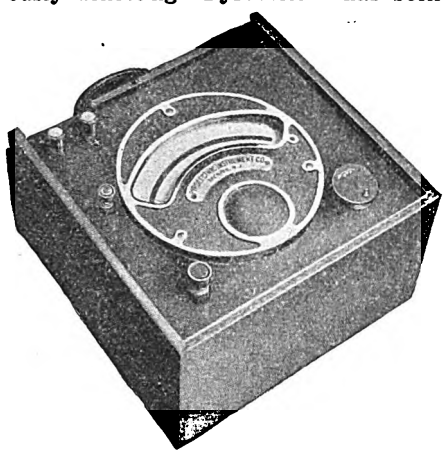
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Continuously Deflecting Temperature Measurer

For accurately measuring temperatures up to 2200 deg. Fahr. (1200 deg. C.) with the use of a base metal couple, where it is desired to have a continuous indication without hand adjustment for each reading, the Northrup continuously deflecting "Pyrovolter" has been



CHECKS UP ITS OWN INDICATIONS

developed by the Pyroelectric Instrument Company, 636 East State Street, Trenton, N. J. It can be used for general base-metal calibration work when potential indications are desired. This instrument operates on the potentiometer principle applied in effect to a deflection instrument. The result is obtained by using the meter as a balancing galvanometer to balance a battery emf. against the unknown emf., then quickly changing connections by pressing a button to permit directly reading the fall of the potential against which the unknown emf. was just balanced. There is a second button on this instrument, which when depressed and locked down puts a small rheostat in series with the meter and the unknown emf., giving an indication on the meter, which is varied with the same rheostat knob with which the "Pyrovolter" balance was effected until the same deflection is obtained as that indicated in the second position of the balance method.

The meter supplied is of the low-resistance, double-pivot type, with jewel bearings. A metal cage shields it from stray magnetic fields. The pointer is of flat design, viewed on edge, with a mirror placed underneath to avoid errors due to parallax. The entire construction of the instrument is said to be unusually rugged to withstand the strains of portable, commercial use. Only one range is procurable in these pyrovolters — that of 0-60 millivolts. When desired this scale can be paralleled with a temperature marking for any metal-base couple.

Cabinet-Type Household Electric Range

The "Jewel" cabinet-type electric range recently developed by the Detroit Stove Works, 1320 Jefferson Avenue, East, Detroit, Mich., is equipped with a cooking top with four units, an oven and a broiler. The four cooking-top heating units are of the inclosed, sheathed-wire-element type. They are made by the General Electric Company, have three heats, are rated at 1000 watts and measure 8 in. (20 cm.) in diameter. The cooking top with the end shelf measures 28 in. (71 cm.) by 22 in. (56 cm.) and is of a size that eliminates crowding of cooking utensils.

Cooking top, oven and broiler heating units are all controlled from the switchboard and fuse box installed in front of the range below the cooking top. The seven three-way, 125-volt, 15-amp. switches are inclosed but have exposed dials which show when high, medium or low heat is being used. Separate fuses for each unit are placed just below the switches, a hinged door making them all easily accessible.

Soot-Cleaner Swivel Head

That it permits the easy turning of the soot-cleaner element by simply pulling a chain in either direction is the main feature of the soot-cleaner swivel head just put on the market by the Vulcan Soot Cleaner Company of Dubois, Pa. Other features are that it takes care of expansion and contraction of the connecting pipe line, does not leak steam and does not permit air infiltration.

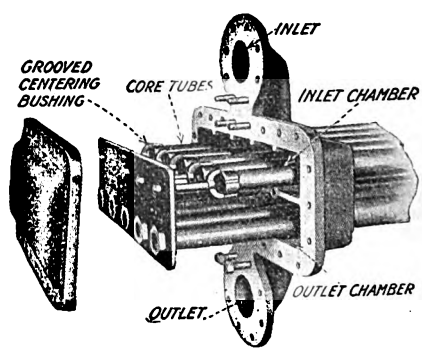
Steam from the boiler passes into the swivel head from the bottom through a vertical pipe, and thence into a horizontal element, which extends from the swivel head through the brick wall and into the setting. After the steam is turned on, the operator rotates the element slowly from one extreme to the other. Steam-turbine nozzles inserted in the element at proper spacings discharge the steam between the tubes in high-velocity jets, and in the course of rotation the tubes are freed from soot. The limitations of rotation are regulated by stops attached to the link chain. A pointer from one arm of the sprocket indicates the direction in which the steam jets are discharging.

To take care of expansion and contraction a gas-tight sliding joint is provided between the sprocket wheel and the metal housing that is mortared into the brickwork. As the vertical riser expands or contracts the swivel head moves up or down and the attached end of the element must, of course, follow. This is taken care of in the sliding, rotating swivel head, which is so designed that air inleakage is said to be impossible.

Steam-Agitating Superheater

Superheating is usually produced by "filming" or "sheeting" the steam through restricted annular passages or by breaking it up into small volumes, passing it through numerous tubes of restricted area, which sometimes causes increased friction with a corresponding drop in pressure. The Dravo superheater, now being marketed by the Superheater & Engineering Company, 233 Broadway, New York City, is built on the principle of agitating the steam as it passes through the apparatus, thus bringing every portion of the vapor into direct contact with the hot surface of the tubes and thereby producing a uniform degree of superheat.

Steam enters this superheater at the side or end of the header, as convenience dictates, and passes into the inlet chamber, then into an annular space between the tubes and core pipes of the ingoing elements, both by way of the grooves in the bushings and through the core pipes themselves. It then passes through the connecting pieces or return bends into the outgo-



DETAILS OF MAIN HEADER WITH COVER REMOVED AND CORE TUBES DRAWN OUT

ing elements of the apparatus, reaching the annular space therein in practically the same manner as it reaches the ingoing elements. The superheated steam next goes through the outlet chamber to the side of the header, which is connected to the steam main.

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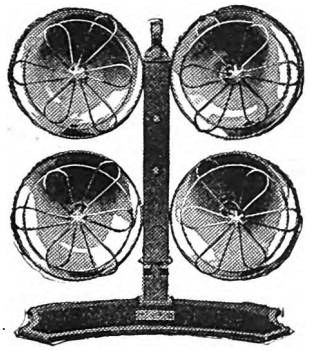
Quadruple Radiant Heater

Similar in design to its twin radiant heater, as it has removable heating elements and guards and movable reflectors, but equipped with four units instead of two, the "American Beauty Quad" radiant electric heater has been brought out by the American Electrical



REFLECTORS ARE MOVABLE; HEATING ELEMENTS ARE REMOVABLE

Heater Company, Woodward, Burroughs and Cass Avenues, Detroit, Mich. It can be used as a portable heater or can be permanently mounted on a wall. Each of the heating elements is rated at 330 watts, making the combined wattage of the heater 1320. However, all four units need not be used at once, since one push-button switch controls the upper pair and another push switch controls the lower two heating elements. One important feature of this heater which the maker calls attention to is that heat may be sent in one or in several directions at the same time because of the movable reflectors.

Double-Throw Pole-Top Disconnecting Switches

Double-throw pole-top disconnecting switches are usually constructed so that they consist of two single-throw switches. One insulator carrying two sets of contacts is common to each switch. This arrangement requires two separate switching operations in order to transfer from one line to the other. The Electrical Engineers' Equipment Company of 710 West Madison Street, Chicago, has developed a double-throw switch which accomplishes this change-over in one complete operation. Moreover, the feeder can be disconnected from both lines and the switch blades remain in the neutral or open position, this being likewise accomplished by a single operation. The mechanism is arranged to lock in all three positions.

The switch is constructed by using a standard "Type 400" single-break switch manufactured by this company and adding a cross pipe which carries three additional insulators each being equipped with jaw contacts. An upward thrust or a downward pull on the operating pole, connected to a toggle mechanism, throws the switch to any position. The pipe base makes the switch very easy to install since it is not necessary to adhere to any fixed drilling dimensions as is the case when a channel-iron base is used. The insulators to which the lines are attached are rigid and do not swing or twist. Each switch is equipped with arcing horns and sleet hoods.

Portable Alternating-Current Galvanometer

The portable alternating-current galvanometer recently developed by the Leeds & Northrup Company of 4901 Stenton Avenue, Philadelphia, for use in alternating-current "balance" methods of measurement is claimed to have quick response to weak currents at commercial frequencies, and has a direct indication of the direction of unbalance. Its moving system resembles that of the direct-current portable galvanometer made by this company, being removable from the case; its sensivity closely approaches that of the corresponding direct-current instrument, and it is said to be just as convenient in use as that device. The particular applications of this galvanometer are to industrial measurements of electrolytic conductivities and to bridge methods of capacity and inductance at commercial frequencies.

Insulator Brackets with Oval Wire Holes

For service connections on poles and buildings insulator brackets with oval-shaped wire holes have just been put upon the market by the L. F. Engineering Company, 462 Hoboken Avenue, Jersey City, N. J., to accommodate duplex wires and consequently cut down the number of fittings necessary. The porcelain conical end pieces have corrugated interiors and grip the wires very securely; they are split in two sections and may be removed from the malleable-iron framework. A lag-screw-type insulator and bracket, which supports the wire 5 in. (12 cm.) from the surface, is one of the styles obtainable. The other three are a foot type, a double foot type supporting the wires 2 in. (5 cm.) from the surface, and a triple foot type which supports wires 3 in. (7 cm.) and 6¾ in. (16 cm.) from the surface.

Multi-Pole Plugs and Receptacles

The receptacles and plugs in three and four poles in 125-volt and 600-volt types recently announced by the Albert & J. M. Anderson Manufacturing Company, 289 A Street, Boston, which are known as "type A B C," have been designed to serve as flexible and quick-acting electrical connectors to motors and other apparatus. One important constructional feature of these devices is the self-aligning contacts, which are said to prevent undue binding and to insure a perfect connection between plug and receptacle. The contacts are equipped with removable cable sleeves, providing an easy and quick means of making soldered connections to cable. The current-carrying parts are embedded in individual members made of a non-conducting insulating compound which is said to have very high dielectric and great mechanical strength as well as extremely high heat-resisting properties. Reversing of polarity is impossible, since these plugs can be inserted into the receptacles only in the correct position.

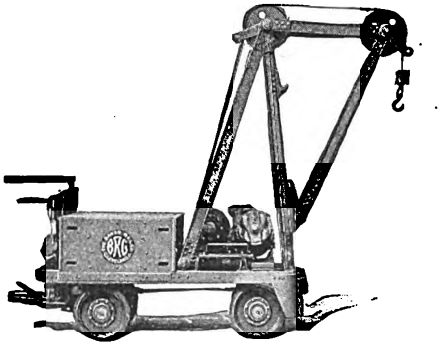
Bridge for Measuring Condenser Capacities

To measure condenser capacities rapidly and accurately a capacity bridge has been developed by the Leeds & Northrup Company of 4901 Stenton Avenue, Philadelphia, which is extremely simple to operate. The source of high-frequency alternating current, the telephone receiver and the unknown capacity are connected to the designated binding posts, the knob is turned until no tone is audible in the receiver, and the scale is then read and the reading multiplied by the standard capacity value.

Two self-contained mica standard condensers of 0.01 and 0.1 microfarad respectively enable accurate determinations to be made within this range, while a pair of extra binding posts permit the use of an external standard capacity of value above or below that range. The instrument is supplied with a protecting cover.

Crane-Equipped Industrial Truck

While developed primarily for picking up projectiles in shell plants and stacking them in piles, the crane-equipped electric industrial truck being marketed by the Baker R & L Company of Cleveland, Ohio, is said to be finding a large field of application in peace-time industrial plants. The truck, controlled from the customary platform,



WILL PICK UP 3000-LB. PROJECTILES

is driven by the motor supplied with energy from a heavy-type storage battery, and the hoist is operated through a double worm-reduction gear by the same power. The boom is movable, the illustration showing it in high position.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Norway (No. 29,157) desires to purchase and secure an agency for the sale of electrical machinery. Credit to be open in New York through local banks.

A firm in Norway (No. 29,156) desires to purchase and to secure an agency for the sale of electric trucks. Payment, cash against documents at destination or at New York.

The representative of a firm in Denmark (No. 29,162) who is at present in this country desires to secure an agency and purchase electrical articles. Correspondence may be in English.

A firm in South Africa (No. 29,171) wishes to purchase two complete wireless telephone or telegraphic equipments for use between two mines located about 80 miles apart. Quotations should be given f.o.b.

A company in England (No. 29,143) wishes to purchase and secure an agency for the sale of electric motors for power purposes, ranging from 0.5 hp. to 50 hp., direct current, 460 volts and 230 volts, three-phase, 50 cycle, 400 volts, alternating. Payment, cash on delivery.

A firm in Spain (No. 29,179) desires to purchase high-pressure turbines and electrical machinery of all sorts for developing waterfall power in that country. Quotations should be given f.o.b. New York. Payment, cash against documents. Correspondence may be in English.

A firm in Norway (No. 29,106) which is building zinc smelting and refining works is in the market for twenty 1100-kva. and 10-kva. furnace transformers, together with oil switches and instruments, to be delivered as quickly as possible, f.o.b. New York. Payment to be made one-third with order, one-third upon delivery and one-third when erected, but not later than three months after second payment. Specifications may be seen at the Bureau or its district offices (refer to Exhibit No. 112,-357). Later the company will be ready to purchase a few storage locomotives, electric unloading cranes and other appliances and machinery for transporting raw material to the works and the finished product to the ship side.

BASIS OF AUSTRALIAN TARIFF ON ELECTRICAL IMPORTS.—The Australian overseas committee of the British Electrical and Allied Manufacturers' Association, according to a recent report in the *Electrical Review*, London, has been strongly urged that the basis of assessment of import duties should be altered from ad valorem to weight in the case of dynamos and motors and to a unit basis in the case of incandescent lamps. In the case of heavy machinery, particularly where time is required for its manufacture, the duty should be based on the cost at the time of contract rather than at the time of shipment.

LARGE VACUUM-CLEANER ORDER.—One of the largest single orders for vacuum cleaners on record is reported by the Hoover Suction Sweeper Company, North Canton, Ohio, in the sale of $182,000 worth of cleaners to the Sanger Brothers store in Dallas, Tex. Coming from the big selling center in the largest agricultural state in the Union, the order reflects the unparalleled prosperity of the farmer. Having experienced a record business in Hoover sweepers last year, Sanger Brothers are predicting a new sales peak for the coming year and are stocking up to fill their needs. Their order calls for 3200 cleaners for immediate delivery. According to F. M. Rhed, Southwestern sales manager for the Hoover company, the demand from agricultural states this year will be large. Mr. Rhed is in charge of Hoover sales in Missouri, Kansas, Colorado, Arkansas, Oklahoma, Texas, New Mexico and Louisiana. For the first three months of 1919 sales in this territory have been equal to almost one-half the total sales for the territory during the previous year.

PERU'S ELECTRICAL IMPORTS INCREASE.—Electrical supplies imported into Peru in 1916 amounted to $228,351, while in 1917 they increased to $664,219, a gain of 190 per cent.

TRADING WITH CHINA.—The Guarantee Trust Company of New York City has issued a pamphlet entitled "Trading with China," in which are set forth methods found successful in dealing with the Chinese.

BRITISH IMPORT RESTRICTIONS ON EDISON BATTERIES REMOVED.—The War Trade Board announces that all restrictions upon the importation of Edison cells and component parts for electrically propelled vehicles have been removed by Great Britain.

ONE PER CENT OF EXPORTS TO PHILIPPINES ELECTRICAL.—According to figures recently compiled by the National City Bank of New York, the electrical exports to the Philippine Islands from the United States amounted to 1.6 per cent of the total in 1916; 1.8 per cent in 1917 and 0.9 per cent in 1918. The amounts in the three years were: 1916, $379,930; 1917, $478,413; 1918, $443,667.

SWEDEN'S ELECTRICAL EXPORTS DECLINE.—For the four years, 1915, 1916, 1917 and 1918, Sweden's exports of electrical machinery and telephones were as follows:

	Electrical Machinery.	Telephones
1915	$1,618,720	$1,599,960
1916	3,008,032	2,088,524
1917	4,357,680	1,888,596
1918	1,926,652	1,516,612

RESTRICTIONS ON ELECTRICAL EXPORTS TO CENTRAL AND SOUTH AMERICA.—The War Trade Board announces that shipments of electrical generators over 20 kw., electrical motors over 25 hp., and electrical transformers over 50 kw. to Mexico, Cuba, Haiti, San Domingo or to any other country in Central or South America, excluding the colonies of Great Britain and France, will require an individual export license, as these articles do not fall within the provisions of Special Export License RAC-77, effective April 7.

BOX FOR EXPORTING ELECTRICAL INSULATORS.—A new type of crate for shipment of insulators for high-voltage transmission lines has recently been developed by the Forest Products Laboratory of the United States Forest Service at Madison, Wis. The work was done at the request of one of the large manufacturers of electrical goods whose containers had failed to prevent breakage of contents in spite of the apparent strength and durability of the container itself. The redesigned crates were subjected to severe tests and breakage of the insulators was eliminated. Moreover, it was stated, the container proved under test to be 100 per cent stronger, to occupy 15 per cent less space and to save 15 per cent in the cost of material. It is understood that this new type of package will be used to ship thousands of insulators to China for the construction of electric power lines.

BEAMA MAY LICENSE BRITISH ELECTRICAL IMPORTS.—At the annual meeting of the British Electrical and Allied Manufacturers' Association, according to a report in the London *Electrical Review*, the council took the view that none of the existing restrictions on imports of such electrical apparatus as instruments, accessories, heating and cooking apparatus and dry batteries should be removed at present, but that each application for permission to import should be considered as before on its merits, with no granting of leave to import without the fullest inquiry. This association has for some time exercised a government license controlling the import of supplies and essential accessories, and the report states that it is not impossible that the present negotiations will result in its becoming the general licensing authority for the whole trade, thus reasonably controlling the imports in accordance with proved necessity.

LEWIS JALOVEC has been appointed assistant to the United States Foreign Trade Commissioner to Czechoslovakia. He will be stationed at Prague, Bohemia. Information in regard to markets and information of any kind concerning the country where he will be stationed will be gladly furnished upon application. It is interesting that Mr. Jalovec is an engineer—one of the first to be appointed to such a governmental position.

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Finance Building, Philadelphia, reports the successful starting up of a special "Greaves-Etchells" type of electric furnace for the manufacture of corundum at the works of the William McGregor Company, Airdrie, Pa.

THE ELECTRIC PRODUCTS COMPANY, Cleveland, Ohio, announces the return of Capt. J. P. Lyons. Mr. Lyons will be district sales manager for New England, with temporary headquarters at the New York office of the Electric Products Company, 1328 Woolworth Building.

MAJOR ROWLAND TOMPKINS, A. E. F., formerly associated with Almirall & Company, Inc., New York City, has become a member of the Shevlin Engineering Company, Inc., 110 West Thirty-fourth Street, New York City, manufacturer and contractor for the installation of boiler-plant equipment.

CAPT. H. M. ST. JOHN, who left his position as research engineer in the testing department of the Commonwealth Edison Company, Chicago, to enter the gas warfare section of the United States Army, has been released from service and has become assistant manager of the Detroit Electric Furnace Company.

NORMAN HATTON, William J. Klein and S. E. Holmes, Masonic Temple, Cedar Rapids, Iowa, announce the formation of a partnership under the name of Hatton, Klein & Holmes. Their practice will be devoted to general engineering, architecture, machinery layouts, heating and ventilating and industrial engineering.

THE BLACK & DECKER MANUFACTURING COMPANY, Baltimore, Md., has just established a New York office in Room 2920, Equitable Building, which will be in charge of G. R. Lundane, who will supervise the distribution of Black & Decker products in New York City and surrounding territory, including the State of Connecticut.

THOMAS F. KELLEY has become associated with Titus Schmid of Dubuque, Iowa, in the organization of the Crescent Electric Company of that city. The new company will open a wholesale business in all kinds of electrical supplies. Mr. Kelley has represented the Central Electric Company of Chicago in the eastern Iowa field for a number of years.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY announces that its New York office has opened a separate warehouse with 2500 sq.ft. of floor space at 60 Vesey Street, where a complete line of material will be carried for New York distribution. The old quarters at 114 Liberty Street are being refitted as a modern office at which the business in New York City will be transacted as formerly.

THE BAILEY METER COMPANY, Cleveland, Ohio, announces that it has moved its main office and works from Boston to Cleveland, Ohio, effective May 1. The Boston office, with H. D. Fisher as manager, is retained to handle sales and engineering service work in the New England district. For the present the New York and Philadelphia districts will be covered from Boston, and all other districts will be covered from Cleveland.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, Ohio, announces the appointment of R. E. Uptegraff in charge of its transformer department. Mr. Uptegraff was with the Westinghouse Electric & Manufacturing Company seven years, where he had charge of turbine and switchboard operation and was connected with the manufacture of motors, generators and transformers and their accessories. He was also active in transformer designs. His five years with the Pittsburgh Transformer Company as assistant chief engineer were occupied with much transformer design. For two years Mr. Uptegraff was consulting engineer for Rutherford & Uptegraff, in which capacity he still acts, and during this time he redesigned and reorganized the transformer department of the Packard Electric Company.

R. W. VAN PELT, for the past two years in charge of Western sales of the insulated wire department of the B. F. Goodrich Company, Akron, Ohio, with headquarters in Chicago, has been promoted to charge of Eastern sales, insulated wire department, New York City headquarters. Mr. Van Pelt for a number of years was connected with the American Steel & Wire Company in a sales capacity for its insulated wire and cable department both

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in the Chicago and the Pacific Coast offices. He joined the B. F. Goodrich Company in 1912.

EVAN J. EDWARDS is now devoting his time to industrial-plant engineering with the National Lamp Works of the General Electric Company at Cleveland, Ohio.

THE OHIO BRASS COMPANY, Mansfield, Ohio, announces that on May 1 its Chicago office moves from 508 Fisher Building to 1217 Fisher Building, 343 South Dearborn Street.

THE UNITED STATES LIGHT & HEAT CORPORATION, Niagara Falls, N. Y., is having plans prepared for the erection of a one-story and two-story addition to its plant on Highland avenue.

PURNELL O. WILSON, who for several years has been city salesman for the Montana Power Company at Great Falls, Mont., has been appointed manager of the Great Falls Electric Supply Company.

THE AMERICAN APPLIANCE COMPANY, New York City, announces the opening of an additional branch on Live Oak Street, Dallas, Tex. This office is in charge of Campbell Wood and will carry a complete line of tungsten lamps.

E. M. FAY of the Boston office of the Westinghouse Electric & Manufacturing Company has resigned in order to become sales manager for the E. W. Ham Company, Worcester, Mass., electrical jobber and distributer of Westinghouse apparatus.

THE COLWELL STORAGE BATTERY COMPANY, Waukegan, Ill., has purchased the Wetzel Building and will remove to the new location during the month of April. The building is 120 ft. by 130 ft., and the company will have the use of three floors.

C. R. WOOD will assume the management of the office of the Westinghouse Lamp Company in Cincinnati, Ohio, about May 1. For the past ten years he has traveled through Illinois, Iowa, Nebraska and South Dakota as salesman for the Westinghouse Lamp Company.

C. E. HAGUE, formerly production engineer of the Mid-West Engine Company, Indianapolis, Ind., has been appointed sales manager of the American Steam Conveyor Corporation, Chicago, manufacturer of the American steam ash conveyor and other ash-handling equipment.

THE CAPITAL ELECTRIC COMPANY, Salt Lake City, Utah, announces that R. W. Nicol, president, has sold his controlling interest in the company and severed all connections with it on account of ill health. H. D. Randall, formerly of the General Electric Company, has been elected president to succeed Mr. Nicol.

L. HAFT has become treasurer of the C. D. Wood Electric Company, 441 Broadway, New York City, in place of W. P. Ganson, resigned. The Wood company manufactures, imports and exports miniature lamps and novelties. C. D. Wood, president, has just returned from Switzerland, where he has been with the Y. M. C. A.

WILLIAM W. SOFFE, who for five years was manager of the Harter Electric Company, Chicago, and who later was in charge of the electrical department of the United States Shipping Board, Emergency Fleet Corporation, for the Great Lakes district, has become vice-president and general manager of the Inland Electric Company, Chicago.

THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago, announces the appointment of Charles H. Florandin, formerly of the National Electric & Welding Company, New York, as general manager of its Eastern territory with headquarters at 110 West Fortieth Street, New York City. Mr. Florandin, who assumes charge of his new duties May 1, was born in France and received his technical education at the Lycée de Marseilles. He is an engineer by profession and upon coming to the United States did important work with the Brooklyn City Railway Company in the early days when the road was being electrified. After five years' service with this company he joined the C & C Electric Company, New York, and he held a responsible position with that firm for many years. After a brief connection with the Western Electric Company, he returned to the C & C Electric Company and later organized the National Electric & Welding Company. During the war Mr. Florandin was a member of the welding committee of the Emergency Fleet Corporation.

Trade Publications

GARAGE PUMPS. — Models P and W "master" garage pumps are described and illustrated in a leaflet from the Hartford Machine Screw Company, Hartford, Conn.

TAPES AND WEBBINGS.—The Mitchell-Rand Manufacturing Company of 18 Vesey Street, New York City, has got out a folder cataloging Hope electrical tapes and webbings.

HIGH-TENSION AIR-BREAK SWITCHES.—Bulletin No. 11 on high-tension air-break switches is the first of a new series of publications issued by Hickey & Schneider of Elizabeth, N. J.

STEAM AUTO TRUCK.—A new model of the "Steamobile" road truck is the subject of an illustrated booklet just issued by the Winslow Boiler & Engineering Company, 530 North Western Avenue, Chicago.

FARM-LIGHTING PLANTS.—The Superior Engineering Company, Jenkins Arcade, Pittsburgh, Pa., has issued a circular about its new lighting sets, which consist only of generator, switchboard and batteries.

STEAM TURBINES.—Bulletin No. 5 is being distributed by the Steam Motors Company, Springfield, Mass., to describe its "steam motor." The booklet is illustrated by a number of halftones and line drawings.

TWO-WAY PLUG.—The Benjamin Electric Manufacturing Company, 806 West Washington Boulevard, Chicago, has issued a new twenty-eight-page book to help dealers sell Benjamin two-way plugs in cartons of three.

HOUSE WIRING.—The Society for Electrical Development, 29 West Thirty-ninth St., New York City, has prepared an attractive illustrated folder that tells why houses should be wired for electricity and how clean, easy and quick the process is.

BRASS CASTINGS. — "Do-Di Finished Brass Castings" are the subject of a well-printed booklet just issued by the Doehler Die-Casting Company, Court, North and Huntington Streets, Brooklyn, N. Y. Many of these castings used in different machines are shown.

HEATING APPLIANCES.—The Hotpoint Division of the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is distributing an elaborate colored broadside containing reproductions of its advertising material. A new price list effective April 1 has also been issued.

HOSPITAL LIGHTING. — The M. J. Grady Fixture Manufacturing Company, Minneapolis, Minn., has issued a thirty-two-page booklet showing its new designs in hospital lighting fixtures and featuring particularly the installation at one of the new hospitals in Minneapolis.

STORAGE BATTERIES.—Bulletin No. 55, on storage batteries for automobile starting and lighting and for ignition purposes, has been issued by the Universal Battery Company, 3410 South La Salle Street, Chicago. This company has also got out bulletin No. 50, which catalogs replacement parts for standard-make storage batteries.

LIGHTING PLANTS.—The Mathews Engineering Company of Sandusky, Ohio, has published a new catalog of its full-automatic lighting plants. The first section of the book presents the idea of more and better light for homes. The latter section contains information on the complete line of Mathews lighting plants. A number of interesting photographs illustrating the application of lighting plants by the government in France are included in this handsome publication.

STOKERS.—The Green Engineering Company, East Chicago, Ind., has issued a complete catalog covering its stoker and furnace equipment. Besides being well-illustrated, this book contains considerable engineering information, including cross-sectional drawings of settings for burning coal under various conditions, tables showing analyses of the coals of the world, information on stoker improvement, with particular reference to rear drums, chain skids, air-sealing systems, "Sealflex" arches and pressure waterbacks.

SOOT CLEANERS.—"Vulcan Soot Cleaners for Return-Tubular Boilers" is the title of a bulletin just published by the Vulcan Soot Cleaner Company, Dubois, Pa., to describe its model "M," front-end type, and model "R," rear-end type. The bulletin shows how these cleaners are installed in settings of typical construction. It gives the results of tests conducted by the engineering department of the University of Illinois and by the Iowa Soldiers' Home, at Marshalltown, Iowa.

New Incorporations

THE BEAUDETTE & GRAHAM COMPANY of Boston, Mass., has been incorporated by George C. Graham of Watertown, Joseph Beaudette of Boston, Harold L. French of Clinton, and Albert C. Gowing of Braintree.

THE ELECTRIC EQUIPMENT & SUPPLY COMPANY of Sandusky, Ohio, has been incorporated by R. C. Beebe, E. A. Bechstein, George J. Doerzbach, C. Webb Sadler and J. B. Arbour. The company is capitalized at $25,000.

THE AMERICAN DUPLEX SIGNAL COMPANY of Bridgeport, Conn., has been incorporated with a capital stock of $10,000 to manufacture automobile signal and signal devices. The incorporators are Andrew Simon, George H. Wood and Frank Pekar.

THE COLFAX (IND.) ELECTRIC COMPANY has been incorporated by George Davis, Homer R. Woodburn, Albertis D. Clark, Luther H. Perigo and Jerre B. Casey. The company is capitalized at $10,000 and proposes to generate and distribute electricity.

THE ARTHUR BOUDREAU COMPANY of New York, N. Y., has been incorporated by Arthur Boudreau, H. C. Beaver and F. Shultis, Jr., 16 West Sixty-first Street, New York City. The company is capitalized at $50,000 and proposes to manufacture electric motors, etc.

THE HALL RADIO CORPORATION, Union Station, Chicago, Ill., has been incorporated under the laws of the State of Delaware with a capital stock of $400,000 to manufacture wireless apparatus. The incorporators are Samuel C. Wood and A. D. Suess.

THE FARMERS' LIGHT & POWER COMPANY of Decatur, Ind., has been incorporated by Charles S. Mumma, B. Wolf, Louis F. Holle, C. D. Spuhler, Ross Harden and John D. Neidlinger. The company is capitalized at $5,000 and proposes to supply electricity in Decatur.

THE WIRELESS TRAIN CONTROL COMPANY of Terre Haute, Ind., has been chartered with a capital stock of $200,000 by Thomas G. and Harry W. Beggs, John T. and John H. Beasley and John F. O'Brien. The company proposes to manufacture railroad signal systems.

THE JOHN J. LEAHY ELECTRICAL SUPPLIES, INC. of New York, N. Y., has been incorporated by J. J. Leahy, T. L. Gorman, Jersey City, N. J., and P. J. McSweeney, 533 Tinton Avenue, New York City. The company is capitalized at $150,000 and proposes to deal in electrical supplies and devices.

THE ACME ELECTRO PLATING COMPANY, 64 Richmond Street, Toronto, Can., has been incorporated with a capital stock of $40,000. The new concern has taken over the plant and business of Walter E. Lewis and is planning to enlarge the building and install new equipment. Walter E. Lewis is president.

THE COCKADE CITY ELECTRIC COMPANY of Petersburg, Va., has been incorporated with a capital stock of $10,000 to do a general electrical and mechanical construction business. Mason Hill is president, J. J. Hall is vice-president and manager, and D. M. Barnes, R. F. D. No. 3, is secretary and treasurer—all of Petersburg.

THE MONTREAL ARMATURE WORKS, LTD., of Montreal, Que., has been chartered with a capital stock of $50,000 to take over the business of the Eastern Electric Company of Montreal, which manufactures electrical and mechanical appliances and tools, etc. The incorporators are Samuel D. Sweetman, Stanley H. Cunha, Philip J. Dolan and others.

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New England States

SACO, ME.—Work has begun on a preliminary survey for the proposed development of the Cataract Falls in Saco by the Clark Power Company. If the plans are carried through, sufficient power will be developed to operate the mills of the company in both Biddeford and Saco.

WINN, ME.—The Penobscott Light & Power Company, recently organized, is planning to supply electricity for lamps and motors in Winn and Mattawankeag The company is capitalized at $10,000. F. D. Sherrard is president and B. F. Wyman s treasurer.

MANCHESTER, VT. — The Equinox Spring Company of Manchester is planning to install electrically driven pumping machinery.

NEWBURY, MASS.—Plans are under consideration for the installation of a municipal electric light plant in Newbury.

NORWICH, CONN.—The Public Utilities Commission has approved the petition of the Shore Line Electric Railway Comrany for the erection of an electric transmission line from Montville, northerly, to the State line.

WATERBURY, CONN. — Ground has been broken for a power house, 80 ft. by 45 ft., for the International Silver Company.

Middle Atlantic States

BINGHAMTON, N. Y.—The Brewer-Tichener Corporation of Cortland is planning to install new equipment in the enameling department of its local works, including a new electrically operated oven and auxiliary apparatus.

NIAGARA FALLS, N. Y.—The John W. Cowper Company, Fidelity Building, Buffalo, has been awarded contract for the construction of the large addition to the plant of the United States Light & Heat Company at Niagara Falls. Mills, Rhines, Nordhoff & Bellman of Toledo, Ohio, are architects.

WATERTOWN, N. Y.—The Northern New York Utilities, Inc., is contemplating the erection of an electric transmission line from Watertown to Brownville, a distance of 6½ miles, replacing the present 3000-volt service with one of 22,000 volts.

ALLENTOWN, PA.—The City Council has engaged Frank Koester, consulting engineer and city planning expert, 50 Church Street, New York, N. Y., to make investigations and prepare a report on the installation of a municipal electric light plant in connection with the municipal waterworks. Mr. Koester recommends replacing the present arc-lamp-lighting system with nitrogen-filled tungsten lamps. It is estimated that a plant of 350-kw. capacity will take care of the present lighting system and provide for future extensions to the system. The cost of a municipal plant, including generators, transformers, wiring and street lamps, is estimated at less than $200,000.

EAST FREEDOM, PA.—Claar Brothers are contemplating enlarging the electric plant in their planing mill to supply electricity for lamps and motors in East Freedom.

HUNTINGTON, PA.—The board of trustees of Juniata College is having preliminary plans prepared for the construction of a power plant at the college, to cost about $25,000. G. Edwin Brumbaugh, Real Estate Building, Philadelphia, is architect.

PHILADELPHIA, PA.—A permit has been granted to Frank G. Stewart, 1610 Sansom Street, for the construction of a power house and stable on Twenty-fourth Street, between Ritner and Wolff Streets, for the city of Philadelphia.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until May 16, under Schedule 3959, for furnishing seventy-five 120-volt electric heaters at Philadelphia. Bids will also be received until May 23, under Schedule 3951, for furnishing miscellaneous electrical measuring instruments at Philadelphia. Application for proposal blanks should designate the schedule desired by number.

BALTIMORE, MD.—Plans are being prepared by the Chesapeake & Potomac Telephone Company for the erection of a new telephone exchange on Kate Avenue in the Park Manor district, to cost about $20,000.

CHARLESTON, W. VA.—The Kanawha Collieries Company is contemplating the construction of an electric power plant, 32ft. by 50 ft.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

North Central States

DETROIT, MICH.—Plans are being prepared for a new plant for the Yeomans Box Company of Detroit, consisting of a main building, 175 ft. by 225 ft., with building adjoining, 25 ft. by 85 ft., and also a boiler and engine plant, 25 ft. by 100 ft. Clarence W. Yeomans, 274 Wight Street, is interested in the company.

GRAND RAPIDS, MICH.—Bids will be received by Herbert N. Morrill, business manager, board of education, until May 16 for the construction of the new Henry School, including general construction, heating and ventilating, plumbing and sewering, electrical work, vacuum cleaning apparatus, etc. Plans and specifications are on file at the office of Henry H. Turner, 234 Division Avenue, North, Grand Rapids.

HOLT, MICH.—The Village Board is considering the question of lighting the village by electricity.

MARQUETTE, MICH.—Plans have been completed by Thomas W. Orbison, consulting engineer, Appleton, Wis., for a hydro-electric power plant to be constructed by Marquette County. The cost is estimated at about $140,000.

ONSTED, MICH.—The Village Council has voted to purchase the local electric light plant at $7,506.

SODUS, MICH.—The Benton Harbor & St. Joseph Railway & Light Company of Benton Harbor has submitted a proposition to the Council to furnish electricity for lighting the village. The company has offered to extend its service here, provided that the people interested would sell bonds for the company aggregating $1,000 per mile.

AKRON, OHIO—The B. F. Goodyear Rubber Company is contemplating the construction of a three-story machine shop and extensions, to cost about $93,000. The company is also planning the erection of a substation, to cost about $15,000.

CASTALIA, OHIO.—Arrangements are being made by the Castalia Portland Cement Company for equipping its electric plant for electrical operation. The plans provide for the installation of motors aggregating about 2000 hp., ranging from 10 hp. to 250 hp. Energy to operate the plant will be supplied by the Lake Shore Electric Railway Company.

HOLGATE, OHIO.—The Holgate Light & Power Company, recently incorporated, has taken over the municipal electric light plant and will supply electricity in the town and energy to operate the waterworks system. The company is capitalized at $20,000. W. P. Wallace, John F. Deatrick of Defiance and Thomas R. Wickenden of Toledo are among the incorporators.

LIMA, OHIO.—The franchise committee of the Council has approved the installation of an ornamental lighting system on Main Street from the Pennsylvania Railroad to the Ottawa River. The street-lighting service is furnished by the Lima Electric Railway & Light Company.

PORT CLINTON, OHIO. — The Council has authorized the installation of additional street lamps on the lake front.

SALEM, OHIO.—A bond issue of $200,000 for the installation of a municipal telephone system has been recommended to the City Council by the special committee.

SHERWOOD, OHIO.—Bids will be received by L. M. Kauffman, clerk of board of county commissioners, Sherwood, until May 12, for rebuilding and repairing the electric light plant and furnishing meters, lamps, etc.

TOLEDO, OHIO. — The Electric Auto-Light Company, it is reported, will build an extension to its plant.

WAVERLY, OHIO. — Bonds to the amount of $11,000 have been authorized for the installation of a new municipal electric plant to replace the present plant.

CATLIN, ILL.—The Council is considering issuing $35,000 in bonds to rebuild the municipal electric light plant.

CHICAGO, ILL.—The Hill Pump Valve Company is planning to erect a large plant at the corner of Belmont and Knox Avenues, the first unit of which will cost about $500,000.

ELDORADO, ILL.—The City Council is considering establishing a municipal electric light plant in Eldorado.

ELGIN, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 20, for installing conduit and wiring and lighting fixtures in the post office at Elgin.

MASON CITY, ILL.—The Abbott Light & Power Company is contemplating erecting a number of rural electric transmission lines to supply electricity for lamps and motors to the farming districts.

ROCKFORD, ILL.—The Rockford & Interurban Railway Company is contemplating an issue of $105,500 in bonds for improvements.

ALTURA, MINN.—Steps have been taken to organize a company to install and operate an electric light plant in Altura, to cost about $300,000. For further information address the Power Engineering Company, Corn Exchange, Minneapolis, engineer.

RED WING, MINN.—At an election held May 28 the proposal to issue $350,000 in bonds for a municipal electric light plant was carried.

NEWTON, IOWA.—The City Council is considering the question of purchasing energy to operate the municipal electric system. Owing to the increasing demands for electrical service it will be necessary to enlarge the municipal plant or secure energy from outside sources.

WIOTA, IOWA.—Bonds to the amount of $5,000 have been authorized for the installation of a lighting plant.

HOLT, MO. — The Excelsior Springs (Mo.) Water, Gas & Electric Company has been granted a franchise to supply electricity in Holt. The company will extend its transmission line from Kearney to furnish the service here.

MARSHALL, MO.—All contracts have been awarded and work has begun on the installation of the new municipal electric light plant in Marshall.

MANDAN, N. D.—Bids will be received by the Board of City Commissioners at the office of the city auditor, Mandan, N. D., until May 15 for furnishing all material, including plant equipment and installing an ornamental street-lighting system. The proposed work covers approximately 80 blocks with 294 posts. Black & Griffin are engineers. W. H. Seitz is city auditor.

CLAREMONT, S. D. — Bonds to the amount of $10,000 have been voted for the installation of a municipal electric light plant in Claremont, S. D.

CUSTER, S. D.—The laundry, lighting and power plant at the State Tuberculosis Sanitarium was destroyed by fire recently, causing a loss of about $5,000.

GREGORY, S. D.—At an election held recently the proposal to issue bonds for the installation of a municipal electric light plant was carried. The cost is estimated at about $25,000.

PUKWANA, S. D.—At an election held recently bonds were authorized for the installation of a municipal electric plant in Pukwana.

CROFTON, NEB.—At an election held recently $10,000 in electric lighting and heating bonds were authorized.

ELLSWORTH, KAN.—The local electric light plant has been purchased by John Erber of Salina.

HOMINY, KAN.—The installation of an ornamental lighting system in the business district in Hominy is under consideration.

LARNED, KAN.—The Pawnee Power & Water Company has applied for permission to issue $50,000 in bonds for the erection of an electric transmission line to Burdette.

Southern States

SALISBURY, N. C.—The City Council has granted the Southern Power Company of Charlotte a franchise to supply electricity for lamps and motors in Salisbury.

MANNING, S. C.—The capital stock of the Manning Light & Ice Company has been increased from $15,500 to $20,000.

ATLANTA, GA.—The Georgia Railway & Power Company is contemplating an additional water-power development on Tugaloo River.

COLUMBUS, GA.—Plans are being considered to build a new power house and alter the present plant at the Eagle and Phoenix Mills on Front Street. Lockwood, Greene & Company, Healy Building, Atlanta, Ga., are engineers.

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LUMBER CITY, GA.—The establishment of a municipal electric light plant in Lumber City is under consideration.

MOUNT VERNON, GA.—Plans have been perfected for the introduction of a bill at the forthcoming session of the State Legislature to amend the charter of Mount Vernon so as to permit the town to issue bonds to establish a municipal electric light plant.

SAVANNAH, GA.—Bids, it is understood, will soon be asked for electric wiring for the auditorium.

UVALDA, GA.—An election will soon be held to submit to the voters the proposal to issue bonds to establish a municipal electric light plant in Uvalda.

MIAMI BEACH, FLA.—Improvements are contemplated to the local system of the South Atlantic Telephone & Telegraph Company, to cost about $50,000. A new switchboard and underground conduits will be installed.

TALLAHASSEE, FLA. — Preparations are being made by the city of Tallahassee to rebuild the municipal electric light plant, recently destroyed by fire. The loss is estimated at about $75,000.

LEE VALLEY, TENN.—The installation of an electric light plant in Lee Valley is under consideration. John N. Adams is engineer.

ANNISTON, ALA.—Improvements to the electric street-lighting system are under consideration by the City Council.

SELMA, ALA.—The Selma Electric Railway Company, recently organized with a capital stock of $10,000, proposes to operate a traction system in Selma and vicinity.

LEXINGTON, MISS.—An election will be held May 15 to submit to the voters the proposal to issue $40,000 in bonds for the installation of an electric lighting system in Lexington.

SENATOBIA, MISS.—At an election held recently a bond issue was authorized to provide funds for improvements to the electric light plant and waterworks system. A crude-oil engine and other equipment, it is understood, will be installed in the power plant, and the electric lighting service will be extended to Coldwater, 6 miles distant.

ALTHEMIER, ARK. — Arrangements have been made by the town of Althemier with the Arkansas Light & Power Company to extend its service here from Stuttgart. The transmission line is practically finished.

ASHDOWN, ARK.—The electric plant of the Ashdown Light & Power Company was recently destroyed by fire, causing a loss of about $35,000. Arrangements have been made to install an electric generator at the local oil mill to furnish electricity for lighting. The plant, it is understood, will be rebuilt.

HUMPHREY, ARK. — A franchise has been granted to the Pine Bluff Light & Power Company to supply electricity in Humphrey. Work will begin immediately on the erection of a substation and transmission lines.

PRESCOTT, ARK.—The City Council is considering a proposal to supply electricity to the town of Gurdon, 10 miles distant. M. B. Morgan, owner of the plant in Gurdon, proposes to erect a high-tension transmission line from Gurdon to Prescott to secure energy to operate the system in the former city.

NEW ORLEANS, LA.—The New Orleans Petroleum Company is planning to equip an oil refinery in New Orleans, to cost about $1,500,000. The proposed equipment will include turbo-generators. The main offices of the company are located in the Woolworth Building, New York, N. Y.

YALE, OKLA.—A bond issue of $220,000 for public improvements has been approved by Attorney General Freeling. Of the total issue $100,000 will be used for extensions and improvements to the municipal electric light plant, $100,000 for waterworks extensions and $20,000 for the purchase of additional equipment for the fire department.

ALBANY, TEX.—Preparations are being made for the installation of a new light plant and ice factory in Albany.

HIGGINS, TEX.—The City Council has awarded a contract to C. L. Tennison to install an electric light plant in Higgins.

HILLSBORO, TEX.—The Texas Power & Light Company is contemplating erecting an electric transmission line from Hillsboro to Dublin to connect with the Brownwood system.

STRAWN, TEX.—The Texas Power & Light Company, it is reported, is contemplating the erection of a power station at Strawn to serve electricity to the Ranger and Duke fields.

PADUCAH, TEX.—An election will be called to submit to the voters the proposal to issue bonds for the installation of a municipal electric light plant and ice factory.

SNYDER, TEX.—The local electric light plant, owned by E. F. Renkin, has been purchased by Wilcox & Dunn of McKinney. Extensive additions will be made by the new owners to the plant and service.

Pacific and Mountain States

PORT ANGELES, WASH.—The Puget Sound Bridge & Dredging Company has awarded the contract for rebuilding the entire electrical machinery at its plant, recently destroyed by fire, to Thompson & Castleton, electrical engineers, 316 First Avenue South, Seattle. The equipment will include a 650-hp. motor and starting apparatus.

SEATTLE, WASH.—According to a report submitted to the City Council by F. C. Henny of Portland, Ore., and C. F. Uhden of Spokane, Wash., consulting engineers, construction of the Skagit River municipal power plant along the general lines suggested by A. H. Dimmock, city engineer, is feasible. The cost of the first unit is placed at $5,500,000, for which bonds have been sold.

SPOKANE, WASH.—The property of the Spokane Heat, Light & Power Company was recently sold at a receiver's sale for $400,000. The electrical equipment was purchased by F. C. Paine, local banker, representing Eastern interests, for $140,000; the remainder of the property was bought by E. P. Towhy, an attorney, for $250,000. The plant was erected in 1915 at a cost of about $2,000,000.

ASTORIA, ORE.—The Astoria (Ore.) Marine Works are planning to build a marine railroad, authorized some time ago by the Emergency Shipping Board, to cost about $500,000. All equipment will be electrically operated.

REEDSPORT, ORE. — The Reedsport Light & Power Company, recently organized, has awarded a contract to the Marshfield Electric Company to construct an electric plant and distributing system in Reedsport.

FRESNO, CAL.—Preparations are being made by the California Associated Raisin Company of Fresno for the erection of a new plant here, to cost about $750,000. Considerable electrical and mechanical equipment, conveyor systems, packing machinery, etc., will be installed. W. M. Giffen is president.

SAN BERNARDINO, CAL.—The construction of a new electric power plant to replace the one recently destroyed by fire is under consideration by the Yellow Pine Mining Company.

ST. GEORGE, UTAH.—The Dixie Power Company has filed application with the State Engineer for permission to take 25 second-feet of water from Santa Clara Creek at a point north of Foster in the Dixie National Forest. This will be diverted by means of a crib dam and carried 3½ miles in a canal and flume and utilized under a 314-ft. head with two 50-in. Pelton waterwheels, developing 712 hp. The company already has a plant on Santa Clara Creek.

FLORENCE, ARIZ.—Bids will be received at the office of the town clerk, Florence, until May 28, for improvements to electric light plant and waterworks system as follows: Section No. 1—For building main power plant, well houses and derricks, concrete reservoir, fuel-oil reservoirs, electrical and water distribution systems, hydrants and valves, steel tank and tower, foundations, etc. Section No. 2—Furnishing and erecting two 80-hp. boilers with stacks, oil-burning equipment and steam auxiliaries; two 80-hp. engines directly connected to 60-70-kva. alternators; two 300-gal.-per-minute motor-driven centrifugal pumps, switchboard, two 300-gal.-per-minute motor-driven centrifugal deep-well pumps, all piping and electric wiring complete. The town may decide to install oil engines for prime movers, or to buy power from an outside source, and desires bids upon alternate proposals as follows: Alternate No. 1—For furnishing one 80-hp. boiler with stack, oil-burning equipment and steam auxiliaries; one 80-hp. engine directly connected to one 60-70-kva. alternator; other equipment as specified under section No. 2. Alternate No. 2—For furnishing two 100-hp. compression ignition type, oil engines directly connected to two 60-70 kva. alternators; other equipment as specified under Section No. 2. Section 3—Cast-iron pipe and special castings. Section No. 4—For California redwood pipe and special castings. Plans and specifications are on file at the office of the town clerk, Florence, and at the office of Burns & McDonnell, sngineers, Inter-State Building, Kansas City, Mo. Copies may be obtained from the engineers upon deposit of $15, of which $10 will be refunded upon return of same.

PRESCOTT, ARIZ.—The Arizona Power Company of Phoenix, which operates in Verde Valley, is extending its electric transmission lines to Phoenix, a distance of 70 miles.

RYEGATE, MONT.—The Public Service Company is planning to erect new telephone lines to cost about $40,000.

CARLSBAD, N. M.—The property of the Carlsbad Light & Power Company, it is reported, has been purchased by Chicago capitalists. The new owners will operate an ice factory and laundry. The dam will be enlarged and new machinery will be installed at the power house.

Canada

BOIESTOWN, N. B.—The installation of an electric plant, to cost $25,000, is under consideration. B. J. Thibedeau is reported interested.

CHIPPAWA, ONT.—Immediate action, it is understood, will be taken to secure electricity for lighting the village from the Ontario Hydro-Electric Power Commission.

CORNWALL, ONT.—The Toronto Paper Company is planning to install 1200 hp. at its plant. Electrical service will be supplied by the Hydro-Electric Power Commission of Ontario.

GUELPH, ONT.—The city of Guelph is considering an issue of bonds to extend the municipal electric railway from Hespeler north to Mount Forest.

PERTH, ONT. — Alterations are being made to the local power plants and transmission lines by the Municipal Council, which are later to be used in conjunction with the system of the Hydro-Electric Power Commission.

RIDGETOWN, ONT.—The Township Council has petitioned the Ontario Hydro-Electric Power Commission to extend its service to Ridgetown.

TORONTO, ONT.—The Ontario Hydro-Electric Commission is planning to construct a radial railway between Toronto and Port Perry.

WALKERVILLE, ONT.—The Maxwell Moore Company of Detroit, Mich., is planning to erect a plant in Walkerville, for which an appropriation of $1,000,000 has been made.

CHARLOTTETOWN, P. E. I.—Tenders will be received until May 13 for the construction of power house and laundry, Dalton Sanitorium, including plumbing and heating apparatus, East and West pavilions, Military Hospital, North Wiltshire, P. E. I. Plans and specifications can be seen and form of tender obtained at the office of the chief architect, Department of Public Works, Ottawa, Ont.; superintendent of military hospitals, Charlottetown; superintendent of Dominion buildings, Halifax, N. S., and of the overseer of Dominion buildings, Central Post Office, Montreal, Que.

CARTIERVILLE, QUE.—The Montreal (Que.) Tramways Company, it is understood, is planning to erect a new substation in Cartierville.

MONTMAGNY, QUE.—The city of Montmagny is considering the construction of a power plant, including dam, power house and electric line. Gauvin & Lessard of Quebec are architects.

THREE RIVERS, QUE.—The Canadian Pacific Railroad, Windsor Street Station, Montreal, it is understood, will soon ask for bids for equipping the branch line from Three Rivers to Shawinigan Falls and Grand' Mère for electrical operation. J. M. Fairburn is chief engineer.

VALLEYFIELD, QUE.—Contracts have been awarded by the Montreal Cottons, Ltd., for the installation of additional hydroelectric units at its works. R. S. Kelsch is consulting engineer.

HANLEY, SASK.—The Town Council is considering the installation of an electric light plant in Hanley. Murphy & Underwood, consulting engineers, Saskatoon, have been engaged to make a survey of the town and prepare an estimate of cost for the local government board.

MOOSE JAW, SASK.—A by-law authorizing an expenditure of $219,000 for the installation of a 3500-kw. turbine generator, line extensions, etc., has been passed by the ratepayers.

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(Issued April 15, 1919)

1,300,319. Car-Door Safety Device; Anna K. Winter, New York, N. Y. App. filed Oct. 28, 1918.

1,300,320. Car-Door Switch Control; Anna K. Winter, New York, N. Y. App. filed Nov. 15, 1918.

1,300,326. Telegraph System; John H. Bell, East Orange, N. J. App. filed Oct. 29, 1917.

1,300,367. Circuit Breaker; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Oct. 31, 1914. Condenser terminal bushings decrease arcing.

1,300,373. Dynamo-Electric Machine; George H. Garcelon, Swissvale, Pa. App. filed Jan. 21, 1916. Moisture-proof semi-inclosed motor.

1,300,387. System of Control; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Sept. 8, 1914. Drum controller.

1,300,388. Electrical System; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed March 4, 1915. Prevents power from exceeding certain amount.

1,300,410. Steel-Making Process; Woolsey McA. Johnson, Hartford, Conn. App. filed May 3, 1915. Ferruginous lead reduced to iron.

1,300,420. Process of Conducting Electrolysis; Ernest A. Le Sueur, Ottawa, Ont., Can. App. filed July 19, 1918.

1,300,431. Battery Terminal; Joseph O. Luthy, San Antonio, Tex. App. filed July 1, 1918.

1,300,440. Radiator Heater; Chauncey L. C. Magee, Chicago, Ill. App. filed April 25, 1918.

1,300,483. Rheostat; Edward Podsenick, Brooklyn, N. Y. App. filed March 28, 1916. Series resistance.

1,300,484. Circuit Controller; Guy R. Radley, Milwaukee, Wis. App. filed March 30, 1914. For electric vehicles.

1,300,491. Paper-Perforating Machine; John T. Schaaff, Washington, D. C. App. filed Nov. 17, 1916. For perforating record cards.

1,300,506. Dynamo-Electric Machine; Charles W. Starker, Pittsburgh, Pa. App. filed Sept. 10, 1914. Made of pressed steel.

1,300,508. Armature for Dynamo-Electric Machines; Charles W. Starker, Pittsburgh, Pa. App. filed Oct. 30, 1916. Small weight for safety cars.

1,300,525. Recording Mechanism; James C. Warren, Fredericksburg, Va. App. filed Oct. 15, 1917. For recording temperatures or pressures.

1,300,539. Polarized Signaling Mechanism; Daniel S. Wilson, West Somerville, Mass. App. filed May 11, 1917. Alternating-current horn.

1,300,542. Series-Multiple Control; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 29, 1914. Phase converters.

1,300,543. System of Phase Modification; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 23, 1917. Power factor of phase converter improved.

1,300,544. System of Phase Modification; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Feb. 23, 1917. Eliminates magnetizing current in stator windings of phase converter.

1,300,545. Starting Phase Converters; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 29, 1914. Stabilizes series generator used as exciter.

1,300,546. Ground Detector; George E. Armstrong, Los Angeles, Cal. App. filed Dec. 27, 1915. Located in substation and sensitive to unbalanced current.

1,300,589. Dynamo-Electric Machine; Joseph Le Conte Davis, Pittsburgh, Pa. App. filed July 29, 1913. High-voltage direct current.

1,300,603. Electric Welding Apparatus; James H. Gravell, Brooklyn, N. Y. App. filed Sept. 7, 1918. Uniform current-carrying contact.

1,300,637. Magneto for Internal-Combustion Engines; Richard A. Oglesby, South Bend, Ind. App. filed March 19, 1917.

1,300,665. Switch; Thomas E. Smith, Los Angeles, Cal. App. filed June 18, 1917. Actuated through single handle.

1,300,690. Meter-Testing Connection; Carl H. Bissell and Harold P. Hastings, Syracuse, N. Y. App. filed Nov. 15, 1913. Meter connected in the feed circuit without interrupting current.

1,300,721. Interchangeable Transmitter Casing; Felix Gottschalk, Hilton, N. J. App. filed March 31, 1916.

Record of Electrical Patents

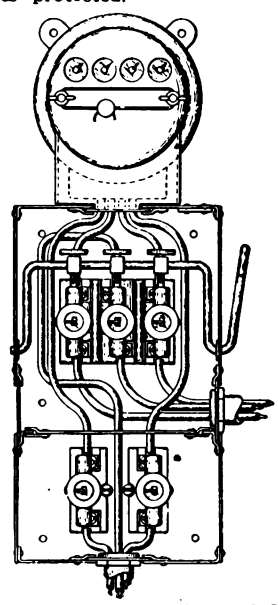
Notes on United States Patents

1,300,742. System of Control; Benjamin G. Lamme, Pittsburgh, Pa. App. filed Jan. 5, 1915. Induction motor for frequency changers.

1,300,774. Weatherproof Plural Lamp Socket; Adolph C. Recker, Oakville, Conn. App. filed June 16, 1917. Weatherproof.

1,300,779. Timer Brush; John H. Richards, August J. Simon and John H. Haas, Overbrook, Kan. App. filed July 10, 1918.

1,300,789. Car and Electric Coupling Device; Charles H. Tomlinson, Mansfield, Ohio. App. filed June 10, 1914. Live contacts protected.



1,301,175—Electric Service and Meter-Testing System

1,300,812. Attachment Plug; Reuben B. Benjamin, Chicago, Ill. App. filed March 15, 1915. Easily assembled.

1,300,827. Electric Lighting Fixture; Garry J. Dormandy, Troy, N. Y. App. filed June 28, 1917. For workbench.

1,300,855. Electric Switch; Don A. Munger, Detroit, Mich. App. filed May 28, 1917. Coil of automatic switch is inclosed in iron case.

1,300,859. Coil-Retaining Device and Method of Assembling the Same; John P. Nikonow, Wilkinsburg, Pa. App. filed Dec. 26, 1913. Strong support of few parts.

1,300,890. Navigational Instrument; Elmer A. Sperry, Brooklyn, N. Y. App. filed Feb. 3, 1915. Accurate readings may be transmitted to other instruments.

1,300,922. Igniter; Phelps Brown, Springfield, Mass. App. filed April 9, 1917.

1,300,970. Engine Starter; Edward S. Huff, Detroit, Mich. App. filed Nov. 16, 1914.

1,301,002. Magneto Coupling; Ralph H. Pierce, Eugene, Ore. App. filed Aug. 29, 1918.

1,301,009. Fuse Plug; Ralph A. Schoenberg, New York, N. Y. App. filed Nov. 11, 1914. Indicates whether fuse has been blown.

1,301,011. Thermostatic Alarm; Floyd L. Scoutten, East Cleveland, Ohio. App. filed March 19, 1915. For furnace flues.

1,301,014. Electric Drive for Gyroscopes; Elmer A. Sperry, Brooklyn, N. Y. App. filed Feb. 9, 1915. Avoids use of starting box.

1,301,050. Electric Motor; Edwin V. Hagman, Boston, Mass. App. filed May 13, 1914. Device for inching motor.

1,301,053. Ignition Device for Motor Vehicles; John A. Heany, Jersey City, N. J. App. filed July 27, 1910.

1,301,077. Electrical Generator; William D. Pennington, French Lick, Ind. App. filed April 12, 1906. Auxiliary electromagnets on field yoke.

1,301,079. Incandescent Lamp; William L. Van Keuren, North Bergen, N. J. App. filed June 15, 1918. Molded insulating material used for base.

1,301,080. Electric System; John L. Creveling, Auburn, N. Y. App. filed May 21, 1915. Automatic operation of batteries floating on line.

(Issued April 22, 1919)

1,299,057. Signal; Edwin L. Storer, Tulsa, Okla. App. filed Aug. 10, 1917.

1,301,088. Motor Controller; Thomas E. Barnum, Milwaukee, Wis. App. filed Jan. 12, 1915. Self-starter for elevator or printing press.

1,301,135. Fixture for Use with Magnetic Chucks; Samuel Karasick, New York, N. Y. App. filed March 28, 1917.

1,301,152. Lamp Socket; Milton W. Morse, Mount Vernon, N. Y. App. filed Aug. 3, 1916. For two-filament lamp.

1,301,175. Electric Service and Meter-Testing System; Joseph Sach, Hartford, Conn. App. filed May 11, 1915. Service connection appliance, placed so as to be accessible only to the authorized person.

1,301,206. Electric Lighting System; Dana E. Wescott, South Bend, Ind. App. filed March 31, 1916. Plurality of lamp circuits controlled from a central station to extinguish the lamps simultaneously.

1,301,212. Automobile Signaling Device; George W. Albright, Kansas City, Mo. App. filed March 9, 1917.

1,301,213. Duplex Printing-Telegraph System; Charles G. Ashley, Toronto, Ont. App. filed May 7, 1917.

1,301,222. Switch Governor; Adolf M. Bruss, Central Butte, Saskatchewan, Canada. App. filed April 12, 1917.

1,301,227. Variable Resistance; Theodore W. Case, Scipio, N. Y. App. filed Oct. 9, 1917. Resistance diminishes as the intensity of the light to which it is exposed increases.

1,301,231. Electric Regulation; John L. Creveling, New York, N. Y. App. filed July 21, 1911. For constant voltage.

1,301,233. Electric Vulcanizer; Oliver C. Dennis, Wilmette, Ill. App. filed March 6, 1917. Flexible cord protected.

1,301,239. Rail Bond; Harold H. Febrey, Newark, N. J. App. filed Aug. 7, 1917.

1,301,246. Receiver for Wireless Signals; Charles S. Franklin, London, Eng. App. filed Feb. 26, 1919.

1,301,253. Portable Electric Lantern; William Grether, Dayton, Ohio. App. filed July 9, 1917. Watertight.

1,301,279. Method of and Means for Controlling Electrical Energy; Irving Langmuir, Schenectady, N. Y. App. filed Nov. 20, 1914. Large variations in the amplitude of the current may be produced.

1,301,331. Electrode for Arc Welding; Reuben S. Smith, Milwaukee, Wis. App. filed Dec. 6, 1918. Slag is not formed.

1,301,334. Electricity Transforming and Converting Apparatus; Henry R. Summerhayes, Schenectady, N. Y. App. filed May 7, 1917. Rotatable transformer, synchronous converter and booster.

1,301,347. Welder's Tool; Roy O. Williams, Columbus, Ohio. App. filed Feb. 24, 1919. Effects support and manipulation of a welder's electrode.

1,301,363. Telephone System; Sidney A. Beyland, Rochester, N. Y. App. filed Sept. 28, 1914.

1,301,396. Traffic Signal; William A. Dau, Detroit, Mich. App. filed April 19, 1916.

1,301,412. Electromagnetic Device; Gustaf W. Elmen, Bogota, N. J. App. filed Oct. 10, 1917. For telephones.

1,301,425. Direct-Current Signaling System; Benjamin F. Gardner, Chicago, Ill. App. filed Nov. 24, 1917.

1,301,434. Electric Meter; Edwin J. Heitman, Philadelphia, Pa. App. filed June 14, 1917. Closing cover damps needle automatically.

1,301,456. Socket for Incandescent Lamps; Oscar Kupferman, Brooklyn, N. Y. App. filed April 6, 1917. Easily disassembled key socket.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, May 17, 1919 *Number* 20

The N. E. L. A. Meeting in Victory

LAST year the National Electric Light Association held its historic "win the war" convention. Next week is to be the "victory" convention. In 1918 the resolution which was adopted with great enthusiasm by the convention called for war to "a victory so complete and overwhelming that the forces of evil will be glad to accept such terms as an outraged world may be willing in justice to accord."

The association meeting almost coincides with the presentation of the terms to the defeated mad power that sought world dominion. Curtailed though the proceedings of last year's convention were, they served to put the industry on imperishable record as desiring to serve the nation in every way. This year is the first opportunity of the association, as representing the country-wide membership of a great industry, to take stock of its gains and losses in the war period and to begin to meet the new problems which are gathering.

Delegates who will gather at Atlantic City in the coming week have abundant cause for thanksgiving over the victory of the nation and its allies. With good reason to be proud of the past achievements, they will also sense clearly the dangers brought by the shattering of many precedents and the reconstruction policies now in process of crystallization. There is a sobering consciousness of weighty issues which the industry will have to face as a unit if it is to meet them successfully. It is not a time for a divided house. Joined forces will present a stronger front than sundered camps of dissociated interests. On the great questions of the times—affecting the conservation of investments, the rigid economy of operation, the continuation of expansion to provide for community power requirements as or before they are actually needed—the industry has neither room nor desire for difference. To make every central-station operator in the country realize that these are the really vital matters is the task which logically falls to the executives, leaders and supporters of the N. E. L. A.

The power which the N. E. L. A. can wield is a vast one. It should not be minimized. It should receive the full recognition of the membership to the end that its wise direction may result in substantial benefit to the industry. At all times the central-station industry should have an organization capable of grasping any exigency that may arise. Its leaders are all men of recognized parts in their individual communities. There is just as much necessity that they shall be recognized as having unselfish and civic parts in national life. That they may be sympathetically kept together by a national organization is the present mission of the N. E. L. A. It is a mission whose importance the world-wide unrest of these times sharply accentuates.

The influence of the central-station industry will be directed naturally to strengthen constructive movements. This influence may be exerted most effectively and with the greatest possible benefit only if there is little lost motion. The vigorous power innate in the N. E. L. A. is a factor in helping to preserve the structure of society.

A silent revolution in industrial production methods has been accomplished in the transition from war to a peace basis of output. That so large a proportion of the installed electrical equipment has been kept out of the second-hand market speaks volumes for the flexibility and efficiency of electrical service.

The War and After

WE ARE presenting in the current issue a conspective view from various parts of the country as to the conditions imposed on the central-station industry by the continuance of the war and by its sudden cessation at the signing of the armistice. The several reports from different portions of the nation all join in showing the tremendous burden which was placed on the electrical supply companies of the country by the industrial activity of the war, the shortage of fuel and the equally serious shortage of labor. The situation at the start was a very grave one, since not only was the immediate general demand for industrial power great, but it increased rapidly as the country's activities got under way and the rising cost of fuel, to say nothing of the difficulty of getting it, bore more heavily upon every manufacturer requiring power. This burden was of necessity in very large measure transferred to the central stations, which faced the situation manfully and in spite of vast trouble in getting supplies and fuel pulled the country through its crisis of production with a vigor and success which should be the subject of nation-wide congratulations. Then came the sudden stopping of war work when the victory was won, the shutting down of many factories, and the danger to the supply companies of finding themselves with greatly increased investments and lessened business. But the general situation with respect to electrical supply had changed with all the other industrial changes; the burden of operating certain types of isolated plants had become more evident, the value of electrical service more keenly felt.

To sum up the situation briefly, it has so turned out that the central-station industry has on the whole kept most of the output it had won. It has found through necessity a closer touch with public needs, a better appreciation of the services it has rendered; and to-day the industry bids fair to go on very nearly upon the

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plane established by war needs, losing here, gaining there, but on the whole in a stronger position than when it made, two years ago, the supreme effort to meet the requirements that were thrust upon it. Through a remarkable display of energy in providing for the needs of the community it has won a place from which it is not likely to retreat and an appreciation which will strengthen its growth in the future.

Irresponsible, indifferent and sometimes omitted meter readings created a peck of trouble in the past year, even among well-managed central stations. Lost good will must be overcome by a new spirit of service on the part of employees constantly meeting the public.

The Story from New England

THE history of the war demands in New England and of the successful struggle of the central stations to meet them is one chiefly of forced equipment, station efficiency and interconnection upon a large scale. During the four years of the war the combined capacity of the large New England plants was increased more than 50 per cent, the connected loads by something like 75 per cent. The combined peak, neglecting diversity factor, was increased by a similar amount. As the war went on the equipment was worked more and more intensively, and the rising price of fuel compelled renewed attention to the minor economies of power-house operation. It is notable that under these conditions the average coal consumption per kilowatt-hour was lowered by nearly 10 per cent in spite of the many shipments of fuel of somewhat uncertain quality. The coal situation was indeed serious. The cost of fuel was in general nearly or quite doubled, and some companies had to pay $10 to $12 per ton and were lucky to get it at that. But for the determined efforts to better utilization of fuel the total cost of coal consumed would have risen much higher than it did. As it was, the aggregate in 1918 was two and eight-tenths times that of four years previously. New England quite certainly suffered more than any other section of the country from the shortage, and but for the efforts of the territorial fuel administrator very real hardship would have been suffered by the central-station industry, for the exigencies and influences of the situation tended to divert coal away from the northeastern section of the country.

To meet the rising cost of fuel a large proportion of the central stations introduced coal clauses in their contracts, which on the whole were taken in good part by the public as an unpleasant war-time necessity. Another item of expense not so easily recouped was the necessary high increase in investment to meet the increasing demand, to say nothing of added costs of labor. No small degree of relief was obtained in this territory by steadily increasing interconnection between the larger systems. The hydroelectric transmission lines of the New England Power Company and the Turners Falls Power & Electric Company have been tied in with the majority of the central stations in western Massachusetts together with parts of southern Vermont, New Hampshire, Rhode Island and Connecticut, reaching to the northward the hydroelectric systems of the Merrimac valley and southward to Long Island Sound. Even the larger stations in the territory, themselves able to produce power economically, took advantage of interchange with the hydroelectric companies and with each other, so that their amounts of purchased power have risen notably. There have been great increases, too, in the capacity both of the water-power and the steam plants, mainly in big units, although it is interesting to note that the needs of war service forced into use again some of the large engine-driven units which had been, so to speak, laid on the shelf after the coming of the turbine. On the whole, the close of the war has produced relatively little effect in the New England plants, much less than would offhand have been expected. The significance of this relatively small drop in output is noteworthy. In some places occupied very largely with munitions the loss in load was considerable, but the general requirements of the manufacturing situation, the abandonment of uneconomical isolated plants no longer able to make a fair showing in face of the high costs of fuel and labor, and the general prosperity of the country, have had a strong influence in uplifting load and earnings.

A mighty demand for water-power development under practicable laws should be made upon the incoming Congress. While we bicker over minor details, other nations are ordering hydroelectric equipment and advertising cheap power.

Southern Hydroelectric Systems

FROM the very beginning of long-distance transmission the South has occupied a prominent place in the utilization of its water powers and the construction of high-voltage lines. The name of the Southern Power Company appears in this development as far back as 1905, when that company was formed to take over a 10,000-volt hydroelectric plant on the Catawba River built in 1900 and to operate a 13,000-volt transmission system which had its beginning in 1895. It was in the latter year that the Fresno-Sacramento plant in California was placed in operation, with the first polyphase transmission line operating at 10,000 volts. In 1915 the Southern Power Company had in operation more than 1500 miles (2400 km.) of transmission lines, six water-power stations and four steam stations, aggregating more than 150,000 hp. To-day it operates 2100 miles (3380 km.) of single-circuit transmission lines fed by eight hydroelectric stations and is one of the most important factors in industrial development in this country. This is evidenced by the fact that 90 per cent of its load is made up of cotton mills and factories of North and South Carolina.

Coincident with the development of the transmission system of the Carolinas, there has come into existence almost entirely since 1910 the interconnected network of high-voltage power lines, shown in an illustration elsewhere, which covers the greater part of five states and stretches from Henderson, N. C., on the east to Tuscaloosa, Ala., on the west, something like 1000 miles (1600 km.) in a straight line. This system if superimposed upon the Northern States would extend from Boston, Mass., past Cleveland, Ohio, and touch Roanoke, Va., on the south. It involves twenty-three hydroelectric stations and fourteen steam plants and more than 4000 miles (6400 km.) of high-voltage, wood-pole and steel-tower lines, carrying in the majority of cases two circuits.

Not only have the Southern hydroelectric possibilities been well and wisely developed but the further oppor-

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tunity of securing maximum efficiency and reliability has been grasped by tying together the systems depending upon the stream flow of several rivers. The wisdom and benefit of this arrangement were proved in the winter of 1917-18, when low water in North Georgia was supplemented by the exchange of power from neighbor plants not fully loaded. Aside from the extensions to serve government cantonments and in connection with nitrate production in northern Alabama, the Southern systems during the war were forced to expand under the pressure of natural increase of Southern industries. Important among the new developments are two new hydroelectric stations and 100 miles (160 km.) of transmission lines built by the Southern Power Company and about 90 miles (144 km.) of lines built by the Alabama Power Company, together with extensions to its substations and the doubling of the rating of a reserve steam plant. High costs of construction, lack of labor and inadequate rates of return for electric service have hindered development in other sections of the South, but this must come at an early date, for the Southern States are now reconstructed, alive with industry and possessed of a general spirit of confidence in the future that is inspiring investors and enlivening business activity in all lines.

The public is sensible of the need of high taxes to meet war outlays, but it will insist upon more efficient expenditure in future. The days of embarking upon magnificent projects financed by easy money and accelerated by governmental extravagance are over for the present, if we mistake not the temper of the people.

The Middle Atlantic States

THIS territory was the center of the heaviest war work of the last four years. Most of the big shipbuilding plants were there, and there also were made the heavy guns and the ammunition for them, to say nothing of an enormous amount of miscellaneous material. Therefore, on the whole, the greatest percentage of strictly war load which had not reached its maximum possibilities before the signing of the armistice was in that district. Within the sphere of influence of the Philadelphia Electric Company 90 per cent of the industries were engaged upon war orders, and the total load but for the armistice would have reached more than 600,000 hp. at the end of the year. An interesting feature of this situation is that the peak demand increased only 13 per cent because of extreme measures taken to conserve power resources, curtailments in other uses of electricity and the increase of output in very many cases obtained by going to three shifts. The effect of this particular change, while lowering the maximum demand which otherwise would have been incurred, was to produce a complete overlapping of the peaks due to various sources. The contravening factors in the demand were curtailment of sign lighting, disconnection of the less essential industries during the peak, and the effect of the daylight-saving law, which threw the lighting peak to a later hour.

Very strenuous efforts were necessary to take care of the added load, and 60,000 kw. was added to the plant equipment in the Chester station in addition to increases elsewhere. The new plant was interconnected with the old one by 66,000-volt transmission, which passed through a region of very intensive war activities and enabled added load there to be carried. Still further preparations of great extent were made for increased capacity not yet realized at the close of hostilities, and great additions were also made in the distributing system, including in all nearly 1300 miles (2090 km.) of conductors. In spite of the nature of the load there was no marked decrease after the armistice, for the curtailed load came promptly back again increased by a considerable volume of new business.

From the hydroelectric viewpoint the result of the new demands was certainly beneficial to operating characteristics. The Pennsylvania Water Power Company devoted itself, for instance, to improve methods of load dispatching directed in particular toward raising the power factor by carrying the wattless load on already underloaded steam auxiliaries so as to throw a pure power load, as far as possible, on to the hydraulic plant.

The Pittsburgh territory, too, was hard put to it by war demands, for in this territory such manufacture was in enormous bulk. One industrial plant alone added more than 20,000 kw. to its output. The bulk of the stress fell on the Duquesne Light Company, the output of which had to be forced desperately by pushing the stokers regardless of economy, and emergency connections were also provided to permit interchange of power between this and other plants. The addition of a 40,000-kw. turbo-generator greatly relieved the situation. Here in the heart of the coal country there was really serious trouble with fuel, and at times the main trouble was with exceptionally poor fuel with high ash and low heating value. Here again load dispatching to relieve the power factor was found useful.

In adjacent territory the West Penn Power Company did most efficient work, especially in stiffening the production of coal mines and furnishing large amounts of power to steel plants in the vicinity. An additional mouth-of-the-mine plant of 40,000 kw. at the start was under construction at the close of the year.

Outside of Pennsylvania there were great increases in demand in the territory between Buffalo and Albany, particularly about Rochester. In the hydraulic plants thereabouts an improved development furnished 25,000 kw. in large units, and considerable water storage was provided. During the last two years not only was all the water power available called for, but the steam plants were pushed to the limit, with the usual trouble in obtaining proper fuel. The power transmissions from Niagara did sterling service all the way along their territory. There was not here much deliberate curtailment, but many of the less essential industries were automatically reduced by difficulties in obtaining material and labor. Here again the loss of load since the armistice has been less than anticipated.

At the other end of the Middle State territory lies the system about Baltimore, which had to deal with extreme loads. Its steam plant had to be utilized to its utmost capacity, and unfortunately the extensions which had been planned far enough in advance could not be completed at the time desired. A very notable feature of this plant was a load factor of 73 per cent even on the day of its highest peak load, due to the extraordinary diversity factor of the industries served and by most skillful efforts at building up the hollows. Here again the diminution in load since the armistice is less than was expected, and already some of it is being regained.

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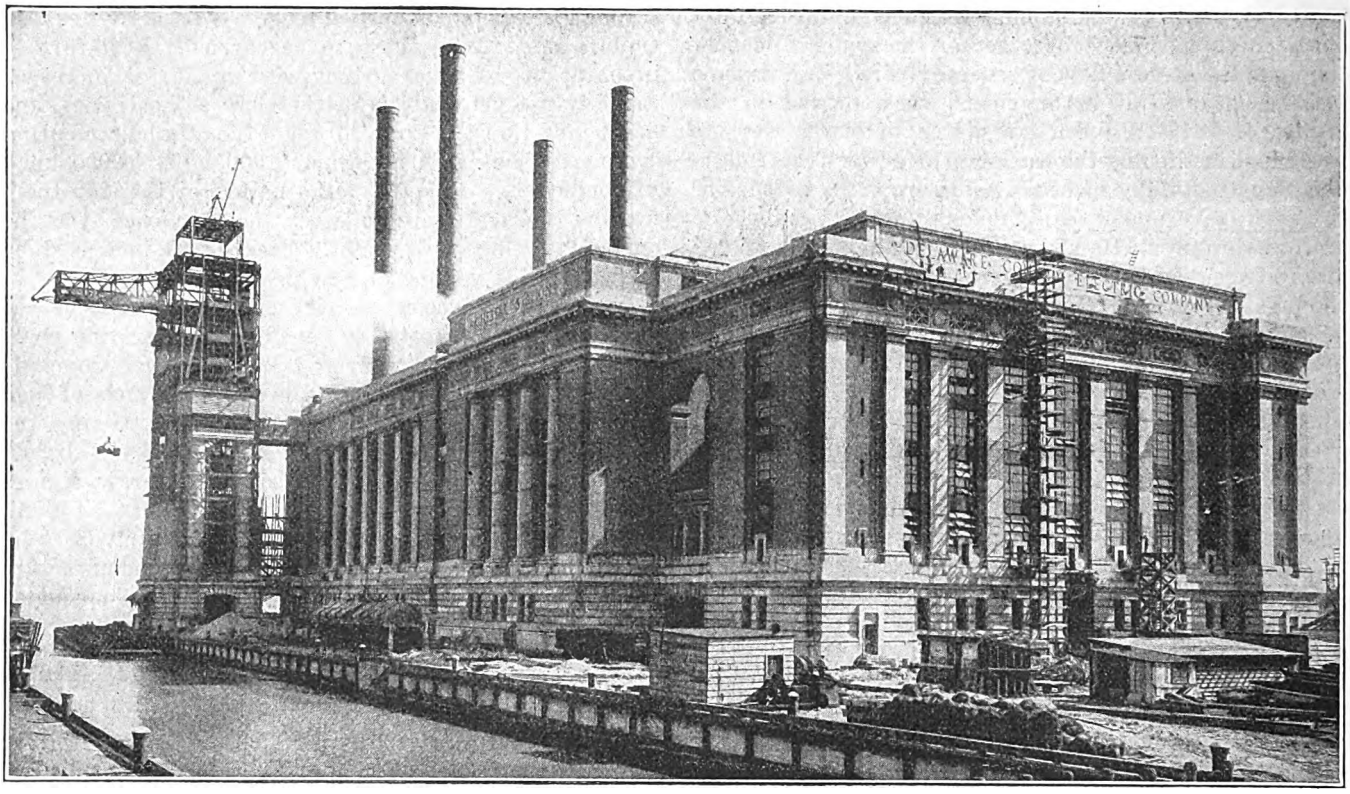

Promising Outlook for Eastern Companies

Armistice Caused Only Temporary Slump in Business, and Central-Station Output Is Again Increasing and Is Better than a Year Ago—Present Situation Outlined for Several Communities

BEING in the heart of the shipbuilding, steel, coal and electrochemical industries, the larger electric service companies of the Middle Atlantic States had a big responsibility thrust on them during the war, and they met it admirably by carrying every war load thrown on them. They realized the importance of the situation and coöperated with the War Department nobly, operating their equipment to the limit regardless of economy and maintenance expense and exchanging surplus energy with adjacent companies wherever possible to assure the most reliable supply of energy to their consumers. They worked against unprecedented obstacles like enormous increases in load, scarcity of good fuel, slow deliveries of new equipment, shortage of good labor and high operating expenses but weathered the gale by virtue of the ability to handle an emergency situation and sailed through without interruptions of service which would have been of far-reaching seriousness. The way in which they met their responsibility is eloquent testimony to the long-argued advantages of central-station service over isolated-plant service, the central stations being the only ones which could expand quickly and which could be dealt with as a body by the government to meet an emergency. It is true that some of the less essential industries had to be curtailed for lack of power, but the companies had a very short time to get into swing and were just getting to the point where they could have taken on every load that they would be called upon to serve. That the advantages of central-station service are better recognized than ever before is shown by the fact that the loads dropped off only slightly after the armistice was signed and are again increasing on every system reported in the Middle Atlantic States. As several important industrial-plant managers have said, the rate of increase in industrial load is now limited only by the fact that the government has not definitely stated how it is going to settle the claims of manufacturers who were engaged in war work. As soon as this is done the industries will be prepared to finance new undertakings.

H.P. CONN. LOAD Dec. 31, 1917	CONNECTED LOAD AND WAR REQUIREMENTS TO BE MET DURING 1918	H.P. CONN. LOAD FOR WAR REQUIRMTS	TOTAL H.P. CONN. LOAD EXPECTED Dec. 31, 1918	PER CENT. OF TOTAL
30,945	SHIPBUILDING	96,525	127,470	20.6
17,437	MUNITIONS	11,557	28,994	4.7
7,709	ORDNANCE	17,458	25,167	4.1
16,451	QUARTERMASTER	7,307	23,758	3.8
23,991	MISC. INDUSTRIES ON GOVT. WORK	18,106	42,097	6.8
45,703	TRANSPORTATION	17,312	63,015	10.2
1,495	PUBLIC UTILITIES	2,145	3,640	0.6
—	MISCELLANEOUS	6,836	6,836	1.0
24,023	SMALL INDUSTRIES LESS THAN 100 H.P.	3,789	27,812	4.5
62,947	COMMERCIAL POWER	6,077	69,024	11.1
173,749	COMMERCIAL LIGHT	17,008	190,757	30.8
11,030	MUNICIPAL LIGHT	102	11,132	1.8
415,480	TOTAL	204,222	619,702	100.0

Connected Load Dec. 31, 1917 — H.P. CONN. LOAD IN 1918 — War Requirements for 1918 partly conn.

FIG. 1—WAR PROGRAM OF PHILADELPHIA COMPANY

Public utilities, like virtually all other business, experienced enormous increases in construction and operating costs during the war period, and the high prices obtaining during the years 1917 and 1918 are still prevalent. This condition naturally brought about a curtailment of all but the most urgent expenditures in the public

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utility field, where margins of profit had been none too large even in pre-war times, and the huge additional expense of operation brought about by the war made the problem of financing extensions and developments so different as practically to cause a cessation of construction work, except that which was absolutely essential. No doubt, however, the work which has been

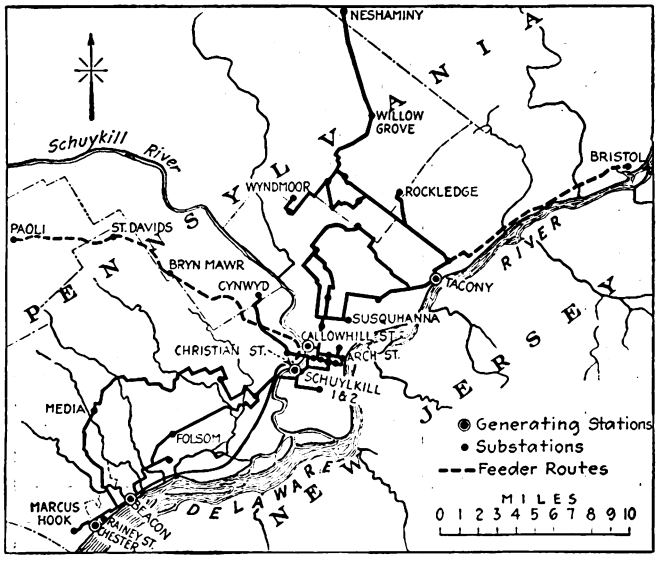

FIG. 2—TERRITORY SERVED BY PHILADELPHIA COMPANY

delayed during the war will increase the volume of construction which will be undertaken when conditions are more favorable.

During the war the replacement value of plant equipment increased so appreciably that in order to maintain adequate insurance protection thereon considerable additions in premiums had to be paid. In addition, the yearly taxes—municipal, state and federal—advanced so enormously that a tremendous burden was added to the already high operating expenses of public utilities. In view of the fact that operating expenses plus taxes are becoming such a large proportion of the income, about the only relief lies in still greater economies, growth of business or increases of rate. Some broad-minded commissions have recognized the need of the latter and have granted them.

To review the growth, accomplishments and vicissitudes of central stations in the Middle Atlantic States some specific examples of what occurred on some of the larger systems or those serving important industrial centers will be cited.

Philadelphia

Within the territory served directly and indirectly from the Philadelphia Electric Company system, 90 per cent of the industries were engaged in the fulfillment of war orders. The aggregate of shipbuilding capacity within this area well exceeds that of any other location in the United States, and the power requirements of this industry together with those of the numerous others working on war essentials had to be met and adequately provided.

The war program affecting these activities became well defined early in 1918, and the outline of these requirements is shown in Fig. 1. This program was not carried entirely through, owing to the signing of the armistice, so the connected load, which was expected to reach a total of 619,702 hp. at the end of 1918, was limited to 482,000 hp., an increase of 28 per cent from April, 1917, to the end of 1918. The peak demand increased only 13 per cent because of curtailments arranged and ordered by the War Department and other measures taken with a view of effecting a saving in the resources available and their proper distribution to meet the emergency in the most useful and efficient manner possible.

To take care of the additional load requirements suddenly arising from the war activities, the Philadelphia Electric Company hastened to bring to completion part of its program of extension and finished on short notice one-half of its Chester station, located in the center of an important and continuously growing industrial district on the Delaware River. This plant (see headpiece on page 984) will have an ultimate generating capacity of 120,000 kw. in four 30,000-kw. steam turbo-generator units, of which two only have been installed. In addition, one 20,000-kw. steam turbo-generator was installed in the Schuylkill station to replace two 5000-kw. vertical turbo-generators, thus securing greater capacity and greater economy of operation. It was also necessary to increase the steam generating capacity at the Tacony station by the erection of a new and complete boiler room of 3000 hp. in two stoker-fired boilers with ash and coal handling equipment.

To secure the greatest economy of operation, together with the largest possible generating capacity, and to make it available to the entire system, it was necessary to interconnect the Chester station with the Schuylkill station in Philadelphia, through a 32-mile (51-km.) 66,000-volt, double-circuit, steel-tower transmission line with an outdoor substation at each end rated at 30,000-kva. transformer capacity. Through this medium it was possible to eliminate standby units in each plant and at the same time secure the full benefit of diversity factor of the system, considerably increase the generating capacity available throughout, and insure a greater reliability of service. This high-tension line also served another very useful purpose.

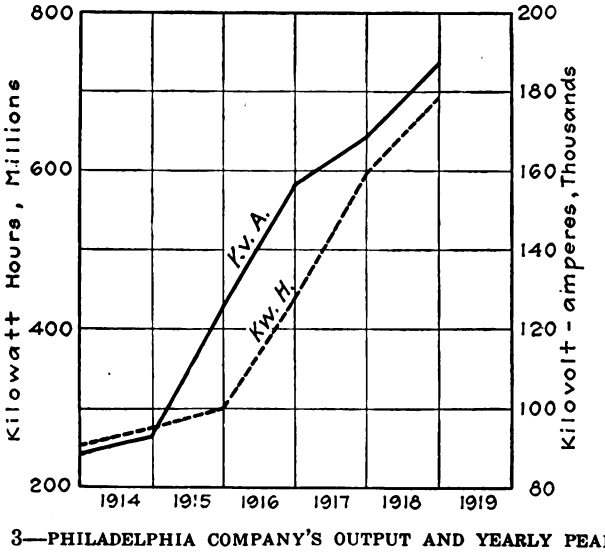

FIG. 3—PHILADELPHIA COMPANY'S OUTPUT AND YEARLY PEAK LOADS FOR PERIOD OF WAR

Passing through an important industrial district, the site of the largest war activities, such as the Hog Island Shipyard, the new Westinghouse turbine plant, the Remington munition plant, the Baldwin Locomotive Works, the Sun and Chester shipbuilding industries, etc., it made possible the supply of these requirements

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and in addition was of sufficient capacity to fulfill the dual purpose of a feeder and interconnecting line.

In order to take care of the constantly increasing power requirements in the central and northern Philadelphia districts, a convenient site on the Delaware River was acquired and the work of construction begun for the new upper Delaware station, which is so situated as to supply these districts economically. The contemplated ultimate capacity of this station will be 180,000 kw. in steam turbo-generators. In view of the uncertainty in the coal supply and its transportation it was necessary to acquire a coal-storage ground at Petty's Island on the Delaware River and equip it with coal-loading and unloading facilities up to 400,000 tons capacity, the coal being received either by water or rail.

To provide a greater flexibility and margin in the power available between the 25-cycle and 60-cycle generating system, 9000 additional kw. in frequency changers was installed at the Schuylkill station.

For the distribution of power considerable additions were made to the transmission and distribution system, approximately 50 miles (80 km.) of 13,200-volt feeders, 1223 miles (1967 km.) of miscellaneous distribution wire and over 11,000 kva. in distribution transformers being installed. The Hunting Park substation was built with 15,000 kva. initial transformer capacity;

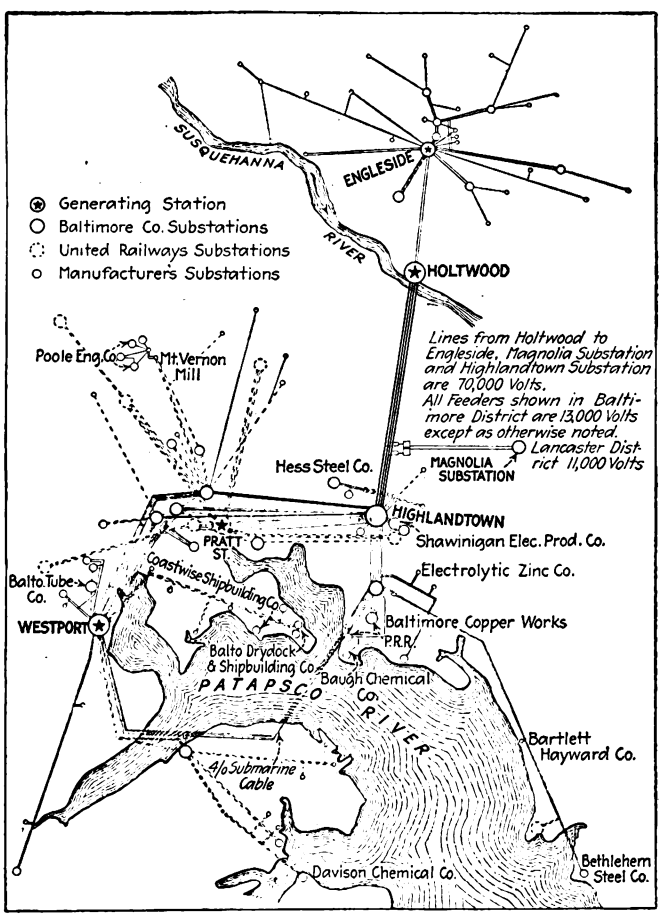

FIG. 4 — DISTRICT SERVED BY BALTIMORE COMPANY AND CONNECTIONS WITH PENNSYLVANIA WATER POWER COMPANY

7500 kva. transformer capacity was added to the Tacony station, and 3750 kw. in rotary converters was also added to the system. In addition to other extensions, 36,000 kva. in industrial substations were installed within the customers' premises.

The increase in war activities changed power demand from a one-shift to a three-shift-a-day basis, which demand definitely overlapped the peaks in the lighting and railway demand, tending to overload all available generating equipment. Curtailment of street sign lighting, disconnection of the less essential industries during peak periods, voluntary decrease in residence lighting by the public and the daylight-saving law served to keep the peak demand within the station's

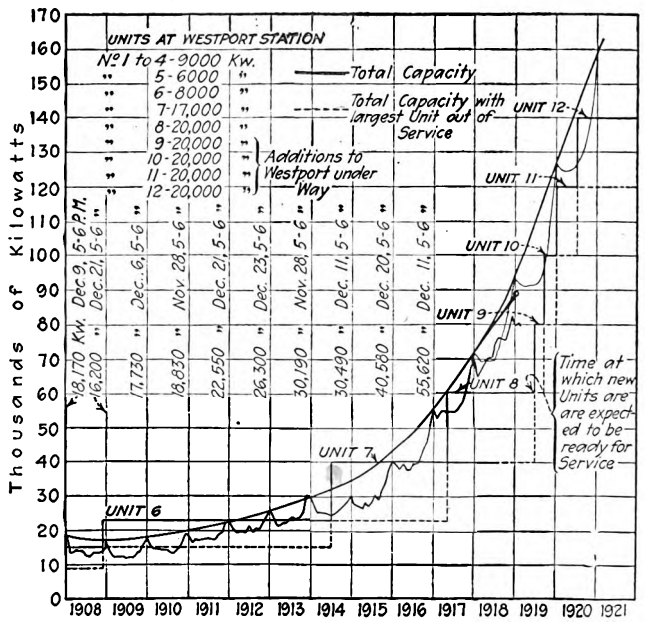

FIG. 5—PEAK LOADS OF BALTIMORE COMPANY WITH GENERATING CAPACITY AVAILABLE AT ALL TIMES

capacity. The discontinuance of the daylight-saving law necessitated greater sacrifices of power loads.

Notwithstanding all efforts made to carry out further the program of developments in generating capacity, transmission, substation and distribution equipment of the system as laid out by the Philadelphia Electric Company at the inception of the war, the additions were not quite proportional to the additional load demand because of the sudden great increase in war industry requirements. The situation was, however, met by caring for the war industries at the expense of industries of less essential character in accordance with a classification by order of importance. Besides, operating conditions were the object of a special study and so adjusted as to secure the greatest benefit of the diversity factor. Improvements in operating economies and schedules of operation adapted to the special situation made feasible the greatest possible system capacity during the emergency.

A serious decrease in load was not experienced after the signing of the armistice, owing to the release of the less essential loads and the addition of new load demands. The signing of the armistice resulted in an early annual peak for the system, which otherwise would have occurred at a later period of the year and at an increased value.

New extensions to the system are being considered, including additions to generating station capacity, increase in substation equipment and extensions in transmission and distribution lines. Voltage regulation of 66,000-volt tie lines by use of 13,200-volt induction type regulators is among the contemplated improvements to be made this year.

The complications which arose from the state of war of the country, resulting from the mobilization of most

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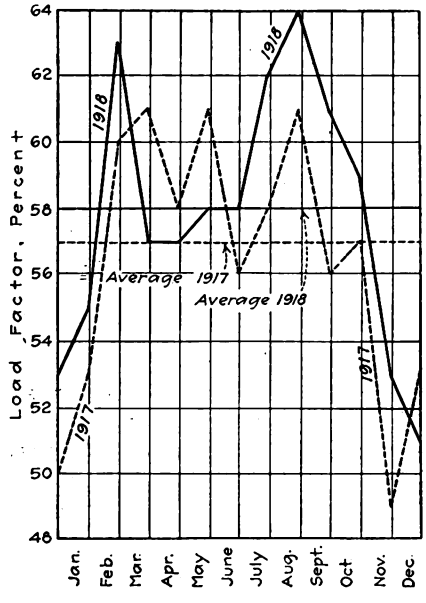
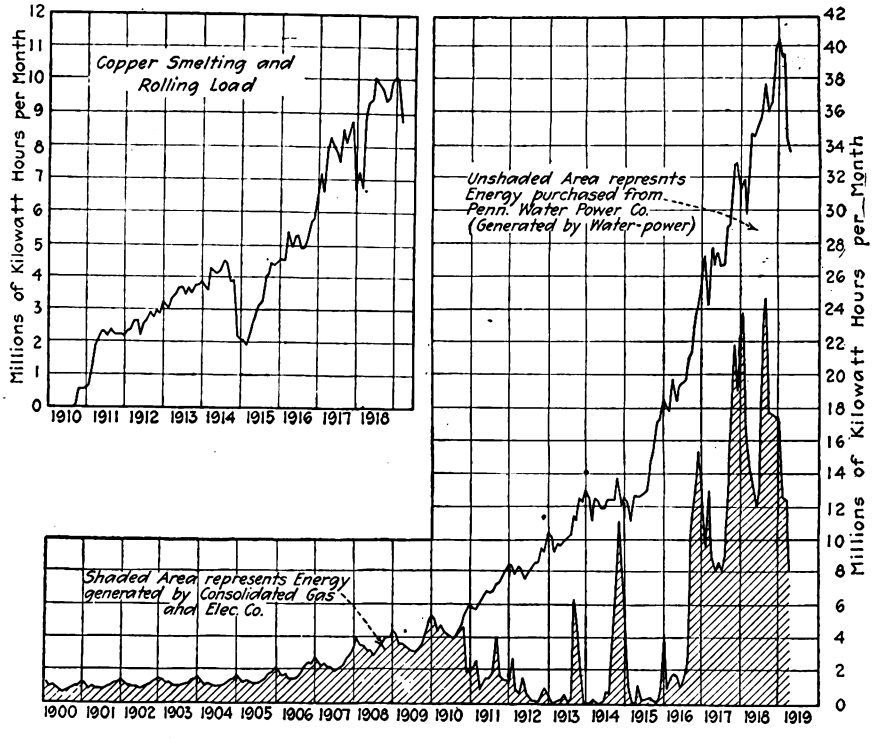
of its resources, greatly affected the central-station service in all its branches. A new and entirely abnormal situation had to be met. Financial, labor, supplies and materials, operating and maintenance problems of an unusual character had to be solved promptly and economically because of the paramount importance of saving and preserving all resources available and bending all efforts to speed of production and maximum efficiency.

All these requirements were answered during this period, and the final cost of the central-station service was maintained as low as was consistent with its quality. These results were obtained through timely addition of new and naturally more efficient plants, labor-saving devices, greater efficiency in management and personal sacrifices made by the entire organization of the company.





FIGS. 6, 7 AND 8—EFFECT OF WAR ON LOAD FACTOR OF PHILADELPHIA COMPANY, ON A TYPICAL WAR INDUSTRY IN BALTIMORE AND ON THE OUTPUT OF THE BALTIMQRE COMPANY

Baltimore

Some indication of the rate at which steel, copper, shipbuilding and other industrial loads in Baltimore increased after the European war started is given by the curve for a particular plant in Fig. 7 and by the company's peak-load and energy output curves for 1910 to date. To meet this demand the Baltimore Gas & Electric Company more than doubled its steam generating capacity to supplement the power available from the Pennsylvania Water Power Company. While the monthly peak loads never exceeded the available steam capacity to any extent until 1913, they did exceed it considerably during the winter of 1916-1917, and especially after the latter part of 1917. If the new 20,000-kw. turbines which were on order at the time and are now being installed had been ready for service when planned, there would not have been the great divergence between peak load and steam generating capacity that now exists.

Fortunately, however, the Baltimore company had been purchasing hydroelectric energy from the Pennsylvania Water Power Company since the latter part of 1910, so all the power that could be obtained from its Holtwood plant was utilized to meet the war emergency. The fact that the water-power company had a sort of industrial flywheel on its system, in the form of the Shawinigan Electro-Products Company, to which it only had to supply surplus energy, helped considerably during peak loads when the plant could be cut off and the power which was released supplied to the Baltimore company. However, the water-power supply is variable, owing to seasonal changes in river flow, so that the Baltimore company had to operate its steam station to capacity on many occasions.

In heavy-flow seasons not so much energy had to be generated by steam, the steam plant being used only to carry peaks. In low periods the reverse happened—*i.e.*, the steam plant carried the base load and the water was allowed to accumulate behind the dam at Holtwood so that station could carry the peaks. From 1910 to the middle of 1913 the amount of purchased power was on the increase and generation of steam was on the decrease. Since then, however, larger and larger amounts of energy have been generated by steam. When the new 20,000-kw. units in the Westport station are ready for service, more steam-generated power can be available in case of interruption to water power and will be used because only a limited amount of power is available from Holtwood anyway. The 1917 portion of the energy-consumption curves shows this limitation in water power clearly.

Owing to the limitations in power available during the war, the automatic increase of load, the shortage of man power and the fact that such men as were available had to be used to help handle the increased business due to the war, there was not the customary solicitation of new business. In fact, so much business came in unsolicited that the less essential industries had to be notified to curtail their demands during peak loads. None had to be cut off, however, because of the steps taken to provide sufficient power and because

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some complied with the request to curtail demands. Active solicitation of business has not been resumed yet on the usual scale, although it will be in the near future, when conditions become more certain.

Construction and extensions, of course, were curtailed during the war, but an 80,000-kw. extension to the Westport plant was carried on for the reasons previously mentioned and is now nearing completion. Difficulty was experienced in securing material and labor, but priority ratings were obtained, which helped considerably. Because of the fact that there was no room in existing substations for additional equipment, a new substation was built in the downtown district, from start to finish, for two 2000-kw. rotaries. One particularly interesting feat accomplished during the war was the laying of four 26,000-volt, 12,000-kva. submarine cables across the bay to the south of Westport station to serve industrial plants in that district and supplement the overloaded cables already running through the business section of the city. Six other No. 4/0 13,000-volt cables will be laid between Westport and Pratt to give a carrying capacity between these points comparable with that from Holtwood. To permit operating the existing cables to their maximum capacity many of them are cooled with water by perforated pipes laid in the ducts. Increased radiation has been permitted on the newer duct lines laid by making them only two ducts wide and eliminating the concrete on the outer sides.

One interesting fact in connection with the load is its high load factor (73 per cent) even on the day of the peak load. The load factor was brought to this high value by the diverse requirements of Baltimore's industries and by the carefully planned soliciting of business which filled up valleys that existed in the load curve.

Despite the great stimulation of industry by the war, there was little falling off in load after the armistice was signed until March, 1919. This drop, which has probably run its rope, was not due to the ending of the war alone, but partly to the seasonal drop always experienced after the first of the year and to the slump in the copper market. It is interesting, also, to point out that the commercial business of the company for

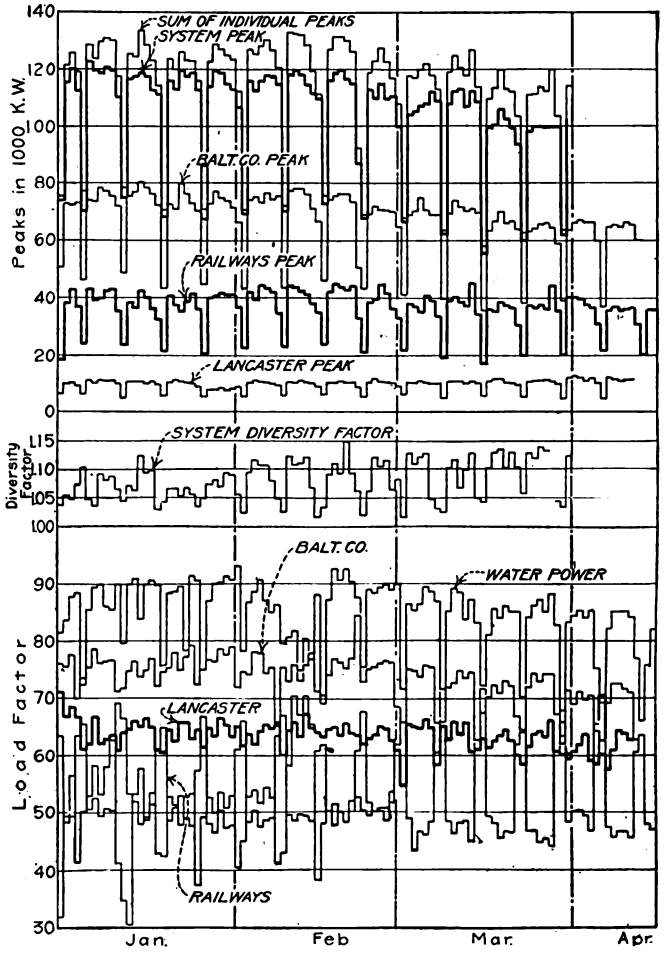

FIG. 10 — SYSTEM DIVERSITY FACTOR, PEAK LOADS AND LOAD FACTORS OF COMPANIES INTERCONNECTED WITH PENNSYLVANIA WATER POWER COMPANY

does not believe that it will come into extensive use until good-grade fuel is scarcer or the difference in price of low and high grade fuel is enough to justify the expenditure for powdered-fuel equipment. Good-grade coal is now available in quantities, provided pur-

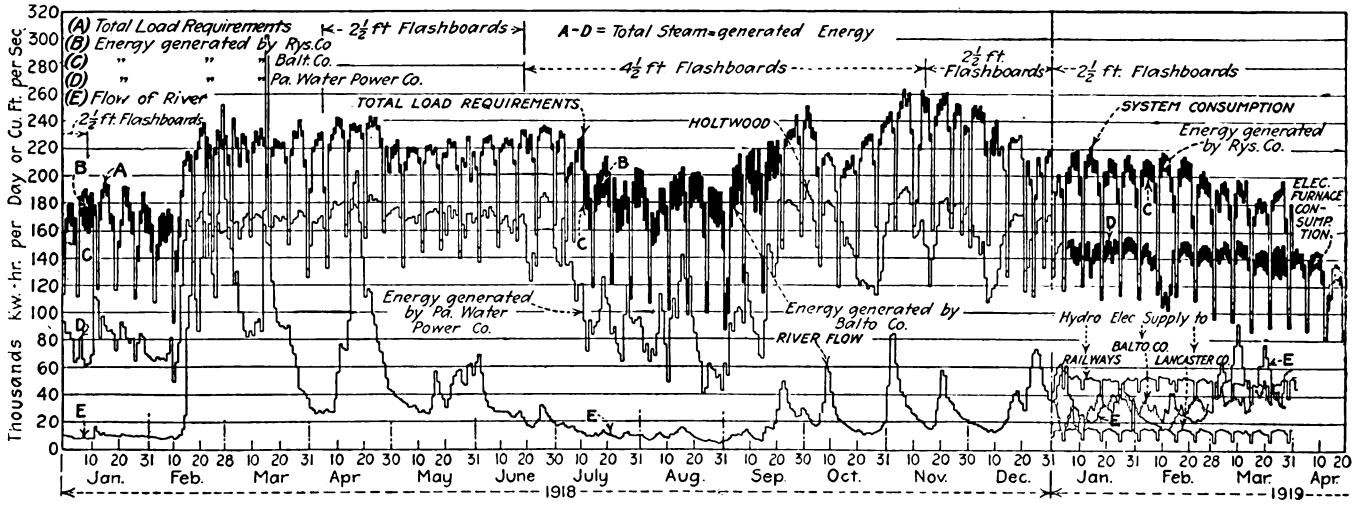

FIG. 9 — HOW GENERATION OF ENERGY WAS SHARED BY COMPANIES CONNECTED WITH THE PENNSYLVANIA WATER POWER COMPANY

March, 1919, is 11 per cent in excess of a year ago, and there is an upward trend again.

The company is now studying the advisability of burning powdered fuel under its boilers, but so far

chasers know the mines and veins producing it. Companies cannot depend too much on mine samples or published analyses, the best test being to burn different kinds of coal under operating conditions.

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Pennsylvania Water Power Company.—Considerable attention was given during the war by this company to obtaining the maximum use from equipment, insuring higher economy, providing more reliable service and improving operating methods in general. Wattless component dispatching, as distinguished from ordinary load dispatching, is one of the most interesting subjects which have been under consideration, and establishment of such a practice has great promise of benefits. While the investigation in this direction has not been completed, considerable has been accomplished in outlining the factors which will have to be considered and in following this scheme on a moderate scale. Need of such a practice exists because the water-power plant is often limited in its output by power factor when plenty of water is available. By so exciting the underloaded steam-driven generators on the system that they will supply all the wattless current the water-power equipment can be made to develop the maximum actual power with practically no added expense (water being free), the steam-driven generators are relieved of part of their load with a consequent saving in fuel, and only a small amount of coal is required to make the steam-driven units supply the wattless current. The problem is to know definitely the sources of poor power factor and the magnitude of the wattless component at every moment, so the system load dispatcher can determine the portion of wattless component which each station shall supply. This is being studied very systematically by means of wattless-hour meters.

Charting all maintenance work which has to be done on all parts of the system so that as many jobs can be handled at once as possible has resulted in minimizing energy losses. Instead of shutting down haphazardly any portion of the system to remedy only one or closely related cases of trouble as is usually done by many companies, this company lists all work that needs attention, and when any urgent repair work is necessary all other accumulated trouble is remedied at the same time. Whereas by the old method production was curtailed or line losses were increased (where load was shifted from four lines to three), line losses are now almost cut in half for the same amount of work done. Closely related to this economy measure is the listing of estimated loss in output caused by interrupting service. These data give the operators a very tangible picture of the value of keeping equipment in service.

From data based on previous tests and performance the company has also established certain unit economies (kilowatt-hours per cubic foot per second of river flow) which can be realized, and these have been established as a basis toward which operators should work. In the very brief period during which this practice has been in use improvements in economy of 3.2 per cent have been accomplished and much better results are expected when this scheme is in full force.

During the war there was such a demand on the sys-

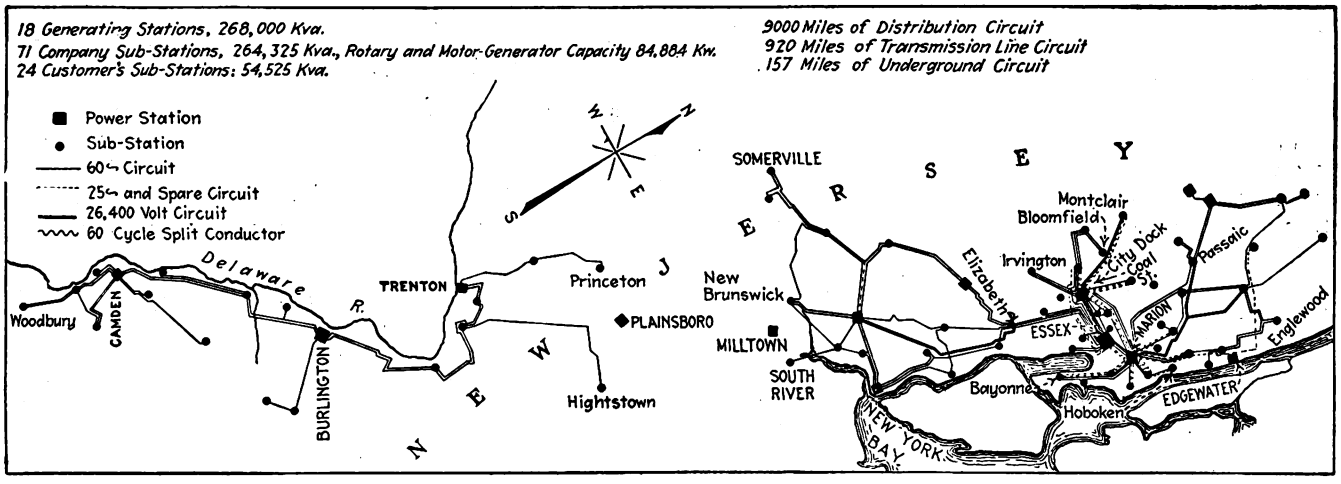
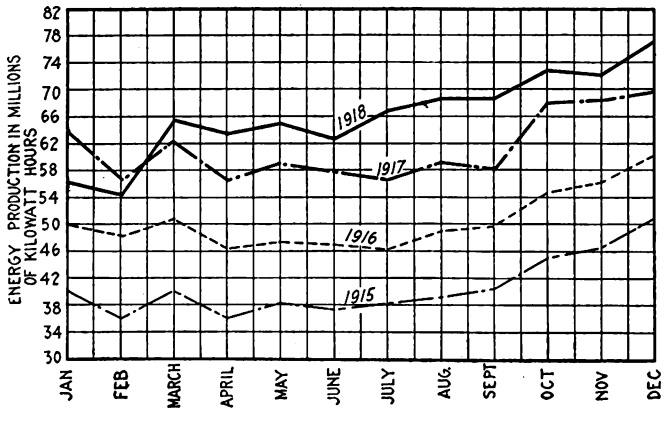
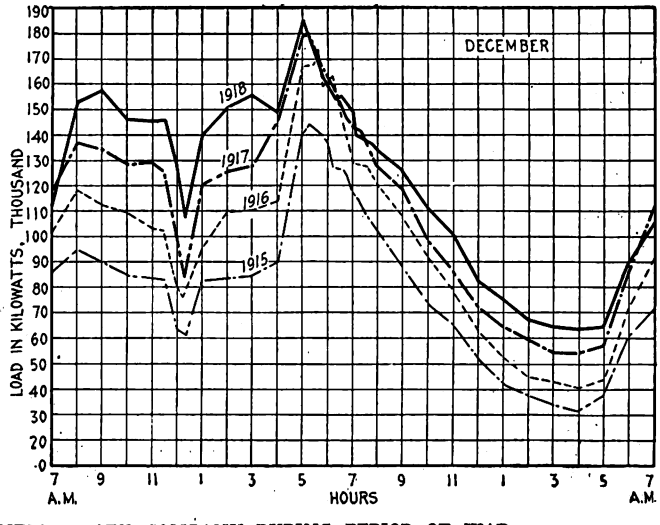


FIG. 11—TERRITORY SERVED BY PUBLIC SERVICE ELECTRIC COMPANY OF NEW JERSEY





FIGS. 12 AND 13—OUTPUT AND PEAK LOADS OF NEW JERSEY COMPANY DURING PERIOD OF WAR

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tem for power that the company made a patriotic appeal to its employees to save coal by increasing economy, indicating by actual figures how much coal could be saved by proper operation of the water-power plant and how essential each individual's job is to the ultimate result. Because of the excellent response to this appeal the following results were obtained, based on a comparison of corresponding periods of operation before and after the systematic endeavor for higher efficiency had been made:

The economy index of 96.1 per cent (an arbitrary value obtained in the low-water period prior to the campaign) was increased to 99.32 per cent. Of the gain in output, about 55 per cent was permitted by more efficient planning and execution of flashboard work and reduction in leakage and overflow. About one-eighth of the gain was due to maintaining a higher forebay level and more careful estimating of the river flow and load. Other gains were effected by better synchronizing of maintenance work, more economical loading of main units, economies in station auxiliaries, closer coöperation with the steam-plant operators and more rapid restoration of service. The improvements in operating methods were not left alone to the individuals' judgment, but were instigated by suggestions.

Another study which is very important at the present time and which is also being conducted with some very satisfactory results is to determine how the present organization can be employed so none will have to be released. This is being done by the company as its share in alleviating the worldwide non-employment of labor.

The more extensive use of hydraulic instruments for checking operation and giving data for future operation is seen by the company as another method of obtaining higher economy. No small amount of the improvement in operating conditions can be attributed to the excellent instruction course which the Pennsylvania Water Power Company conducts to educate its operators in the operation and maintenance of hydro and electric equipment under normal and abnormal conditions. Extracts from this course will be presented in future issues.

Indication of this company's load and how it fitted in with those of companies with which it is connected is given by the accompanying curves.

New Jersey

One of the greatest industrial districts in extent of territory served by one public utility company, in size of load and diversity of activity and in importance from its participation in carrying out the war program, is that part of New Jersey served by the Public Service Electric Company of New Jersey. (See map.) The character of the industries is too varied to indicate by naming activities, but it can be said that 90 per cent of the company's connected commercial power load consists of undertakings which were associated with the war, including shipyards, ordnance and quartermaster's depots, ammunition and chemical factories, steel fabricating shops, cable, airplane and automobile makers, producers of foodstuffs and clothing and other allied industries. The power demand imposed upon this electric company has necessitated the operation of the entire plant at an exceedingly high plant factor for two years. The growth experienced by this company in peak load and energy consumption is well indicated by the accompanying curves. It might be pointed out that the kilowatt-hours sold for lighting and power alone (excluding railways) has increased over 200 per cent since the European war started, the connected load for the same purposes having increased about 100 per cent.

While additions and extensions to the system were curtailed, as on all other systems, by the stringent conditions imposed by the war, many important additions to the generating stations, substations and transmission lines had to be made in the last eighteen months to provide service for essential war industries. These included the installation of a 35,000-kva. turbo-generator at Essex station in July, 1917, with the necessary boilers; a 12,500-kva. unit at Perth Amboy in 1918,

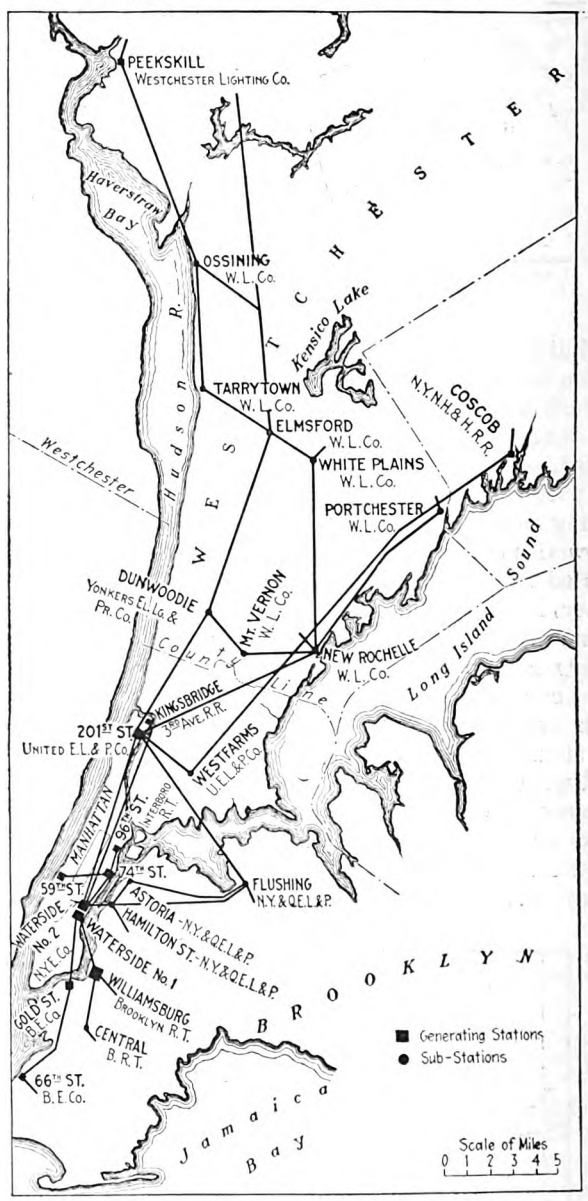

FIG. 14—ELECTRICAL INTERCONNECTION OF NEW YORK CITY PROPER, BROOKLYN, LONG ISLAND CITY AND WESTCHESTER COUNTY

new substations at New Brunswick and Englewood (the latter to serve Camp Merritt), 22,750 kva. in substation transformers, 85 miles (136 km.) of transmission line and 199 miles (320 km.) of distribution line, 2000 kw. in railway substation equipment, besides many minor installations and changes. However, the construction program was somewhat hindered by war conditions, so that it was not possible to keep pace with

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growth of load and applications for power had to be refused in many cases. However, by careful analysis of its load conditions and by fully coöperating with the governmental agencies, the company was able to furnish power to the majority of essential war industries in the territory served.

In common with other operating companies, the New Jersey company experienced great difficulty in obtaining labor, the turnover of the production department being 280 per cent in 1918. Wage increases were necessary in all departments to meet the conditions of the labor market, but they were particularly large in the construction department, where it was necessary to bid for skilled labor in competition with neighboring shipyards, munition plants, etc. The price of coal was unusually high, too, and up to date there has been no indication that there will be a material reduction during the coming year.

As previously mentioned, the Public Service Electric Company operates in a territory particularly advantageous for large industrial development, so it is expected, from a survey of probable power requirements, that the load will increase at least 25,000 kw. a year for several years to come. Of course, the lighting business will not increase in any such proportions, but there is every reason to believe that there will be a normal increase in the demand for this service.

New York City

Of all the electric service companies operating in large communities in the Middle Atlantic States, probably none were less affected by the war so far as load was concerned than those on Manhattan Island—the New York Edison Company and the United Electric Light & Power Company—owing to the fact that this was not a war-industry district. In addition, the Fuel Administration's various lighting curtailment orders, together with the daylight-saving plan, have checked the normal growth so that the total output for 1918 was very little above that for 1917. On the other hand, the Brooklyn Edison Company, the New York & Queens Company and the Westchester Lighting Company did have a considerable increase in load because they serve districts which are more favorable to industrial plants. These affected companies, however, were fortunate in being interconnected (see map) with the less-affected companies, so together with their own efforts they were able to carry their war loads without one of the main obstacles—shortage of generating capacity—which confronted many other companies.

As pioneers in the interconnection of systems, the New York Edison Company established ties with the Metropolitan Street Railway as long as twenty years ago. This scheme has been constantly expanding until to-day the New York Edison Company, the Interborough, the New York Railways, the Third Avenue Railway, the Brooklyn Rapid Transit, the New York, New Haven & Hartford Railroad, the Brooklyn Edison Company, the United Electric Light & Power Company, the New York & Queens and the Westchester Lighting Company are all tied together. Of these the interconnection with the Brooklyn Rapid Transit Company and the New York & Queens Company has been materially increased during the war, the former by the installation of additional feeders and the latter by changing the tie-line voltage from 7800 to 15,600. The total system of ties and interconnection now makes it possible, if desired, to transmit energy generated in the Edison station from the lower end of Manhattan and Brooklyn throughout New York, Kings, Queens, Bronx and Westchester Counties to Peekskill on the north and east to Cos Cob, Conn.

At the request of the United States government a study was made and complete plans were already drawn up for interconnecting the companies in the New York territory with the Public Service Company of New Jersey by means of 15,000-volt cables passing through the tunnel of the Pennsylvania Railroad Company. This plan was, however, not carried into effect owing to the signing of the armistice.

Following the requirements created by the development of the art in higher efficiency, lower upkeep and renewal charges, the New York Edison Company is removing seven of the old 4000-kw. engine-driven generating units and replacing them with two 35,000-kw. turbo-generators. This has necessitated modifying some of the other equipment used in conjunction with the generators.

The New York Edison Company has always maintained a high factor of safety in its generating and distributing systems in order to secure the highest degree of continuity of service. In carrying out this policy during the war the system has been changed from an ungrounded to a grounded system with special ground relay protection, and feeder reactors are being installed on every outgoing feeder. A new type of oil filled joint which has proved successful on 16,000-volt and 25,000-volt cables is being inserted in all the remaining cables at this voltage, and the new generating units are being provided with insulation which will permit a test voltage of three times normal operating voltage plus 1000.

Parallel operation of high-tension feeders to some of the substations has also been accomplished to secure greater cable capacity.

The New York Edison Company has for years past maintained a large reserve stock of coal conveniently located in New Jersey opposite Manhattan Island, so that at no time was its service in jeopardy owing to the general coal and transportation shortage throughout the country.

Despite the fact that no increase in load was obtained, a further reduction in rates was made on July 1, 1917, by ruling of the Public Service Commission, which materially reduced the revenue, the operating expenses showing a large increase. The increase in operating expenses was brought about not only by increase in cost of fuel and labor but also by inferior quality of coal and by the serious difficulties in obtaining it after it had reached tidewater.

The United company has maintained its normal healthy rate of load increase through the war, to take care of which a 25,900-kva. turbo-generator is being added to its 201st Street station with the corresponding equipment. A duplicate will be installed in the latter part of this year, giving a total generating capacity of 107,000 kva., 60-cycle, and 40,000 kva., 25-cycle, with a 10,000-kva. frequency changer between. Owing to additions in excess of what were contemplated when this station was designed modifications have to be made in the circulating-water tunnel. In order to assure greater continuity of service to the Bronx, Westchester and Queens territory, twenty three-conductor 350,000-circ.mil submarine cables have been laid from the 201st Street station under the Harlem River.

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War Load Felt Greatly Around Pittsburgh

Increase in Coal and Steel Load Carried Almost Entirely by Duquesne and West Penn Companies, Which in Order to Take Care of the Emergency Had to Adopt Many Interesting Expedients Outlined in This Article

WITHOUT any reminder everybody knows that Pittsburgh is the heart of the steel industry and that all the demands of the war were very strongly felt there. Of the increased load due to the war in this and its affiliated industries it is conservative to say that the Duquesne Light Company carried the bulk. The load consisted principally of the manufacture of shells, gun forgings, aëroplane apparatus, gun carriages, guns, hand grenades, torpedo bodies, rifle grenades and miscellaneous steel products required for helmets, marine castings, etc. Most of the plants erected for war munitions were built so that they could be converted to peaceful purposes. One industrial plant alone increased its load by 15,000 kw. or 20,000 kw. during the war. The total increase in business is shown by the energy consumption and load curves (Figs. 2 and 4). It will be noted that the output reached its maximum after the armistice was signed (in December) and a decline was not felt to any extent until March. It is believed that the drop has now reached its lowest point and that the load will again increase. As shown by the daily load curves before and since the armistice, the night load has decreased materially.

With the very rapid increase in load due to the war, which was very much in excess of the normal rate of growth for the territory, the generating capacity of all plants was pushed to its utmost. Every generating unit was called upon to carry its maximum load, a number of units which were obsolete and supposedly permanently out of commission being overhauled and put back into service. The capacity of a 40,000-kw. unit of the Duquesne Light Company which was installed in December, 1917, was entirely absorbed before the end of the war. On the steam end stokers were forced and

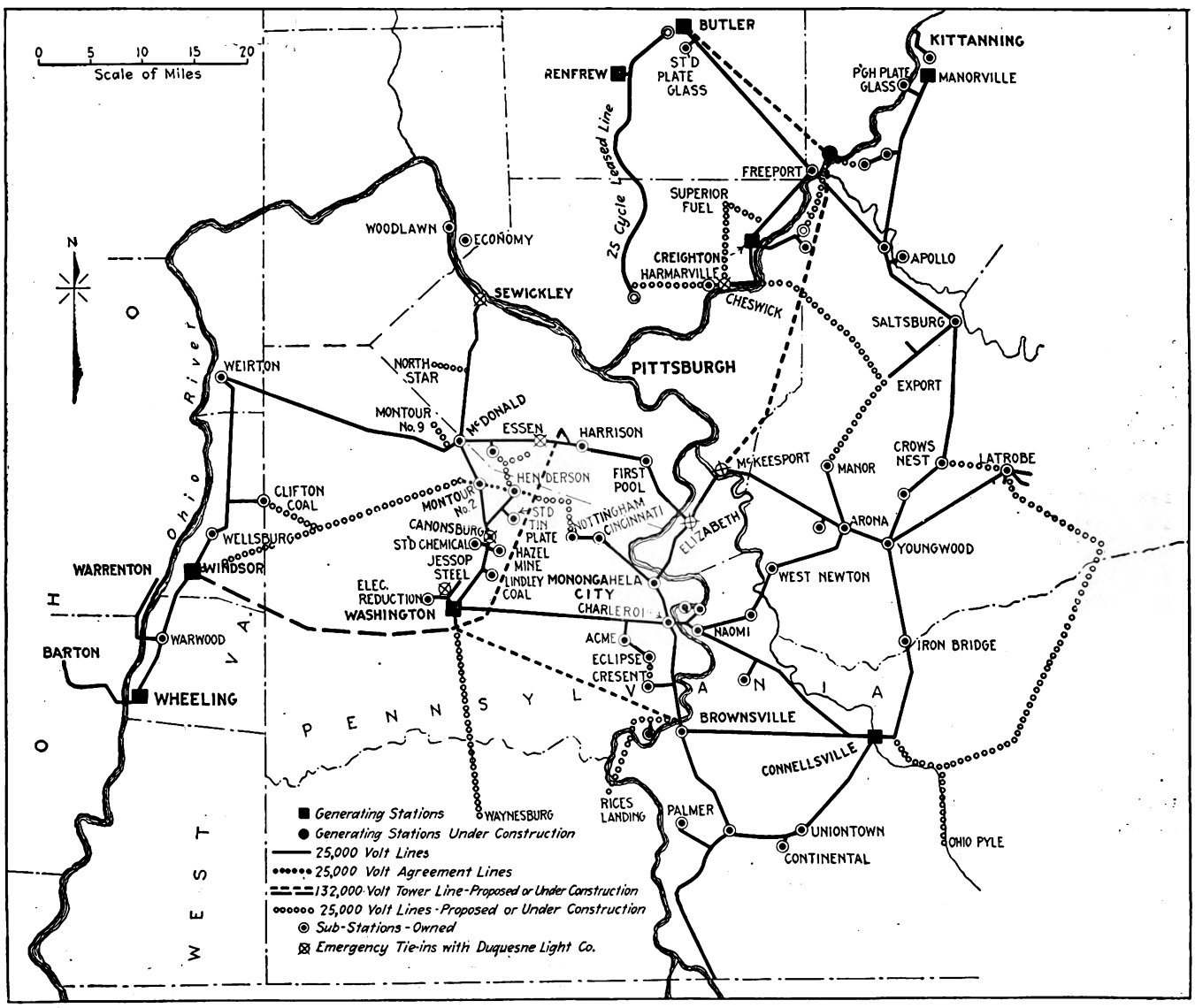

FIG. 1—WEST PENN SYSTEM WHICH HAS EMERGENCY CONNECTIONS WITH DUQUESNE LIGHT COMPANY

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boilers worked to their ultimate limits, regardless of economy of operation or of cost of maintenance. Serious difficulties were encountered with fuel, both as to quality of coal obtained and the maintenance of an adequate supply. In the winter of 1917-18 the stock of coal got down to only one day's supply, so that it was necessary to feed the bunkers directly from the cars. In some shipments the ash ran as high as 36

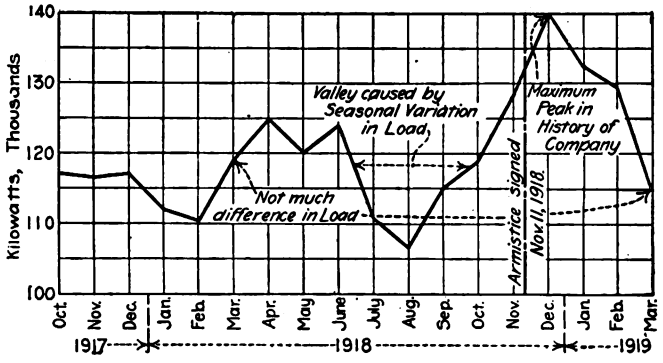

FIG. 2—HOW PEAK LOADS OF PITTSBURGH COMPANY WERE AFFECTED BY WAR

per cent and the heating value as low as 9500 B.t.u. The low-grade fuel which had to be used necessarily reduced the capacity of the boilers and increased operating costs.

The high temperature of the condensing water in the summer—which at times ran to 90 deg. Fahr.—also limited the output of the generating plants. Like every other organization, the company was also handicapped by loss of men, difficulty in securing deliveries on new equipment, etc.

One effective factor in taking care of the power demands in the Pittsburgh district during the war was the arrangement between the West Penn Power Company and the Duquesne company for exchange of surplus energy. This was accomplished by means of interconnection between the two systems at various substations shown in Figs. 1 and 3. Owing to the limited capacity of the lines running to the interconnecting points, the two systems were not operated permanently in parallel, but the interchange of power was accomplished by merely throwing loads from one system to the other. In this way the total combined capacity of both systems was always available, and owing to the fact that there was considerable diversity between the load of the two systems and trouble did not generally occur on both systems at the same time, very material benefits were derived from this arrangement by the consumers of both companies' lines.

The additional power load produced by the war consisted to a great extent of induction motors, with the result that the system power factor became very low—70 to 75 per cent during the peak load and as low as 60 per cent at light-load periods. In order to bring this power factor up to the point where the maximum output could be obtained from the prime movers without overheating the generators, synchronous condensers were installed at various points on the system, so that large portions of the wattless component were supplied from points very near to the load which created them. This materially increased the capacity of the transmission system as well as the capacity of the power stations. The same attention is given to the distribution of the wattless component of the load between the various generators and condensers as is given to the distribution of the energy component between the various power stations.

The problem of line extensions was comparatively simple, since the territory was well covered by existing lines. Extensions to new customers, on the average, were therefore short. It was found, however, that in the overhead system voltage regulation more often than heating determined the load which could be transmitted. Connections of small capacity were made to the 2200-volt distribution lines, while large installations were connected to the 11,000-volt system. Connections ordinarily consisted of transformers mounted out of doors with air-break switches, choke coils and horn-gap lightning arresters. Small transformers are mounted on two-pole structures, large ones on concrete foundations. Meters were generally placed indoors in order to avoid the injurious effect of moisture, vibration, rapid changes of temperature, etc.

Not much underground cable was installed during 1918 because of the high cost and long deliveries. Even in restricted districts overhead lines were put up, these being permitted only as a war measure. In cases where the load on existing installations has permanently decreased with the end of the war the transformers will probably be replaced by smaller units.

Blowing air through ducts has helped in increasing the carrying capacity of the underground cables, as has been pointed out before in the ELECTRICAL WORLD. This was very beneficial during the war, as increased loads

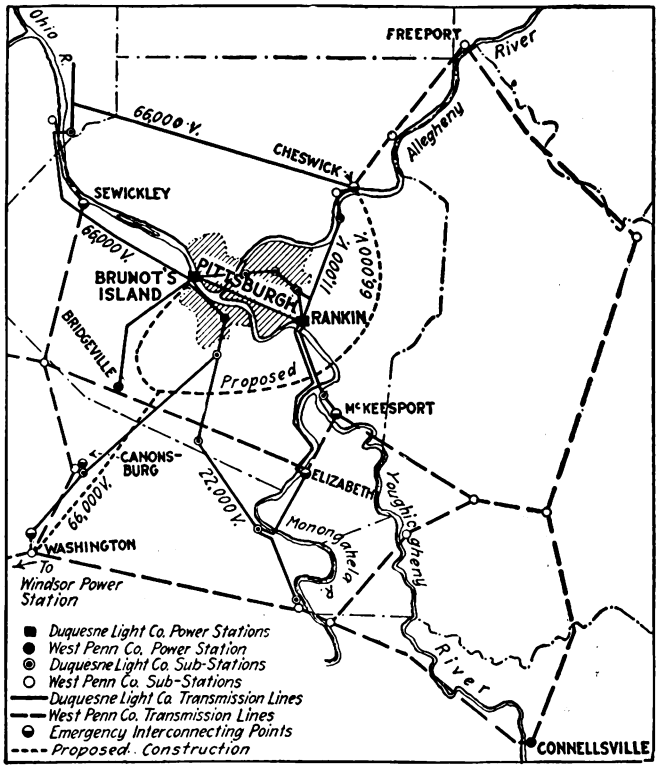

FIG. 3 — DUQUESNE LIGHT COMPANY'S SYSTEM, SHOWING EMERGENCY CONNECTION POINTS WITH WEST PENN POWER COMPANY

had to be carried and installing additional cables would have been very expensive.

On account of the tremendous increase in the cost of coal, labor, steel, copper, and in fact everything that went to make up the cost of producing electrical energy, an increase in power rates was put into effect. Before

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doing this the situation was presented squarely to the large industrial consumers of power—that an increased rate would be necessary in order to offset the greatly increased operating expenses. As a result the new rate went into effect without any protests from consumers. It is expected, however, that the company will follow its usual policy of reducing rates when it becomes possible to do so without slighting service.

Owing to the shortage of labor it was sometimes found necessary to go from eight-hour shifts to twelve-hour shifts in order for enough men to be available. Any spare time of these men was utilized in testing meters, repairing torches, reclaiming line material, etc. The substation shortage was met by taking men from the construction crews, which were of course not so active during the war.

In the opinion of the Duquesne company engineers, coal storage has not been considered as seriously as it should be by some companies. In Pittsburgh, of course, it is not necessary to store more than sixty to seventy days' supply because the city is so close to the mines. Powdered coal as fuel will probably be considered seriously in the near future because of its high efficiency and flexibility. Lower-grade fuels must be used as good-grade fuels get scarcer.

Looking forward into the future when more generating capacity must be made available, the company has purchased a coal mine near Cheswick, on the Allegheny River, with an estimated content of 40,000,000 tons. Eventually it is planned to build a plant at its mouth, the condensing water available permitting a 300,000-kw. development. According to present prospects, it appears that this plant can be loaded to 240,000 kw. in ten years. The loop line previously mentioned will tie in this station with the plant situated on Brunot's Island.

West Penn Power Company.—Coal mines constituted a large share (probably 50 per cent) of the West Penn Power Company's load during the war, about 200 being connected. Steel plants ranked next, representing

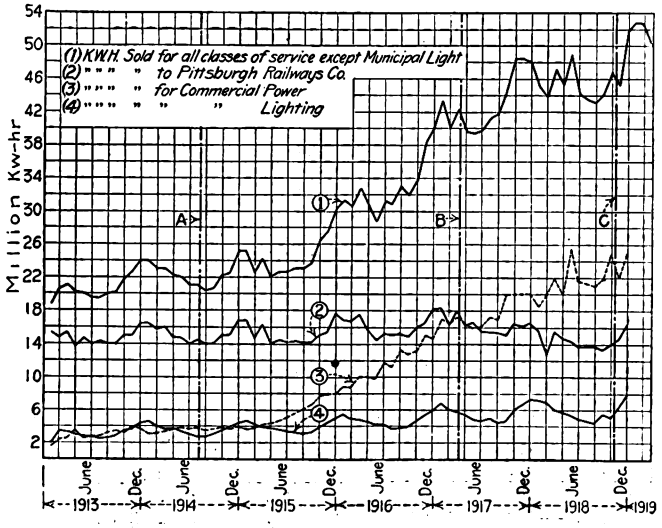

FIG. 4—OUTPUT OF PITTSBURGH COMPANY DURING PERIOD OF WAR

about 25 per cent and including special alloy furnaces, sheet mills and cold-rolled strip mills. While this company had a plant at Connellsville and received considerable energy from the Duquesne Light Company through emergency connections established for the exchange of surplus power, it was fortunate in having 30,000 kw. made available through the completion of the Windsor plant at the mine mouth during the war. Some features of this plant, which is jointly operated with the American Gas & Electric Company, sharing the generating capacity, have been covered before in the ELECTRICAL WORLD. The power available will be increased to 40,000

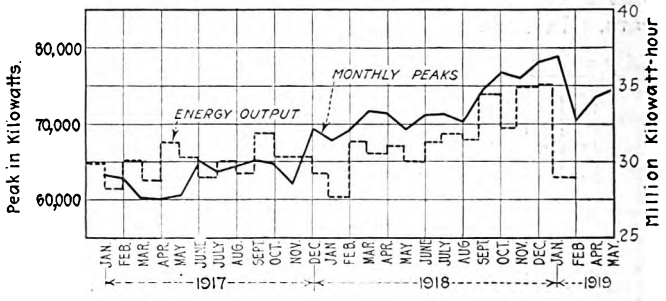

FIG. 5 — EFFECT OF WAR ON PEAKS AND OUTPUT OF WEST PENN COMPANY

kw. about June by the installation of a third 30,000-kw. machine. In addition, a plant is being built at a mine mouth (near Springdale) which will have 40,000 kw. to 45,000 kw. to start with. This rating will ultimately be increased to 250,000 kw.

In connecting with the Windsor plant several lines were built or reinforced to make the power more readily available on the West Penn system, one being built to Washington, Pa., and insulated for 132,000 volts but now operated at 66,000 volts. The rest are operated at 25,000 volts. Eventually a 132,000-volt loop will be built around the outskirts of the territory to serve as a sort of feeder for the rest of the system, which is made up of 25,000-volt distribution lines. The latter are tapped at various points to serve coal mines, etc. As mentioned earlier in this article, emergency connections are afforded at various points around Pittsburgh for exchange of surplus power, and permanent connections will be afforded later, when the lines have been reinforced sufficiently to permit synchronizing the two systems.

Whereas the coal mines worked only about three days a week before the war, they operated in a more nearly continuous manner during the war except for limitations imposed by lack of car supply. About Jan. 15, 1919, the coal load dropped approximately 20 per cent, the mines going back to three-day operation, but the load is about at its lowest decline now. Of the steel loads the electric furnaces were shut down first.

Fairly good coal and a steady supply were obtained during the war because of the long-continued relations with the mines and government help. Shortage of car supply did not hinder much because this company's plants are near the mouths of the mines. Owing to the increase of ash (from 10 to 15 per cent), however, and lack of skilled labor, the coal consumption per kilowatt-hour increased 15 to 25 per cent. Besides, fires had to be cleaned more frequently, boiler output was reduced and maintenance was increased. By operating with higher draft than usual some of the troubles with ash were minimized. Because of the demands on the system the boilers were forced to as high ratings as possible, letting efficiency run what it would. Being close to the mines, not more than sixty days' coal storage had to be provided. This company does not favor buying coal on specification, believing that better results can be obtained by purchasing from mines or veins known to produce a certain quality which has been tested under

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operating conditions. Even with the coal available during the war (10 to 13 per cent ash, 13,000 B.t.u.) and under the severe operating conditions imposed, the Windsor station was running with about 1.5 lb. (0.68 kg.) of coal per kilowatt-hour including auxiliaries. The water rate of the 30,000-kw. units used there is

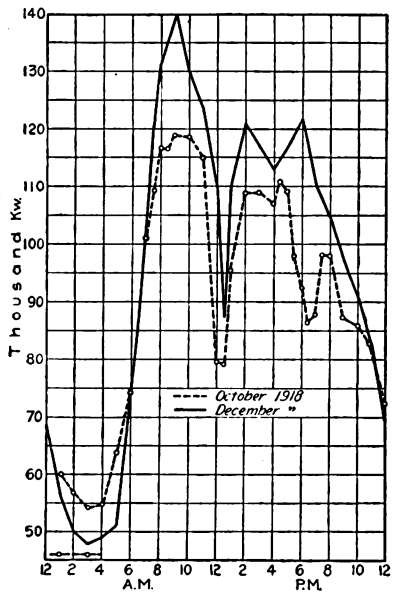

FIG. 6—DAY LOAD CURVE OF PITTSBURGH COMPANY BEFORE AND AFTER SIGNING OF ARMISTICE, SHOWING DROPPING OFF OF NIGHT LOAD

10.2 lb. (5.4 kg.) per kilowatt-hour at 300 lb. pressure and 200 deg. superheat. With the same steam conditions the water rate on the Connellsville 20,000-kw. units is about 11.3 lb. (5.1 kg.) per kilowatt-hour.

It has been figured that by substituting 45,000-kw. generators and correspondingly larger boilers for the units at Windsor a reduction of 25 per cent in capital cost per kilowatt can be effected with a 10 per cent reduction in cost of power, including operating cost. In the new plant which is being built it is expected to go to 350 lb. pressure with 225 deg. superheat. By strengthening certain parts of present boilers 400 lb. could safely be used in the opinion of this company.

For auxiliaries the company favors house turbo-generators with motor-driven auxiliaries, supplying feed water to the economizer at 210 deg. From calculations

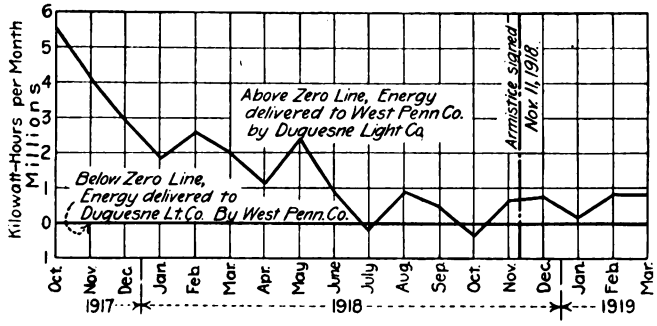

FIG. 7—EXCHANGE OF ENERGY BETWEEN DUQUESNE AND WEST PENN SYSTEMS

it has been estimated that they do not cost any more than steam-driven units, the heat balance is just as good if not better, and the maintenance is reduced owing to the elimination of small turbines. Besides, leakage of steam and condensation will be minimized by reduction in piping, making the make-up only 1½ per cent as compared with 5 per cent with mixed drive. In addition, 2 per cent more capacity can be secured from the station at the same or less cost.

About 80 acres have been purchased in connection with the new plant, with the expectation of studying the economy and practicability of operating powdered-fuel burners or a by-product plant in connection with its boilers. While no tests have been conducted, it looks probable that 15 per cent increase in efficiency can be obtained with the first method.

Lehigh Navigation Electric Company.—The principal change in the territory served by this company consisted in the combining of a number of individual systems and plants under one management, giving a total generating capacity of approximately 100,000 kw. in five steam plants and two hydroelectric plants. An extension of nine miles (12.6 kw.) of 100-kv. steel-conductor transmission line was built to the Bethlehem Steel Company to take care of its war work. In addition two 12,000-kw. turbines were installed at the Harwood plant and one 7500-kw. frequency changer at the Hauto plant.

During the war period the plants were taxed to the utmost. The economy of the plants was lowered to some extent on account of the overload and inability to take the equipment out of service for necessary maintenance and repairs, and at times on account of poor quality of coal. In order to meet the full requirements for electric power of munition plants the supply to some of the other customers was reduced by order of the War Industries Board. Since the signing of the armistice the load has decreased approximately 10 per cent.

BARE WIRES VERSUS THOSE WITH WEATHERPROOF COVER

Tests Made on D. B. Weatherproof Wires Lead Authors to Believe that Bare Wires Should Be Considered for Distribution Above 750 Volts

Tests made in 1917 by the Hydro-Electric Power Commission of Ontario of wires covered with weatherproofed insulation are described in a paper "Bare Versus Weatherproof-Covered Wires for Potentials Above 750 Volts," by A. S. L. Barnes (see the *Electrical News*, Feb. 15, 1919). Although the tests were not exhaustive, the author considers the results so erratic that not much reliance should be placed in such coverings. Representative tests as made by the commission are shown in Table I, while relative costs are indicated in Table II.

TABLE I—COMPARATIVE TEST ON NO. 6 B. & S. DOUBLE-BRAID WEATHERPROOF MEDIUM-HARD-DRAWN COPPER WIRE

	Weight, Lb. per 1,000 Feet		Tensile Strength,		Insulation Resistance, Megohms per Mile, 15 Hours'			Breakdown Voltages	
	Bare	Covered	Wire (Lb.)	Lb. per Sq.In.	Dry	Immersion	New	After Baking	After Boiling
A	77.06	100.7	740	37,000	23.6	3.85	3,600	2,000	800
B	78.64	101.8	713	35,500	12.5	2.74	3,000	1,200	800
C	80.77	103.5	736	36,800	17.75	2.94	1,200	2,600	800
D	79.25	102.1	722	36,000	*35.5	3.42	1,200	2,600	800

TABLE II—RELATIVE COSTS OF BARE AND INSULATED WIRES

	War Prices		Pre-War Prices	
	No. 6	No. 0	No. 6	No. 0
Bare	100	100	100	100
D. B., W. P.	130	128	135	135
T. B., W. P.	145	136	150	148

* Comparative figures only. Not sufficient length of wire used.

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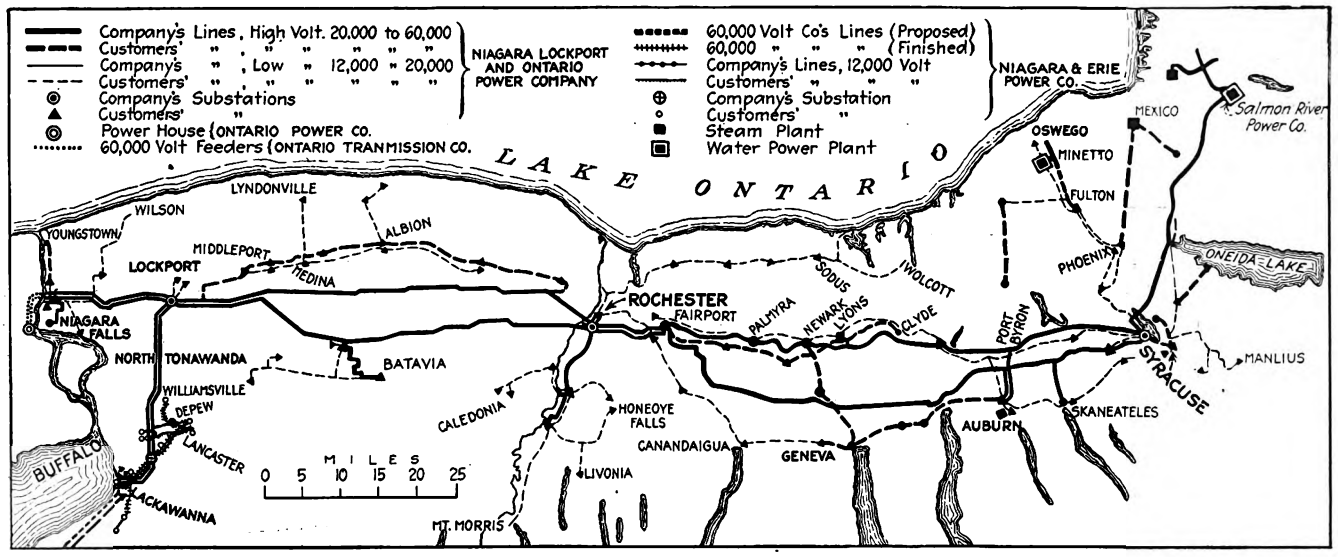

FIG. 1—TERRITORY SERVED BY NIAGARA, LOCKPORT & ONTARIO SYSTEM, WHICH WAS INTERCONNECTED WITH ROCHESTER (N. Y.) COMPANY

Niagara Falls a War-Load Center

Electrochemical and Electrometallurgical Loads Stimulated by the War Were Carried Principally by Electric Service Systems Around This Part of New York State—Interconnection Helped Greatly There

AT THE time of the entry of this country into the war there were at Niagara Falls processes developed for the production of commodities for which continuous Niagara power is particularly adapted, and practically all of them were of vital importance for carrying out the plans of the Council of National Defense. Up to the signing of the armistice all the Niagara Falls power plants were crowded to the limit of their power output, and it was a source of satisfaction to the owners and operators that so little time was required for ordinary repairing and refitting.

In response to the request of the War Department the companies on the American side of the falls, including the Niagara Falls Power Company, the Cliff Electrical Distributing Company and the Hydraulic Power Company, put forth every effort to develop every kilowatt of electrical power that their machinery could turn out, and the plans of the Hydraulic Power Company were accepted to increase the emergency power supply by constructing a 100,000-hp. addition to its plant.

The work of constructing the generating station, transmission systems, etc., was rushed by the power company up to the signing of the armistice, since which time the work has not been pushed so rapidly, as the company did not feel it could incur the excessive expense for rush work after the patriotic incentive had been removed. However, it is probable that the first unit (35,000 kw.) will be in operation in July, 1919. The additional water (4400 second-ft.) required for this extension was granted by the government as a war measure and is available only until July, but it is hoped that the grant will be made permanent for the good of the country as a whole in stimulating industry and saving coal. For this extra diversion the amount of water allowed the American side of the falls is 15,600 second-ft., which is about 7.5 per cent of the total flow of the Niagara River (200,000 second-ft.).

To increase still further the power supply available and give fullest assurance of continuity of service to the war industries, the Cliff Electrical Distributing Company, the Niagara Falls Power Company and the Hydraulic Power Company of Niagara Falls consolidated in October, 1918, under the name of the Niagara Falls Power Company. Since that time many interconnections and improvements have been made which are indicated on the accompanying map of this system.

The companies did not increase their rates during the war, although their operating expenses were materially increased. In fact, under the government schedule for the delivery of power, which was willingly and fully responded to by the power companies, their income was less than under pre-war conditions; but no claim or request was made for compensation for these decreases in income.

Since the armistice very little decrease in power output has been noticed, although there has been a readjustment of use as between customers. The necessity for the manufacture of certain commodities has been so emphasized by the war conditions that several new industries are locating in Niagara Falls, and the general prospects for the maintenance of power utilization seem to be good.

The greater part (80 to 85 per cent) of the energy developed by the Falls Power Company is supplied to electrochemical and electrometallurgical industries. About 20 per cent is furnished to central stations in the vicinity. Foremost among them from the consumption point of view is the Buffalo General Electric Company, which took more than 252,000,000 kw.-hr. during the war. This is relatively less than it ordinarily takes, because it was requested by the government to release about 10 per cent of its normal supply to the Niagara Falls Power Company to serve war industries around Niagara Falls. Now the Buffalo General Electric Company is

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taking about 70 per cent of its energy needs from the Niagara Falls Power Company and the rest is generated by steam in its own plant. Of the industrial load in Niagara Falls, the principal activities are to manufacture abrasives, refractories, aluminum, ferro-alloys, silicon, magnesium, sodium and potassium compounds and other chemicals.

It is interesting to note that the peak load during the war was little different from that before or since, because the only change in operation which could be made was to operate generating units, including all spares, continuously, the hydraulic characteristics being such that the generators could not be run overloaded as was done by some companies during the war. In this connection it may be pointed out that the flow of the Niagara River is very uniform throughout the year, being affected only by the wind. The war required the shutting down of the less essential industries and supplying the more essential as indicated by a priority list established by the government. This had the effect of lowering the load factor considerably because the war industries handled their increased demands by operating all spare equipment so that when any unit broke down it lowered the individual load and hence the system load factor. Owing to the limited output of hydroelectric power and the reduced load factor, the output of energy was slightly less than it would have been under normal conditions. Since the armistice was signed the load factor has also been affected by taking on commercial loads which run only ten hours a day. Another condition that existed during the war was that the transmission cables were being worked to capacity so that when any broke down the load factor was reduced. Considerable assistance was secured in this emergency by shifting cable connections to utilize cable capacity best and by cooling the underground cables with water circulated through the ducts, this method having been used for some time. Shifting loads from one plant to another also helped appreciably when any plant became overloaded. Such operation was facilitated greatly by the interconnections afforded. Other benefits were secured by grounding the neutral in the system and employing bus and tie-line

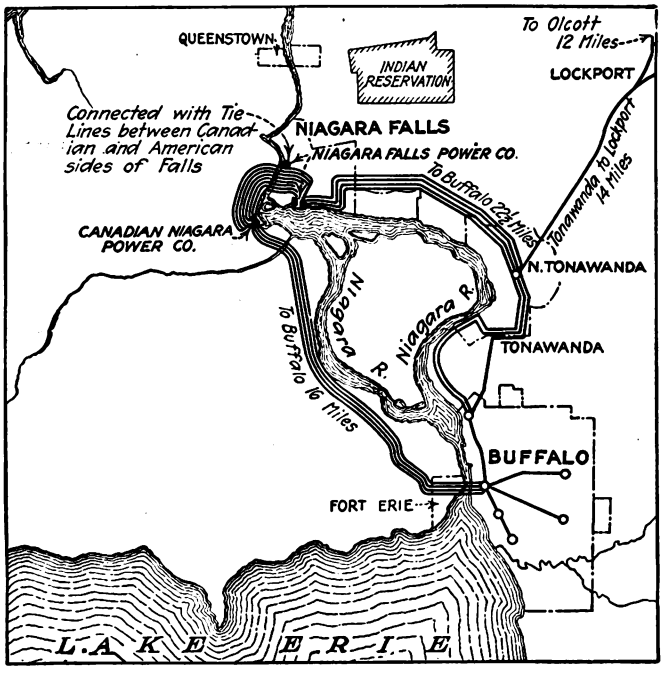

FIG. 2—NIAGARA FALLS POWER SYSTEM, WHICH SERVES BUFFALO

reactors, both of which were contemplated or in use, however, before the war. Not much new cable or many new transformers had to be installed during the war because of the limitation in output mentioned and the fact that the plants used spare equipment mostly to meet increased demands.

While there is not the opportunity to improve the diversity factor that there is in some localities by consolidating plants, owing to the high load factor naturally obtained in Niagara Falls, the company does expect to benefit considerably from an economy point of view when the new 100,000-hp. extension is completed, by the better utilization of head available and by the higher economy which this new plant will have. Whereas the present plants have relatively small generating units (5000 hp.), the new extension will have 35,000-hp. units with a better water rate and besides will make use of a head of about 213 ft. (65 m.), compared with less than 150 ft. (46 m.) in the old Niagara Falls plants Nos. 1 and 2.

In other words, the new plant is expected to have an efficiency of 90 per cent compared with 45 per cent in the old plant (based on the total head available but not utilized.) The actual efficiency of the old plant is about 86 per cent. Because of these conditions it is expected to carry the base load on the new plant and the remainder on the old plant.

Buffalo

Before the European War started the Buffalo General Electric Company was operating exclusively with hydro energy, but fortunately in 1916 it installed three 20,000-kw. generating units in a new steam plant,* to which a 35,000-kw. unit was added in 1918. As a result it was possible on request from the government to release the Niagara Falls Power Company from supplying 10 per cent of the hydroelectric energy ordinarily received and which was sorely needed for war industries around Niagara Falls. Whereas hydroelectric energy and steam energy were employed in the ratio of seventy to thirty before the war, a fifty-fifty ratio was maintained during the emergency, a little over 252,000,000 kw.-hr. of hydroelectric energy being received.

Even with water power available from the Niagara Falls Power Company, it was necessary to operate spare generating equipment continuously. Since this plant, like most other plants, was not designed to have enough boiler capacity to operate all of its units including spares at maximum load, some of the boilers had to be forced to unusual ratings (350 to 500 per cent), regardless of economy and maintenance. Maximum output and reliable service were the chief considerations. Conditions became so bad that stokers had to be operated with burned-out grates, since the load never slackened except on Sundays and then only for a sufficient time to install new grates. Besides, great chunks of slag and coke had to be removed frequently. It is interesting to note, however, that in spite of these conditions and the fact that very poor coal (25 per cent ash) was obtained frequently, the brickwork of the furnaces stood up for ten months at a time and no interruptions to service occurred. When better grades of coal were obtained economies around 1.5 lb. (0.68 kg.) of coal per kilowatt at the switchboard were realized. Of course, attempts were made to obtain additional boilers, but these were not received until late in the war. Stoker drives were also hard to get so motor drive with

*See ELECTRICAL WORLD, Jan. 27, Feb. 3 and 17, 1917.

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automobile transmission was used as an expedient. One time the coal supply was so short that the plant was within three to four hours of shut-down, but interruption of service was avoided by obtaining assistance from Washington. Whereas $3 per ton was ordinarily paid for coal, a price as high as $6.50 was paid during the war.

Labor was also scarce and inexperienced, so, together with the further decrease in forces during the influenza epidemic, the company had to employ turbine oilers to remove ashes and resort to similar expedients at times. To avoid coal shortage, fuel was purchased from the nearest mines, as car supply and length of haulage seemed to be the greatest obstacles to securing fuel. The use of self-cleaning cars also facilitated getting the cars back into service.

Coal is better now (9 to 10 per cent ash) and much easier to secure. While the company contemplates purchasing it on a specification basis, it is at present burning up about 15,000 tons of run-of-mine and slack that accumulated during the war. To permit buying by specification, plant tests are being conducted with coals from different mines and veins.

Despite the severe conditions faced during the war, this company is one of the few that did not have to cut off consumers. By suggestion of the government it did ask the less essential industries, as determined by the government priority list, to curtail production during morning and afternoon peaks, but practically every demand for power was met nevertheless. This was partly possible by reason of the diversity of load obtained and the fortunate circumstance of having the new steam plant in service.

There were only about three "war babies," amounting to 4000 kw., and these consisted of shipbuilding, shell and airplane-motor enterprises. Two of these ran up to two months ago and the other is operating yet. Most of the total load (about 60 per cent) consisted of industries which were on the lines already and which merely increased their activities, calling for an increase in transformer capacity. Only about 20 per cent (on peak) was lighting and the rest railway load.

Of the industrial load considerable is electric furnace load (30,000 kw.), about 12,000 kw. being supplied for making ferro-silicon and 8000 kw. for graphite. The daily load factor is 84 per cent now as compared with 75 per cent before the war, and the load is about the same as a year ago. The peak occurred just before the armistice, and the slight slump since then has been due largely to stopping of night work.

As mentioned before, very little line extension was necessary during the war, the two principal cable lines that had to be installed being for shell and airplane manufacture. These were financed by the concerns served.

Buffalo is practically saturated, so far as industrial electric service is concerned, so that future increases in industrial load will depend to a great extent on the development of new industries or the extension of old, Isolated steam plants have been practically wiped out. It is intended to develop new applications of electricity like electric furnace and heating loads. Since the war has brought considerable attention from the outside world to Buffalo, it is expected that the load will increase naturally in any event. The company expects Buffalo to become the steel center of the world, or at least a ranking second, in the near future. During the war the Buffalo Company did obtain an industrial power rate modification, but it merely rectified a condition that had existed for some time and did not greatly offset the high operating cost.

Rochester

If the war had continued to be waged through the winter there wouldn't have been a bit of surplus generating capacity available between Albany and Buffalo, despite the interconnections made between Albany and Utica and between Syracuse and Buffalo. Even the Rochester Railway & Light Company, with its diversified industries, was cramped to the limit, though it managed to serve all essential industries in addition to helping out the Niagara, Lockport & Ontario Power Company, from which it ordinarily receives energy. Fortunately, the Rochester company had started the combination of two water-power heads under one plant on the Genesee River in 1914, so it went ahead with the

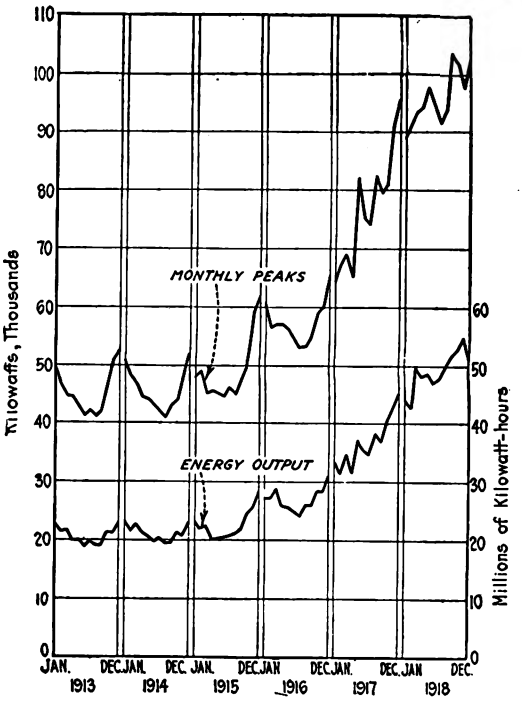

FIG. 3—OUTPUT AND PEAK LOADS OF BUFFALO GENERAL ELECTRIC COMPANY

work despite the increase in expense caused by the war. This development, which displaced two old inefficient plants utilizing only part of the head in two steps of 27 ft. (8.2 m.) and 94 ft. (28.6 m.) respectively, is designed for three 12,500-kw. units, to be operated on a 140-ft. (42.6-m.) head. Two of the units went into service during November, 1917. In addition to utilizing the head formerly lost between the old plants, the new plant makes use of another increase in head and an additional 60,000 kw.-hr. of water storage made available by backing the water up to the tailrace of water-power developments farther upstream. The old plant utilizing the 94-ft. head is still retained for peak load operation when sufficient water is available to operate it. Since the contracts for this plant had been made before the prices of material were seriously affected by the European war, the company's biggest increase in expense for this plant was for labor, which began to get very scarce and expensive before the plant was completed.

In 1917 an order was also on file for a 10,000-kw. turbo-generator and the corresponding equipment for the company's steam plant, but this unit was not ready for

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service until about the time the armistice was signed. During 1917 and 1918 all the boilers and turbines that were installed were operated to their absolute limit with no chance for inspection or maintenance. Coal which used to contain 7 per cent ash ran to 12 or 15 per cent, and as a result boiler capacity was reduced and stokers were clogged with clinkers. Attempts were made to operate so as to avoid clinkers, but maximum production was the main consideration, even economy being allowed to go by the board. At times fuel got dangerously low owing to lack of cars. Two critical situations arising from boiler trouble were tided over by obtaining energy from the Niagara, Lockport & Ontario Power Company. Despite the severe operating conditions, no serious disasters occurred. However, the equipment was so overworked that the maintenance expense is now

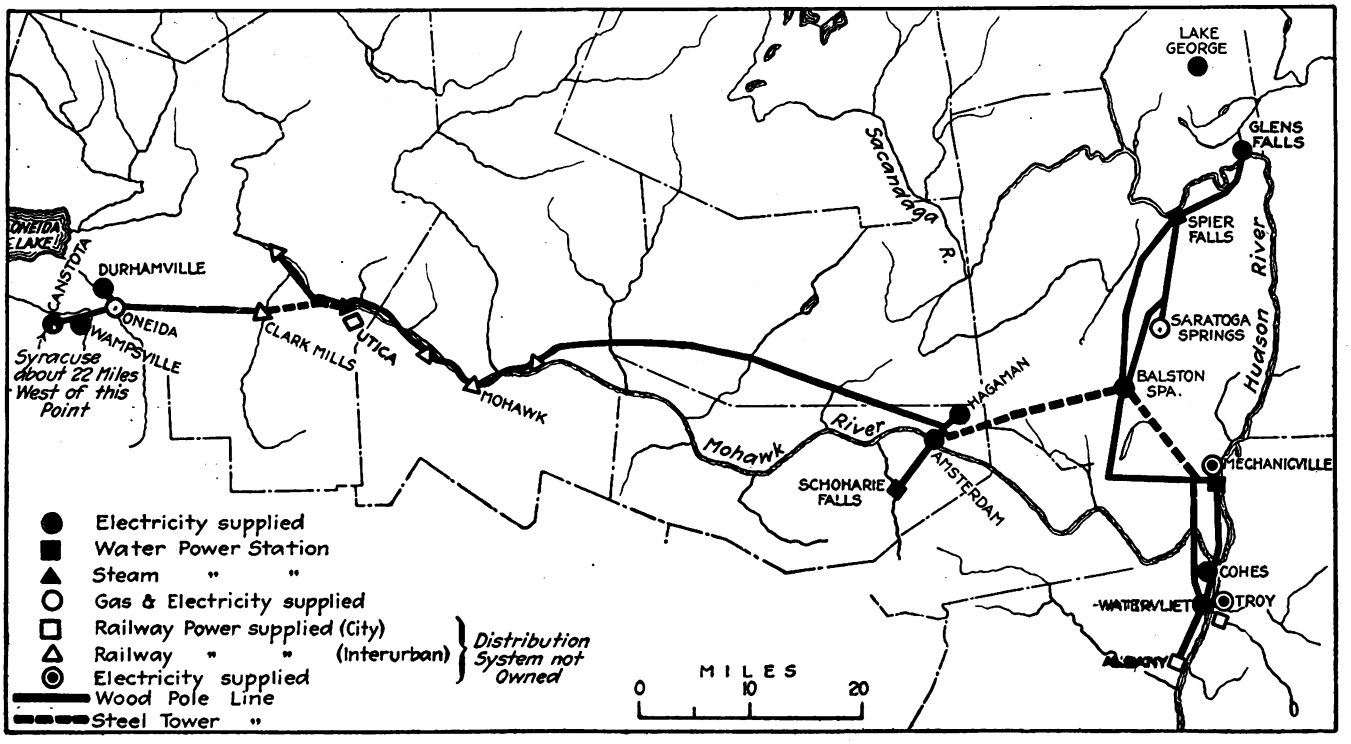

FIG. 4—SYSTEM OF ADIRONDACK ELECTRIC POWER COMPANY (NEW YORK STATE) WHICH EFFECTED SOME BENEFICIAL INTERCONNECTIONS DURING THE WAR

latter company was so badly in need of power for serving war industries along its lines that the Rochester company temporarily released it from the contract, by direction of the government, and in addition pumped back 1000 kw. to 10,000 kw. The old contract will be resumed again June 1.

Most of the increase in load during the war was due to stimulation of industries already on the companies' lines, but 10,000 kw. had to be supplied to a "war baby" in the form of gun, shell and forge factories. In fact, about 80 per cent of the 75-mm. shells were manufactured in Rochester. To serve these the government advanced the cost of the cables, the central-station company returning 5 per cent of the power bills as part payment on the cables. An arrangement was also made whereby the electric company agreed to return, on declaration of peace, the difference between half the cable cost and the amount already rebated on bills. This agreement was made on the basis that the cables cost twice as much as in peace times. For other industries the cable capacity, in general, was sufficient with minor modifications, and about all the changes which were necessary were to increase the transformer rating, units of such size being banked as could be absorbed easily in peace time.

running very high, work having to be done that should have been performed during the war.

Some trouble was also experienced in the summer of 1918 in not getting the usual amount of water for the hydroelectric plants. This was due to water being diverted from the Genesee River into the Barge Canal to float barges which had run aground. On the other hand, Rochester was served entirely from the hydroelectric plants on the Genesee River for four or five hours on one occasion by utilizing stored water.

To get along with the small supply of labor available toward the end of the war it was necessary to eliminate vacations, except in special cases where the employees' health demanded them, and the men were given double pay. Women were employed for clerical work in the steam plant and for repairing, testing and reading meters, and delivering bills. In addition, the department heads did more than their usual work, oftentimes performing that belonging to positions ranking below their own to make up for shortage of help.

While the company had a contract with the Niagara, Lockport & Ontario Company for 6000 kw. in power, the

Less essential industries were not curtailed to any extent, because they automatically reduced loads due to difficulty in obtaining material, labor, etc., and to the government ordering a reduction in the number of styles of shoes, clothing, etc., much of this equipment being manufactured in Rochester. Extensions except to industrial plants were curtailed and lighting was reduced by the lightless night orders. This is about the only company in the Middle Atlantic States where the peak load occurred before the armistice; that is, in October.

Since the armistice was signed the load has dropped perceptibly, but rapid recovery is noted, optical, cloth-

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ing, instrument, camera and other industries now coming back on lines automatically. In November, 1919, it is expected that the load will be 10 to 15 per cent greater than in November, 1917. Lighting of all kinds is increasing again, lighting of signs being stimulated by the company's painting them free of charge. While it may not pay under present price conditions to go out after new business of this kind, this company does believe it advisable to stimulate business on existing services because the equipment is already there. Machine shops are shifting back from war work to peace work, and government plants can be converted to peaceful purposes, but this will take time.

Increased operating expenses were partly offset by a coal clause in the rates for electric service, but the biggest salvation will be in growth of business. While a still further increase in rates is needed, the company is adopting every device and economy to avoid it, but may have to ask it.

The combination of two other water-power heads is now under way on the Genesee River, and this is expected to be completed in one year. This development will be similar to the one completed during the war but will utilize only 120 ft. (36 m.) compared with 20 ft. (6 m.) and 90 ft. (27 m.) used by the plants to be displaced. This development and the one completed supplant six old hydroelectric stations, give flexibility, higher economy and utilize more of the 260-ft. (79-m.) head available inside the city of Rochester. Among other improvements under consideration is the installation of stokers which will burn breeze low-grade coal or anthracite screenings.

Great Increase in Chemical and Metallurgical Plants

Niagara, Lockport & Ontario Power Company.—As was emphasized at various times during the war, electrochemical and electrometallurgical industries increased their activities very considerably, no locality feeling it much more than that around the northern part of New York State, where power at a relatively low rate is available from Niagara Falls and other water powers. Among the electric service companies most affected was the Niagara, Lockport & Ontario Power Company, which serves a strip of territory along the south shore of Lake Ontario from Buffalo east to Syracuse, operating lines of different voltages up to 66,000. Forty-two per cent of this company's output is sold directly to industrial consumers, chief among which are the silicon-steel manufacturers, other electrometallurgical and electrochemical industries ranking next. Most of these industries were already connected to lines of the electric service company before the war and merely required increased transformer capacity to handle their loads. Only one "war baby" was connected, that being a government contract requiring 439,000 kw.-hr. a day. About 44 per cent of the output of the Niagara, Lockport & Ontario Power Company is sold to distributing companies, which in turn had many important war loads connected to their lines. The remainder of the power sold by this company is used for transportation. The company operates all of the electric railways between Buffalo and Syracuse except that of the Rochester company.

The Niagara, Lockport & Ontario Power Company operates a 12,000-hp. hydroelectric station on the Oswego River at Minetto, another rated at 35,000 hp. near Altmar on the Salmon River, and a 40,000-hp. steam station at Lyons. In addition, about 60,000 hp. is purchased from the Ontario Power Company at Niagara Falls. All of the public utilities to which the Niagara, Lockport & Ontario Power Company supplies energy in bulk also have generating stations, which, while not ordinarily called upon to pump back into the transmission company's system, were utilized in some cases to help out when there was a shortage of power. Foremost among them is the Rochester Railway & Light Company, which has water and steam stations. The Empire Gas & Electric Company of Auburn and Geneva and the Lockport Light, Heat & Power Company also have both kinds of stations; the Syracuse Lighting Company has steam stations, and the Northern New York Utilities Company of Medina has hydraulic stations. Arrangements for exchange of surplus energy have been in existence with the Rochester, Medina and Syracuse companies, the first being the only one from which any large amount of energy is ever received, however.

Before the war the output of the Niagara, Lockport & Ontario Company was running about 900,000 kw.-hr. a day, but in the last days of the war (Dec. 1, 1918) it reached over 1,800,000 kw.-hr. Now it is about 1,200,000 kw.-hr. a day, but the load is increasing again and is about equivalent to that of a year ago—exclusive, that is to say, of direct war supplies. The biggest increase in load took place in the fall of 1915, the load during 1916 remaining practically constant. Fortunately it was possible to install a 10,000-kw. steam turbo-generator at Lyons in February, 1917, and in September, 1918, an additional unit, rated at 12,000 kw., was put in service. However, the demands for power were so severe that the government had to order the curtailment of the less essential industries to help out the war industries. Help was also secured by the Rochester Railway & Light Company releasing the Niagara, Lockport & Ontario Power Company from a 6000-kw. contract and delivering about 15,000,000 kw.-hr. in 1918 to loads ordinarily supplied by the latter.

Aside from the large increase of war industries and the curtailment of power to less essential industries, the most marked effect of the war was to shift the center of load from the east to west, changing the voltage regulation and power factor on the lines. Whereas 15,000 kw. was ordinarily transmitted eastward from Lockport before the war, 12,000 kw. was transmitted toward it from the east during the war. To minimize the voltage gradient auto-transformers were installed about midway between the east and west ends of the system to permit boosting the transmission voltage 7000 volts in either direction. Power factor was improved considerably by separating the trunk line into two sets near Niagara Falls and operating them in parallel at the easterly end of the system. Whereas the ordinary method of operating these lines in parallel throughout full length gave a poor power factor, carrying the load on a smaller number improved it and permitted carrying increased loads. Another effect of the war was to increase the load factor, that of 1918 being 68 per cent as compared with 57 per cent in 1915.

Since excess generating capacity is now available, no extension work will be undertaken until new business justifies it. There is no reason to hold up maintenance work, however, except high price of porcelain, since copper as low and steel is medium. While plenty of labor is available, skilled workers are still scarce or expensive to secure. Some line extensions to serve industrial plants or to duplicate overloaded lines are being made, but no further interconnection is being considered, as about all that can be accomplished along this line has been done.

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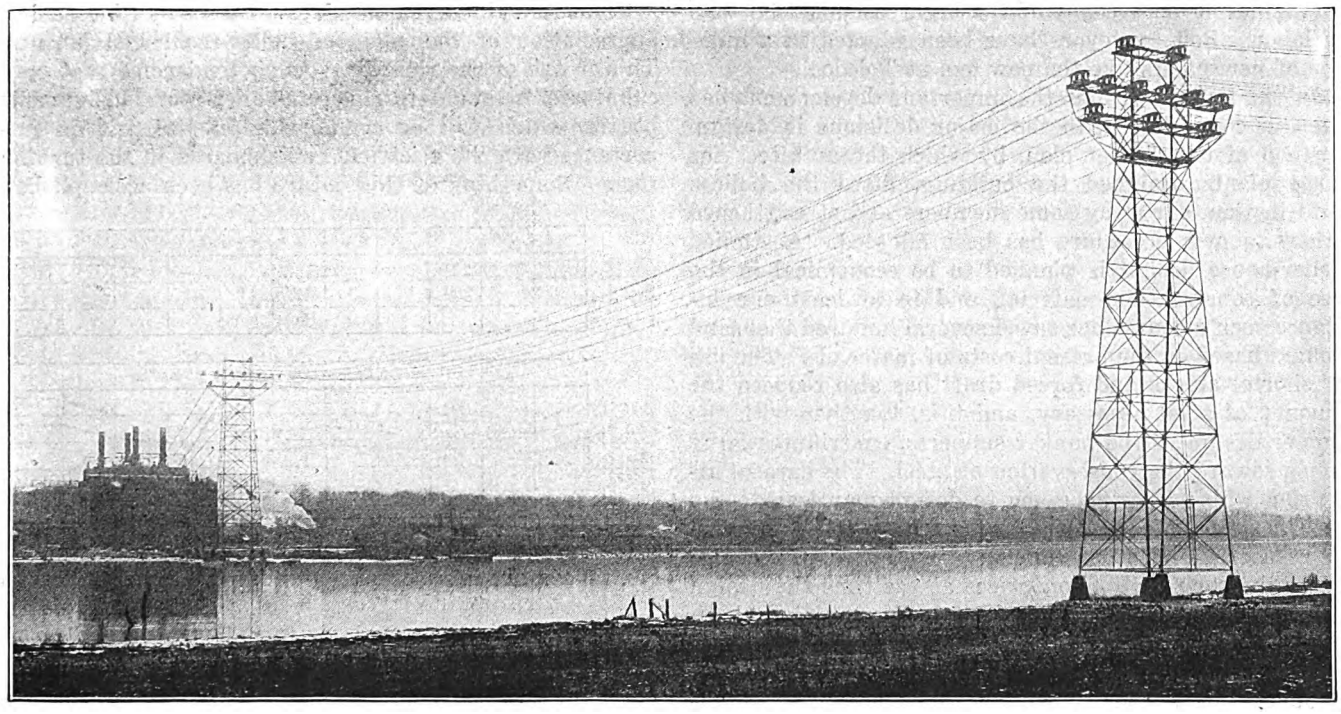

FIG. 1—A THOUSAND-FOOT RIVER SPAN AT JOLIET WITH SPECIAL SLIDING SUPPORTS

Special sliding supports equalize the strain on the insulators used on these river-span towers, which carry energy away from the high-steam-pressure station of the Public Service Company of Northern Illinois at Joliet. The river crossing towers are 155 ft. (47 m.) in height from the top of the foundation to the top of the towers, and the crossing span is 1000 ft. (305 m.) long. The dead-end towers, which stand about 360 ft. (110 m.) from the river crossing towers, are 55 ft. (17 m.) in height. The towers, as shown, carry three circuits, and the conductors, which are of 311,600-circ. mil. stranded copper-clad steel, extend from one dead-end tower to the other. Three other transmission lines leave the generating station in another direction on 60-ft. (18-m.) steel towers, and two transmission tie lines are also carried away from the plant on wooden poles.

Central Station Progress in the Middle West

Engineering Developments of the Last Eighteen Months in the Indoor and Outdoor Plants and in Customers' Utilization Apparatus Have a Background of Sound Conservation Principles

IT HAS been possible to make engineering progress in the absence of a large coincident construction program during the last eighteen months. Central stations spent comparatively little money in the Middle West in 1918-19. Yet in spite of this the art has advanced in nearly all of its branches, from the coal pile to the customer's motor. Development in some fields has been greater than in others, the most marked advance, perhaps, being in high-tension work. All have made some progress. It is the purpose of this article to chronicle those developments which seem to indicate the trends that may persist in the coming year. For convenience the article is subdivided into seven sections, dealing with fuel, turbine rooms, switching, substations, transmission, distribution and utilization.

Coal Storage and Water Powers

High coal prices and possibilities of coal shortages are the conditions that forced development in the central-station fuel situation. Not the least of these developments had to do with coal shortage. Central-station engineers had to learn how to store coal economically. In many cases they also had to find a place where it could be stored without excessive cost and large tracts of land were in some cases purchased or rented for this purpose. Sometimes the sites were at a considerable distance from the power houses, but they were almost invariably on easy haulage routes. Examples of this may be seen in the large coal-storage yards of the Commonwealth Edison Company along railroad right-of-way outside Chicago, and in the earth-pit storage of the Iowa Railway & Light Company adjacent to its interurban tracks. Other companies, like the Mansfield (Ohio) Electric Light & Power Company, have developed gas fields adjoining their plants for the use of the plant alone and have arranged for combination coal and gas firing.

Where formerly three factors—namely, adequate water, convenient transportation and proximity to load center—largely determined plant locations, in the future a fourth factor, proximity to economical fuel supply or storage facilities, may enter into a company's choice more largely than ever before.

Still other companies are directing their attention to water powers which formerly they ignored as too small. The coming year may see hydroelectric plants as small as 100 hp. carefully studied for their possibilities as fuel savers for interconnected systems. The greater use of water power from existing plants is also expected to continue. The trend in this direction is evident at Keokuk, where the peak has increased from 75,000 kw. to more than 105,000 kw.

A further development in the fuel situation is the revival of powdered-coal experimentation in this section of the country. Of the development in coal-handling apparatus little can be said except that smaller stations, such as the Northwestern Ohio Light Company at Delphos, have undertaken more serious consideration of

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coal handling on account of the high cost and shortage of labor. Belt conveyors have been adopted in a number of new plants like the new one at Toledo.

In the larger stations the important development has been in connection with the major decisions in design. Instead of the former plan, by which the architect for large plants designed the building, fitted the boilers into it, then cut away some members and strengthened others, a new procedure has been adopted. A studied boiler-house design is planned to be economical in the use of construction material, and in at least one instance such a course has saved several hundred thousand dollars based on the present costs of materials. The use of shorter stacks and forced draft has also reduced the amount of steel necessary, and this, together with the proper design of the bunker supports, contributes large items toward the conservation of steel. The careful attention which is being given to design may lead to the incorporation of reinforced concrete in place of steel or to the use of other substitute materials, the choice depending primarily upon prices at the time the design is made. Some steps in this direction have already been made by the Tri-City Railway & Light Company at its Moline (Ill.) plant.

Conditions which led to the wider use of coal-handling apparatus also induced more companies to install economizers and stokers. High coal costs and high labor costs have forced consideration of this equipment in plants where heretofore its advantages were not accorded a hearing. Economizers are being or have been installed in the new generating stations at Kansas City, Toledo, Cincinnati, Appleton (Wis.) and elsewhere. The new stations at Galesburg, Ill., and Lafayette, Ind., are examples of plants designed to permit economizers to be

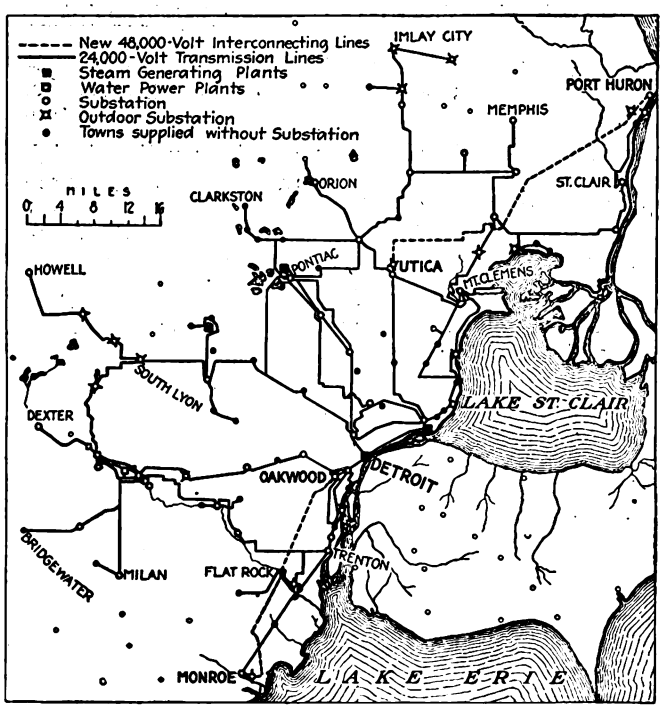

FIG. 2—INTERCONNECTION AROUND DETROIT

The Detroit company's standard transmission potential of 24,000 volts was increased to 48,000 volts on two new interconnecting arteries recently constructed. One line was built between Port Huron and Utica, a distance of 50 miles (80 km.), and the other was installed from Oakwood to Monroe, a distance of 25 miles (40 km.).

installed later if desired. There is talk of bringing a forced-draft chain-grate stoker to the market, but so far there is no central-station installation of this kind.

The last eighteen months have also seen an increasing appreciation of the value of boiler-room instruments. This is one of the rapidly growing tendencies that may culminate in standardizing on boiler-room instrument boards which will be comparable in size and in importance with the electrical switchboards in the turbine room. Something of this nature has been accomplished

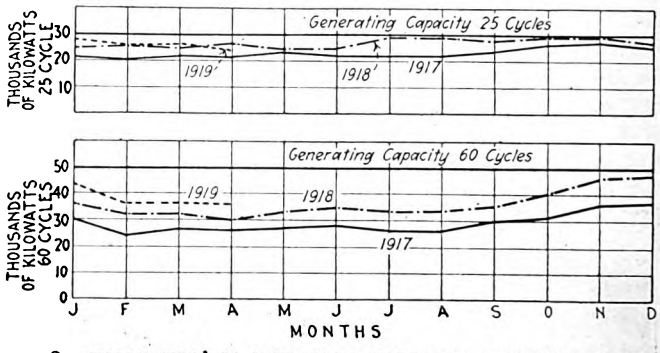

FIG. 3—CUSTOMERS' CO-OPERATION KEEPS MILWAUKEE DEMAND WITHIN CAPACITY OF GENERATING STATIONS

The war requirements of electric steel furnaces and other industrial loads called for much more than the full station capacity of the Milwaukee Electric Railway & Light Company. When it seemed probable that the peak load would reach the danger point any evening, the large customers were called up during the day and asked to reduce their demand before the evening peak came on. The customers realized the conditions and coöperated with the company to the best of their ability. This made it possible for the electric company to keep the peak load within its combined station capacity and permitted Milwaukee to make an enviable record in producing war materials for the government.

in several modern plants, including the station of the Union Gas & Electric Company at Cincinnati. The same demand for increased coal economy has also led to the installation of some pioneer plants. One plant at Joliet, Ill., operating on the lines of the Public Service Company of Northern Illinois at high steam pressure and high steam temperature has shown that desirable operating results are to be obtained by paying the proper attention to the essential details. Some of the larger new power houses, with 25,000-kw. units oper-

EFFECT OF ARMISTICE ON BUSINESS OF UNION GAS & ELECTRIC COMPANY OF CINCINNATI

	Kilowatt-hours Generated		
	1917	1918	Per Cent Increase
August	8,444,982	11,985,302	41.92
September	9,233,003	12,762,140	38.22
October	10,748,244	14,290,924	32.90
November	11,077,535	13,686,785	23.57
December	11,223,201	14,631,830	30.38
January	10,628,634	14,828,548	39.5
February	9,847,318	13,290,448	35.0

Year	Kilowatt-hour Output	Peak Loads (Kw.)
1914	53,062,085	18,651
1915	73,861,357	25,725
1916	97,635,173	31,150
1917	112,037,853	34,010
1918	140,247,456	46,400

ating at temperatures and pressures that are considered standard, are now producing a kilowatt-hour on about 1.5 lb. of 14,000 B.t.u. (680 g. of 3528-cal.) coal. These records in plants like the one at Cincinnati are being made with turbines from which the last two stages have been removed.

Load Conditions and Turbine Sizes

Recent turbine-room developments in the Middle West divide themselves into two classes—those for plants serving war needs and those for plants in less active

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centers. In the cities serving munition loads additions to plants required by normal growth have been accelerated somewhat by war conditions. These additions to equipment were planned and in most cases were contracted for prior to the country's entrance into the European war. The increases in load were greater than the increase in generating capacity, however, in most instances. The discrepancy was sometimes met by operating with a smaller margin of safety, as shown in the data (Fig. 5 and Fig. 3) cited from the Detroit and Milwaukee companies. In other cases, notably Milwaukee, it was also met to a certain extent by improved equipment, such as new stokers, increased boiler capacity, etc. The signing of the armistice and the resultant slowing down of industry reduced the demand on some of the larger systems, including Milwaukee, by several thousand kilowatts. On others the effect was not appreciable. The three months just prior to the signing of the armistice (August, September and October of 1918) showed an average rate of increase of 37.7 per cent in the kilowatt-hours generated by the Union Gas & Electric Company of Cincinnati compared with the previous year. The average for three months following the cessation of fighting (November, December and January) shows an average increase over the previous year of 31.2 per cent. The apparent decrease due to the armistice appears to be 6.5 per cent. This is quite insignificant, however, in comparison with the increase of 164 per cent which the company showed between the years 1914 and 1918. With some industries slacking down and with new industries hesitating to invest money at a time when labor and material costs were so high, some companies made really serious attempts to offset the loss in war load by going after higher-rate business.

The turbines that are being installed in large stations indicate that units of from 25,000 kva. to 35,000 kva. are becoming most popular. Instances of this tendency will be found at Minneapolis, Moline, Cincinnati, Cleveland, Toledo, Louisville, Chicago, Detroit and Kansas City. In smaller stations it is probable that turbines with comparatively high water rates may within the next twelve to eighteen months be replaced by modern and more efficient units. Such a change is being considered for an Illinois station containing 2500-kw. turbines purchased about six years ago. These units can show records of steam consumption around 22 lb. (10 kg.) per kilowatt-hour, but modern turbines of 5000-kw. rating, which could now logically be installed in this station, would show a wa-

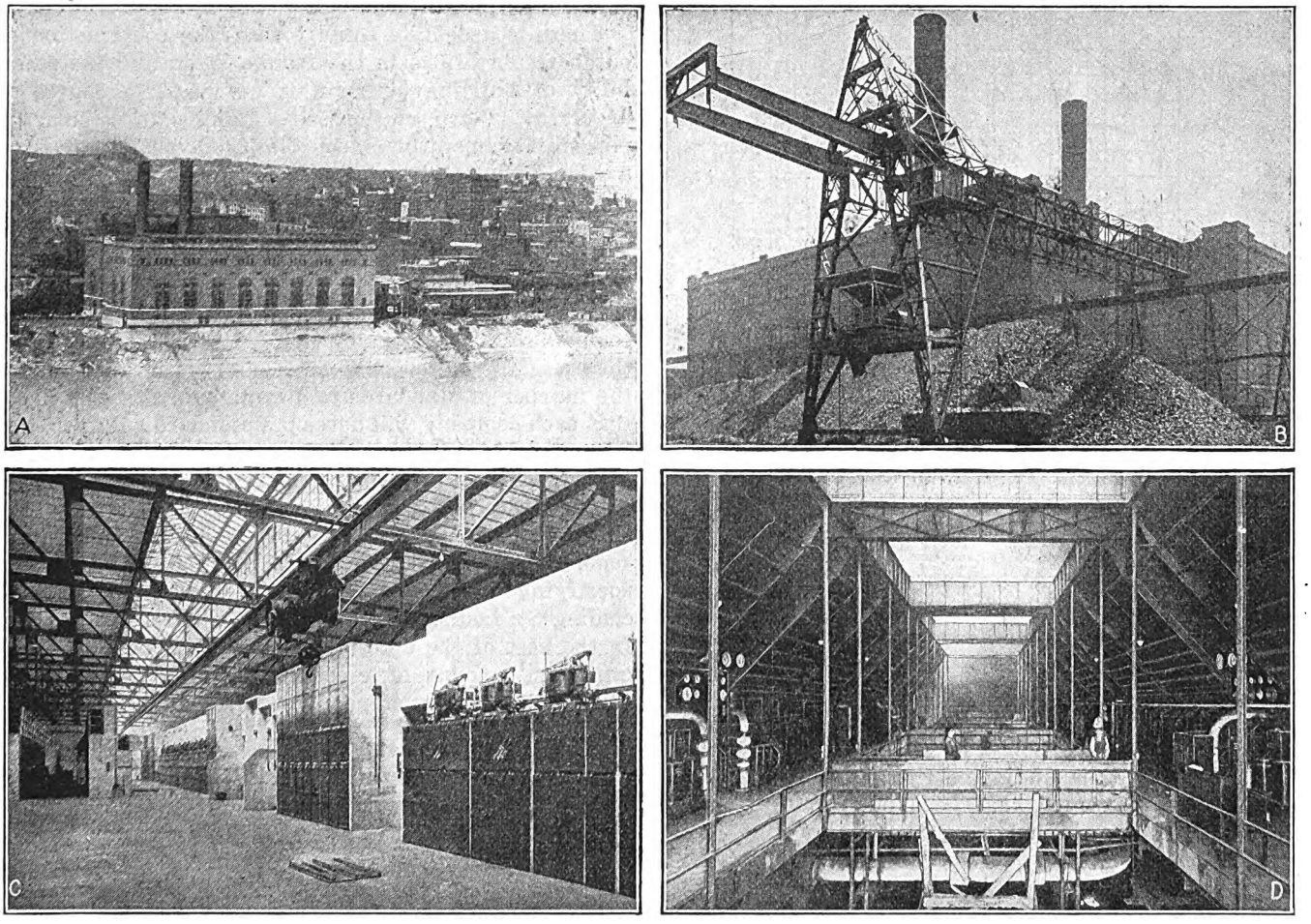

FIG. 4—VIEWS OF RECENTLY COMPLETED STEAM GENERATING STATION OF UNION GAS & ELECTRIC COMPANY, CINCINNATI

A—View of the station from the Ohio River. The plant will have an ultimate capacity of 100,000 kw., of which 50,000 kw. has been installed. Enviable operating records with both gas and coal fuels are being made. A 13,200-volt underground transmission system connects this station with the old plant and the five substations. B—Coal storage and apparatus for handling the fuel economically. Combustion engineers realize the advantage of burning properly prepared coal and are experimenting with methods of crushing coal at various locations between the mine and the stoker. C—Switch-house interior, showing liberal use of doors, barriers and other protective apparatus which are the results of continued safety-first campaigns. D—Boiler-room instrument and control panels have been installed at easily accessible points. This is indicative of the growing appreciation in the Middle West that boiler-room instruments are as essential as the instruments on the electrical switchboards.

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ter rate around 13 lb. (5.8 kg.) per kilowatt-hour. With coal at present prices a substitution of the more efficient turbines could probably be justified. There are many stations which have not been serving war-time loads where the installation of new equipment has been de-

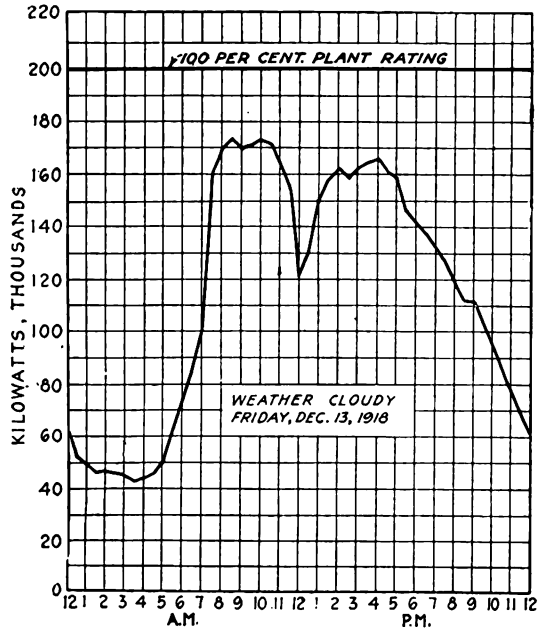

FIG. 5—DECEMBER, 1918, PEAK OF DETROIT EDISON COMPANY IS 84.4 PER CENT OF PLANT RATING

The aggregate rating of the generating stations of the Detroit Edison Company last December was 204,075 kw., and the peak was 172,000 kw. In 1916, however, when the plant rating was only 130,800 kw., and in 1917, when the rating was 153,300 kw., the maximum demand on the system was less than 3 per cent below the ratings of all the generators available in each year. The kilowatt-hours generated during 1918 totaled 773,876,700, or an increase of 13 per cent over 1917, which in turn showed an increase of 22 per cent over 1916.

layed so long that it may now be necessary to install additional generators, etc., regardless of the condition of the labor and material market.

Results of Safety First in Switching

The effect of the continued safety-first campaigns is noticeable in the design of the generating stations and substations which have been built in the Central Western States during the past few years. These results manifest themselves in the more liberal use of barriers, doors and protective screens, and one of the photos of the Cincinnati station (Fig. 4) illustrates this. There is also a tendency to minimize the hazard in operating disconnecting switches through the use of remotely controlled, manually operated "disconnects," through auxiliary fused disconnects, through oil switches in which disconnecting switches are an integral part of the operating mechanism, and through other devices designed to show the operator whether the "disconnect" which he may be about to operate is open or closed. Such devices as these, in addition to minimizing hazard, also save time. There also appears to be a tendency to isolate the transformers from switching equipment and from positions usually occupied by the operating force. The Public Service Company of Northern Illinois has placed barriers around 2300-volt potential transformers and other similar apparatus installed in its new substation at Joliet.

Another unique development in switching occasioned by the interconnection of long lines to form looped networks has come to light. In this particular instance the two lines which formed the loop operated at 110,000 volts and 33,000 volts respectively, one being something less than 100 miles (160 km.) while the other was twice as long. Both were fed from the Keokuk power station and they came together at a synchronizing station at the other end. When it was desired to place these two lines in parallel at their outer end the time lag on the longer line was found to be so great that the need for a phase-shifting device arose. The connections for synchronizing the lines were made through frequency changers, and it was a comparatively simple matter to shift the stator of one of these frequency changers so that the proper phase relation could be obtained for synchronizing. The stator is now adjusted manually, but a motor-operated device will probably be installed for this purpose later.

There is a definite trend toward the construction of outdoor substations in the Middle West, and the feasibility of building outdoors is no longer a source of argument. Such stations are gaining in popularity, not only for operating one or two 2300-volt feeders from a high-potential transmission line, but also for supplying large individual industrial plants.

The outdoor substation practice in the Middle West has probably made its most striking advance in the direction of standardization of design. However, the trend has been toward standardization by individual companies rather than by any section or group up to the present. Unless a concerted effort is made to reduce the number of standards to a minimum, it seems likely that each company will develop a standard substation of its own or it will adopt that of a neighboring company and only a few companies at most will employ the same standard design. Several companies have worked out standard designs for 33,000/4000-2300 volt substations, some companies specifying wood-pole construction, some specifying steel-tower construction, while others, including St. Louis, use both to meet different conditions. In the best of these designs the aim has been to use a minimum amount of erection material, all of which can be taken from standard stock, and to arrive at a

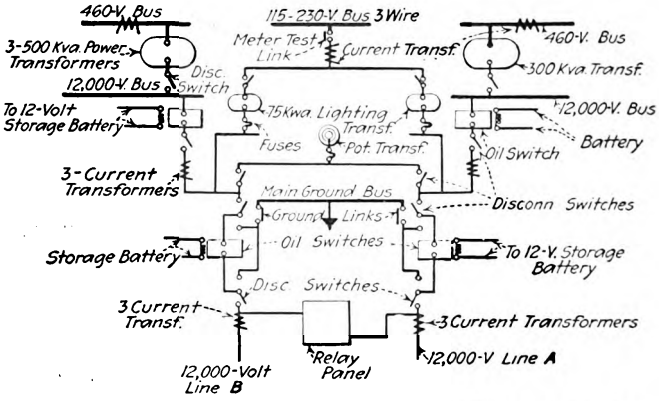

FIG. 6—12,000-VOLT INDUSTRIAL SUBSTATION IN CHICAGO MUNITIONS PLANT

This customer's substation was laid out by the Commonwealth Edison Company with two incoming 12,000-volt lines. The bank of three 500-kva. single-phase power transformers may be connected to one incoming line and the bank of three 300-kva. transformers may be connected to the other line. However, the diagram is so laid out that both banks of power transformers can be connected to either line or both lines can be tied in together to feed the entire station. Duplicate 75-kva. lighting transformers are connected to the 12,000-volt lines, making the lighting independent of the power service.

design which would fit a variety of conditions. Future designing of substations where this policy is carried out will be necessary only for special applications.

There has been a rather marked difference of opin-

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ion among Middle Western engineers in the last eighteen months as to whether transformers should be hung on poles or set on the ground. The practice of drawing this dividing line at substations containing three 25-kva. units appears to be gaining in popularity.

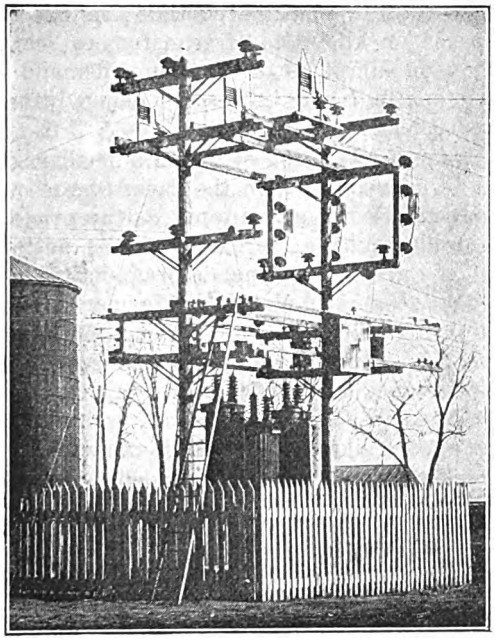

FIG. 7—33,000-VOLT OUTDOOR SUBSTATION USED IN NEBRASKA

This pole-type outdoor substation is the standard small substation used by the Central Power Company of Grand Island, Neb., for serving rural communities from its 33,000-volt lines.

Where more than three 25-kva. units are incorporated in the design an important Wisconsin company sets the transformers on the ground, and for stations of smaller ratings than these it hangs the transformers on poles.

Transmission-Line Practice

Transmission lines have been the salvation of the public utility business in the small towns. This is especially true in Illinois and other nearby states, where the interconnected networks are fairly complete. Coal prices would have driven small isolated stations into bankruptcy in many of these communities. As it was, a large number of municipal power plants in this section of the country sought transmission-line service to avoid increasing rates to extraordinarily high figures or piling up a large deficit. In serving some of these small communities the tendency is toward longer spans. While 125-ft. (38-m.) spans were formerly in vogue, distances exceeding 200 ft. (61 m.) are now being used with success. This is quite an item in reducing the cost of transmission lines when it is figured that the cost of a pole top is about $15. Wooden arms are gaining in popularity for this work.

The proper choice of voltages in high-tension transmission is receiving careful consideration. To some engineers connected with the manufacture of high-tension apparatus in the Middle West it appears that 33,000 volts as a common high-tension potential has passed the peak of its popularity and that it must give way to 44,000-volt and 66,000-volt service. These engineers believe higher voltages are necessary to take care of the larger blocks of power that must be handled, and 66,000 volts does not appear to be much more troublesome to handle than 33,000 volts. There is also some tendency in high-tension transmission to break away from the delta-connected system. The Northern States Power Company is operating its system star-connected, and other Middle Western companies are contemplating a change from delta to star connection. When the delta-connected system was adopted in earlier days its principal advantages were thought to be the possibility of operating in open delta and the further possibility of operating with one leg of the line grounded. It has been found in practice that it is just as possible to operate in open star, and that for long mileages it is not advisable to run with one leg of a delta system grounded, because the charging current flowing to the ground will open the breakers. The belief seems to prevail in the section that delta operation is not objectionable for small systems but that large systems rob it of its advantages. This situation led engineers to ask what would happen when a system operated at 110,000 volts star-connected was transformed to 66,000 volts star or 44,000 volts star. The most likely answer seems to be to use the ground wire as a fourth conductor to eliminate the trouble that arises from operating a star-to-star three-wire system.

Transmission progress of another type is being made by Middle Western operating companies which control a large number of properties. One of these upon making an analysis found that fifteen voltages were being

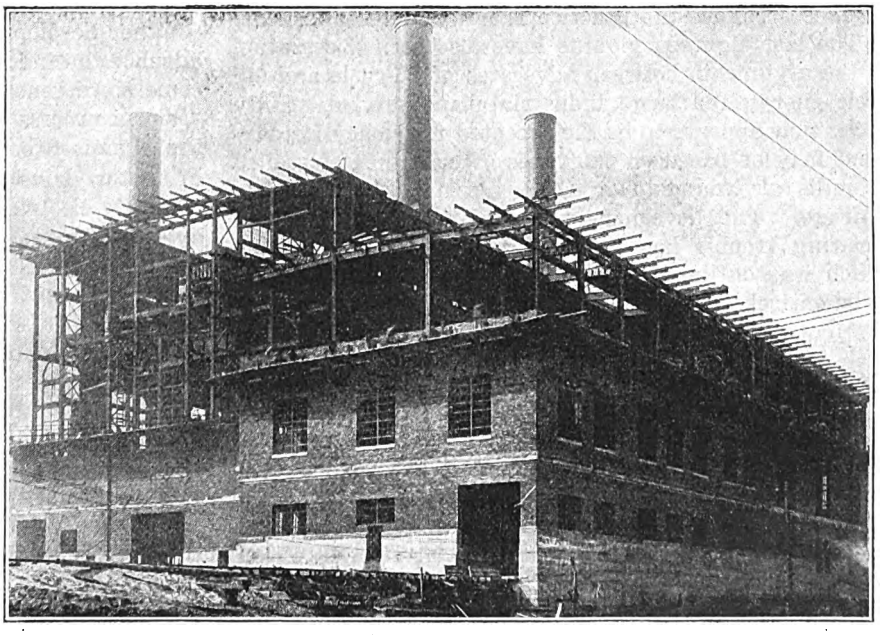

FIG. 8—FIRST UNIT OF THE KANSAS CITY LIGHT & POWER COMPANY'S NEW POWER PLANT NEARING COMPLETION

This unit will house three 20,000-kw. turbo-generators and will cost about $5,500,000. Of this expenditure the equipment costs represent about 65 per cent and the building costs about 35 per cent. The switchboard costs will be about $250,000. The building is unique in that the foundations will cost more than the superstructure, but this is accounted for by the fact that the plant, built on the bank of the Missouri River, stands over an immense condenser well about 60 ft. (18 m.) deep and draws water from an intake well excavated to approximately the same depth. Over the second condenser well, which is yet to be excavated, it is likely that two 30,000-kw. machines will be set. It will be necessary to extend the building before any of the 30,000-kw. machines can be installed.

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used by its various subsidiaries. To obtain the benefit that comes through interchangeability of materials and apparatus, particularly transformers, and in order to conform with the manufacturers' standards, this company proposes to work toward the following standard voltages: 2300 volts (4000 volts Y, using 2300-volt equipment); 6600 volts (11,430 volts Y, using 6600-volt equipment); 13,200 volts; 33,000 volts. High-potential transmission lines were worked and tested alive to a greater extent during the war than ever before, and the Utilities Development Company of Indiana is one of the companies of the Middle West which have adopted this practice. Considerable experimental work has been done, and as a result engineers expect that much more work will be done with "hot" lines in the future.

Refinements in Distribution Practice

While not a great many additions to distribution systems were made in the Middle West during the war, some refinements in distribution practice were worked out. Moreover, since the war ended a considerable quantity of distribution construction work has been started to supply the requirements of people who were asked to defer their demands when labor and material were so badly needed by the government. Reinstatement of the two-pole free-extension rule by the commissions in Illinois and other states may have accelerated this action.

Chief among the refinements that have been made in distribution practice are the successful banking of transformers and interconnecting of secondaries on the overhead system of the Minneapolis and other companies; the successful reinstallation of old lead-covered cable in Chicago and the constantly growing use of 12,000-volt and 13,200-volt service for wholesale industrial customers in Chicago, Milwaukee, St. Louis and Cleveland. The use of these voltages has proved so satisfactory for supplying the large industrial loads that engineers believe the practice is now well established.

The last eighteen months have also seen a cessation of the arguments between advocates of 25-cycle and 60-cycle energy for large industrial-plant service. Sixty cycles now appears to be the accepted frequency if judgment may be based on the types of equipment installed in mills at Youngstown, Ohio, Peoria, Ill., and near Chicago. The development of relay installations for isolating trouble has been carried out along the line which was outlined earlier, with results that are said to be entirely satisfactory.

Problems of Utilization

On account of the fact that the central stations of the Middle West were fairly well supplied as to generating capacity when the United States declared war, and because of the further fact that a great deal of industrial development took place in that territory, there was really more of engineering accomplishment on the premises of the central-station customer than in either the indoor or outdoor plant of the company itself. One such notable development has occurred in the soft-coal fields of several states. It has long been known that power production at coal mines was on a very inefficient basis, but it required the high coal prices to bring this home to the mine operators. Since they have seen it these operators have begun buying power in bulk, building their own substations and caring for their own distribution. One coal-mining company which is purchasing power in bulk for a number of substations has been able to take advantage of diversity which the central-station company counted on getting when it made the rate to which it at first thought the coal-mining company was entitled. Further development of this tendency on the part of coal companies to buy power in bulk for several of their mines may lead to changes in the type of rate schedule so that the fixed charge may be based on kilowatts of transformer installation rather than on kilowatts of maximum demand. Some very competent engineers in western Pennsylvania favor the former scheme.

A somewhat similar proposition on a smaller scale has developed in connection with the farm power business. This has again become a live topic, as the prices of the farmers' products have increased and as national advertising of gasoline-engine, storage-battery, farm-lighting plants has stimulated the farmer's interest in electric lighting. At least three companies in Illinois have been formed to buy high-tension service and to build transmission lines which will carry energy to the farmer. To some observers it appears that the situation is very much like the one which existed in the telephone industry about fifteen years ago. Some of the larger telephone companies did not feel called upon to serve the farmer. The farmer, wanting the service and having money to pay for it, provided it for himself after a fashion. There was usually a considerable lack of engineering in his methods of providing himself with service which later reacted to the disadvantage of the telephone companies when they took over the lines which the farmer had built. Engineers who believe that this situation exists are advising the central-station companies not to make the same mistake which the telephone companies made earlier. In some places the advice has been well taken, as central stations are showing an interest in the farmer's venture and are seeing to it that three-phase lines are being constructed for the purpose of serving him.

Other developments are under way which promise to advance the industry materially as their advantages become more generally understood. Among these are the "triplex process" for electric steel melting employed by the Illinois Steel Corporation, the further development of motor drive in the sugar-manufacturing industry, complete electrification of steel mills such as Brier Hill at Youngstown, Keystone Steel & Wire at Peoria, and the Acme Steel Goods Company near Chicago. These mills represent three different branches of the steel industry.

Important developments are also promised in the electric refrigeration industry, especially in connection with small motor-driven plants for household and small commercial use. This is of particular importance to the central-station industry this year on account of the fact that practically no natural ice has been stored in the Middle West south of Oshkosh, Wis. Development in electric heating is also confidently expected, but this may perhaps be rather of a commercial nature than of an engineering nature, since the electric steel-melting furnace and the continuous-process enameling oven have been practically perfected.

Another engineering development in utilization practice will be found in the improved illumination being installed in factories. Efforts to interest manufacturers in higher intensity lighting have influenced the design of industrial lighting systems in practically all parts of the country.

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War-Time Service Problems in New England

Details of Plant Growth, Connected Load and Enforced Economies, Together with the Other Factors Which Have Demonstrated the Reliability of Central-Station Service in Spite of Unprecedented Obstacles

AN ENORMOUS increase in output made possible by liberal plant reserve at the beginning of the war and by prompt additions to plants thereafter enabled greatly augmented loads to be satisfactorily carried by the central-station companies of New England. Energy was thus made available to numerous war industries far more quickly than would have been feasible had these plants attempted to meet their entire power and lighting service growth by the enlargement or new construction of small and inefficient isolated plants. The high efficiency of central-station service, combined with interconnection of plants, released important generating capacity for war service and saved fuel by taking advantage of non-coincident peaks.

Station Ratings and Connected Loads of Ten Massachusetts Companies

The leading central stations in Massachusetts (Table I, page 1009) increased their plant rating from 191,471 kw. in 1914 to 301,350 kw. in 1918, a gain of 57.5 per cent. The combined connected loads of these plants rose from 324,185 kw. to 568,387 kw., an increase of 75 per cent. The ratio between connected load and station rating was 1.69 in 1914 and 1.89 in 1918. In 1914 the combined peaks of these plants totaled 109,836 kw., against 184,616 kw. in the fiscal year 1918 (ended June 30). The increase in combined peaks, neglecting their non-coincidence, was 68 per cent. It is noteworthy, however, that the reserve rating over the peak was 81,635 kw. in 1914 and in 1918 it was 116,734 kw. The ratio of station rating to peak was 1.74 in 1914 and 1.63 in 1918. There is no question that as the war progressed the equipment was worked more intensively, and again, the policy of interconnection has achieved wider recognition as an economic benefit. During this period the ten companies increased their purchases of energy from other companies from 2,526,506 kw.-hr. in 1914 to 28,598,748 kw.-hr. in 1918, while their sales of energy to other companies increased from 13,887,027 kw.-hr. to 37,207,081 kw.-hr. This total interchange of energy in ten cases only is significant of a new viewpoint among companies of larger size, many of which produced practically all the energy delivered at their system buses prior to the war.

In 1910 the combined generator rating of these companies was 118,959 kw., and their combined connected loads were 194,358 kw. Table II shows the generator rating, connected load and total energy delivered at the buses of these stations in the fiscal year 1910. Table V shows the comparative growth of plant rating during the four years preceding the war with the four years of war, as well as the comparative increases in connected load and the energy outputs.

It will be seen that in the four years preceding the war the station rating of these companies increased by 72,512 kw., while from 1914 to 1918 it increased by 109,819 kw., or about 50 per cent more than in the last four years of peace. The total kilowatt-hour output of these systems increased by 141,552,463 kw.-hr. from 1910 to 1914 on the basis of a per annum comparison. This was a 75.6 per cent increase in itself, but the pressure of war business actually forced the 1914-1918 per annum output up by 283,250,895 kw.-hr., reaching a grand total output for these ten stations of 611,675,092 kw.-hr. in the fiscal year 1918. In other words, the plant ratings combined at the beginning of the war were increased 57.5 per cent during the war and the outputs were increased 86.4 per cent. The connected loads gained 75.5 per cent. Near the end of the war these ten important stations in the single state of Massachusetts were producing (by generation or purchase) nearly three and one-third times the output they handled in 1910, and this with but two and one-half times the plant available in 1910. During the war the extension of stations was often seriously hampered by

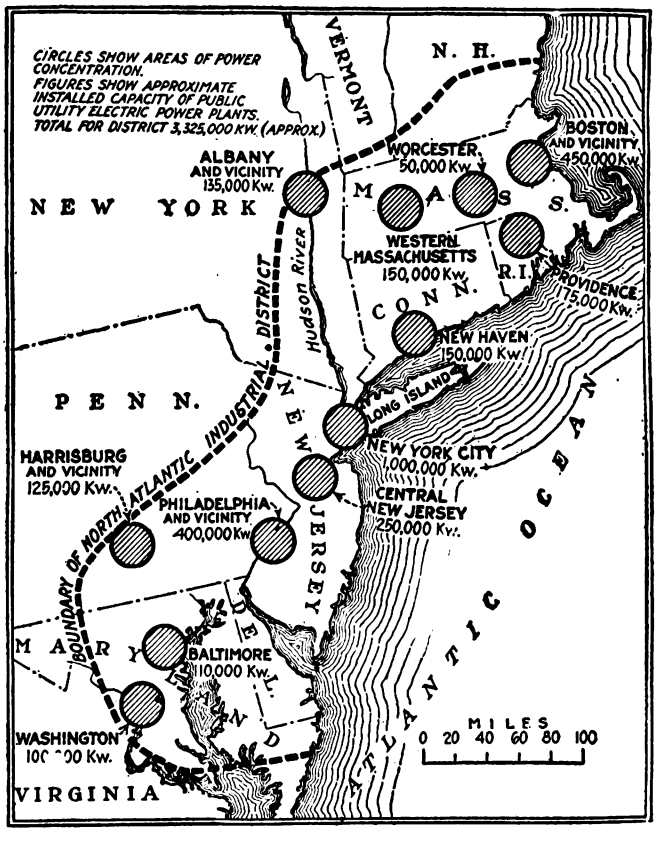

FIG. 1—CONCENTRATION OF POWER AND POSSIBILITIES OF INTERCONNECTION AS PROPOSED BY SECRETARY LANE FOR THE NORTH ATLANTIC SEABOARD

shortage of labor, material and transportation difficulties, despite priority rights, and the quality of fuel available was at times most unsatisfactory. Costs increased heavily, but with the exception of the introduction of coal clauses into contracts embracing the sale of energy in larger amounts, the companies in general rendered service without radical departure from the pre-war rates. Even coal clause and war surcharge increases were generally recognized by customers as just, and in commission rulings little trouble was en-

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countered from this source. These were often of the order of 0.5 cent per kilowatt-hour or less.

A graphic exhibit of how a progressively managed central station has shared its growth with its community, so to speak, appears in Fig. 2. From 1908 to 1911 the company did a small business, the rates yielding a total revenue about in proportion to the output. A period of rapid expansion then began, continuing to the outbreak of the war. The company (at Worcester, Mass.)

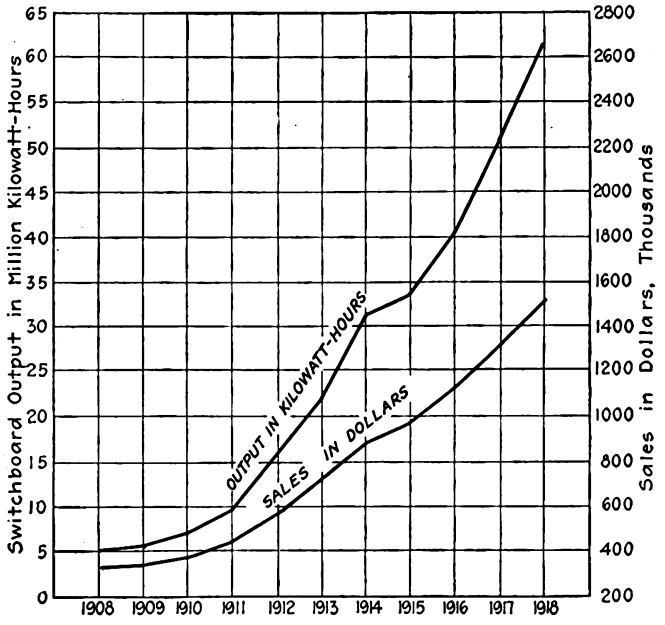

FIG. 2—OUTPUT AND REVENUE FOR WORCESTER (MASS.) ELECTRIC LIGHT COMPANY DURING 1908 TO 1918

received a lower average revenue in proportion to its output each year, though its total revenue increased substantially. The war gave a sharp jolt to the company's normal growth of business for a year or so; after which the pro-Ally stride was hit in war-material production, and from 1915 forward the growth of output was extremely rapid. In spite of increased costs of fuel, labor, capital and commodities generally, the company continued to give the community more and more for its money, on the average, and the "spread" between the two ascending curves furnishes eloquent testimony that the company serves its public without attempting to exact a revenue even directly proportionate to the output.

The increases in total outputs for ten systems during the fiscal years 1914, 1917 and 1918 are shown in Table VI. The output of companies serving Worcester, Fall River, Brockton, Lowell and Cambridge virtually doubled during the war. At Salem it more than trebled, and at New Bedford it rose to the extraordinary figure of ten times the 1914 output. This last increase was the result in large measure of the acquisition of great textile mills as customers, combined with energetic development of general patronage and plant construction to meet the needs of the future. Utilities serving the Buzzards Bay and Cape Cod districts of Massachusetts, including street-railway lines and central stations, are interconnected with New Bedford, where a tidewater plant has recently been constructed, of 37,000 kw. rating, to bear the chief burden of electrical service supply in a territory whose most distant point, the naval aviation base at Chatham, is about 90 miles (126 km.) away. Diversified manufactures for war service were supplied at Worcester, Lowell, Springfield and Cambridge. The Boston Edison company supplied energy to extremely varied customers during the war, some of the more important including the destroyer plant at Squantum of 2000 kw., the Watertown Arsenal, of 10,000 kw., the Boston Navy Yard, Boston army base and numerous manufacturing plants. The increase at Salem was due among other things to the taking over of service to a very large textile plant and to the completion of the Salem-Malden-Revere tie line. Reference to the results of the first year's operation of this line was made in the ELECTRICAL WORLD of Sept. 21, 1918.

Tables III and IV show the growth in connected power loads and in the total energy sold by the ten companies named during the four years preceding the war and the major part of the war period. It is significant that from 1910 to 1914 the connected power load did not quite double for these companies combined, whereas during the war it was considerably more than doubled. Looking at this increase from another angle, it appears that the combined power-load (connected) increase from 1910 to 1914 was 66,468 kw., whereas during the war it increased 171,127 kw. In other words, the increase in connected power load during the war period was nearly two and six-tenths times as great as in the last four years of peace. As for total energy sold by these companies to commercial customers, including other utilities but not street lighting, the output delivered increased by more than 115,000,000 kw.-hr. in the last four years of peace and by more than 226,000,000 kw.-hr. in the war period. That is, had the increase in output enjoyed in 1910-1914 been followed in 1914-1918, the output sold in the latter period would have been over 100,000,000 kw.-hr. less than was actually experienced.

Expansion of Rhode Island, Connecticut, New Hampshire and Maine Companies

Other New England companies also underwent a remarkable expansion during the war period. The Narragansett Electric Lighting Company, Providence, R. I., for example, sold 36,477,837 kw.-hr. in 1914, 45,377,485 kw.-hr. in 1915, 61,893,000 kw.hr. in 1916, 100,242,080 kw.-hr. in 1917 and 132,150,000 kw.-hr. in 1918. During this period the generating plant capacity rose from 21,650 kw. to 79,000 kw. and the peak loads increased

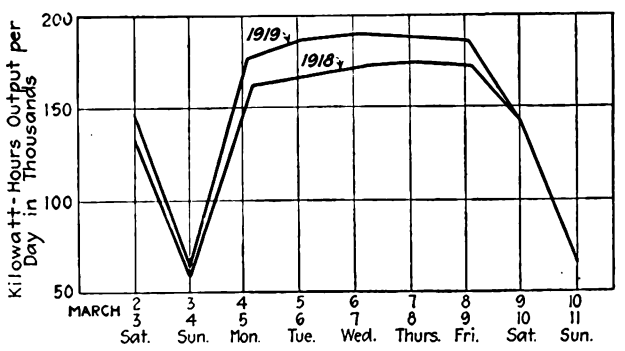

FIG. 3—COMPARATIVE DAILY OUTPUTS MARCH, 1918 AND 1919, FOR BRIDGEPORT (CONN.) DIVISION OF UNITED ILLUMINATING COMPANY

from 16,900 kw. to 45,000 kw. In 1910 the station rating was but 15,500 kw. The expansion during the war was nearly fourfold, and yet the gross earnings for 1918 were but about 107 per cent more than in 1914, or $3,464,623 against $1,670,253. A better instance of taking the public into partnership with its growing business could hardly be cited.

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TABLE I—INCREASE IN GENERATOR RATING AND PEAK LOAD IN KW. FOR MASSACHUSETTS COMPANIES DURING WAR PERIOD (APPROXIMATE)

Year Ended June 30		1914	1918
Boston Edison	(a)	101,400	116,400
	(b)	63,131	83,966
Worcester	(a)	14,620	34,600
	(b)	8,500	17,000
Salem	(a)	4,500	17,000
	(b)	3,600	11,300
Fall River	(a)	10,000	15,200
	(b)	4,750	9,750
Brockton	(a)	10,926	18,500
	(b)	4,555	9,000
Lowell	(a)	5,400	9,550
	(b)	3,940	8,000
Springfield	(a)	19,025	33,600
	(b)	9,200	15,000
New Bedford	(a)	11,550	37,000
	(b)	2,900	17,800
Cambridge	(a)	7,400	11,000
	(b)	4,875	7,600
Lynn	(a)	6,650	8,500
	(b)	4,475	5,200
Total generator rating		191,471	301,350
Total peak loads		109,836	184,616
Total reserve capacity		81,635	116,734

(a) Represents generator rating; (b) peak load.

TABLE II—GENERATOR RATING, CONNECTED LOAD AND OUTPUT, 1910

	Generator Rating in Kw.	Connected Load in Kw.	Total Kw.-Hr. at Buses
Boston Edison	73,850	120,279	112,999,207
Worcester	5,460	8,276	7,165,420
Salem	2,700	5,795	4,002,978
Fall River	3,160	5,474	4,873,250
Brockton	5,061	6,372	8,079,038
Lowell	5,400	10,542	12,986,367
Springfield	10,730	13,582	17,156,328
New Bedford	2,36	3,855	2,350,714
Cambridge	4,900	8,346	7,346,000
Lynn	5,336	11,837	9,912,432
Total	118,959	194,358	186,871,734

TABLE III—CONNECTED POWER LOAD IN KW. OF TEN COMPANIES FOR 1910, 1914, AND 1918

	1910	1914	1918
Boston Edison	42,821	79,654	185,940
Worcester	1,548	11,384	20,966
Salem	2,910	2,895	9,170
Fall River	1,513	4,910	14,833
Brockton	2,513	5,784	10,638
Lowell	6,160	6,305	11,544
Springfield	5,707	10,053	14,790
New Bedford	751	3,034	24,293
Cambridge	3,236	7,460	9,695
Lynn	3,094	5,242	6,079
Totals	70,253	136,721	307,848
Increase (four years)	.....	66,468	171,127

TABLE IV—KW.-HR. SOLD COMMERCIAL CUSTOMERS (EXCLUDING STREET LIGHTING)

	1910	1914	1918
Boston Edison	65,052,414	130,653,669	187,262,943
Worcester	4,555,508	24,198,484	48,024,886
Salem	2,354,028	7,010,899	30,940,093
Fall River	2,444,193	9,209,602	25,349,115
Brockton	5,520,062	9,329,687	22,970,578
Lowell	8,529,620	7,646,899	20,971,128
Springfield	10,030,361	17,944,018	35,173,347
New Bedford	1,476,772	4,035,347	53,136,983
Cambridge	4,854,664	9,117,206	19,037,754
Lynn	6,669,721	7,783,298	10,590,932
Totals	111,487,343	226,929,109	453,457,759
Increase (four years)	.....	115,441,766	226,528,650

TABLE V—COMPARISON OF COMBINED PLANT RATINGS, CONNECTED LOADS AND ENERGY OUTPUTS AT BUSES, PRE-WAR AND WAR YEARS, FOR THE COMPANIES LISTED IN TABLE I

Fiscal Year	Total Generating Rating in Kw.	Connected Load, Kw.	Total Kw.-Hr at Buses
1914	191,471	324,185	328,424,197
1910	118,958	194,358	186,871,734
Increase	72,512	194,358	141,552,463
Increase, per cent	61.5	66.5	75.6
Fiscal Year			
1918	301,350	568,387	611,675,092
1914	191,471	324,185	328,424,197
Increase	109,879	244,202	283,250,895
Increase, per cent	57.5	75.5	86.4

TABLE VI—TOTAL KW.-HR. OUTPUTS FOR TEN CENTRAL-STATION SYSTEMS

Fiscal Year	1914	1917	1918
Boston Edison	188,723,854	252,732,114	273,102,645
Worcester	31,564,026	51,178,400	61,997,800
Salem	9,188,860	22,334,290	33,103,670
Fall River	13,578,430	21,896,597	31,552,692
Brockton	13,990,203	27,059,110	30,286,260
Lowell	12,785,899	23,481,871	28,179,512
Springfield	27,900,008	44,091,825	49,801,164
New Bedford	6,283,355	30,306,662	62,831,921
Cambridge	12,404,482	21,248,709	24,956,708
Lynn	12,005,080	15,289,960	15,862,720
Totals	328,424,197	449,619,538	611,675,092

TABLE VII—COAL CONSUMPTION PER KW.-HR. GENERATED AND COAL COST PER TON

	Lb. Coal per Kw.-Hr. Generated			Average Coal Cost per Ton		
	1914	1917	1918	1914	1917	1918
Boston	2.129	2.008	1.95	$3.920	$3.756	$5.75
Worcester	2.541	2.642	3.11	4.180	5.732	7.38
Salem	2.713	2.090	1.92	4.218	5.12	8.25
Fall River	2.514	2.356	2.31	3.931	5.076	7.76
Brockton	3.055	2.230	2.10	4.659	4.935	6.91
Lowell	3.375	2.309	2.22	4.585	4.957	6.76
Springfield*	.....	.....	....	4.332	6.024	7.20
New Bedford	3.861	2.290	2.01	3.942	6.115	7.65
Cambridge	2.544	2.383	2.52	3.933	6.387	7.35
Lynn	2.860	2.951	2.15	3.730	5.551	12.76

* Combined steam and hydroelectric plants.

TABLE VIII—STATION OPERATING EXPENSES IN WAR PERIOD IN CENTS PER KW.-HR. MANUFACTURED AND SOLD

	Per Kw.-Hr. Manufactured						Per Kw.-Hr. Sold	
	Fuel		Labor		Total			
	1914	1918	1914	1918	1914	1918	1914	1918
Boston	0.373	0.499	0.150	0.198	0.675	0.872	0.975	1.142
Worcester	0.474	1.026	0.104	0.101	0.698	1.276	0.817	1.392
Salem	0.511	0.711	0.166	0.096	0.778	0.899	0.920	0.945
Fall River	0.441	0.801	0.135	0.094	0.686	0.983	0.856	1.134
Brockton	0.635	0.650	0.235	0.159	0.989	0.897	1.339	1.132
Lowell	0.629	0.670	0.195	0.148	0.956	0.943	1.294	1.152
Springfield	.....	.....	0.137	.....	0.803	1.443	1.020	1.547
New Bedford	0.680	0.685	0.437	0.080	1.276	0.824	1.604	0.948
Cambridge	0.447	0.828	0.345	0.259	0.932	1.183	1.123	1.483
Lynn	0.476	1.229	0.198	0.251	0.928	1.840	1.207	2.379

TABLE IX—DIVIDENDS AND BALANCE PER KW.-HR. SOLD, IN CENTS

	Dividends		Balance	
	1914	1918	1914	1918
Boston Edison	1.724	1.302	.....	0.040
Worcester	0.751	0.373	0.112	0.097
Salem	0.637	0.253	.....	.....
Fall River	0.809	0.409	0.001	0.006
Brockton	.....	0.492	.....	0.161
Lowell	0.996	0.510	0.642	0.311
Springfield	.....	0.712	0.117	.....
Cambridge	1.003	0.752	0.229	.....

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In the past four years the output of the Hartford (Conn.) Electric Light Company increased from 54,500,000 kw.-hr. to 93,000,000 kw.-hr., and that of the New England Power Company, the largest wholesaling company in this territory, increased from 120,000,000 kw.-hr. in 1914 to 323,000,000 kw.-hr. in 1918. Incidentally, this system produced but 34,000,000 kw.-hr. in 1910. In 1916, the year before the United States entered the war, the company's output was 246,000,000 kw.-hr., and in 1917 there was an increase to 300,000,000 kw.-hr. The Hartford company's plant rating increased from 18,200 kw. to 38,000 kw. in the 1914-18 period. All through industrial New England the growth of central stations and hydroelectric systems was quickened by the war, and while in some cases a very rapid expansion followed the entrance of the United States into the conflict, in general the manufacture of war material for the Allies in the first three years of the struggle brought about the major part of the expansion and laid the foundation for much future development. The Turners Falls (Mass.) Power & Electric Company, another great wholesaler of energy, sold 48,269,210 kw.-hr. in 1916, 100,565,300 kw.-hr. in 1917 and 116,630,855 kw.-hr. in 1918.

A few more examples of growth in load or output will suffice to indicate what happened to central-station record sheets during the war. Just about the time the United States declared war on Germany the Cumberland County Power & Light Company, Portland, Me., completed a fiscal year in which the total power sales were 10,561,262 kw.-hr. In the calendar year 1918 this power output increased to 20,778,152 kw.-hr., and the total sales of energy increased from 25,453,026 kw.-hr. to 36,389,414 kw.-hr. In the corresponding periods the Central Maine Power Company's output increased from 26,094,268 kw.-hr. sold to 32,307,367 kw.-hr. The Bar Harbor & Union River Power Company of Maine increased its switchboard output from 10,281,173 kw.-hr. to 13,456,487 kw.-hr. in this period.

The Bridgeport (Conn.) division of the United Illuminating Company exhibits a growth in station output of from 25,000,000 kw.-hr. in 1914 to 81,000,000 kw.-hr. in 1918, with peak-load increases of from 4000 kw. to 16,000 kw. and a growth in station rating of from 10,000 kw. to 32,500 kw. The population of Bridgeport increased during the war from about 120,000 to 170,000. In the year 1917 alone 286 new stores were opened in the city. The United States Housing Corporation built or is completing 1081 new tenements in Bridgeport, and during every month of 1918 the company took on an average of 300 new lighting and power customers in this district. The company ran for eighteen months after the price of coal rose materially before increasing its rates. At this point it may be noted (Fig. 3) that the week-day station output at Bridgeport during the first week of March, 1919, substantially exceeded that of the same period in 1918.

The Manchester (N. H.) Traction, Light & Power Company expanded in the 1914-18 period from an annual sale of 16,158,272 kw.-hr. to 23,883,088 kw.-hr. in 1918. The largest output in this period was in 1917, when the company sold 25,030,947 kw.-hr. The peak loads on the system, which is both steam and hydroelectric, were as follows: 1914, 5000 kw.; 1915, 5980 kw.; 1916, 8633 kw.; 1917, 9425 kw.; 1918, 9709 kw. Substantial growth is reflected also in the smaller central stations since 1910, as shown in Table X.

Increased Plant Investment of New England Companies

New England central stations increased substantially in investment outlay during the war. The ten large Massachusetts companies named in previous tables had a plant account, including real estate, buildings, lines, underground conduits, generating stations and other equipment, of $55,497,309 in 1914 after depreciation had been deducted from the original cost as required by the Gas and Electric Light Commission. In 1917, about the time the United States entered the war, the net increase in plant investment brought the total to $72,937,068. Discarded or obsolete equipment was written off in the interim, so that the gain of over $17,500,000 in three years in ten companies represents additional physical property value. In the last year of the war a further increase of about $7,000,000 net took place, giving a combined plant account in 1918 of $79,875,813 for these companies. The net gain during the war was therefore about 44 per cent. More than half the increase occurred on the system of the Boston Edi-

TABLE X—LOAD AND OUTPUT DATA, SMALLER COMPANIES OF MASSACHUSETTS
(Revere Company serves residential area and shore resort chiefly)

	Total Connected Load, Kw.			Peak Loads, Kw.		Kw.-Hr. at Switchboard		
	1910	1914	1918	1914	1918	1910	1914	1918
Buzzards Bay	.....	464	1,640	.....	.....	.....	975,094	1,674,559
Fitchburg	2,675	5,597	9,014	2,600	3,490	4,461,580	8,213,500	12,118,723
Haverhill	3,826	7,978	10,902	2,750	3,700	3,961,180	6,938,080	9,645,780
Newburyport	749	1,276	3,901	475	2,550	7 474,059	1,190,965	8,905,320
Pittsfield	3,524	6,259	11,333	1,700	3,309	3,231,156	5,121,530	11,491,190
Revere (substation)	6,357	5,002	15,970	1,950	1,900	2,836,658	3,441,356	3,430,848
Webster and Southbridge	1,111	2,813	4,407	.....	3,750	1,258,428	4,118,300	11,387,090

TABLE XI—NET INCREASE IN PROPERTY INVESTMENT DURING WAR PERIOD, APPROXIMATE DATES

	Outbreak of War, 1914	Entry of U. S. Into War, 1917	On June 30, 1918
Boston Edison	$39,235,686	$48,745,094	$53,611,679
Worcester	2,512,265	3,102,029	3,354,317
Salem	748,102	865,766	873,269
Fall River	2,205,319	2,386,513	2,831,914
Brockton	1,935,418	2,676,109	2,841,105
Lowell	1,988,002	2,401,323	2,455,796
Springfield	3,407,123	4,344,101	5,478,633
New Bedford	1,245,584	3,596,754	4,437,014
Cambridge	1,346,526	1,594,150	1,666,669
Lynn	1,873,284	2,225,229	2,325,417
Totals	$55,497,309	$72,937,068	$79,875,813
Increase three years	.....	$17,439,759	.....
Increase four years	.....	.....	$24,378,504

TABLE XII—KW.-HR. GENERATED, COAL COSTS AND TONS BURNED

	Kw.-Hr. Manufactured		Coal Cost		Tons of Coal Burned	
	1914	1918	1914	1918	1914	1918
Boston	188,723,489	267,646,180	$703,084	$1,335,139	179,364	232,225
Worcester	30,031,300	50,896,500	142,379	522,122	34,049	70,646
Salem	9,188,860	33,103,670	46,945	235,384	11,129	28,412
Fall River	13,578,430	31,529,200	59,898	252,406	14,988	32,522
Brockton	13,990,203	30,286,260	88,892	196,753	19,159	28,406
Lowell	12,785,899	28,176,708	80,466	188,921	16,876	27,875
Springfield	26,914,708*	37,794,664	116,846	347,887	26,975	48,228
New Bedford	6,283,355	62,831,921	42,696	430,568	11,132	56,406
Cambridge	12,396,367	24,948,521	55,366	206,629	14,076	28,127
Lynn	12,005,080	15,862,720	57,171	194,993	15,206	15,228
Total	325,897,691	583,076,344	$1,393,743	$3,910,802	342,954	568,075

Average ten stations, lb. coal per kw.-hr.: 1914, 2.36; 1918, 2.18.

* Combined steam and hydro-electric plants of company.

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son company. Table XI shows the increase in each of the companies named.

The growth of the plant account of a single company during the period from June 30, 1914, to Jan. 1, 1919, indicates the expansion required. Thus, the Hartford (Conn.) Electric Light Company's physical property increased in fixed capital assets from $4,327,521 to $7,590,500 during the active part of the war, roughly speaking. Increase of business added the following net investment in typical items: Power plant buildings, $305,568; boilers and furnaces, $571,097: generating units, $355,404; substations and equipment, $231,562; accessory electrical equipment, $134,442; conduits, $284,472; transmission and distribution system, $455,471. At the beginning of 1917 the plant and equipment account totaled $6,971,179. The company's load increased from a maximum of 13,000 kw. in 1914 to 31,000 kw. in 1918, and the connected power load rose from 20,253 hp. on June 30, 1914, to 32,214 hp. on Dec. 31, 1918. It should not be forgotten that many of the central stations, in enlarging their plants to meet the pressing demands of war service, were obliged to dismantle and remove units representing a long expectation of life, to sell them at a sacrifice and put in their places larger machines involving a much greater increase in capital outlay than is expressed in the net plant account increases.

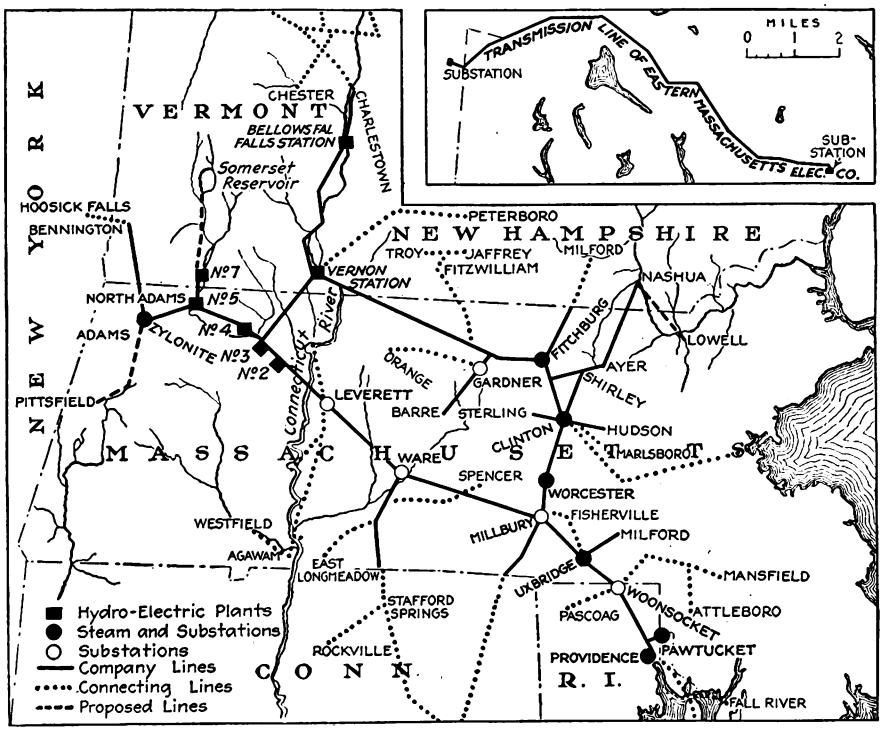

FIG. 4 — TRANSMISSION LINES OF NEW ENGLAND COMPANY'S SYSTEM; INSERT UPPER RIGHT HAND, HIGH-VOLTAGE TRANSMISSION LINES CONNECTING WITH UNDERGROUND SYSTEMS OF SALEM (MASS.) ELECTRIC LIGHTING COMPANY AND MALDEN ELECTRIC COMPANY AT MELROSE, MASS.

Cost of Operation in War Time

The cost of operation has increased enormously during the war, despite the utmost skill in management and station engineering. Foremost in the advancing war of expense increase was fuel. The cost of supplies, as is well known, increased during the war by from 50 to 100 per cent or more in many items. The total cost of station labor also rose materially in many plants, but this was more than overcome by the increased output, so that the cost of labor per kilowatt-hour was frequently reduced in 1918 as compared with 1914.

Table XII shows the comparative output, coal consumption and total fuel cost of ten large Massachusetts stations in 1914 and 1918, and Table VII gives the average coal consumption per kilowatt-hour generated by steam in these plants, together with the average price paid for coal burned in each year. It is significant that the average coal consumption per kilowatt-hour was reduced from 2.36 lb. to 2.18 lb. in the two years contrasted, showing the attention paid to plant efficiency and also reflecting the benefits of increased output upon the load factor. The total cost of fuel in 1918 was 2.8 times that of 1914, the output was 1.79 times that of the opening year of the war, and the total coal consumption in 1918 was but 1.65 times that of 1914. Considering the fact that central stations contributed many of their best operating men to the colors, this is indeed a tribute to the stewardship of those who remained at home and did their part in providing energy for the operation of essential industries, utilities and other vital activities.

The increases in the price of coal in the foregoing stations, and in others also, were too great to enable any general reduction in fuel cost per kilowatt-hour to be attained. In fact, as Table VIII shows, the latter advanced all along the line of plants. The extent of the advance was considerably reduced in some instances where the station efficiency showed a striking gain or where advantageous coal contracts held over into the war period far enough to produce lower average annual fuel prices. With the exception of New Bedford, Mass., the grand total operating cost at the station per kilowatt-hour sold increased in every station; but in this exceptional case the increase in output resulting from the taking on of the large mill power and lighting business previously referred to was so great that even an advance in coal price of from $3.94 to $7.65 per ton was insufficient to affect the cost adversely. During the war period this company cut its fuel consumption nearly in half per unit of output. It is a striking fact that the ten companies had to pay $2,517.059 more for coal in 1918 than in 1914, and it is a question, too, if the quality of coal available in the fiscal year 1918 was within hailing distance of being so good as that burned in the year the war started.

During the approximate war period included in the fiscal years 1915-18 these ten companies burned 1,833,893 tons of coal and the total cost was $9,221,665. The cost did not begin to advance seriously until the latter part of 1917, and it was only during the period when the United States had entered the war that the price became really burdensome. Individual plants in New England had to pay from $10 to $12 per ton for coal and were considered fortunate to obtain it at all in some cases; but the average price per ton burned during the years listed was in most central stations of the size and situation of those listed in Massachusetts a little more

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favorable. The history of the fuel supply of New England utilities in the severe winter of 1917-18 cannot be compressed into the limits of this article, but the way in which the handicaps of weather, railroad and water carrier shortages, inferior quality, high cost and sudden load increases were overcome reflects lasting credit upon the central-station managements and staffs of this section. The imperative necessities of utility coal supply were appreciated by the United States Fuel Administration through Fuel Administrator James J. Storrow of New England, and it is believed that not a single central station in New England was obliged to shut down for lack of fuel during the entire war period, although the stock on hand came at times perilously near disaster.

Other expenses of operation, administration and fixed charges increased heavily during the war among New England central stations. Thus, in the case of the Hartford (Conn.) Electric Light Company, whose experience was by no means unique, taxes increased in four years from $56,600 to $133,000, while the ratio of operating expenses to revenue from sale of electricity increased from 49.5 per cent to 60.5 per cent. The depreciation increased from $217,300 to $341,400, and in the four years the total depreciation charged off was $1,133,000. On the Boston Edison system taxes increased from $785,713 in 1914 to $938,178 in 1918, and the ratio of operating expenses to gross earnings increased from 45 per cent to 50.2 per cent. In the aggregate the operating expenses of the Boston company were about $1,680,000 greater in 1918. The operating ratio on the New England Power Company system increased from 36.6 per cent in 1916 to 62.8 per cent in 1918. On the Central Maine Power Company's system taxes increased from $33,654 in 1917 to $53,108 in 1918. Operating expenses on the Narragansett Electric Lighting Company's system increased from 57 per cent of gross earnings in 1914 to 68.7 per cent in 1918. Numerous other instances might be cited, but it is unnecessary to prove that the cost of living went up during the war for the central stations of New England as well as for other organizations and for individuals.

The effect of these increased costs and also of increased charges on capital has been to pull down the surpluses of many companies in order that dividends might be declared at substantially the usual rate. In 1914, for example, the Narragansett company credited $20,290 to surplus, whereas in 1918 $32,415 was taken from surplus and applied to dividends. Table IX shows the dividends declared per kilowatt-hour sold in 1914 and 1918 and the balance per kilowatt-hour sold for the same years for some of the larger Massachusetts companies.

The Hartford (Conn.) Electric Light Company had a balance after dividends in 1915 of $69,500, whereas in 1918 there was a failure completely to earn the dividends paid by $6,200. The dividend rate was reduced to 8 per cent for 1918, compared with 10 per cent in 1917 and 14 per cent in earlier years. The difficulties of earning full previous dividends in many companies in the face of the increased fixed and operating costs resulting from the war are far from negligible. It is far from the purpose of this article to attack the policy of making up reasonable dividends out of surplus in such an emergency as that which the industry is now passing through; but it is important that the public realize how costs have risen whenever rates and the extension of service are brought up for consideration. That it was possible to declare dividends at all during the war has been due to high-efficiency engineering in central-station management as well as to the increased revenue resulting from the growth in output. Without scientific management the increased expenses in many cases might easily have wiped out the return.

Interconnection of Plants and Systems

There were numerous methods of securing higher operating efficiency applied by the New England companies during the war period. Three of the more important were the enlargement of generating plants, with the replacement of smaller units by larger and more

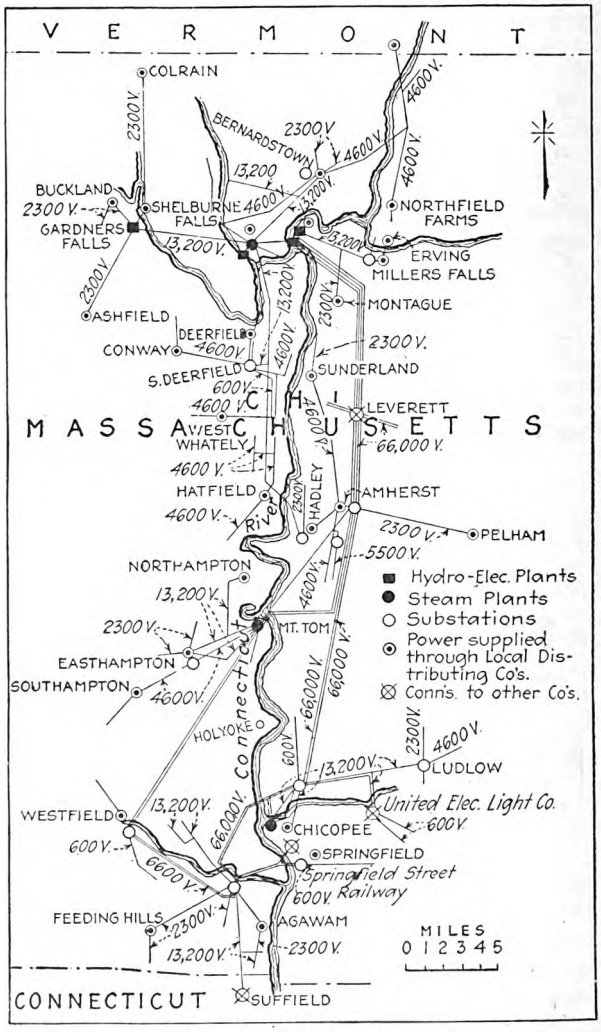

FIG. 5—TRANSMISSION SYSTEM OF TURNERS FALLS POWER & ELECTRIC COMPANY

efficient generating sets and boilers; the construction of new stations, steam or hydroelectric, and the interconnection of plants and systems. So extensive was this work that only a few representative examples can be cited. The electrical supply of central and eastern New England has been greatly facilitated during the war period by the interconnection of the New England Company's system (Fig 4) with practically all the electrical utility companies between northwestern Massachusetts, southern Vermont and New Hampshire and Providence, R. I. This system is interconnected with the Turners Falls Power & Electric Company's transmission lines (Fig. 5) at Leverett, Mass., and has recently been extended from Camp Devens, Ayer, Mass.,

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to Nashua, N. H. Fig. A-3 (page 1013) is a view of the 66,000-volt lines supplying Camp Devens and is the latest type of construction employed by the New England company. Another celebrated interconnection is that of the Eastern Massachusetts Electric Company (Fig. 4, insert at top), which ties the stations at Salem, Malden and Revere, Mass., into a common interchange bus.

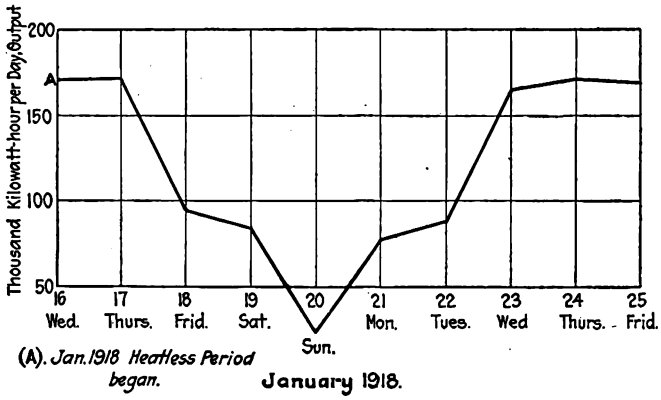

FIG. 6—EFFECT OF FIRST "HEATLESS" DAYS ON OUTPUT OF BRIDGEPORT (CONN.) DIVISION OF UNITED ILLUMINATING COMPANY

Recently the Edison Electric Illuminating Company of Boston has been connected by a 3000-kw. line with this system, and a 66,000-volt transmission line to connect the systems of the Boston company and of the New England Power Company was planned during the war and is now under construction for an initial delivery of 15,000 kva. off-peak energy from the Boston tidewater station at L Street to the New England system. Interconnection has made important strides in Vermont within the past few years, and Connecticut has advanced far along this line, as was shown in the ELECTRICAL WORLD of Nov. 16, 1918, page 924. There are many minor interconnections in New England which are doing good work in proportion to the capacities of plants and loads involved. Important savings in fuel, labor and investment costs are obtained where these ties are intelligently made.

Before touching upon the expansion of various individual plants to meet war conditions, attention may be called to the increasing interchange of energy which is becoming the practice among progressive central stations within electrical reach of one another. In comparison with the total energy generated during the war period the amount interchanged in New England was of course small. Nevertheless, the ten stations listed in Table I purchased 28,598,748 kw.-hr. from other companies in 1918, compared with only 2,526,506 kw.-hr. in 1914, and their sales of energy to other plants rose in the four years from 13,887,027 kw.-hr. to 37,207,081 kw.-hr. That is, nearly four times as much energy was interchanged between these ten stations and other companies in 1918 as in 1914. Centralization of energy supply is constantly increasing, and the introduction of units of 15,000, 30,000 and 45,000 kva. rating under favorable conditions of fuel and water supply is steadily doing away with the use of small and relatively inefficient units. As yet the large centralized plants have not attained a number and size which permits of the general disposal of these smaller plant units, and they are often held as a reserve.

During the height of the war it is scarcely an exaggeration to state that the market absorbed practically all the hydroelectric energy developed in central New England, and under these conditions the interconnections between the hydroelectric systems and the steam-driven central stations proved of great mutual value. It is noteworthy that, although the generated output of many plants in New England increased enormously during the war, the purchases of energy increaed heavily among even the larger central stations. This indicates the mutual benefits of interconnection. Thus, the Worcester (Mass.) Electric Light Company purchased 1,532,726 kw.-hr. in 1914 and 11,101,300 kw.-hr. in 1918, and the United Electric Light Company of Springfield, Mass., increased from 985,300 kw.-hr. to 12,006,500 kw.-hr. The Boston Edison company purchased nearly 9,000,000 kw.-hr. in 1917 and 1918, taking advantage of the development of hydroelectric energy in plants built by the Metropolitan Water & Sewerage Board at Clinton and Sudbury, Mass. These interconnections enable the companies to take energy and deliver it at mutually convenient times with respect to load, water and fuel conditions. The Fall River Electric Light Company, in southeastern Massachusetts, is now connected with the Narragansett system at Providence and with the New England Power Company system through a tie line (Fig. A-4), about 18 miles (29 km.) in length. This line is designed to transmit energy at 66,000 volts, and it affords a flexible outlet for secondary energy on the hydroelectric systems of the New England and Turners Falls companies, with a resultant fuel saving in the steam turbine plant at Fall River.

As a result of the Salem-Malden-Revere interconnection, the Salem generating plant has become the mainstay of electrical supply in the northern suburban section of greater Boston. Figs. A-5 and A-6 show an exterior and a view of the switchboard room of the Salem plant. It is very conservatively estimated that in 1917 and 1918 the tie line saved at least 8550 tons of coal. The average coal consumption per kilowatt-hour at the bus in the Salem plant for these two years was 2 lb., and the average of the Malden and Revere stations was 3.3 lb. The two companies purchased from the Eastern Massachusetts company, owning the tie line, 14,777,600 kw.-hr. in the two years. Thus there was an average difference of 1.3 lb. per kilowatt-hour in favor of Salem. An exhaustive analysis of the economic benefits and justification of this tie line was published in the ELECTRICAL WORLD of Sept. 1, 1917, page 422. In the fiscal year 1918 the Salem company delivered to the line 14,-

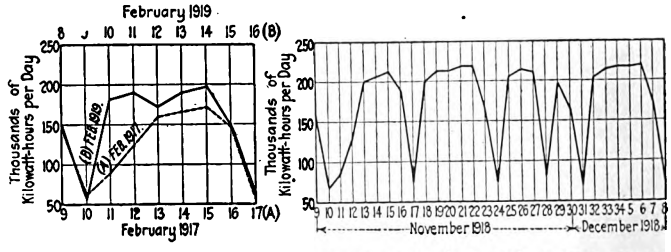

FIG. 7—LOAD CURVES FOR BRIDGEPORT (CONN.) DIVISION OF UNITED ILLUMINATING COMPANY, SHOWING INCREASE SINCE SIGNING OF ARMISTICE

351,000 kw.-hr. at an average price of 0.835 cents; the Malden company purchased 9,404,600 kw.-hr. from the line at 1.273 cents, and the Suburban company (Revere) purchased 2,797,500 kw.-hr. at 1.527 cents. The Malden company produced 5,113,880 kw.-hr. in its own plant in 1918, and the Revere company 544,100 kw.-hr. The Salem company's total generated output was 33,-

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103,670 kw.-hr. The average cost of coal per ton in 1918 was $8.83 at Malden, $8.60 at Revere and $8.25 at Salem. The cost of production at Malden was 2.02 cents, at Revere 4.14 cents and at Salem 0.895 cent per kilowatt-hour. The line saved Malden and Revere from operating at a coal rate far above that obtained at Salem for a period which would have increased the operating costs of both Malden and Revere substantially had the

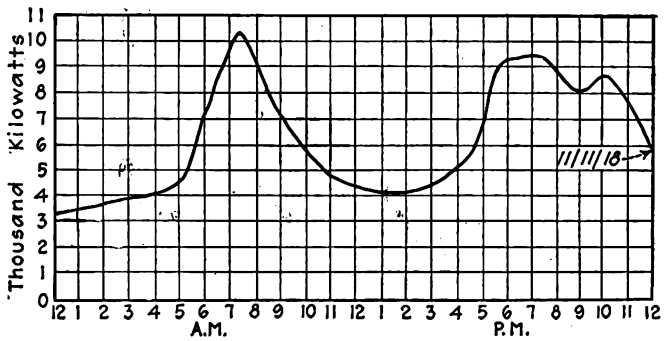

FIG. 8 — LOAD CURVE FOR SYSTEM OF CUMBERLAND COUNTY POWER & LIGHT COMPANY ON NOV. 11, 1918

line not been in service. The machinery in each station, on the other hand, constituted a useful reserve in case of trouble elsewhere, and, as intimated above, the non-coincidence of the load peaks, separated as they are by seasonal differences in demand in the case of Revere and the other two stations, contributed to the economic benefits of the interconnection. The cost of the interconnection was estimated last summer at $551,626, including unfinished work.

The 33,000-volt interconnection between the Manchester (N. H.) Traction, Light & Power Company's 17,150-kw. plants and the 1500-kw. Nashua (N. H.) central tation has assisted in coal conservation, as the Nashua load has been run almost entirely from the hydroelectric plants of the Manchester company or from its larger steam plant at Kelley's Falls (Fig. A-7). A 3750-kva. hydroelectric plant was recently put into operation (Fig. A-8) by this company at Greggs Falls, on the Merrimac River. This station was built on the site of a former 1200-kva. plant and by a new concrete dam the head was increased from 51 ft. to 65 ft. (16 m. to 20 m.), with a corresponding increase in water storage. The increased rating of this plant enables the company to operate a longer period without resorting to steam-plant service. Energy was interchanged by this company with industrial power plants in its territory. In this connection a 600-kw. textile-plant addition handling war orders was taken on, and the Manchester company also helped out a large shoe-manufacturing plant having large orders for the army at a time when it seemed likely to close down for lack of fuel. Coal was interchanged as well as energy, thus enabling operations to be continued.

Plant Additions in New England During the War

Among the larger power-plant developments of the war period in New England are the following: Completion of 45,000-kva. hydroelectric plant of Turners Falls Power & Electric Company at Montague City, Mass.; building of 30,000-kw. initial-capacity steam plant (Hampden station) of same company at Chicopee Junction, Mass.; installation of 45,000-kw. turbine-generator at the South Street station of Narragansett company, Providence, R. I.; building of extension of the L Street station of the Boston Edison company, with 30,000-kw. initial unit and a second unit of the same size on order; installation of a 20,000-kw. turbo-generator by the Worcester (Mass.) Electric Light Company and ordering of a second unit of the same rating; reconstruction and enlargement of the State Street station of the United Electric Light Company, Springfield, including a 20,000-kw. unit and new boiler plant; construction of a 37,000-kw. steam-turbine station by the New Bedford Gas & Edison Light Company; increase in rating of the Hartford (Conn.) plant from 17,500 kw. to 38,000 kw., with provision of new coal field and gantry crane and increase of the generating plant rating of the Rumford (Me.) Power Company from 9000 hp. to 26,000 hp. with plans for 50,000 hp. ultimate installation. The Connecticut Light & Power Company at Waterbury expanded considerably during the war, and a new hydroelectric plant at Stevenson, Conn., on the Housatonic River, is under construction by the interests controlling this system. The Shore Line Electric Railway interests are completing a steam plant near New London, which will be tied by a 10,000-kw. line into the New England Power Company's system for interchange of energy. Many other plants were extended or built in the smaller cities or towns of New England in the four years. One of the most useful of these, although rated at only 3000-kva., was built by the Cumberland County Power & Light Company, Portland, Me., at Hiram Falls, on the Saco River, and another, which was designed to furnish an additional energy supply to the shipbuilding plants at Bath, Me., was built at Rice Rips, on the Messalonskee River, near Waterville, Me., by the Central Maine Power Company, its rating being 2000 kva. Not a few companies installed 10,000-kw. turbo-generating sets, and 15,000-kw. units were provided in some cases in addition to the previous facilities. Mention should be made of a 33,000-volt transmission line (Fig. B-1, page 1015) built by the Buzzards Bay Electric Company from

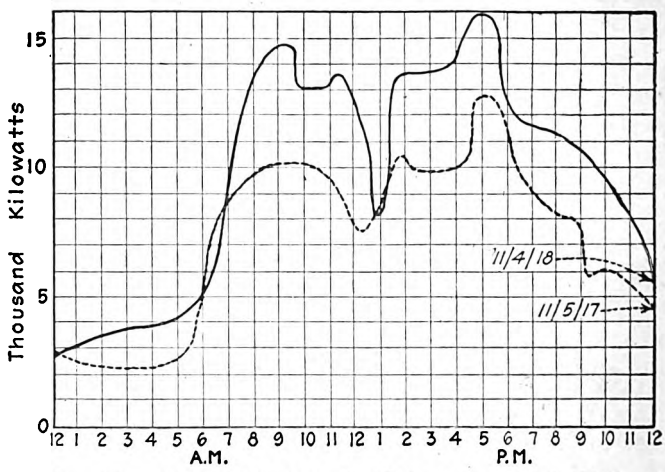

FIG. 9—LOAD CURVES FOR NOV. 5, 1917, AND NOV. 4, 1918, ON SYSTEM OF CUMBERLAND COUNTY POWER & LIGHT COMPANY, PORTLAND, ME.

the Cape Cod Canal to the naval air station at Chatham, Mass., in touching upon the war service of the smaller systems.

A few points in the development and war service of individual companies may be cited. It would require a volume to list and describe all of the war industries supplied with energy by the New England companies, and another to describe the different plant developments in detail.

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The illustrations of A, B and C inclusive are views of various plants associated with central-station expansion in New England states during the period of the war.

A 120,000-kw. extension of the Boston Edison station at L Street, South Boston, was started in October, 1916. The first unit, of 30,000-kw. rating, has not yet been placed in regular service, and a second unit of this size, for which the extension of the plant provided, was commandeered by the government during the war. Delivery of this second unit is expected shortly. In connection with the first unit four 1230-hp. boilers designed for operation at 300 lb. steam pressure, 200 deg. maximum superheat, and at 300 per cent rating, have been installed. They are each equipped with thirteen-retort stokers and are provided with motor drive subdivided into four units per stoker.

The wisdom of maintaining in the reserve at L Street six 1500-kw. engine-driven alternators installed in the early days of the plant was illustrated in the latter part of last year, when it became necessary to run some of this equipment. The system peak load in 1918 was 95,774 kw., the largest output of the company's history, occurring Dec. 6. It is estimated that the so-called lightless nights and workless days ordered by the Fuel Administration in 1918 resulted in a decrease of at least $175,000 in earnings, and that the daylight saving act cost the company another $150,000 in the fiscal year 1918. Coal increased in cost by $463,000 compared with pre-war figures, and on the Boston system a 10 per cent increase of salaries was granted last spring to all employees receiving $3,000 a year or less. All materials except lamps used in operation or repairs increased from 25 to 100 per cent in cost.

It is interesting to note that the peak at Boston came after the signing of the armistice in 1918, and that in December there was an increase in the connected load of 3981 kw. against 2922 kw. in 1917 the same month. The Watertown arsenal and Squantum shipyard purchased 2,869,000 kw.-hr. from the company in October, 1918, the system output being 27,227,739 kw.-hr., compared with 24,754,341 kw.-hr. in October, 1917. Last February the arsenal went upon a part-time schedule and shut down two days a week. On the first two days of shut-down the load dropped to 6600 kw.-hr. and 700 kw.-hr. The company supplied two 6-ton electric furnaces at the arsenal and the load these imposed was about 6700 kw.

In addition to the 45,000-kw. turbo-generating unit which was purchased by the Narragansett company at Providence about two years ago at a cost of approximately $500,000, that company installed a 20,000-kw. turbine set in its South Street station in 1915. Last year four new boilers were installed at a cost of $165,000, and this increased by 10,000 kw. the amount of energy which the company can deliver to the New England Power Company's system through interconnection. The Providence plant is the largest steam station connected with the New England system for comprehensive interchange of energy. Another improvement in the Providence plant last year which will reduce the cost of coal handling was the installation of a coal conveyor, both for reclaiming coal and for placing it in storage, at an investment cost of about $165,000. This installation has a capacity of handling 5000 tons per day, or enough coal to supply the requirements of a 400,000-hp. plant. Last year the company consumed 128,930 tons of coal, and it is of interest that the cost of this fuel was $1,224,000, whereas in 1914 the coal consumption was 52,067 tons and the cost $181,475. The output generated was produced at a fuel cost of 0.429 cent in 1914 and at 0.816 cent per kilowatt-hour in 1918. The station capacity at Providence increased from 1910 to 1914 from 15,550 to 21,650, and in 1918 it totaled 79,000 kw. Here, as in many other cases, the growth was hastened by war demands. In comparing yearly outputs generated in 1914 and 1918, respectively 47,405,874 kw.-hr. and 150,000,000 kw.-hr., it is to be noted that industrial establishments worked sixty hours per week in 1914 and forty-eight in 1918.

The United Electric Light Company, Springfield, Mass., attained its peak load in August, 1918, the amount being 23,230 kw. The United States Armory took about 1500 kw. and the New England Westinghouse Company about 1000 kw. for war purposes, besides which many other regular customers increased their demand owing to war business. This company built a new switch house at its State Street station at a cost of about $600,000, an increase of $200,000 above the estimated cost under more favorable conditions. It was necessary to complete this work during the war period.

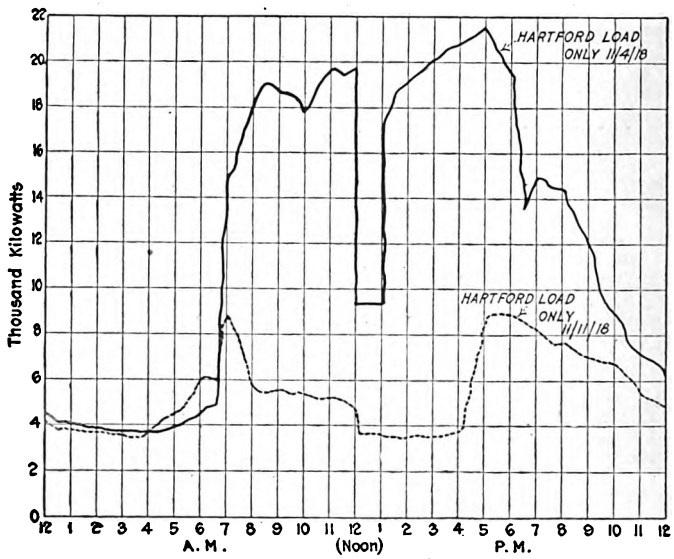

FIG. 10—LOAD CURVE OF HARTFORD ELECTRIC LIGHT COMPANY FOR DAY ARMISTICE WAS SIGNED AND FOR A WEEK EARLIER

Fig. C-4 is a view of the Narragansett plant at Providence, the largest present available source of relay steam power on the New England Power Company's system.

Output of New England Companies Since Nov. 11, 1918

In general, New England central stations have suffered an appreciable loss of output since the signing of the armistice, but it has not as a rule been alarming in amount. In some cases the output is greater than last fall, but by and large one would find in going about reductions in day load of perhaps 10 to 20 per cent. The cutting off of overtime and of night work in many industries has naturally curtailed output, but, on the other hand, the use of commercial and residential lighting has increased greatly. Many small power users have been taken on since the cessation of hostilities. At Rumford, Me., all the established industries of this great paper-making and chemical center have continued operating at full load or increased outputs. The pres-

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ent demand on the Rumford Power Company's plant is about 12,000 kw. with a 92 per cent load factor. For several years one of the customers of this company made metallic magnesium. During the war this customer doubled his capacity and all the product was turned to war uses. Plans for other increases were terminated with the ending of the war. A new plant made ferrosilicon for war service. Both these customers are now continuing the same products, but for peace uses. A prospect for a furnace and electrolytic load was canceled by the ending of the war. The power company met all demands upon it, and while it gained only a little in output during the war, it lost nothing that it had gained.

The United company, at Springfield, Mass., has sustained a loss of about 30 per cent in night power load since the war ended, and the other power load about town has dropped about 10 per cent. The average weekly output in April, 1918, was 974,365 kw.-hr.; in August, 1,237,962 kw.-hr.; in November, 1,154,427 kw.-hr., and in March, 1919, 994,835 kw.-hr. At Manchester, N. H., the close of the war made very little change in the load. On this system the yearly output increased (sales) from 16,152,272 kw.-hr. in 1914 to 23,883,088 kw.-hr. in 1918, and the peaks from 5000 kw. to 9709 kw.

Fig. 6 shows the effect of the first "heatless" and "workless" days upon the Bridgeport company's daily kilowatt-hour output, in January, 1918, and Fig. 7 shows the daily output of this plant following the armistice declaration. It is noteworthy that the mid-week daily outputs actually increased after the first two or three days of celebration, and that in a typical week in February, 1919, the outputs were above those of the same week of the year previous. In March practically every week showed a daily output rising to a maximum of 190,000 kw.-hr. to 200,000 kw.-hr. Some of the larger munitions concerns in Bridgeport have shut down or curtailed their output, but there has not been as heavy a drop in loads as might have been expected. The day power load and night and overtime loads have of course suffered somewhat.

Fig. 8 shows the effect of the armistice celebration upon the hourly load curve of the Cumberland County Power & Light Company's entire system, and Fig. 9 shows the system load curves of this company for Nov. 4, 1918, and Nov. 5, 1917. A large shipbuilding, marine hardware, electric railway and general industrial load was handled by this company during the latter part of the war. It is of interest to note that the interconnection of this system with the hydroelectric plants of the S. D. Warren company on the Presumpscott River enabled the latter to carry the entire load on the "heatless," "workless" Mondays of early 1918, and also for five days in February, 1918. Water stored in Sebago Lake was utilized to advantage by interconnection and the plants on the Saco River articulated in operation with those on the Presumpscott, cutting down to a minimum the use of steam-reserve power in the city of Portland.

As the Presumpscott is the outlet of Sebago Lake, it is the policy of the companies to draw as much power as possible from the "flash" stream, the Saco, using coal at Portland only when the Presumpscott plants are unable to supply the load above that of the Saco plant ratings. The system peak at Portland attained a maximum of 16,870 kw.-hr. Jan. 4, 1918. The present generating capacity of the company's hydroelectric plants at Hiram, Bonny Eagle, West Buxton and North Gorham is 16,500 kva., and the steam reserve capacity is 7200 kw. The Cumberland company carried from 600 kw. to 2000 kw. war load at the Warren industrial plants.

It is estimated that approximately 30,000 tons of coal were saved at Portland by interconnection and hydroelectric development in the years 1917-18. The company expended $538,461 for its Hiram development (Fig. C-5), including transmission connections with the rest of the system, and also expended $60,000 for a new tie line between the Sewall and Plum Street substations in Portland.

The curves of Fig. 10 show the Hartford company's hourly loads on a representative day just before the armistice, on Nov. 11, 1918, and on April 11, 1919. It is of interest that the weekly output in kilowatt-hours was 9 to 11 per cent lower in early January, 1919, than a year ago, but that by the middle of March it had risen to within 2 per cent of the previous year's weekly rate. In the week ended April 6, 1918, the output, excluding sales to other companies, was 1,504,550 kw.-hr., and in the week ended April 5, 1919, it was 1,438,300 kw.-hr.

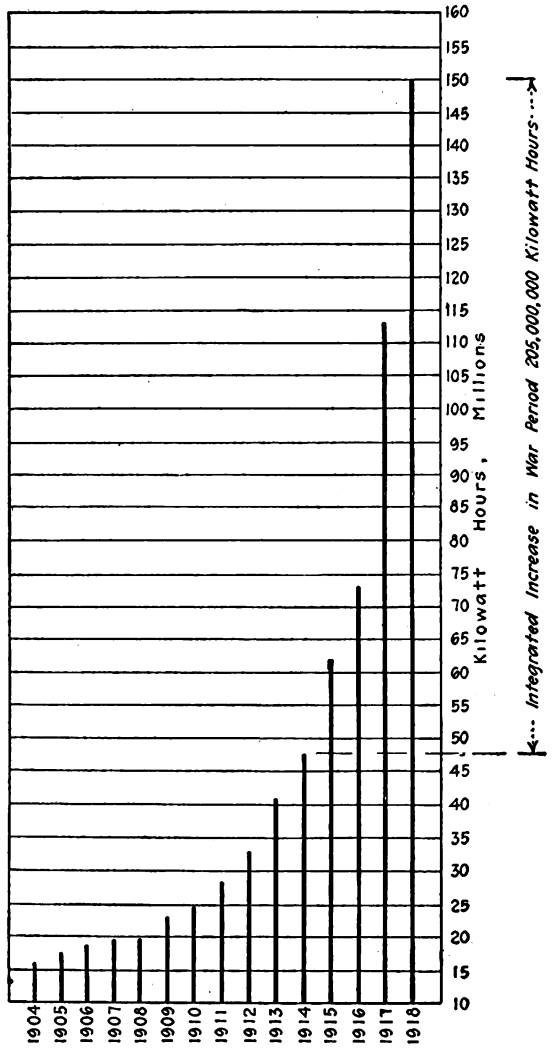

FIG. 11—KILOWATT-HOURS GENERATED 1904 TO 1918 BY NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

The Central Maine Power Company supplied energy to a considerable number of war industries and undertook many system improvements to further this work.

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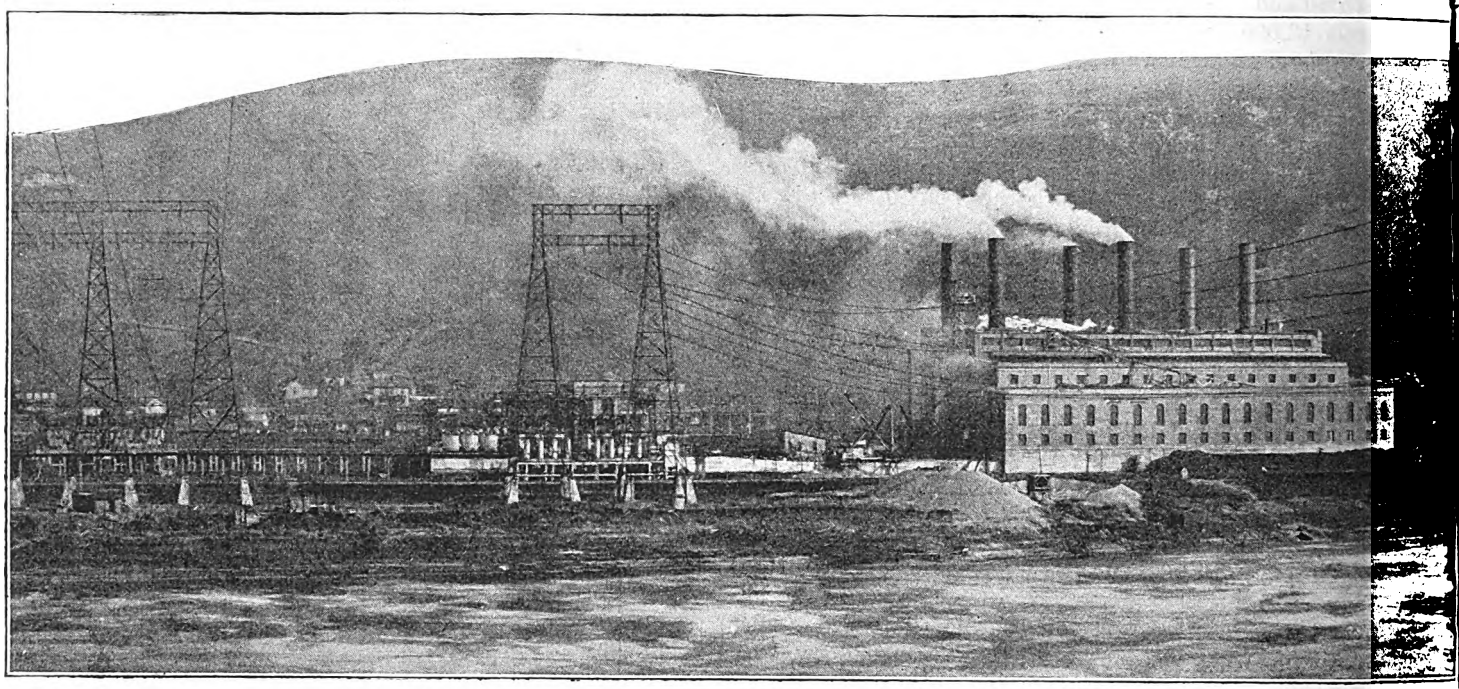

THE GREAT GENERATING STATION AT WINDSOR, W. VA., REPRESENTS THE ADVANCED THOUGHT OF THE INDUSTRY

The New Outlook in the Industry

Changes Following the War Bring Additional Strength to the Central Station, and the Industry Is Alive to the Increasing Responsibilities Which It Must Meet

CONDITIONS in the industry have been changed, just as all other conditions of human life and industry have been changed, by the touch of war. The changes carry a new element of powerful strength into the central-station position through the keener public recognition of the economic importance of power production. They also call, however, for careful consideration of various matters involved in management policy so that what has been attained in the past shall serve as firm foundation for the inevitable great growth of the future.

War brought the central station into sharp relief as an economical producer of power on an enormous scale. What the central station has maintained for years about its position as the logical generator and distributer of power for the community was borne out in a way that gave it nation-wide advertisement. Willing recognition came from the United States government officials primarily burdened with the responsibility for conducting America's part in the war. It was given by other officials, representing cities and states, whose work takes them into contact with the public utilities. Further than this, thousands of large consumers of power for industrial purposes obtained a better and more appreciative understanding of the essential character of central-station service in their operations. The industry, therefore, has the opportunity of using wisely in the post-war period this more general acceptance of the indispensable nature of its service. After the war era of tremendous expansion it faces the outlook with full confidence that development must continue.

Confidence is based in the last analysis, of course, upon an abiding faith in the future industrial activity of America. It rests upon a conviction that the rise in America's influence and commerce will continue. It traces the growth of the industry and decides that even without further substantial progress of the nation's industries there would be an increasing demand and need for power which cannot well be met except by central-station expansion. The outlook is not limited by the closely defined lines of the industrial position of the country to-day. No American thinks for a moment that the nation stands otherwise than upon a threshold facing wider opportunities of development than those held by the brilliant past.

THE PUBLIC SEES

The new public consciousness of the economic value of central-station service in the community will remain undiminished by the change from war to peace. Relief from labor troubles incident to operation of the small industrial plant, freedom from fuel problems and the assurance of reliable service from a great central station regulated as a public utility have impressed a lesson upon independent operators which will never be wholly lost. If the central stations are lax in following through the advantage which the war has given them, if they fail to keep the lesson before the public mind, there will be less growth in their volume of business; but the old doctrine that these utilities are merely competitive plants seeking business has been dissipated by a showing of the essential facts.

Economic conditions underlying the present strong position of the central station mean a demand for the greatest measure of production which this agency in modern industry can be made to yield. They mean, not the present stations, large as they are, but stations superior in size operating at the lowest possible level of economy,

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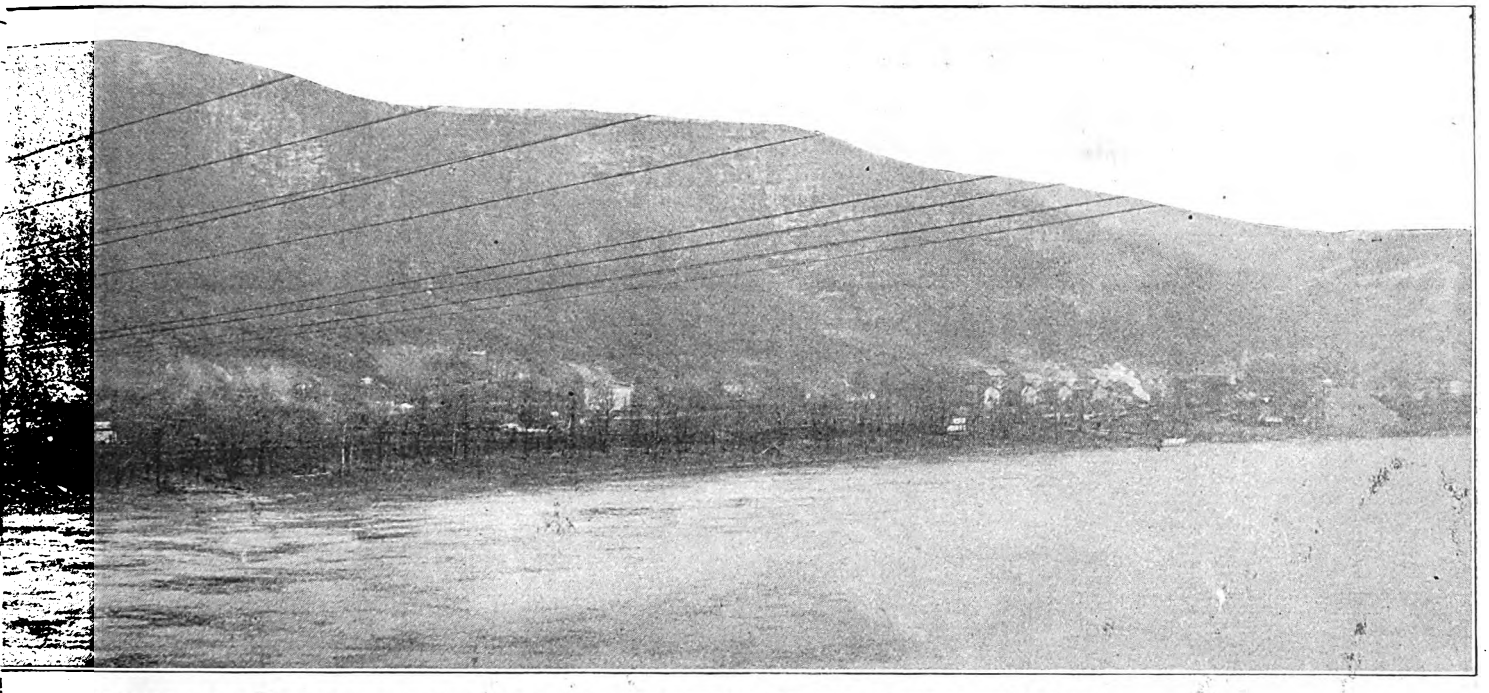

STANDS LITERALLY ALMOST AT THE MOUTH OF THE COAL MINE WHICH IS SHOWN AT THE EXTREME RIGHT

groups of stations tied together by interconnection arrangements covering large sections of the country. Up to this time the single station which best carries into practice the advanced thought of the industry is the Windsor (W. Va.) joint station of the American Gas & Electric Company and the West Penn Power Company. It is literally situated almost at the mouth of the coal mine from which it gets its fuel, being about 2000 ft (600 m.) away. The industry sees clearly that more of such stations will be built and that interconnection will follow. It realizes the call that will be made upon every branch of activity in the industry. It foresees the requirements in construction and operating skill, in engineering, in commercial development, in financing and in coöperation with the public authorities and bankers in order to put and to keep the properties on a profitable basis.

For the future central-station enterprise will call still more largely upon the financial supporters of its community. When it becomes operative in groups of communities it will require capital upon the broader scope that this indicates. Besides industrial and public load, it will tend as time passes to take over not only the load of surface, elevated and subway urban railway systems and of interurban lines, but also of electrified railroad terminals, and ultimately through interconnected systems also the trunk-line railroads when those properties are electrified. It may be expected that when this condition is realized there will be a highly developed scheme of conservation throughout the country. In the public interest this will require the most rigid supervision of our perishable fuel resources and the closest possible utilization of water-power resources.

AN OBLIGATION TO MEET

A definite obligation is laid upon the central-station industry to prepare to fill the large part in the nation which foresight, accepted economic monopoly and opportunity open. Looking out upon the busy industrial life of the new world, appraising the future demand for energy with the bright hope which is fully justified, the industry has also to consider what difficulties lie in its path.

One is that of the threatened diversion from private to public operation, now apparently less menacing. The answer to this is in a degree of efficiency, of economy that public operation cannot possibly attain.

Another is that of rates. It is desirable that rates to small consumers shall be made as low as possible and that meter reading, collection and accounting cost for small accounts shall be reduced. On power contracts cost plus profit is better policy than an agreement which may be turned into loss by fluctuating coal prices.

Ownership of sources of coal supply will be a protection.

The huge sums of money needed will call for active coöperation by large groups of bankers to the end that interest and commissions may be kept moderate. Exploitation as such is inadmissible; the future electric utilities cannot be burdened with new watered stock.

Not only raw materials but prices of apparatus and supplies will have to be studied. The position of these will be determined by economic conditions which the central stations cannot control. Manufacturers thoroughly understand the needs and problems of utilities and will coöperate with them in the effort to lighten burdens until conditions are readjusted.

Centralization of authority in the federal government has brought about, only temporarily in all probability, unprecedented growth in authority at the national capitol. This has severed or disturbed the channels of state regulation of public utilities. The state commissions should be reëstablished in authority.

While the central station has not had labor troubles in the past, it has before it the problem of squaring working conditions in plant and office with the conditions which are being developed in other comparable industries.

Lastly, the service of the industry to the nation in the war may be an index to what it will do in peace in serving the community, not only as a supplier of energy but also as a public leader.

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How the South Handled War-Time Loads

The Demands on Systems of Southern Central Stations Caused by the War—Extensions and Interconnections of Transmission Lines and Details of Operation That Have Been Worked Out

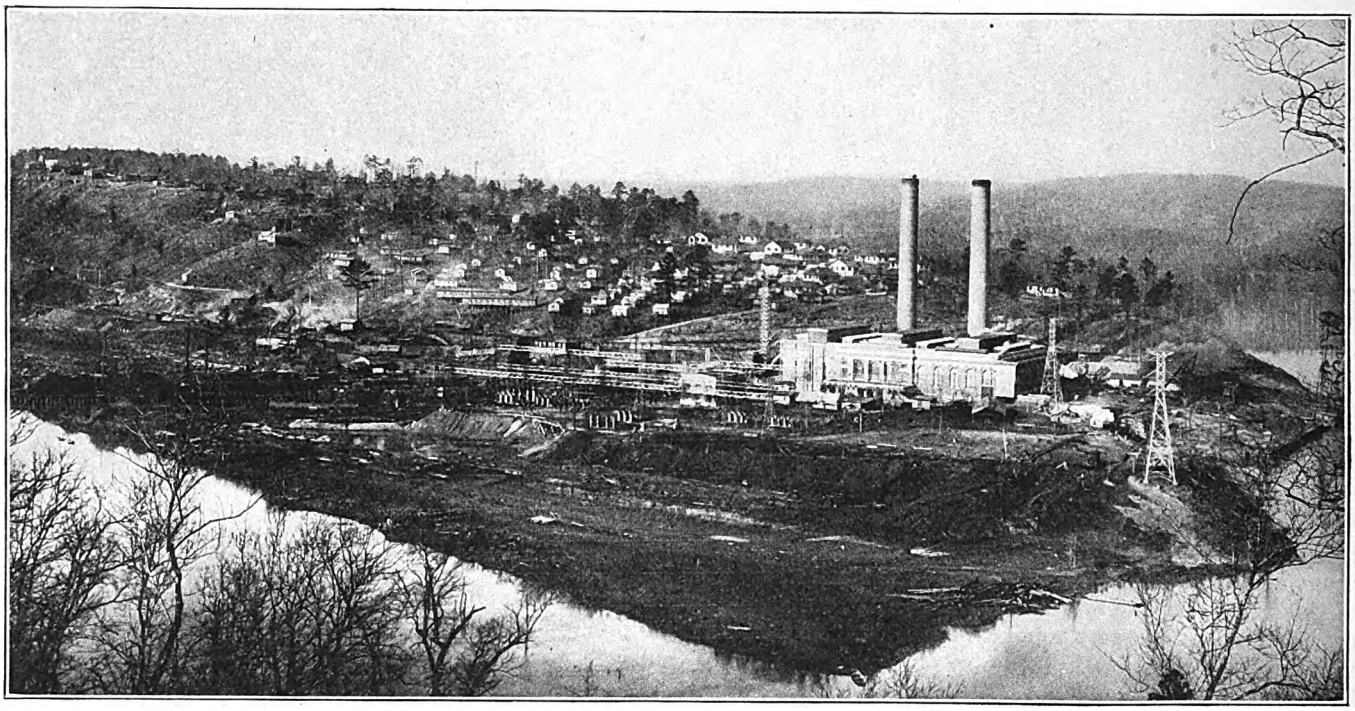

FIG. 1—RESERVE STEAM PLANT INSTALLED BY THE ALABAMA POWER COMPANY AT GORGES ON THE WARRIOR RIVER. THIS PLANT HAS A RATING OF 63,000 KW. AND IS CONNECTED BY A TRANSMISSION LINE WITH A 40,000-KVA. SUBSTATION AT MUSCLE SHOALS ON THE TENNESSEE RIVER

ON ACCOUNT of the existing transmission lines covering wide areas of the South and the interconnection of the systems at several points so as to take advantage of large hydroelectric stations receiving water from different watersheds, the operating companies of the South were well prepared to meet the new conditions which were brought about by the war. In spite of this foresight on the part of operating companies in the interconnection of systems, unprecedented low-water conditions and the difficulty in securing coal for auxiliary steam stations during the winter of 1917-1918 caused considerable worry and called for a degree of operating skill and management that reflects great credit on those who pulled through without accidents or forced shutdowns. The unusual load conditions due to cotton mills working to their limit of capacity and the added loads of plants handling direct and indirect needs of the war forced all companies to load their stations to the limit and to adopt every possible expedient to get the most out of equipment. A great amount of thought was spent on operating conditions, so that loads on various lines and systems were properly balanced and adjusted. The impossibility of obtaining repair parts forced the companies to extend their own repair facilities and to make repairs of a size and nature that would never have been attempted before.

The expansion of industrial operations in the South during the past two years created a demand for skilled labor of all kinds and induced many trained men to leave operating companies with which they had been connected in some cases for a number of years. Later the several drafts took additional men, creating a large number of vacancies which had to be taken care of in different ways. In some cases promotions were made; in others higher wages were paid to bring men in from the outside. In other cases processes and operating practices were changed to simplify them and allow the work to be carried on without replacing men. Changes were also made which allowed the use of unskilled labor, or training schools were put into operation which quickly gave the necessary information and training required to carry on the work. In some cases girls were employed to do work which had formerly been done by men.

In addition to the conditions outlined there was a tremendous increase in cost of materials and labor of all kinds. The operating expenses of central-station companies were consequently increased to unheard-of figures. Notwithstanding these conditions, applications which were made to public utility commissions to increase rates to offset the increased expansion were in many cases refused and in other cases were delayed to such an extent that the companies were put into a very embarrassing financial position. In still other cases where partial increases in rates were granted these increases were not sufficient to keep the companies in safe financial condition. As a result a number of companies have been tremendously handicapped in carrying the unusual burdens which have been forced upon them.

The transmission lines of the six Southern operating

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companies—the Alabama Power Company, the Tennessee Power Company, the Georgia Railway & Power Company, the Columbus Power Company, the Central Georgia Power Company, the Southern Power Company and the Carolina Power & Light Company—are now either interconnected or capable of being joined in one great network extending from Henderson, N. C., on the northeast to Tuscaloosa, Ala., on the southeast, a distance of approximately 1000 miles (1600 km.). The layout of these systems is shown on the accompanying map. If this network were superimposed upon the northern section of the United States it would reach from Boston, Mass., past Cleveland, Ohio, on the west and Roanoke, Va., on the south. This network is fed by twenty-three hydro-electric plants and at least fourteen steam stations, about evenly distributed in five states.

The principal operating features of the six systems mentioned and the extensions and improvements which have been made during the war are outlined in the following paragraphs under the headings of the different companies:

Electrical Expansion in the Carolinas

Southern Power Company.—During the past twelve months the Southern Power Company has completed construction and will soon have in service two new hydroelectric stations. One of these which has a rating of 25,000 kw., with a large storage reservoir, will be known as the Bridgewater plant. The other will be known as the Wateree and will have a rating of 70,000 kw. The former is on the Catawba River about 40 miles (64 km.) from Asheville, N. C. The latter station is on the Wateree River below the Fishing Creek, Great Falls and Rock Creek stations, which have been in operation for several years. Details of these new stations are given later in this article.

The company has also built and placed in operation 100 miles (160 km.) of double-circuit steel-tower transmission line operating at 100,000 volts. The building of these stations and of this transmission line was brought about through a natural development of the textile industry in the different sections of North and South Carolina covered by the transmission lines of the company. The development was not caused by any activities due to the war; in fact, the contracts for the plants were let before the United States declared war.

During the past year there has been connected to the system of the Southern Power Company a textile load of 6750 kw. and a miscellanous load, consisting of flour mills, oil mills, cotton gins and other industries closely allied to the textile industry, of 2430 kw., besides 1000 kw. in lighting in new towns which have had either no electric service or inadequate service in the past. It is interesting to note that the load of the company is divided approximately 80 per cent textile mills, 10 per cent miscellanous manufacturing industries and 10 per cent lighting and railways.

In 1918 the total spindles of the cotton mills of the South increased about 319,000. Of this number 199,000 were added in North and South Carolina, the states in which the Southern Power Company operates. Of this number—namely, 199,000 spindles—165,000 spindles were added to the lines of the company. At the present time the Southern Power Company operates slightly more than one-quarter of the total spindles of the South, or 4,000,000 spindles.

The Southern Power Company operates over the greater part of North and South Carolina. It is connected to the Carolina Power & Light Company at a point between Durham and Raleigh, N. C., and at the Wateree station as indicated on the map on page 1025 and also with the Georgia Railway & Power Company at Tallulah Falls. The location and maximum ratings of the company's various stations are given in the accompanying table.

DATA ON SOUTHERN POWER COMPANY'S STATIONS

Location	Maximum Rating, Kw.	Head, Ft
Great Falls, S. C.	24,000	72
Rocky Creek, S. C.	24,000	63
Ninety-nine Islands, S. C.	18,000	72
Catawba, S. C.	6,600	25
Lookout Shoals, N. C.	24,000	76
Fishing Creek, S. C.	28,000	51
Bridgewater, N. C.	25,000	115
Wateree, S. C.	70,000	75
Greenville, S. C. (steam)	8,000	..
Greensboro, N. C. (steam)	8,000	..
Mount Holly, N. C. (steam)	8,000	..
Eno, N. C. (steam)	10,000	..

The lines of the company now cover a territory of 300 miles (480 km.) in a northeasterly and southwesterly direction and 100 miles (160 km.) in a northwesterly and southeasterly direction. The first transmission system of the company was designed for 11,000 volts. With the expansion of the company and its activities, a 44,000-volt transmission system was built, and all of the recent transmission lines erected by the company have been designed for 100,000 volts. All lines are looped in together, and the 11,000-volt and 100,000-volt systems are joined with tie-in transformers.

The circuits of the Southern Power Company are connected on the north with those of the Carolina Power & Light Company with two 100,000-volt lines. The amount of power that can be transferred is limited only by the carrying capacity of these lines, as no transformers are required in order to effect this connection. On the south the Southern Power Company's system is connected with that of the Georgia Railway & Power Company at Tallulah Falls, with two 100,000-volt lines, and the power which can be transferred between the two companies at this point is limited only by the carrying capacity of the lines.

The company maintains four 8000-kva. turbo-generator steam plants for emergency and supplementary service. The fires under the boilers are banked, and all three stations can be got under way to feed energy to the lines within fifteen minutes.

Two New Water-Power Plants of Southern Power Company

A variable-head hydroelectric plant is being erected by the Southern Power Company at Bridgewater, N. C., between Asheville and Salisbury, close to the Catawba River. This plant will be installed in connection with a large reservoir which is used to impound the water in the wet season. During the dry season, when the water is required for the other plants of the Southern Power Company further down the Catawba River, the water is let out of this reservoir through the turbine wheels. Two turbines will be installed in this plant, each designed to deliver 13,200 hp. to the generator shaft when operating under an effective head of 115 ft. The actual head on these wheels will range from a maximum of 135 ft. to a minimum head of practically zero. In other words, they will continue to run the turbines as the reservoir level is drawn down to the point where the units practically develop no power. It is not, of course, expected that it will ever be necessary

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to draw the reservoir to this extent, the amount depending on the amount of water in the river.

Each of the turbines will be of the vertical-shaft, single-runner type with cast-iron volute casings, governor-operated relief valves and hydraulic operated pivot valves at the entrance of each casing. The two turbines will be fed from one steel penstock, 20 ft. (6 m.) in diameter, which will have with two branches at its lower end for connection to the turbine casings. These wheels are of extremely large size, as may be judged from the fact that the intake opening of each casing will be about 9 ft. 6 in. (2.8 m.) in diameter.

On the Wateree River, about 20 miles (32 km.) below the Fishing Creek, Great Falls and Rocky Creek stations of the Southern Power Company, a new station is being constructed which will contain five 14,000-kw. waterwheels. These waterwheels will operate under a head of 75 ft. The plant will be connected with the system of the Yadkin River Power Company and be operated by the Wateree Electric Company.

Interconnections in Eastern North and South Carolina

Caroline Power & Light Company.—The Carolina Power & Light Company also controls the Yadkin River Power Company and the Palmetto Power & Light Company. It operates the electric light and power service in Raleigh, Goldsbore, Henderson, Oxford, Sanford and Jonesboro, N. C., furnishing electric light and power service for manufacturing properties in Fayetteville, Clayton, Smithfield, Selma, Franklinton, Pine Level and Cumberland. It also supplies under contract the entire requirements of the municipal electric light and power systems in Smithfield, Selma and Clayton and all the privately owned electric light and power systems in Franklinton and Pine Level. It operates 216 miles (347 km.) of high-tension transmission line connecting two hydroelectric and three steam plants with distributing systems in all the communities served. The larger of the hydroelectric plants is at Buckhorn Falls on the Cape Fear River and has an installed capacity of 3000 kva. The smaller is a plant of 1000 kva. on the Neuse River near Raleigh. The company has also in reserve a modern steam plant of 3000 kva. rating at Raleigh, one of 1000 kva. at Goldsboro and one of 3750 kva. at Henderson. It operates nine substations with an aggregate capacity of 23,000 hp.

The properties of the Carolina Power & Light Company are in the heart of the North Carolina industrial district. A large part of the electric energy sold by the company is supplied to cotton mills, cotton gins, cottonseed-oil mills, fertilizer works, veneer mills, furniture factories, machine shops, brick plants and other manufactories and to municipalities for pumping.

A thirty-year contract has been made between the Yadkin River Power Company and the Wateree Electric Company whereby the latter is to supply to the Yadkin River Power Company 14,000 kw. of hydroelectric power to be delivered from the new 70,000-kw. hydroelectric Wateree plant of the Southern Power Company now nearing completion. A 110,000-volt steel-tower transmission line is being built from the Wateree plant to connect with the high-voltage transmission system of the Yadkin River Power Company at Laurinburg, and another line to connect with the transmission system of the Carolina Gas & Electric Company (now owned by the Palmetto Power & Light Company).

The transmission and distributing systems of the Carolina Power & Light Company and the Yadkin River Power Company are now interconnected. The distributing systems of the Palmetto Power & Light Company (a subsidiary company) in all the communities served, with one exception, are also served by high-voltage transmission lines. Consequently, with the completion of the new lines now under construction, the systems of

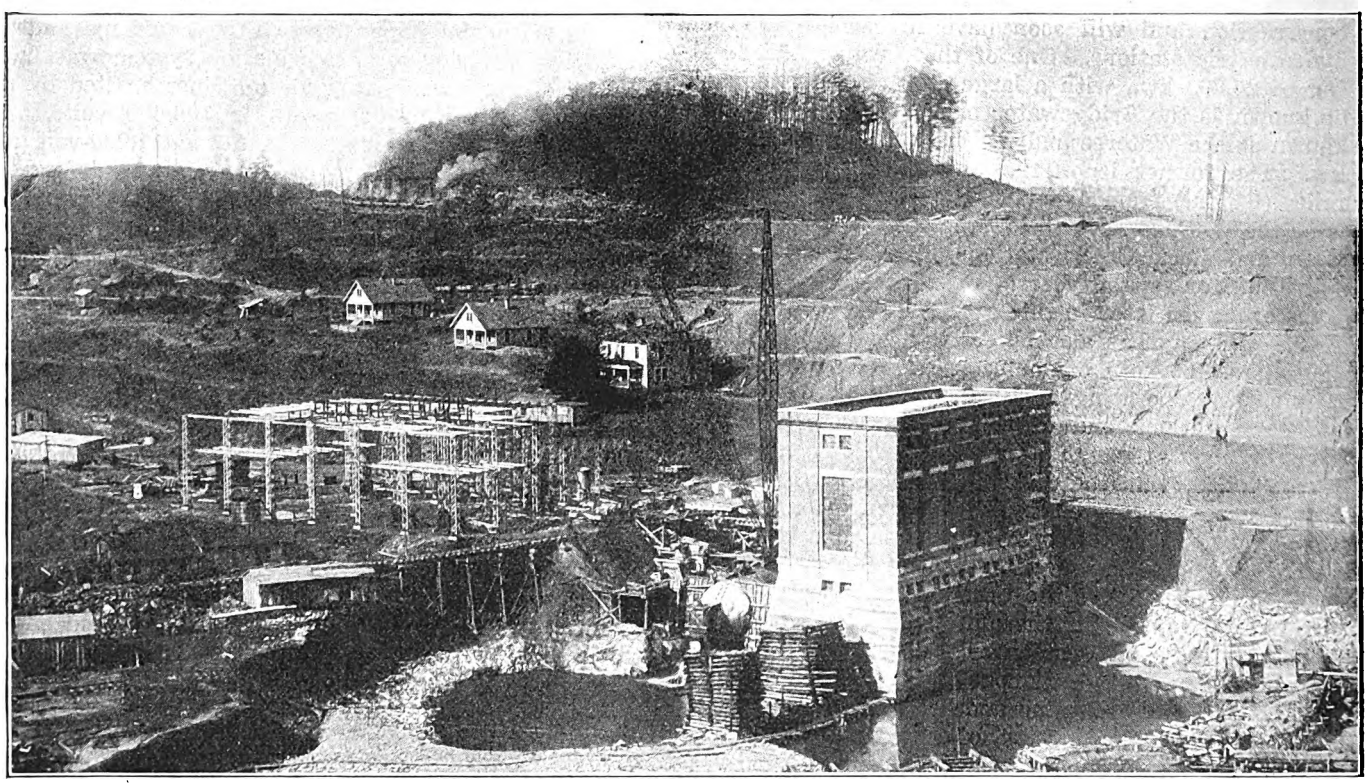

FIG. 2—BRIDGEWATER STATION OF SOUTHERN POWER COMPANY, HAVING A RATING OF 25,000 KVA., AS IT APPEARED MARCH 1, 1918

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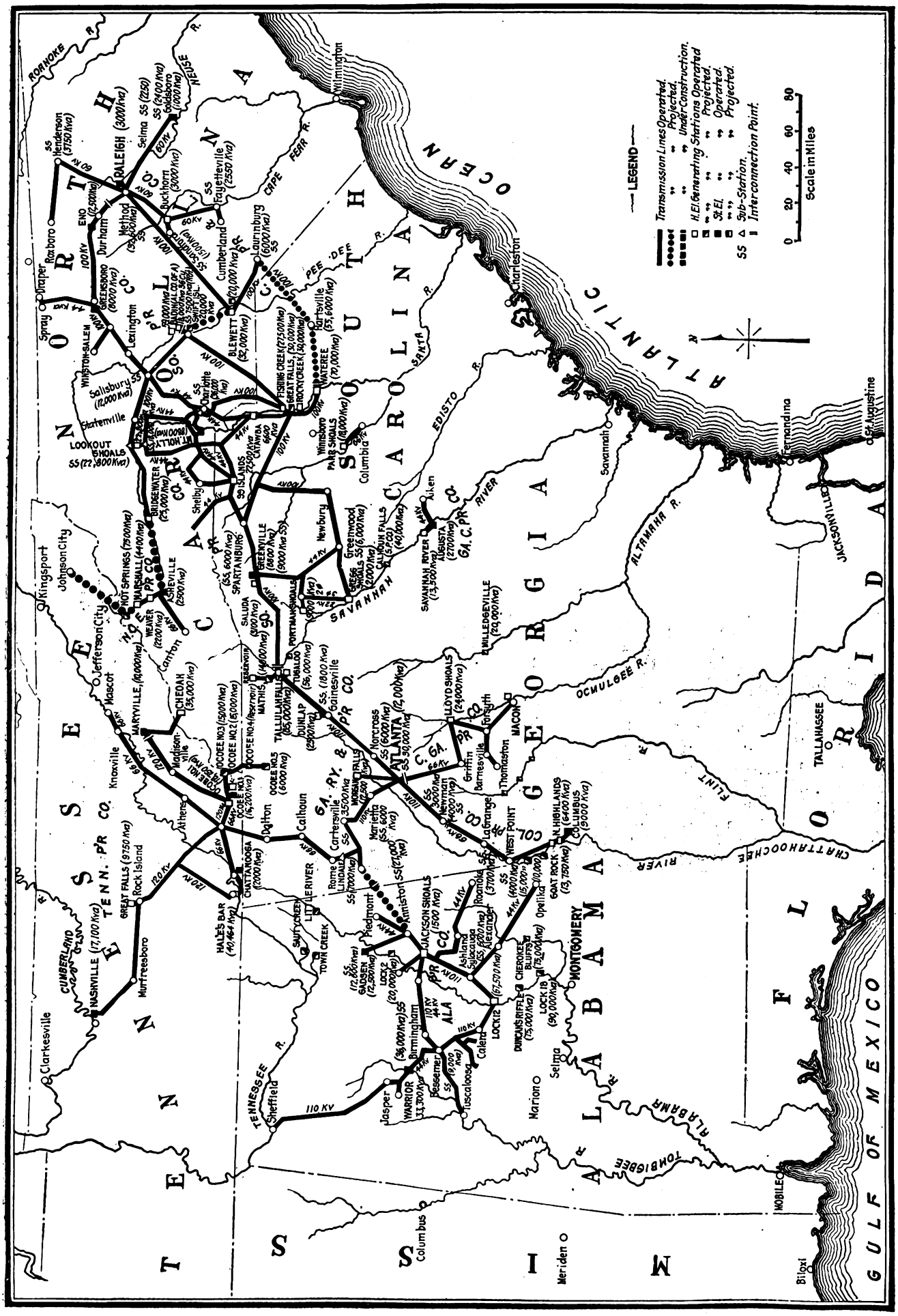

FIG. 3—HIGH-VOLTAGE TRANSMISSION SYSTEMS OF THE SOUTH THAT ARE INTERCONNECTED

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all three companies will be interconnected and all distributing systems, with the one exception, will be fed from these interconnected transmission systems, having a total of 538 miles (865 km.) of lines. This will make a greater supply of power available to all three companies and permit the closing down of all steam plants, except the Summerville station now operated by the Palmetto Power & Light Company, thus enabling the companies greatly to enlarge their business and materially decrease operating expenses. The connected load on the lines of the three companies is approximately 40,000 kw. It is estimated that the 14,000 kw. to be delivered by the Wateree Power Company will, in connection with the Yadkin River Power Company's Blewett Falls reservoir, enable the three companies together to supply power for an additional 20,000 kw. of connected load.

Extensions to Systems in Alabama and Georgia

Alabama Power Company.—The Alabama Power Company as contractor for the United States has made during the past twelve months a 30,000-kw. extension to its Warrior reserve steam plant. Eighteen 1200-hp. Stirling boilers and the usual auxilliaries were installed in the boiler room and a 33,000-kva. General Electric horizontal turbo-generator in the generating room. The latter unit is provided with a Worthington surface condenser. This installation was made to supply power to the government nitrate plant at Muscle Shoals. In this connection the Alabama Power Company constructed a 90-mile (145 km.), three-phase, 110,000-volt transmission line from the Warrior reserve steam plant to Muscle Shoals and installed a 40,000-kva., 110,000/13,000-volt substation at that point.

To take care of the increased load on its system the company found it necessary during the past year to install at Bessemer, Ala., an outdoor type 110,000/44,000-volt switching station and substation. At the present time one bank of transformers of 13,500 kva. capacity is in use at this point. The station has an estimated capacity of 100,000 kva. A 110,000-volt, single-circuit, three-phase line has been constructed approximately 30 miles (48 km.) in length between this substation and the Warrior reserve steam plant.

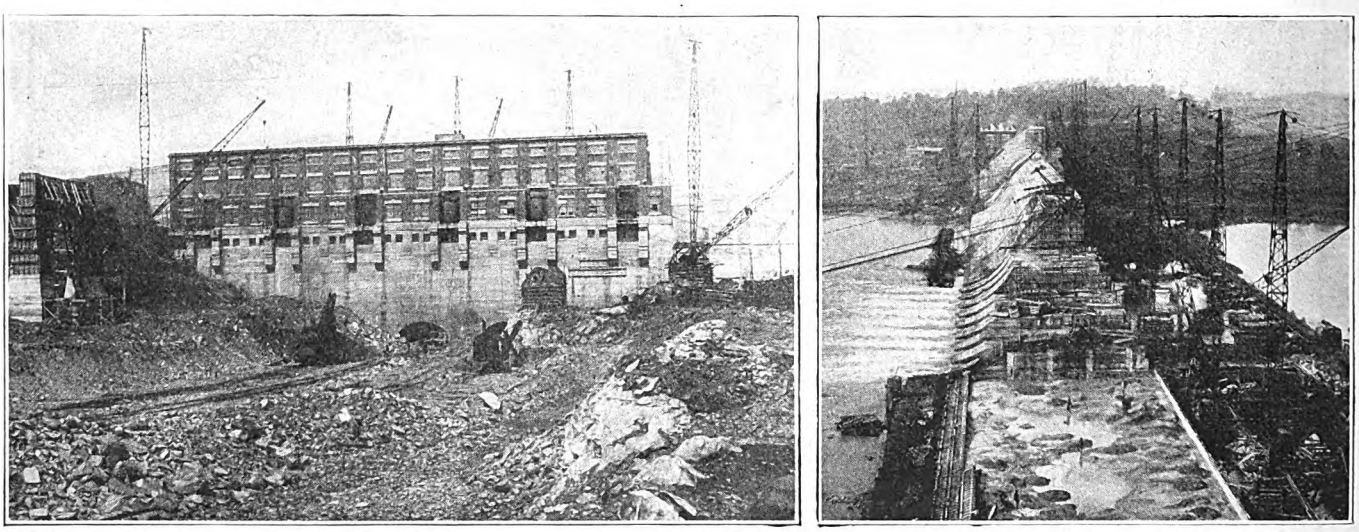
War work and electrometallurgical development incidental to war work put a greatly increased load on the company's system during the past year, but since the signing of the armistice a considerable portion of this extraordinary load has disappeared. Despite this fact, however, the company reports that its load at the present time is practically equal to the load one year ago. This seems to indicate that the natural growth in load has made up for the loss of any temporary war-time load.

It is pointed out by an official of the company that the conditions which have existed since the signing of the armistice make it practically impossible for a public utilities corporation to start new plant extensions, and this company, like many others, is economizing in every possible manner and not contemplating any new developments at the present time. Operating costs during the past year, as compared to those obtaining previous to the war, show an increase of from 50 to 150 per cent in practically all items. For the Alabama Power Company's system this has shown up as an actual total increase in operating costs in 1919 as compared with the year 1915 of over 80 per cent. Increase in cost of labor alone was approximately 70 per cent.

The hydroelectric stations of the Alabama Power Company at present in operation are located at Lock 12 on the Coosa River, where a head of 68 ft. (22 m.) is available, and at Jackson Shoals, on Choccolocca Creek, where a head of 22 ft. (6.7 m.) is available. Sixty-cycle, three-phase energy is generated at 6600 volts in the Coosa River plant and 2300 volts in the Jackson Shoals plant. The company has at present in operation about 200 miles (320 km.) steel-tower transmission lines equipped with suspension-type insulators and No. 00 stranded copper cable for transmitting energy at 110,000 volts to its substations over private rights-of-way.

The main substations are situated at Gadsden, Anniston, Birmingham, Bessemer and Muscle Shoals. Substations operated at 22,000 volts are in operation at Talladega, Leeds, Lovick, Alexander City, Gadsden and Attalla. The high-tension substations are of the outdoor type. At present the rating of the six main substations is 98,800 kva.

The company has two large reserve steam stations. The newest, which is on the Warrior River, is shown in an accompanying illustration. This station has a rating of 63,000 kw. in turbo-generators. The second steam-turbine station at Gadsden contains two 6250-kva. units.



FIGS. 4 AND 5—WATEREE 70,000-KW. POWER STATION AND DAM OF SOUTHERN POWER COMPANY ON APRIL 5, 1919

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During the eleven months between Jan. 1, 1918, and Nov. 25, 1918, arrangements were completed so that what is known as nitrate plant No. 2 was producing ammonium nitrate, using power from the transmission system of the Alabama Power Company pending the completion of the steam plant to furnish the necessary power. In this steam plant a 60,000-kw. turbine was called for to supply electric energy to electric furnaces used in connection with the cyanamide system. Twelve electric furnaces are installed, each requiring 6000 kw. This equipment, together with the motor load, will bring the load of the plant to about 70,000 kw. or 80,000 kw. with a load factor of about 90 per cent. The large and very constant load required the erection of a station similar to a central station designed for an economy as high as war conditions would permit. Plant No. 2 has a 60,000-kw. generator rating (70,000 kw. maximum,) and 18,000 boiler-hp., or 3.3 kw. per boiler horsepower. Details of this plant were given in issues of the ELECTRICAL WORLD for April 5 and 12, 1919.

The power for operating the nitrate plant has been transmitted over a high-tension line approximately 90 miles (145 km.) long, built by the Alabama Power Company. Between 20,000 kw. and 30,000 kw. has been taken over this line, the average load carried by the steam station being in the neighborhood of 50,000 kw. to 55,000 kw.

Georgia Railway & Power Company.—The shortage of coal supply during the war emphasized the importance of existing water-power generating plants and the vital need of additional developments. The 72,000-kw.

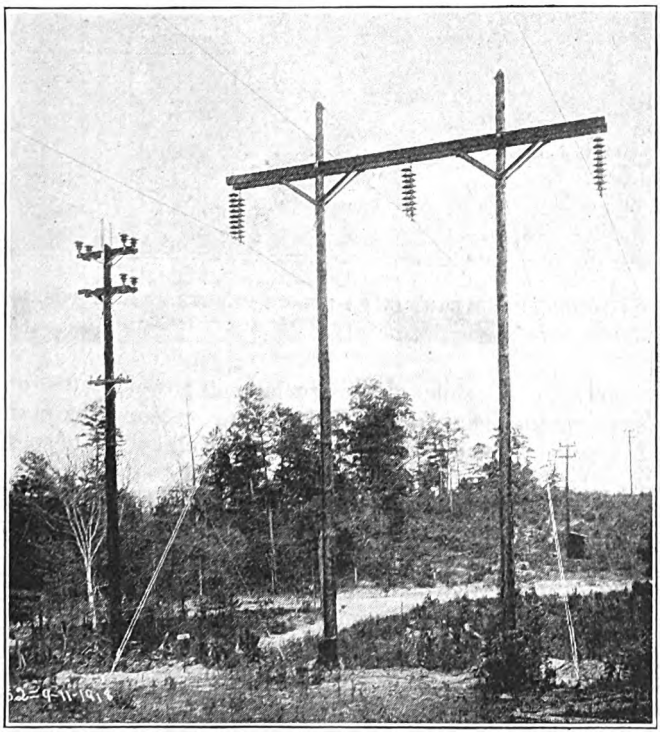

FIG. 6 — SINGLE-CIRCUIT WOOD-POLE 110,000-VOLT TRANSMISSION LINE BUILT BY ALABAMA COMPANY FOR UNITED STATES GOVERNMENT

plant of the Georgia Railway & Power Company at Tallulah Falls was barely finished when the rapid increase in the demand for hydroelectric power forced the company to undertake the construction of an additional storage reservoir and the installation of the maximum generator capacity of the station.

The growth of the business in the past seven years is shown in the following table of yearly outputs in kilowatt-hours:

1912	68,400,642	1916	211,872,638
1913	100,479,902	1917	258,607,802
1914	145,692,403	1918	238,489,012
1915	179,976,596		

This shows an increase up to 1917 of nearly 300 per cent, or, in other words, the volume of business in-

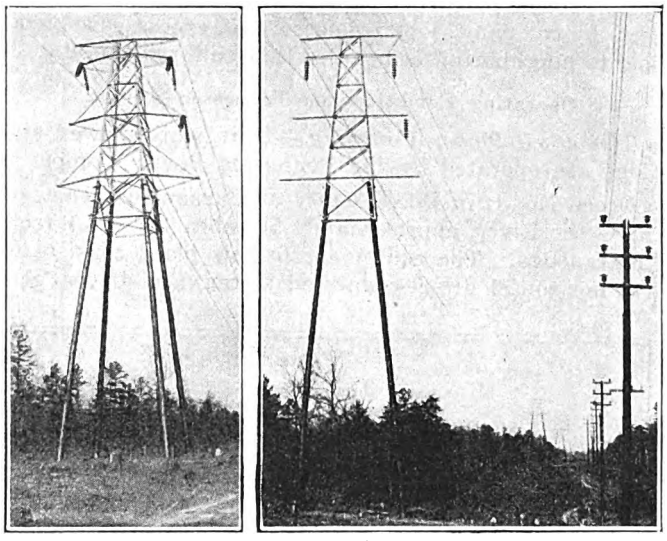

FIG. 7 — TWO-CIRCUIT, 110,000-VOLT WOOD AND STEEL LINE BUILT BY ALABAMA COMPANY IN 1918 TO CONNECT BESSEMER SUBSTATION AND WARRIOR STEAM PLANT SUBSTATION

creased almost four times. The Georgia Railway & Power Company has three water-power plants of approximately 97,000 kw. developed and in service. The company controls approximately 275,000 kw. undeveloped in addition, or a total developed and undeveloped of approximately 372,000 kw. A very large part of the power generated by the company was used by industrial enterprises making supplies necessary to the successful prosecution of the war.

Columbus Power Company.—The Columbus (Ga.) Power Company has three hydroelectric developments on the Chattahoochee River, two at Columbus having an aggregate rating of 9000 kva. and one at Goat Rock, 15 miles (24 km.) north of Columbus, having 13,750 kva. installed, making the total available 22,750 kva. The City Mills development at Columbus comprises five generators with an aggregate rating of 1000 kw., the head being 10 ft. (3 m.). The North Highlands development has six generators, with an aggregate rating of 6400 kva., and waterwheels operating under a head of 42 ft. (12.8 m.) The Goat Rock development, where a head of 72 ft. (21.9 m.) is available, has three generators, two of which are rated at 3750 kw. and the other at 5000 kw. Three-phase, sixty-cycle energy is generated at 5500 volts and 11,000 volts. Two 4000-kw. transformers step up the potential to 66,000 volts for transmission. A 11,000-volt line on wooden poles with pin-type insulators connects the Columbus and Goat Rock properties, and a 60-mile (96 km.) steel-tower line equipped with suspension-type insulators and operating at 66,000 volts extends from Goat Rock ot Newnan. There is 18 miles (28.8 km.) of wooden-pole line operating at 11,000 volts connecting Newnan and Hogansville. Four main substations are connected to the system, one at

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Columbus rated at 1600 kw., one at West Point rated at 1875 kw., one at La Grange rated at 1875 kw. and the forth at Newnan rated at 4000 kw. Provision is made for the transfer of power between the Columbus Power Company's system and the system of the Georgia Railway & Power Company through interconnection of lines. Although gross earnings of the company increased 8 per cent in 1918, operating expenses increased 30 per cent owing to increased costs of labor and coal. Taxes were increased 80 per cent over 1917. The unusual drought conditions of 1918 did not materially affect the company's operation, so that excess power was sold to neighboring companies that suffered thereby.

Operating Conditions on Tennessee System

Tennessee Power Company.—Four water-power stations are operated by the Tennessee Power Company:

Ocoee No. 1, in Polk County at Parksville, Tenn., on the Ocoee River, approximately 50 miles (80 km.) from Chattanooga. The equipment in this plant consists of five horizontal direct-connected waterwheel-driven generators, each one having a capacity of 3750 kva., the total station capacity being 18,750 kva.

Ocoee No. 2, in Polk County on the Ocoee River, about 10 miles (16 km.) east of Parksville. This plant is equipped with two horizontal waterwheel-driven generators, each having a capacity of 7500 kw., the total capacity of the station being 15,000 kva. This plant uses the stream flow from the Ocoee River, which is diverted by means of a low dam, 5 miles (8 km.) above the power station, from which the water is conveyed by means of a flume to a forebay above the power house. The operating head at this plant is 255 ft. (77 m.).

Great Falls Station, in the northwest end of Warren County, about half way between Nashville and Chattanooga. This plant uses the flow of the Caney Fork and Collins Rivers. A low concrete dam has been built just below the confluence of the two rivers, diverting the two streams, which are conveyed to the waterwheel by means of a tunnel and penstock. The plant is equipped with one vertical waterwheel-driven generator, the capacity being 9750 kva.

Hales Bar, on the Tennessee River about 20 miles (32 km.) west of Chattanooga. This plant is equipped with fourteen 3000-kva. vertical turbines, the total capacity of the station being 42,000 kva. The concrete dam across the river at the power-house site backs up the water and makes the river navigable to Chattanooga. The combined capacity of the present hydroelectric stations is 85,500 kva.

The Tennessee Power Company has an arrangement with the Chattanooga Railway & Light Company, the Nashville Railway & Light Company and the Knoxville Railway & Light Company whereby the steam plants at these three cities may be operated at the direction of the power company to supplement the output from the hydro plants during low water. In addition it supplies power to the Aluminum Company of America at Maryville, Tenn., 16 miles (25.6 km.) south of Knoxville, and also to the American Zinc Company at Mascot, Tenn., 15 miles (24 km.) northwest of Knoxville. The total transmission line mileage is approximately 600 miles (960 km.).

The company planned to operate throughout 1918 as nearly as possible on hydroelectric power, with only such steam generation as might be necessary for standby, regulation and unavoidable supplement. In so far as possible this policy was carried out, but the cost of coal and labor increased to such an extent over the previous year that with only about half as much steam generation the total cost was slightly greater than in 1917. More than half of the total operating expense is due to operation of steam plants, and the great problem therefore is to reduce to normal figures this largest item of the expense account. Fortunately the situation in this regard promises to be better in 1919 because of the decrease in price and better quality of coal and the greater efficiency of labor.

In order to save steam generation, arrangements were made to reduce delivery to the Aluminum Company of America during the period of low stream flow, with the result that in 1918 234,591,137 kw.-hr. were delivered, as compared with 295,209,703 kw.-hr. in 1917. The delivery at the present time is about 40,000 hp., but the amount will be reduced, possibly as low as 10,000 hp., some time between May 1 and July 1, 1919, owing

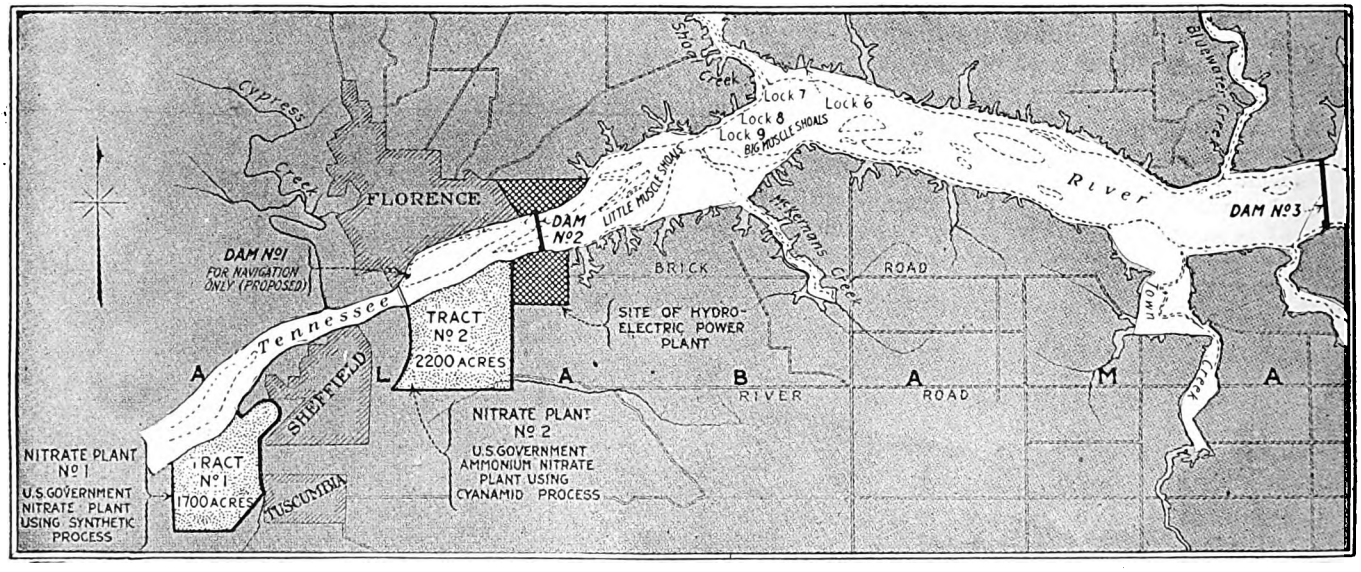

FIG. 8—MUSCLE SHOALS ON THE TENNESSEE RIVER, SHOWING LOCATION OF GOVERNMENT NITRATE PLANTS AND PROPOSED HYDROELECTRIC DEVELOPMENTS

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to the lack of demand for aluminum since the signing of the armistice and to the completion by the Aluminum Company of its own hydroelectric plant. Had the demand for aluminum continued as anticipated, it is probable that this company would have been called upon to continue delivery of as much power as it cared to sell at the price. As delivery to the Aluminum Company is reduced the power can be sold elsewhere at higher prices, possibly not all at once, but gradually. Moreover, during the dry season the company will make more net profit with a less total demand upon its generating plants. The problem of reselling the power released by the Aluminium Company will therefore not be serious until after the dry season of next fall, say, in Deecember, 1919.

All of the hydroelectric plants of the company operated satisfactorily during 1918, no changes being made and no important construction work carried on.

Additions at Richmond and Norfolk, Va.

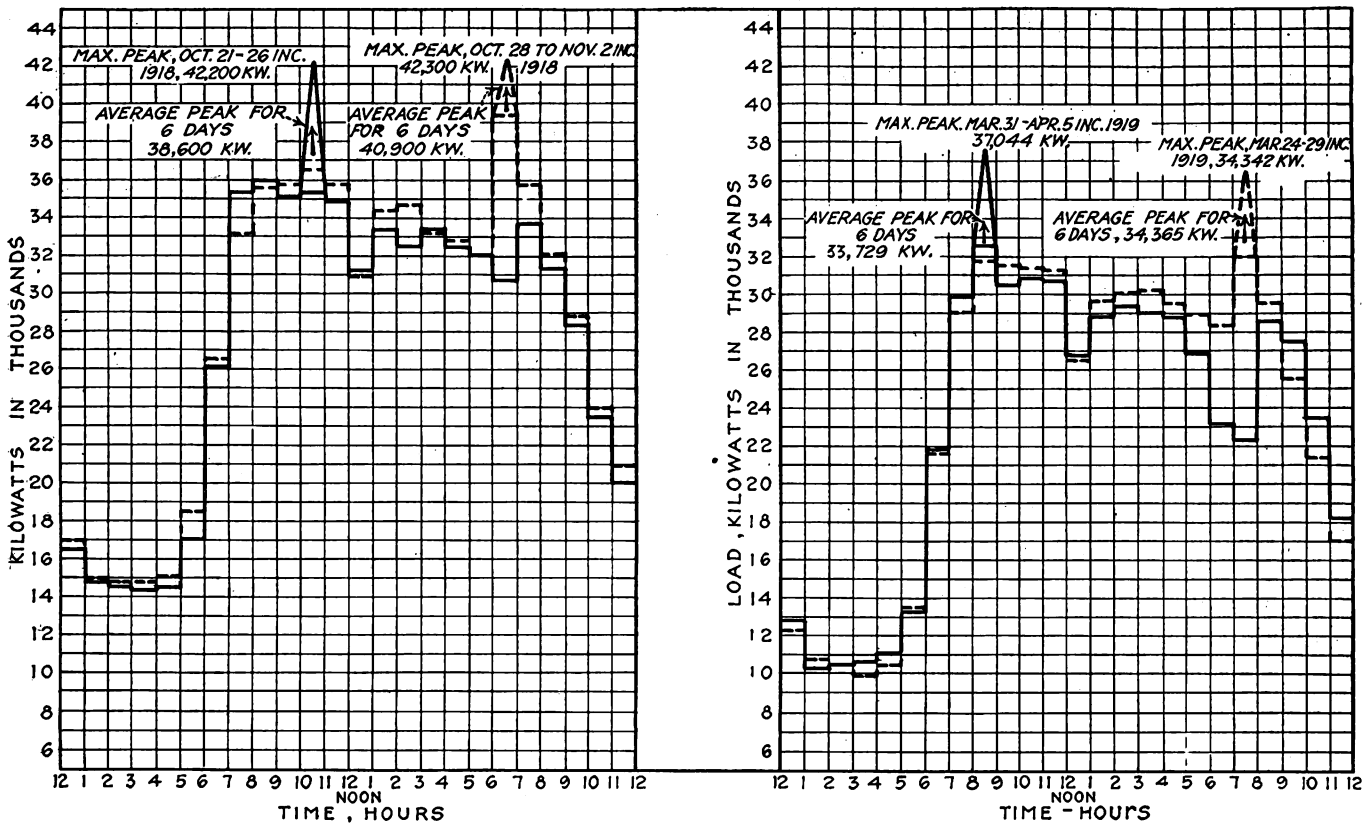
Virginia Railway & Power Company.—Additions by this company during the year 1918 may be divided into three groups: (1) Additions to the Richmond (Va.) power station; (2) additions to the Norfolk (Va.) power station, and (3) transmission line connecting the Richmond and Norfolk power systems, thereby interconnecting all parts of the system of the Virginia Railway & Power Company.

The additions to the Richmond power station consisted of one 20,000-kw., General Electric turbo-generator to operate at 13,200 volts. In connection with the installation of this machine, there were installed two extra boilers with stokers and an extra boiler-feed pump.

The additions to the Norfolk power station, which were started in 1918, include one 12,500-kva. turbo-generator, with a 4000-volt generator, and two additional 500-hp. boilers with Westinghouse underfeed stokers. The turbine was installed in place of a 3000-kw. vertical turbine, which was removed. In addition to this work, the entire heater system and exhaust headers were remodeled by the installation of two 6000-hp. Cochrane feed-water heaters and new exhaust headers throughout. This work was not entirely completed during 1918, but is now in operation. In connection with this turbine unit there have been installed three 4166-kva. transformers for raising the generator voltage to the main bus voltage of 11,000 volts.

A 33,000-volt transmission line connecting Richmond and Petersburg, Va., has been reinsulated and changed over to 110,000 volts, and a new 110,000-volt line has been constructed from Petersburg to Suffolk, there connecting with the Norfolk system of the Virginia Railway & Power Company. In connection with this transmission line there has been constructed one 15,000-kva. outdoor substation at Richmond, one 6000-kva. substation at Petersburg and one 6000 kva. outdoor substation at Suffolk; also two new 1500-kva. outdoor substations furnish power to the interurban car line connecting Richmond and Petersburg. All work has been, in the main, along generally accepted standards, the only variations being in the use of concrete poles for supporting the outdoor 110,000-volt equipment in connection with the transmission line.

The additions to the stations of the Virginia Railway & Power Company were caused by the great development of the Hampton Roads district in and around Nor-



FIGS. 9 AND 10—LOAD OF TEXAS POWER & LIGHT COMPANY HAS INCREASED 445 PER CENT IN FOUR YEARS

On Sept. 25, 1914, the maximum demand on the system of the Texas Power & Light Company was 8700 kw., and the output for the twenty-four hours was 144,235 kw.-hr. Four years later, on Sept. 26, 1918, the maximum demand was 47,400 kw. and the output for the day was 751,448 kw.-hr. The load factors were 70 per cent and 66 per cent respectively. On Sept. 26, 1917, the peak load was 36,000 kw., and 627,642 kw.-hr. were generated at a load factor of 72.7 per cent.

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folk brought about by the location of the government works near Norfolk. This, as well as general activities caused by these developments, created a considerable power load. The company reports that in Norfolk the plant capacity was not increased in the same proportion as the requirements before the signing of the armistice, but this difference was to be taken care of by power furnished from the Richmond district from the transmission line described. The signing of the armistice has not as yet greatly affected the power requirements over the system of the Virginia Railway & Power Company owing to the fact that the majority of the government institutions in that district are of a semi-permanent nature and no very marked decrease in output has been noticed. It is difficult to obtain satisfactory data as to the effect of the armistice, since for some time prior to November there had been a rationing of power in the Norfolk district. At present the company is completing all work that had been started prior to the signing of the armistice. After this work has been completed it will probably defer further extensions until general conditions become more settled.

Improvements by New Orleans Company

New Orleans Railway & Light Company.—In May, 1918, the New Orleans (La.) Railway & Light Company installed a 15,000-kw. turbine in its generating station and in July, 1918, four 1000-kw. rotaries. One new feeder with a capacity of 2000 kw. was also installed from the generating station to serve the United States government commodity warehouse in New Orleans. This feeder was put into service in December, 1918, and supplies a demand of approximately 250 kw. In the boiler room of the company's generating station three 900-hp. boilers have been raised in order to provide greater combustion space and for the installation of underfeed stokers to increase the boiler capacity.

Just prior to the time the United States entered the war the New Orleans company ordered material to change all of its street-lighting system from 7.5-amp. alternating current arc lamps to 5.5-amp. direct-current magnetite lamps. In the past eighteen months a large number of circuits have been changed and the work will be completed at an early date.

The changes and additions in the generating station were due to the natural growth of the New Orleans industries. The demand for energy by war industries in that city during the war was a small percentage of the company's commercial load.

The company reports that coal is now costing practically the same as it did eighteen months ago, while fuel oil costs approximately 126 per cent more than eighteen months ago. Approximately 425 tons of coal and 800 bbl. of fuel oil are required per day. It is also pointed out that labor cost is now 80 per cent more than eighteen months ago, and the taxes for the company's electric light and power properties in 1918 were increased 60.96 per cent. The taxes for the railway properties in 1918 increased 22.65 per cent.

Difficulties Encountered by Texas Company

Texas Power & Light Company.—By utilizing the surplus energy of a city plant and by juggling the energy back and forth on its 1000 miles (1600 km.) of transmission lines, the Texas Power & Light Company was able to pull through a threatened emergency last year caused by the non-arrival of a turbine. To take care of the healthful growth, a 15,000-kw. turbo-generator had been ordered for the Fort Worth plant to replace a 5000-kw. unit which was to be moved to the McKinney plant. The latter unit was moved and the foundation blasted, when it was found that the larger unit could not be delivered on time. The Dallas plant was not connected in with the transmission system, the main reason being that the energy generated there was two-phase. However, two 3700-kv. transformers with Scott connections were installed to change the 2300-volt, two-phase energy to 12,000 kv., three-phase. From the 12-kv. buses the energy was stepped up to the transmission line voltage of 60 kv.

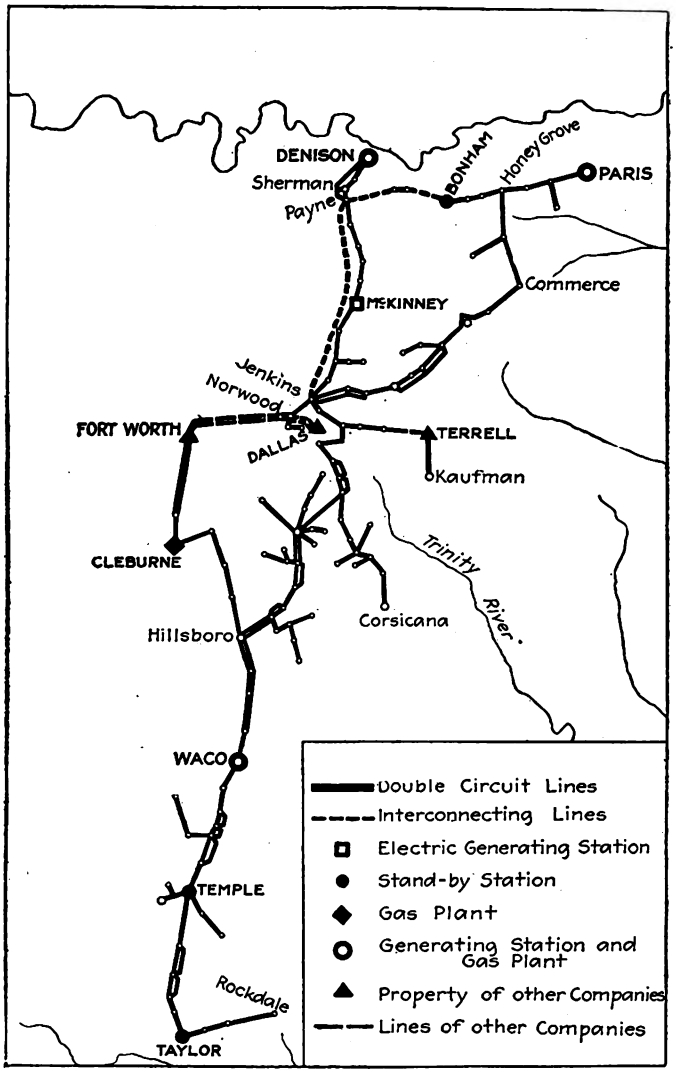

FIG. 12—PARTIAL TRANSMISSION SYSTEM OF THE TEXAS POWER & LIGHT COMPANY, SHOWING INTERCONNECTION

Interconnection in Texas has gone forward during the war. It 1918 the Texas Power & Light Company constructed 130 miles (209 m.) of 60,000-volt line between Bonham and Jenkins (just outside of Dallas) in order to fulfill contracts entered into in the early part of 1917. The new extension gave double-circuit facilities for the Sherman-Dennison district and created a loop through Jenkins, Payne, Bonham, Honeygrove and Commerce. On April 16, 1918, the systems of the Texas Power & Light Company and those of the Dallas Power & Light Company were interconnected by a 7.5 mile (12-km.), 60,000-volt double-circuit tower line from Norwood to Dallas. This interconnected the Dallas, Fort Worth & Texas Power & Light Companies, the two former being tied together since 1914.

In all of the larger towns on the Texas system it has been found that the intermediate voltage of 12 kv. was necessary on account of the larger number of industrial plants springing up around the outskirts of the cities. This type of service is beginning to be a large proportion of the company's load.

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Pacific Coast Plants Fully Loaded

Interconnection of Systems Has Enabled Western Companies to Carry Increased Loads Despite Lack of Hydroelectric Development—High Cost of Fuel Oil, However, Emphasizes Need of More Liberal Water-Power Program

CONDITIONS without precedent in the history of hydroelectric development have affected practically all Pacific Coast companies during the past eighteen months. The dryest winter in forty years, the highest price on record for fuel oil and an increase of demand for energy far exceeding the development of new power sources are the more important of these. The high price of oil served to emphasize the uncertainty in production cost that attends generation by steam and has strengthened the preference for water power. The drought did not turn out to be so serious as at first feared, but it served to give impetus to interconnection plans, and, coupled with a "win-the-war" purpose common to all companies, did much that will probably endure in bringing about economies and eliminating waste.

During war time there was practically no development of hydraulic power, although the demand increased rapidly. Thus the Pacific Coast now finds itself short of power. With the single exception of the Washington Water Power Company, all the coast companies have come uncomfortably close to the limit of available capacity. In fact, only by interconnection and economies that would not otherwise have been thought of were some companies able to meet essential demands. The natural reaction from this condition is the immediate development of more power. In fact, in Major Sever's report to the War Industries Board, submitted last December, after a careful study of conditions along the coast, hydroelectric development at the rate of 50,000 kw. per annum was recommended for California "until the oil-generated power is reduced to a safe and economical value." No changes were made by the last Congress, however, in regulatory legislation for hydroelectric development.

The Question of Financing

The primary difficulty in getting the development program started has been the matter of financing. The international situation has affected all lines of industry, of course, but another cause for hesitation in the electrical field is the uncertainty about the rates at which energy will be sold. During the war surcharges on most rates were granted to enable the companies to meet the higher costs of labor and materials. Now that the war is over there is a strong demand for the removal of surcharges. In the San Francisco district numerous letters and resolutions have been sent to the Railroad Commission urging the removal of the surcharges, and this is typical of sentiment in other quarters. Meantime, operating costs, particularly of labor and oil, remain at the high figure of war time, and no definite prediction regarding the duration of high costs can be made. In several Coast centers there is even a demand for increased wages, and such decreases as there have been—in the price of copper, for example—have not affected operating expense.

In California, however, there seems to be a general confidence in the fairness of the Railroad Commission. Financing has been arranged by several companies, and extensive development projects are now under way. The more important of these are those of the San Joaquin Light & Power Company, the city of San Francisco (financed for this year's program only), the Great Western Power Company and the Southern California Edison Company. The program of the last-named company involves construction to cost about $16,000,000.

Municipal Projects

It is notable that the tendency on the Pacific Coast is strongly toward municipal ownership or municipal control. Not only are San Francisco, Los Angeles and Seattle committed to extensive hydroelectric projects, but smaller cities are beginning to favor the municipal ownership idea, and there is ground for the belief that this may spread. Typical of this tendency is the situation in Oroville, Cal., a town of about 6000, which is having the Railroad Commission appraise the local distributing system of the Pacific Gas & Electric Company with the idea of taking it over if the price is satisfactory. The same company owns the electric, gas and water systems

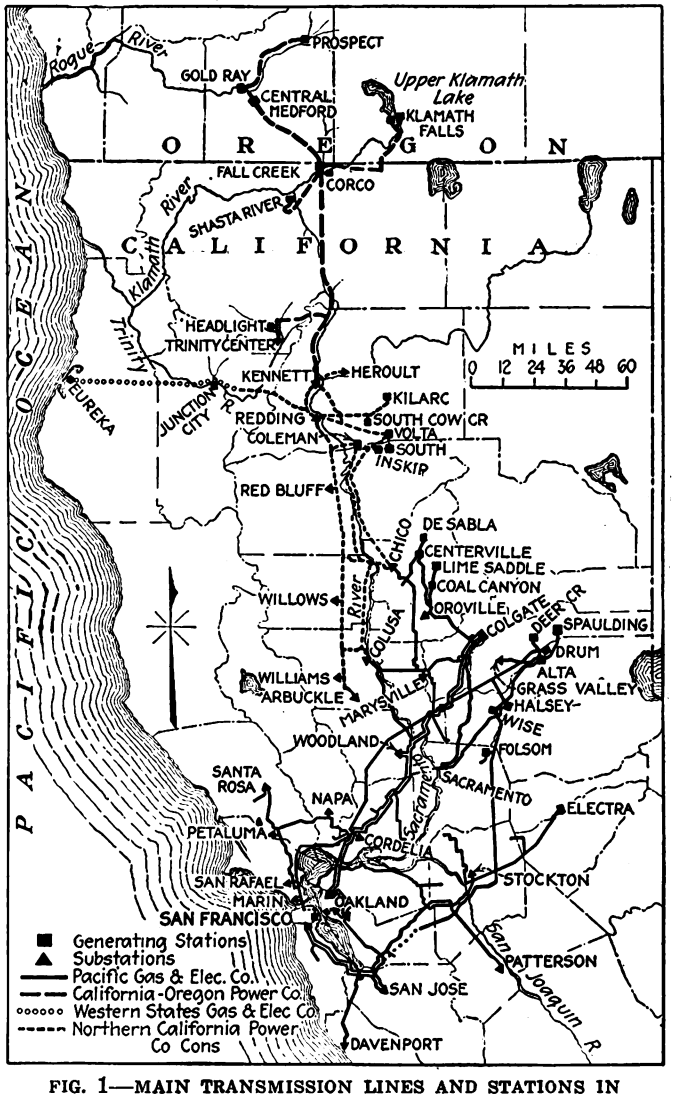

FIG. 1—MAIN TRANSMISSION LINES AND STATIONS IN NORTHERN CALIFORNIA

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ference between residence-lighting and wholesale rates.

This is just the reverse of the plan in two of the largest Coast cities where the policy is to generate energy and dispose of it wholesale. Los Angeles has for some time been delivering power in large blocks to the private company for distribution, and that has been announced as the plan to be followed by San Francisco when the Hetch Hetchy power is available.

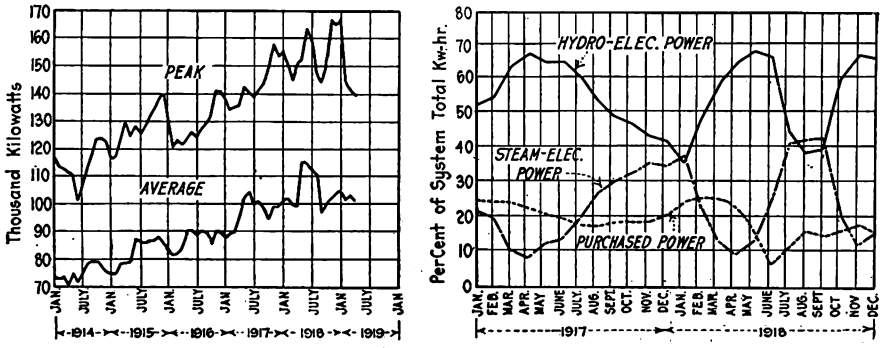

FIG. 3—PEAK AND AVERAGE LOAD CHARACTERISTICS AND GROSS DELIVERY OF ENERGY FROM VARIOUS SOURCES—PACIFIC GAS & ELECRTIC COMPANY

Work on the Hetch Hetchy project is steadily progressing, and if bonds can be sold for the continuation of construction, the first unit of 66,000 hp. in the Moccasin Creek plant can be completed within three years. The limiting factor in construction here, second to the question of financing, is the construction of the 18-mile (28.8 km.) tunnel which is being advanced from six headings and about a mile of which has already been completed.

The Skagit River power project of the city of Seattle has reached the stage where preliminary construction is under way, a bond issue of $5,500,000 having been voted last fall. This city already has its own distributing system and does not plan to sell power for distribution. The tendency toward municipal ownership in Seattle is manifested by the fact that early in April it bought a fifteen-million-dollar electric railway system for operation under municipal management.

War-time conditions are thought to be one reason why the municipal ownership tendency has spread in small towns. That is, with the drain of draft and enlistment, power companies were unable to keep the standard of employees up to par and consumers did not get the treatment and service expected. War prices, too, despite the unquestioned reason for them, certainly did not make the consumer any happier, and under these conditions any tendency toward municipal ownership made rapid progress. The suggestion is now current in the Coast territory that courtesy and service must be watched more closely than ever.

Steam Heat from Standby Plant

A feature of recent Coast progress worthy of study is the way in which the steam-heating business has been developed by the Northwestern Electric Company of Portland. This company has acted on the policy that steam can be produced in a standby station with lower overhead charges than by an independent company and therefore that judicious investment in a properly laid-out steam system should bring returns. After several years' experience with the steam business this company has just laid, from a new generating station, a steam main 6000 ft. (1800 m.) long which takes steam from the plant at 250-lb. (17.6 kg. per sq.cm.) pressure. Not only is this investment significant as to the progress made in making the steam department profitable, but this length of transmission represents a new departure in steam heating for which the company's engineers are entitled to great credit. An interesting side light on this is that an electrical engineer designed those features of the steam system for which there was no precedent. An account of what these problems were and how they were solved is now being prepared for the ELECTRICAL WORLD.

Pacific Gas & Electric Company.—There was a rapid increase in the load of this company during last spring and summer, due principally to essential war industries and extra heavy pumping for irrigation. The abnormal irrigation load was due to very light rainfall and snowfall the previous winter and resulted in the heavy draft on stored water early in the season since the natural stream flow soon fell below normal. At no time, however, were loads larger than installed capacity, and the only reason some loads were ordered off was because of shortage of sufficient stored water to drive the installed generator capacity.

When available hydroelectric capacity was no longer adequate to meet the demand, the auxiliary steam plants were pushed to their full capacity to make up the deficiency. The interconnections with other companies could not always furnish the relief at critical times,

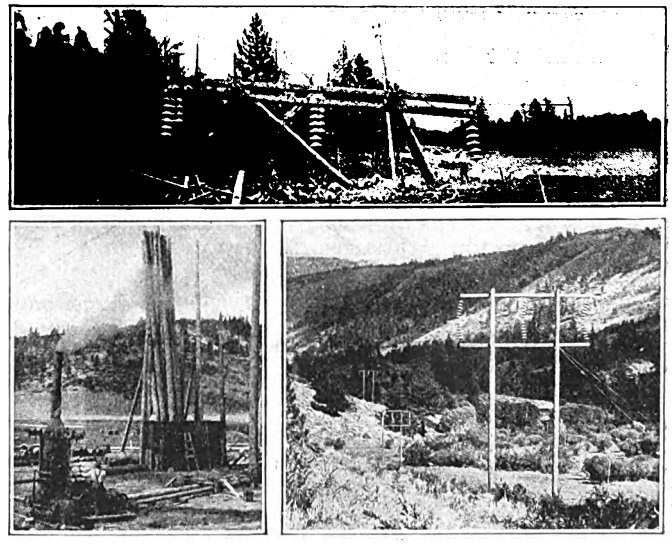

FIG. 4—140-KV. LINE CONSTRUCTION OF NEVADA-CALIFORNIA POWER COMPANY

Above—Raising two-pole structure. Lower left—Pole-treating plant. Lower right—Small angle turn with suspension insulators.

since many companies experienced similar shortage of power from water sources.

Plant for Variable Head

During the winter of 1918 the hydroelectric plant known as the Spaulding power house was completed and a 3750-kw. generator was installed. This plant is built in solid rock excavation, extending 75 ft. (23 m.) inside the mountain. The outlet tunnel of Lake Spaulding is about 4000 ft. (1200 m.) long, through solid rock,

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and it is about 1100 ft. (330 m.) downstream from the Spaulding dam. The plant was connected in series, so to speak, in the discharge tunnel five years after the tunnel was first put into service. The generating unit is of the vertical-shaft type connected to a Francis 5000-hp. turbine. The head varies from full lake at spilling to empty, or about 190 ft. (60 m.) to 0. The windows in the tower over the entrance to the cavern power plant serve as high-tension 60-kv. outlets for the line.

In San Francisco at station A a 15,000-kw. horizontal Curtis turbo-unit with appropriate boiler capacity is now being installed. Substation E has also been increased by the addition of 300-kw. transformer capacity and 2500 kw. in motor-generator sets. Forty-two miles (68 km.) of 60,000-kv. transmission line was installed to connect with the California-Oregon Power Company for the purpose of purchasing energy. There was also constructed a 40-mile (64-km.), 100-kv. single-circuit tower line to serve as a trunk line from the Halsey, Wise and Folsom power houses into the 60-kv. network at Mission San José substation.

The company has been able to take on again loads called non-essential during the war, replacing war in-

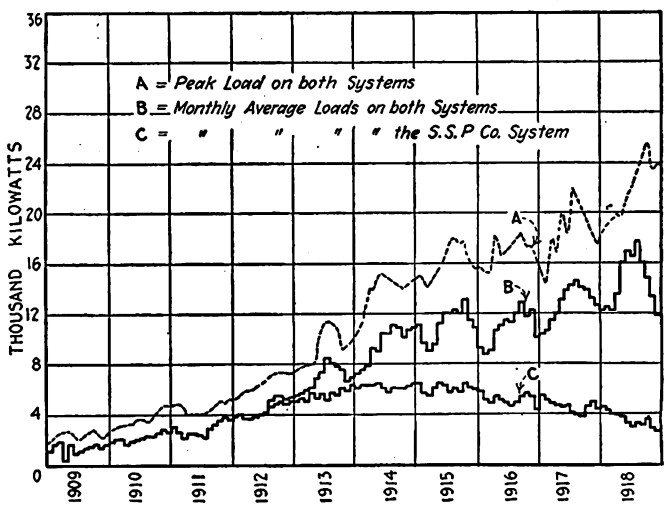

FIG. 5—GROWTH OF LOAD ON SOUTHERN SIERRAS POWER COMPANY AND NEVADA-CALIFORNIA COMPANY SYSTEM

dustry loads which have fallen off. The system was thus not seriously affected by the armistice, except that the average load has been improved by the reconnection of loads such as street lighting, cement mills, gold dredgers and rock crushers.

Southern Sierras Power Company and Nevada-California Power Company.—Since the building of extensions was curtailed during the year 1918, there has been little increase in the system mileage, amounting only to 55 miles (89 km.) of 140,000-volt line, 30 miles (48 km.) of 33,000-volt line and 15 miles (24 km.) of lines of lower voltage. The most extensive transmission line extension was the 140,000-volt line, which was built to replace a 60,000-volt line extending from Bishop, Cal., to the Rush Creek plant of the Nevada-California Power Company. This line is supported on a two-pole structure, with three conductors hung in a horizontal plant from a cross-arm, 24 ft. (7.3 m.) long. The structures are spaced ten to the mile on the average. The line conductor is a steel-core aluminum cable, six strands of aluminum and one of steel, the six aluminum strands amounting in cross-section to 211,000 circ.mil. The insulators are of the Jeffrey-Dewitt suspension type, six of these units being used in suspension strings and seven on the dead-ends.

The poles are 50 ft. (15 m.) in length with a minimum diameter at the top of 8 in. (20 cm.). These poles are native to the locality of the line and were cut

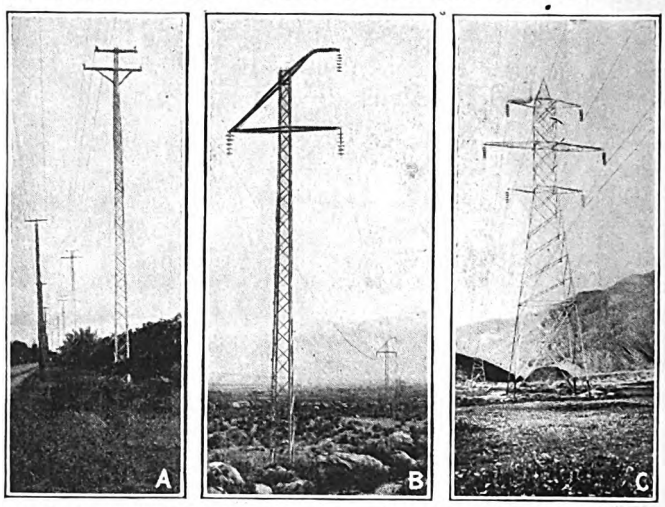

FIG. 6—TRANSMISSION-LINE CONSTRUCTION, SOUTHERN SIERRAS POWER COMPANY

A—33-kv. double-circuit distribution. B—88-kv. line. C—88-kv. delta (or 135-kv. star) transmission line.

from standing timber along the right-of-way, and thus a considerable saving was made in freight rates and in wagon haul. These poles were creosoted by means of a treating outfit that was assembled for the purpose and moved from point to point along the line. This outfit consisted of a treating tank large enough to receive thirty or forty poles at a time, steam for heating of the creosote being furnished by the boiler of a hoisting engine. The poles are given a twenty-four-hour treatment, about 8 ft. (2.4 m.) of the butt being increased. The average absorption of creosote was 3 gal. per pole, and from ¾ in. to 2-in. 1.8 cm. to 5 cm.) penetration was obtained.

Five Plants in Series on Bishop Creek

There are five hydroelectric plants on Bishop Creek, and these plants use the same water successively. The following table shows the rating of the various plants.

	Plant No. 2	Plant No. 3	Plant No. 4	Plant No. 5	Plant No. 6
Kva. and generating capacity	6000	6750	6000	1500	2000
Kw. per second-foot	55	45½	62	22	14
Kw. at 100 second-feet	5500	4550	6200	2200	1400

Thus it is seen that plant No. 5, with 1500-kva. rating, has insufficient capacity to make use of all the water when more than 68 second-feet (1.92 cu.m. per second) is being used by the other plants. To prevent this

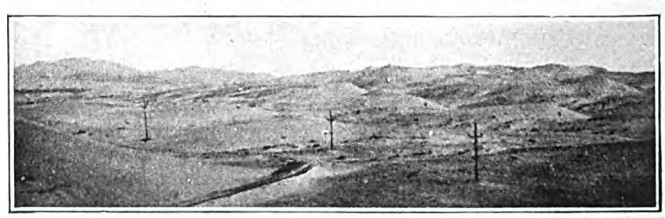

FIG. 7—CROSSING DESERT WITH 55-KV. LINE; PLANK ROAD ALONGSIDE—SOUTHERN SIERRAS POWER COMPANY

waste, a second unit of 1875-kva. capacity is being installed in plant No. 5. At the same time three 1000-kva., 2200/88,000-volt outdoor-type transformers are being set up, permitting the removal of 500-kva. indoor trans-

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formers and giving more room for extensions within the plant.

Interconnection of Two Great Systems

The operation of the Southern Sierras Power Company and the Nevada-California Power Company systems as separate units was very uneconomical, for the reason that generating plants of each system were situated on the same stream and that the load curves of the two systems differed considerably. A 6000-kva. tie-in transformer was therefore installed in 1918. The economy effected by this installation is shown by the fact that an average load of 3000 kva. has been carried by the tie-in transformer since it was put in service, and this load represents what would otherwise have been practically wasted energy.

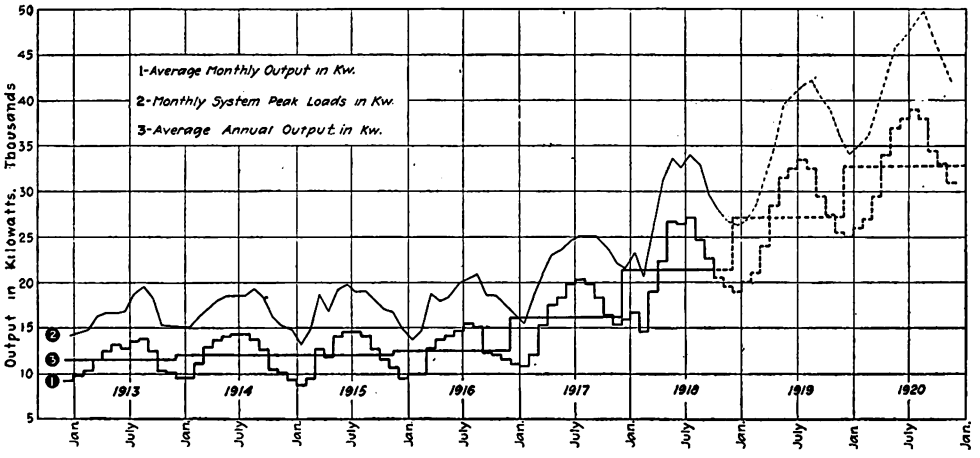

FIG. 8—CURVE OF AVERAGE AND MAXIMUM OUTPUT, 1913 TO 1918 (ESTIMATED 1919 AND 1920), FOR SAN JOAQUIN LIGHT & POWER CORPPORATION

Since every second-foot of water delivered to the hydroelectric development on Bishop Creek has a potential value equivalent to approximately 200 kw., it is natural that every attempt is made to divert all possible stream flow into the development. This was accomplished in the case of Birch Creek, a small stream having a flow of but 6 sec.-ft. (0.13 cu.m. per second) during the greater part of the year, and it was diverted into the flow line of plant No. 2; so that during the months that storage water is being used the water from this source will add some 1200 kw. to the capacity of the plants in the system.

In spite of the fact that no attempt was made to get additional business, 1200 kva. capacity of distributing transformers was installed, and about 4000 kva. of high-tension transformers for larger consumers was added to the system during this year. The load of these two systems was not increased to any great extent on account of war work, neither was there any noticeable effect on the load on account of conservation of electric lighting, for the reason that the connected load is made up as follows:

	Per Cent
Power	95.71
Residence and commercial lighting	3.22
Miscellaneous	1.07

Great Western Power Company.—From this company it is reported that the increased demand brought about by shipbuilding, electric furnaces and welding equipment amounted to about 10,000 kw. By dropping nonessential lighting loads and operating stand-by steam plants at about 100 per cent load factor, for periods of seven to eight days at a time, the company was enabled to carry this new load. It has also added 12 miles (19 km.) of 2200-kv. feeders and 6 miles (10 km.) of 1100-kv. feeders for shipyard and furnace loads. It was also possible to carry increased loads by means of interconnection with other systems. This company reports the increased price of fuel oil, from $0.77 to $1.63 per barrel.

San Joaquin Light & Power Corporation.—During the year 1918 and 1919 this company has constructed seven new substations with an aggregate capacity of 10,900 kw. It has made increases to four substations aggregating 4350 kw. and has now under construction two new substations with a total capacity of 3000 kw. There are under construction also increases to three substations, totaling 2800 kw. During this time 43 miles (69 km.) of 66,000-volt lines have been completed and 26 miles (42 km.) more are under construction. The addition of generating capacity, however, has not been in proportion to the added substation capacity, the difference having been taken care of by interconnection with the Southern California Edison Company and by the more extensive use of steam driven plants.

Unusual Engineering Developments

Of the generating stations two small induction-generator plants, one of 1000 kw. and one of 425 kw. capacity, have been completed. These plants are automatic in operation and require no attendants. They also utilize two small heads in the conduit system which so far had been unused. For the purpose of increasing the steam generating capacity of the system a 23-mile (37-km.) 6-in. (15-cm.) pipe line was laid from the Midway oil fields to the corporation's Bakersfield steam plant, making it possible to burn somewhat over 6,000,000 cu.ft. (168,000 cu.m.) of natural gas per day under the boilers of this plant.

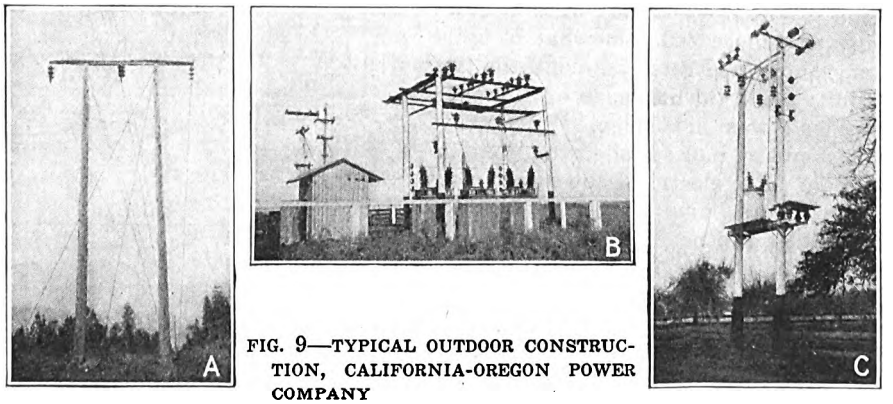

FIG. 9—TYPICAL OUTDOOR CONSTRUCTION, CALIFORNIA-OREGON POWER COMPANY

A—Two-pole tower over Siskiyou Mountains. B—Outdoor substation for irrigation power—900 kw. C—50-kw. substation for rural service.

The conditions calling for the increased plant equip-

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ment have been apparently none other than the natural growth of the system. The principal loads served are pumping of oil wells and pumping of water for irrigation. The increase in the price of oil, due to war requirements, has no doubt increased the demand for electricity for oil-well pumping, and the increased price of food products has probably somewhat increased the irri-

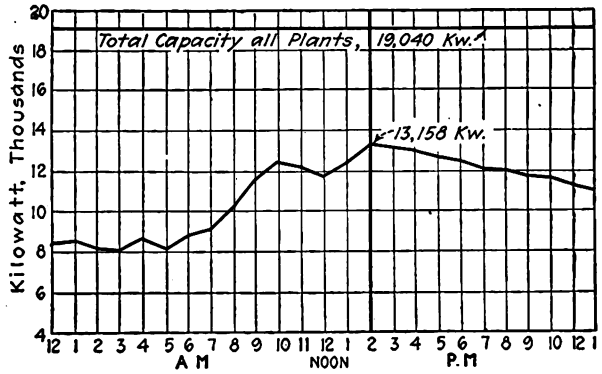

FIG. 10—LOAD CURVE, CALIFORNIA-OREGON POWER COMPANY (JAN. 13, 1919)

gation pumping. Some idea of the growth of this system in the last three years may be derived from the following table:

	Dec. 31, 1916	Dec. 31, 1917	Dec. 31, 1918
Miles distribution lines	2029.6	2395.7	2605.3
Number of consumers	23,238	26,403	26,604
	Year 1916	Year 1917	Year 1918
Sales, kw.-hr.	80,602,724	110,278,839	144,821,025

Operating costs are now much higher than before the war. Fuel oil has increased in price from $0.53 to $1.83 per barrel. The abnormally low rainfall of the last two years, moreover, made it necessary to generate large amounts of energy by steam, causing an increase in operating cost which greatly overshadows any increase in the price of material for construction. This has resulted in smaller net earnings than usual, despite the new business added and the increases in rates allowed by the Railroad Commission of California.

San Diego Consolidated Gas & Electric Company.—The load of this company was increased somewhat by military and naval establishments in the vicinity; but the increase of the system load was not large. Previously this company had supplied the greater part of its electrical energy from steam plants burning fuel oil, but on account of the necessity of saving oil during the war period the system was tied in with that of the Southern California Edison Company, which necessitated the building of a 76-mile (122-km.) 70-kv. line with step-down substations of 600 kva. at Oceanside and one of 6000 kva. at San Diego. Subsequent to the interconnection with the Southern California Edison Company 85 to 90 per cent of the requirements of the San Diego Consolidated Gas & Electric Company have been purchased in the form of hydroelectrically generated energy.

It is reported that materials have gone up on an average 100 per cent in this vicinity and that lines formerly built for $700 per mile now are installed with difficulty for $1,500 per mile.

California-Oregon Power Company.—The California-Oregon company is unique in that it is one of the very few hydroelectric systems that have no steam reserve and no necessity for one. The two largest power plants of the company are on the Klamath River in northern California and on the Rogue River in southern Oregon. The yearly fluctuation of stream flow on these two rivers is very slight. The flow of the Klamath River is regulated by Upper Klamath Lake, which acts as a huge storage reservoir. The Rogue River, on the other hand, is fed by streams from Crater Lake and by huge snow banks which hold back the usual spring freshets and keep the stream flow up in the late summer. Thus the Copco plant in California and the Prospect plant in Oregon are never troubled with low water and operate at maximum capacity in the late summer when many other plants require assistance.

During the year 1918 the power plant at Copco, having a generating capacity of 12,000 kva., was completed. It is situated at almost the exact geographical center of the company's system and is thus in an ideal location to take care of load fluctuations and provide a central switching station for the transmission lines of the company. The dam at Copco provides a storage of at least 5000 acre-ft. (6,150,000 cu.m.).

Energy for San Francisco from Oregon

This addition to the company's generating capacity was necessitated by the rapid increase in the use of electrical energy for irrigation and operating dredging plants. In addition, a contract was entered into whereby 8000 kw. would be delivered from the system of the California-Oregon Power Company to the Pacific Gas & Electric Company, being transmitted over the lines of the Northern California Power Company. For this purpose a 60-kv. transmission line was constructed by the California-Oregon Power Company from Castella to Kennett, a distance of 35 miles (56 km.), to the lines of the Northern California Power Company. The line was constructed in the Sacramento River canyon and involved some difficult engineering features, crossing a twisting, plunging stream many times in its course.

It is estimated that through this interconnection it will be possible to supply to San Francisco something like 49,000,000 kw.-hr. a year, relieving the auxiliary

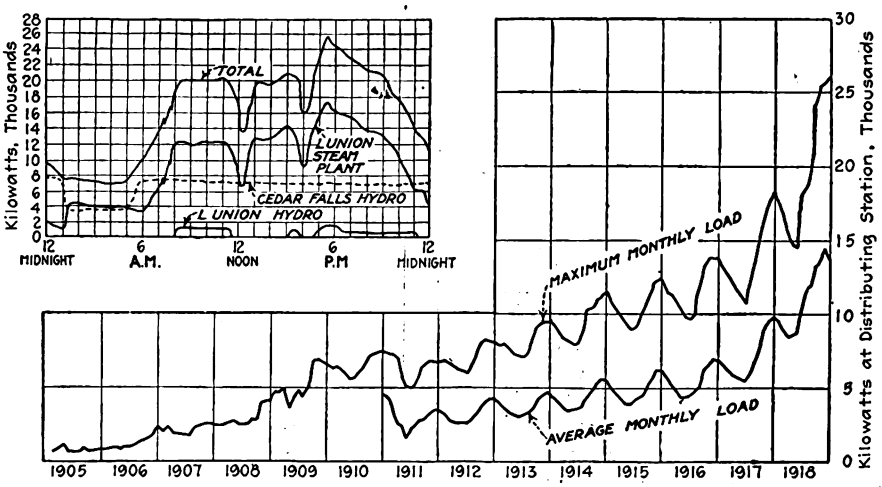

FIG. 11—MONTHLY MAXIMUM AND AVERAGE LOAD, SEATTLE MUNICIPAL LIGHT & POWER COMPANY
Insert—Load diagram for December (1918) peak

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steam plants on the bay of this amount of load and also saving over 150,000,000 barrels of fuel oil per year.

Portland Railway, Light & Power Company.—The system of this company took on about 10,000 kva. additional load due to war industries. The energy consumption for power purposes during the year 1918 showed an increase of 24.5 per cent over 1917, while that required for lighting showed an increase of 16.6 per cent, due largely to the increased population.

Extensive Use of Mill Refuse

In order to handle this business all generating stations were operated to the limit of their capacity. A steam plant which had been idle for some time was overhauled and the boilers were equipped with stokers

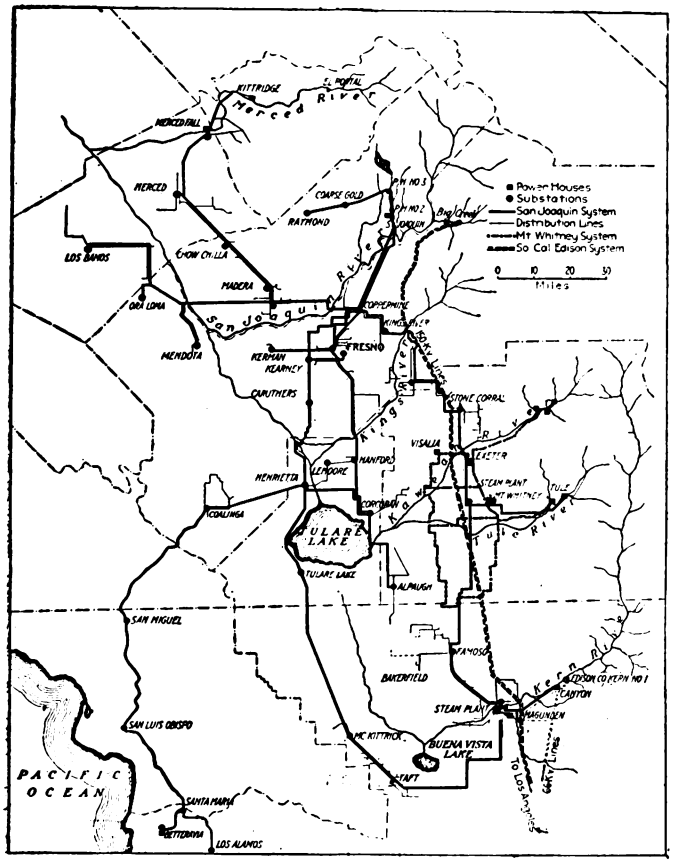

FIG. 12—SAN JOAQUIN, MOUNT WHITNEY AND PART OF SOUTHERN CALIFORNIA EDISON SYSTEMS

for burning coal. Owing to the difficulty of obtaining oil and on account of the water shortage in the early fall of 1918 it became desirable to store sawdust fuel to supply the demands for steam generation during the low-water period. This stored fuel proved to be a great help. For the operation of the steam plant high wages were offered for labor, but none could be obtained. Consequently the office men and officials put on their overalls and handled coal and ashes for at least two weeks during summer.

Operating expenses in the light and power department during 1918 showed an increase of 45 per cent over 1917, due largely to the following causes: (1) Steam generation during 1918 was 40 per cent greater than during the previous year; (2) an increase of approximately 40 per cent in wages of employees; (3) increase in cost of materials of all kinds; (4) high prices for all kinds of fuel. The only physical addition to the stations of this company came from the installation of two boilers of 440 boiler-hp. rating, which enabled the company to burn coal as a supplementary fuel to crude oil and mill refuse. One 11-kv. transmission line having a capacity of 1500 kva. was constructed from Portland to Vancouver, Wash., a distance of approximately 2 miles (3.2 km.), to help handle an increased load of 3500 kva. at that place.

Readjustment of industries has taken place as a result of the signing of the armistice, but so far there has been little more than the seasonal decline in load. Increase in the use of electrical energy from small consumers has made up for the drop in the war industries load due to the falling off of wooden-ship construction.

Puget Sound Traction, Light & Power Company.—Excessive increases in equipment in the power houses and system were made necessary by the heavy shipbuilding load added to the system load. To meet this demand the company purchased and installed a new 16,000-kw. waterwheel-driven generator in the White River plant and a 10,000-kw. steam-turbine-driven generator for the Georgetown plant. Oil-burning equipment under the boilers at Georgetown was replaced with chain grates in order that coal might be used instead of fuel oil, which had increased largely in price. An engineering feature of considerable interest is the equipment for burning powdered coal under the boilers at the Western Avenue plant. This is the largest powdered-coal installation in America at the present time, the total boiler-horsepower of the plant being 3500.

The company purchased 14,600 kva. of large industrial transformers to take care of shipyard, shipbuilding and coal-mining loads. The company also installed a 1000-kv. motor-generator set for the Edison system and a 1000-kw. motor-generator set for the railway system. Another important addition was made necessary for the supply of the new Chicago, Milwaukee & St. Paul Railway electrification, and there are now being installed three 4500-kva., 110,000-volt transformers at the Snoqualmie plant.

Load Factor Raised at Seattle

The load factor of the system has been greatly increased owing to the improvement of load in the morning hours and to an agreement with the shipyards to close these plants at different hours of the day, thus preventing excessive railway peaks.

Seattle Municipal Lighting Department.—A report from the lighting department of the city of Seattle says that the war-time load taken on this system for shipyards, foundries and steel furnaces amounted to about 10,000 kw., and to supply this load a new steam plant of 10,000-kw. capacity was completed in June, 1918, in addition to inside substations of 9000 kw. capacity and 450 kw. of outdoor substations. On April 1, 1919, the street-railway system was taken over by the city, necessitating a considerable extension of the hydroelectric plants. Preliminary work has been done on a new hydroelectric station on the Skagit River, two 20,000-kw. machines constituting the first installation. The final capacity of the plant is to be about 450,000 kw. Work on this plant is now in progress. It is said that fuel oil advanced from $0.80 to $1.90 per barrel. A summary of the unit costs, revenue and net gain of the lighting department are given herewith:

	1912	1913	1914	1915	1916	1917
Total cost	$0.02148	$0.01891	$0.0190547	$0.0198271	$0.0163314	$0.0155863
Total revenue	.02844	.02714	.0272226	.0249991	.0252829	.0222006
Loss or gain...	.00696	.00823	.0081679	.0051720	.0089515	.0066143

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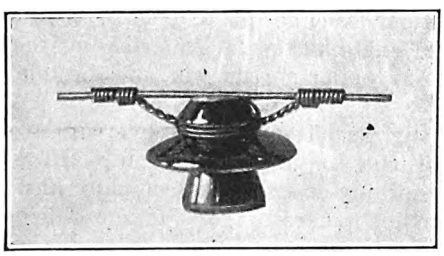
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

NEW INSULATOR TIE IS DEVELOPED BY UTILITY

St. Louis Company Overcomes Difficulty Experienced with Standard N. E. L. A. Ties on Two Makes of 13,000-Volt Insulators

The Union Electric Light & Power Company, St. Louis, has developed an insulator tie which it finds more satisfactory for use on Thomas No. 2020 and Ohio Brass No. 9408 insulators than any of the commonly used 13,000-volt insulator ties. It found by experience that the groove on these insulators would not keep the ordinary ties from slipping off or from permitting the line to pull the ties off the insulators. This led to the



NEW TIE KEEPS LINE WIRE FROM BEING PULLED OFF INSULATOR AND CAN BE SERVED WITHOUT CUTTING WIRE

development of the tie shown in the illustration, and in no case has the line wire become detached from the insulator when the line has been fastened by a tie of this character.

With the commonly used ties the linemen could not hold the wire in place on small angles, where the tendency is to pull away from the insulator sideways, and the same trouble was experienced where there was a slight dip in the line and the tendency was for the line wire to lift off the insulator. It will be noted in the photograph that these difficulties have been entirely eliminated, as the two loops around the tie groove of the insulator are in reality bands which are tightly fitted to the insulator and cannot slip up over the knob or top. When the standard ties, such as those referred to in Section 10, pages 7-14 to 17 inclusive, of the "Overhead Line Construction Handbook" of the National Electric Light Association, were used, the line wire was often injured by nicks or cuts in serving the tie. These mechanical defects in the wire sometimes caused the line wire to break at a later date. This difficulty has also been overcome by the St. Louis engineers in their new tie, as it is not necessary to touch the line wire with the connectors when serving up the tie shown.

The line wire in the illustration is No. 0 and the tie is No. 4 copper wire, which must be "dead" soft. The length of tie wire required under these conditions for the Thomas No. 2020 or the Ohio Brass No. 9408 insulators is 6 ft. 4 in. (1.93 m.), and the weight is 0.8 lb. (0.363 kg).

PRACTICAL AND TECHNICAL SKILL PROVE COMPLEMENTARY

Traveling Combustion Department Properly Constituted Saves Coal in Illinois Plants by Checking Items Which Cause So-Called Small Losses

For the last seven years the Illinois Traction System has had in its engineering department an organization which has as its duty the increasing of boiler-room economy. The personnel consists of one combustion engineer and two or three assistants. The combustion engineer in charge of the work is an elderly man who has been with the company some time and who has had an opportunity to become familiar with the majority of the boilers and engines that have been made in the last twenty years. He therefore knows the inside workings of most of them and consequently his practical knowledge in that direction is valuable. His assistants are technical men who have been out of college only a short time and who know the theory of combustion. The head of the department knows no theory except what he has picked up during the last few years.

The method of operating this department is to send the entire group from one plant to another. They spend from two days to two months at a plant, depending upon the conditions. What they do in general is first to make an examination of the boiler room by taking the temperature of the feed water and the drop in temperature between the feed-water heaters and the boiler. They investigate the cleanliness of the boiler tubes inside and outside, the deposits of soot, and the accumulations of dirt inside the setting. They check up the difference in the time through which the boilers are operated without cleaning and the results which have been obtained in these varying periods. They check little things like steam-pipe coverings, the covering of boiler-feed lines and pump cylinders and look for any other place where heat might be wasted. They also look for air leaks in the boiler settings, the stokers, the ashpit and similar places.

This organization has been very successful in increasing the coal economy at the various plants of the company.

POLES SET IN EIGHT MINUTES

Motorized Gin Wagon Can Be Used for Pole Raising and Other Purposes Without Dismantling Rig

A saving of labor in pole raising has been effected by the Minneapolis General Electric Company through the use of a gin pole and a motor truck with a power winch. The gin pole is let down and balanced on a log bolted to the back of the truck when it is being carried between holes. This allows the truck to be used for other purposes than pole raising without the labor of dismantling a cumbersome rig, as is the case with some other pole-raising outfits which have to be carried on a

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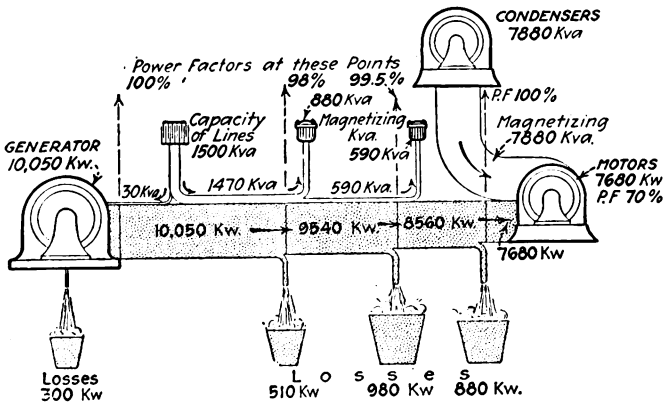
truck. With this gin pole a crew of eight men, including a foreman and truck driver, have raised poles in an average time of eight minutes per pole, which includes the time going to the next pole.

According to a statement made recently by D. F. Parrott, distribution department, Minneapolis General Electric Company, the time was taken on several different occasions and under different conditions without the knowledge of the crew so that no extra speed was put on to make this record.

LOSSES REDUCED ONE-HALF BY SYNCHRONOUS CONDENSERS

Functions of Synchronous Condensers for Power-Factor Correction Illustrated Without Aid of Vector Diagrams

The total I^2R losses of the generating and transmission system outlined below have been reduced from 5610 kw. to 2670 kw. by the installation of a 7880-kva. synchronous condenser. The generator supplies a motor load of 7680 kw. at 70 per cent power factor at the end of the transmission line, also two transformer connections at different points along the line. The capacity in



SYNCHRONOUS CONDENSER SUPPLIES MAGNETIZING KVA. OF MOTOR LOAD

Pipes of different diameters are used in the illustration to show proportion of generator output used for different purposes. Energy in kw. is shown in the shaded pipes and magnetizing kva. is shown in the white pipes. The I^2R losses of the system have been reduced from 5610 kw. to 2670 kw. by supplying the motor magnetizing kva. from the synchronous condenser, at the end of the transmission line, instead of from the generator.

the transmission line, which is 1500 kva., slightly more than neutralizes the 1470 magnetizing kva. required by the two transformers, and if considered alone would give the system a slightly leading power factor. However, in making such a calculation the motor load cannot be neglected.

The power factor of the whole system depends entirely upon the source from which the 7880 motor-magnetizing kva. is supplied. If this wattless component of the motor load should be all supplied from the generator, the power factor at the generating station would be about 85 per cent. This is generally considered a good power factor for industrial loads, but the I^2R losses on the system would total 5610 kw., or 42 per cent of all the power generated under the conditions described.

An alternative is to supply the motor-magnetizing current from a synchronous condenser near the motor load. A 7880-kva. synchronous condenser installed as suggested increased the power factor to unity at the generating station, reduced the I^2R losses of the system by 2940 kw. and minimized problems of voltage regulation.

The data for this article were contributed by the Electric Machinery Company, of Minneapolis, Minn.

INSPECTION AND REPAIR OF TRANSMISSION LINES

Regular Patrolling, Local Line Material Storage and Early Repair Practically Eliminate Interruption on System

Frank Howard, general superintendent of the Wheeling Electric Company, speaking before the transmission and distribution committee of the Ohio Electric Light Association on April 17, outlined the methods by which his company has practically eliminated interruptions on its 132-kv. and 66-kv. transmission systems. The operation of the system is in charge of a load dispatcher, and before sections are cut out for repairs or changes he is notified so that he can reroute service from some other source. In putting the section back in service the same procedure is followed. To anticipate in as great a measure as possible the necessity for sectionalizing for repairs or maintenance a careful and regular patrol is maintained over the entire system. Daily reports of the condition of the line covered by the patrolman are mailed to a division superintendent, who takes action at once to care for anything that might possibly interfere with service, records all work done and forwards the report to the general superintendent's office for filing. If in the judgment of the patrolman the trouble is urgent, he proceeds to get in touch with the division superintendent by telephone and immediate action follows. To assist in taking care of such emergencies, stocks of line material and necessary tools are maintained at accessible points along the transmission line. These may be at substations or at booths especially provided for such purposes, but in no case are these local stocks more than 10 miles apart. After repairs are completed intradepartmental orders are at once drawn to replace the stock or tools that are scheduled to be maintained at the emergency station. The division superintendent is held responsible for any shortage that may be found in the stations on inspection. None of the regular transmission line force is allowed to leave the station to which he belongs unless the division superintendent is notified in advance.

In a district covering 200 miles of transmission line no interruption to service has occurred from failure of supporting structure or insulators on standard construction for a period of three and one-half years, except in two cases when strings of insulators were shot at and broken.

SAFETY REQUIRES PROPER GROUNDING FACILITIES

Grounded Copper Network Throughout Power Plant Serves for the Protection Both of the Employees and Apparatus

One Eastern company has installed a regular grounded copper network throughout its power plant for the protection of its employees and apparatus. Flexible cable jumpers are used to connect the various circuits and pieces of apparatus to the grounded network, and provision is made to connect the jumpers at convenient points.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PROBLEM OF GETTING GOOD METER READERS

H. M. Edwards Says that a Bonus System for Good Performance Is a Necessary Adjunct to the Rate of Pay as an Incentive

Meter readers are indispensable to accurate, prompt and regular accounting for energy consumption. The problem of getting satisfactory meter readers became more acute during the war and it is still a serious one. Experience during the war has led many companies to give more careful study to the subject, and it will undoubtedly receive close attention because neglect is unsafe. Many consumers see only a single employee of the company, the meter reader, and it is important that the training and disposition of the one who bears the responsibility at this point of contact shall promote good feeling for the company. When officials in executive authority try by every means to cultivate good will toward the company, they cannot afford to let public opinion be antagonized by the employees of the department which is in regular touch with customers.

H. M. Edwards, auditor New York Edison Company, in discussing with a representative of the ELECTRICAL WORLD the difficulty experienced during the war in maintaining the meter indexing force of central-station companies on the pre-war basis, said that the work of indexing meters in the central-station industry is peculiar in that it does not of itself lay the basis for advancement. It is conceivable, he said, that a man may be a perfectly competent, trustworthy meter indexer and yet his work would not fit him for anything better; but the work is nevertheless of the utmost importance. In fact, the meter reader's record lies at the very foundation of a company's prosperity, Mr. Edwards declared. The great bulk of the customers of an electric light company meet but two employees of a company—the collector and the meter indexer—and the customer's conception of the company's service is largely made up according to the impression these two men make.

Owing to the places in which meters are set, added Mr. Edwards, the indexer probably gets further into the household than any one else, and therefore it is important that he should be honest, obliging and polite, and neat in his appearance. Purely from the standpoint of the company, he must be trustworthy, possessed of good eyesight and able to make accurate and legible figures. He should be at the least as good a type of man as is employed by the street-railway companies as conductor or on elevated or subway roads as guards. Some years ago this type of man could be procured at from $15 to $18 per week, but that is true no longer.

In the opinion of Mr. Edwards central-station companies should not allow this branch of service to fall below the pre-war type and should be willing to pay whatever amount is necessary to procure men of the proper standard. Furthermore, as the work is routine, tedious and of itself does not fit a man for higher occupations, Mr. Edwards expressed the belief that a bonus system for good performance is a necessary adjunct to the rate of pay. A bonus for this kind of work is an incentive and gives the employee something to look forward to and in that respect counteracts the lack of progressiveness inherent in the work.

"I also believe," said Mr. Edwards, "that meter indexers should be uniformed, as a uniform is a protection to the customer in admitting a stranger to his household; it insures a neat appearance, and a man so identified may be readily apprehended if he misbehaves himself in any way."

ADVICE ON ELECTRIC HEATING SOLICITATION

Central Stations Should Establish Close Relations with Electrical Manufacturers and Do Missionary Work Before Asking Specialists' Aid

In relating some of the experience of the Cleveland (Ohio) Electric Illuminating Company in obtaining an electric heating load, R. T. Kaighin told the commercial men of the Ohio Electric Light Association that electrical manufacturers had helped the sales department considerably in getting such business. He advised keeping in close touch with manufacturers of electrical heating equipment in order that they might help the central-station men not only in closing business but also in electrical matters. Mr. Kaighin also gave information as to where electric heating equipment for furnace work and for oven work can be sold and where it can be purchased. He said in part:

The field for the brass furnace is the brass foundry, the plumbing-goods factory, any of the copper alloys factories, and plants for melting scrap copper or scrap brass. This furnace may also be used for oxidizing or for reducing brass, copper or their alloys. There are three general types on the market. First is the induction type, where heat is generated by passing current through the metal to be melted. Second is the arc type, where the heat is produced by an arc and reflected from the sides and top down onto the metal to be melted. Third is the resistance type, where the heat is developed by the passage of current through a resistor and this heat is then reflected down by the sides and top of the furnace to the metal to be melted. The induction type is made by the Ajax Manufacturing Company of Philadelphia, Pa. The arc type of furnace is made by the Detroit Electric Furnace Company, Detroit, Mich., and the Booth-Hall Company, Chicago, Ill. The resistance type of furnace is made by the Electric Furnace Company, Alliance, Ohio, and the General Electric Company at Schenectady, N. Y.

The field of low-temperature electric heating is the factories for japanning, enameling, drying paint, baking cores, bread baking, etc. The electrically heated oven here must compete against steam and both direct and indirect gas heating. There is only one generally accepted type of electrical heater and that is the resistance type. This consists

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of nichrome wire ribbon-wound on porcelain to form the resistor element. This heater is built by the Westinghouse company and the General Electric Company. The box-type oven, the continuous type of oven, the semi-continuous type oven and the drum type are manufactured by the Young Brothers Company, Detroit, Mich., the Oven Equipment Company, Hartford, Conn., and the Industrial Heating Manufacturing Company, Cleveland, Ohio.

The subject of heat-treating and melting steel is a field which should be considered separately. The heat-treating of steel is of great importance to the toolmaker, the automobile manufacturer and the manufacturer of high-grade steel. A good example of the benefits of heat treatment is shown in the case of the National Malleable Castings Company. This company had a contract with the Navy Department to make anchor chain. It installed an electric furnace for melting steel and after casting links for the chain and properly heat-treating them in an electric furnace, its product under test was found to have a 25 per cent greater tensile strength than the old forged chains, and the new method permitted a greatly increased output of more uniformly satisfactory product.

Here is another case, where a heat-treating firm in Cleveland lost a good account by not having an electric heat-treating furnace. This firm makes a business of heat-treating steel for its customers. A firm in Erie, Pa., had a government contract for turnbuckles, etc., for airplanes. These parts had to be heat-treated very carefully, and several times they sent a ton or more of their product, accompanied by a representative of their firm, from Erie, Pa., to Cleveland, to have this product heat-treated and returned. After one lot had been spoiled by heat-treating with an oil furnace, the Erie firm decided to buy an electric furnace and heat-treat its own work. It soon installed a second furnace and now takes care of its own heat-treating work. By keeping abreast of the times and installing new and improved equipment the Cleveland firm would have retained a valuable account in Erie, Pa.

A partial list of the manufacturers of heat-treating furnaces includes the General Electric Company, Schenectady, N. Y., the Hoskins Company, Detroit, Mich., the Electric Furnace Company, Alliance, Ohio, and the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

The advantages of the electric furnace are: First, the temperature obtainable is limited only by the ability of the refractories to withstand it; second, the furnace can be operated in any kind of atmosphere; third, the heat generated is not due to the products of combustion; fourth, very accurate control of the temperature conditions in the furnace is possible.

In conclusion, I wish to emphasize the fact that we found in Cleveland that by getting acquainted with the manufacturers of electrical heating equipment, learning the different applications and calling on these prospective customers and educating them up to the point where they are ready to receive a proposition from the manufacturers, we were more successful in getting a power load on our lines. We found that the manufacturers do not have time to educate the trade in general and it is up to the central-station representatives to do the preliminary work in this connection.

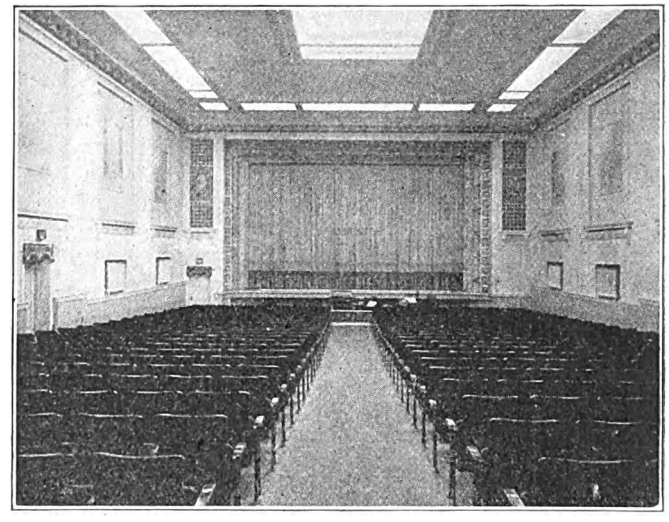
INTERIOR LIGHTING FOR MOTION-PICTURE THEATERS

Requirements Which It Must Fulfill, and an Illustration of the Method in Which the Requirements Are Filled

When lighting problems are considered auditoriums of photoplay theaters prevent a condition differing somewhat from that presented by the legitimate theater because sufficient light must be furnished to permit the audience of the photoplay theater to find its way about, yet the distribution of this light must be such as not to interfere with the picture on the screen. The intensities in different parts of the theater may be materially different since the surface most vitally important is the screen. It is usually quite practicable to raise the illumination in the rear or at the entrance if the motion-picture screen itself is properly submerged in darkness.

In this way a person entering is not at first subjected to so low an intensity of illumination as he is after passing down toward the front of the theater. The minute or two which elapses between the time of entering and the time of reaching an area of low illumination gives the eye a certain amount of time in which to accustom itself to the lower intensity.

A second requirement of this type of lighting is that the greatest amount of illumination should be thrown upon the horizontal plane, that is, the seats and aisles. It is considered poor practice to throw any amount of light on the side walls because of the effect of reflection toward the screen. Moreover, such light serves no useful purpose. The third point to be considered is the elimination of sources of light from the field of vision. In this category fall such items as bracket lamps along the side walls or lamps on either side of the screen, if



LIGHTING SCHEME UTILIZED IN A MOTION-PICTURE THEATER AT ESCANABA, MICH.

the units are low enough to catch the eye. Such lamps not only tend to disturb the eye but they also produce depression of vision and cause a diversion which distracts attention from the picture.

As an example of a method by which such lighting can be worked out, an illustration is shown of a lighting installation at the Delft Theater, Escanaba, Mich., the design of which was prepared by Vaughn & Meyer, Milwaukee. The lighting is effected solely by means of artificial windows in the ceiling. Above these windows are long boxes approximately 18 in. (45 cm.) in height, painted white inside. These boxes act as diffusers, throwing the light through the windows into the auditorium. The type of glass used gives very good diffusion and efficiency. The lamps are arranged on three separate circuits, allowing for the use of full intensity, a secondary intensity or a very low intensity for photoplay work. The lamps on the circuit which give the lowest intensity have been so graded in size as to furnish a very low value of illumination near the front of the theater and a higher value of illumination near the rear. This type of lighting directs the greater percentage of light to the seats and aisles, where it is needed.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Application of Diagram for Asynchronous Motors.—L. LAGRON.—In continuation of his remarks upon his asynchronous-motor diagram (*Revue Générale*, Dec. 7, 1918) the author makes some applications of it, holding that the simplicity and exactitude of his method permit the precise solution of most problems connected with asynchronous motors.—*Revue Générale de l'Electricité*, April 5, 1919.

Design of Current Transformers.—E. WIRZ.—According to a Swiss law of 1917, current transformers must be officially certified, and in order to be approved for certification must fulfill certain conditions regarding the loading capacity, ratio of transformation and phase displacement between the primary and secondary currents. A method of calculation, based on experimental results, is now given to aid in the laying out of a design. It is shown that the value of the external secondary impedance that gives the maximum value of secondary volt-amperes for a constant value of the primary current is a criterion of the limits of error of the transformer.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Bulletin* of Schweizer. Elektrot. Verein, January, 1919.)

Determining Friction Loss by Retardation Method.—F. HONSU.—A method is evolved mathematically by which the friction loss may be determined from the measured light-load losses either by a graphical solution of the light-load and coasting (retardation) curves or by calculation from two values of the stopping time. The method is very simple and eliminates determination of the retardation constant, though yielding very reliable results. The experimental determination of the retardation curve is effected easily and quickly, but for the new method it is unnecessary to draw the retardation curve itself. This method is shown to give good agreement with the graphical method; sometimes higher accuracy is obtained by basing the calculation upon values read from the retardation curve. A few experimental observations often provide all the information desired concerning the friction loss of a machine if this method is employed. The well-known sub-normal method is less convenient and gives lower accuracy.—*Science Abstracts, Section B*, February, 1919. (Abtracted from *Elektrot. Zeits.*, Oct. 31, 1918.)

Improvement of Power Factor.—A. SOULIER.—Dwelling on the importance of this question, the author alludes to a plant in the suburbs of Paris where the power factor at certain hours is only 20 per cent. In considering remedies he speaks first of installing overexcited synchronous motors. These are difficult to adapt, especially if it is desired that they shall be put into action without expense and that they shall replace asynchronous motors in driving certain machines, their performance without load being a luxury that does not appeal to industrial establishments. To introduce condensers is a simple solution, but a costly one because of the high value of the capacity which is necessary. The author advocates a plan applicable to all asynchronous motors in service which will render them synchronous when they have no load or even when they have a feeble one. This method is simply to introduce continuous current through the rings of the rotor of a motor. A trial was made with a 10-kw., three-phase, 50-cycle motor, connected star-delta, with rings and exterior rheostat. The motor being started in the usual way, continuous current was introduced into the rotor by means of a simple commutator mounted upon the starting rheostat, the current being produced in the first instance by a 4-volt, two-element storage battery. Simultaneously the amount of reactive current affecting the stator diminished, and, on increasing slightly the strength of the continuous current, the power factor attained unity. To avoid the use of storage batteries and render the installation automatic, a transformer equipped with a vibrator was then substituted, with the same result. A small direct-current generator of the sort used for lighting vehicles, impelled by the asynchronous motor, also brings the same result. The author concludes that it is thus possible to avoid a deplorably low power factor by bringing motors into synchronism automatically. He intends making a more systematic study of the plan before committing himself to figures, but in the meanwhile directs attention to his discovery.—*Revue Générale de l'Electricité*, April 5, 1919.

Generation, Transmission and Distribution

Electrical Constants for the Calculation of Aerial Lines.—R. NORSA.—Since all of the electrical constants necessary in the calculation of aërial conductors are not given in any manual, the author planned a work which should fill this want. Owing to pressure of war work he was unable to carry out his intentions, but he now puts forward tables and diagrams giving the resistance, skin effect, reactance, impedance, etc., for round wires and twisted and stranded conductors. The range of sectional areas considered is from 6 sq.mm. to 240 sq.mm., and the distances apart of the conductors ranged from 25 cm. to 300 cm. Frequencies of 42 and 50 cycles have been chosen as those usually employed industrially.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elettrotecnica*, Nov. 25, 1918.)

Fuel Economy in the Boiler House.—J. B. C. KERSHAW.—This is the third article of a series and includes a description of the German types of CO_2 recorders, which depend on measurements of the physical properties of flue gases. Other boiler-room instruments described are the thermoscope, Arndt's gas balance, the Krell recorder, the telezometer and the Haber-Loewe refractometer. Checking and recording instruments with Orsat apparatus are also taken up.—*Chemical and Metallurgical Engineering*, March 15, 1919.

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Electrical Equipment of a Modern Shipyard.—A. HENDERSON.—Power generation, electric cranes and portable electric tools and appliances are described and illustrated in this article.—London *Electrician,* April 11, 1919.

Installations, Systems and Appliances

Electric Light and Power Circuits on Board Ship.—O. H. KENNEDY.—The author deals in detail with some of the difficulties that are encountered, such as the running of cables through decks and bulkheads.—London *Electrician,* April 11, 1919.

Experiments with the High-Tension Magneto.—NORMAN CAMPBELL.—The object of the experiments was to investigate the applicability of the theory of the high-tension magneto which had been given by Prof. E. Taylor Jones. Experimental methods for tracing the wave form of the magneto are described, and it is shown that the observed values are very much less than those calculated. It is also shown that the main sources of damping are eddy-current and hysteresis losses which are not contemplated in the theory. It is pointed out exactly in what points theory and experiment agree.—*Philosophical Magazine,* March, 1919.

Electric Furnaces as Applied to Steel Making.—H. L. HESS.—The writer deals with a plant operating two 6-ton and four 7-ton Héroult furnaces, stating that this type of furnace was selected on account of the fact that there are more of these than any other type in operation in this country and that operators are consequently less difficult to get. He deals with both the cold-melt method of producing electrical steel and the duplex method, where molten steel partly refined in the open hearth is taken from the open hearth and charged in the electric furnace for finish refining. He states that the rapidly increasing demand for electrically refined steel is the best evidence of the success of this method of manufacture.—*Journal A. S. M. E.,* March, 1919.

Electrochemistry and Batteries

Preparation and Use of Rapid Nickel Baths.—E. P. LATER.—Good deposits have been obtained from a bath containing 32 oz. $NiSO_4$, 3 oz. $NiCl_2$ and 3 oz. boric acid per gallon when working under the following conditions: 49 amp./sq.ft. at 25 deg., 130 amp./sq.ft. at 25 deg., 295 amp./sq.ft. at 67 deg., 422 amp./sq.ft. at 71 deg., and 890 amp./sq.ft. at 92 deg. In the operation of hot baths the regulation of the acidity is of importance, as hot baths quickly become alkaline, with the resultant production of dull deposits. Furthermore, the conductors must be able to handle the current without heating.—*Chemical Abstracts,* March 10, 1919.

Units, Measurements and Instruments

Testing Conductors and Resistance Materials.—W. V. KRUKOWSKI.—The equipment described is intended for the works testing of conductors and resistance materials. The Thomson bridge as usually employed is considered to be unsuitable because the bridge ratio can generally be varied only in decimal ratio; also, the sliding contact can hardly be set more accurately than 1 to 1000 of the total wire length; heating of the slide wire causes thermoelectric currents, and the resistance of the jockey contact is a source of error. The principle of the Thomson bridge is retained, but the above disadvantages are, it is maintained, eliminated.—*Science Abstracts, Section B,* February, 1919. (Abstracted from *Helios, Nos.* 33 and 34, 1918.)

Resistivity and Temperature Coefficient of Aluminum.—G. GRASSI.—The determination of the resistivity of aluminum is being carried out in several countries, as the values adopted by them do not agree one with another. The author has already (*Abstract* 39, 1918) published the results of a series of experiments, and the present article forms a continuation. The methods adopted for the measurement, the probable degree of exactitude and the different corrections are carefully indicated. Four series of wires, the chemical constitutions of which were determined, were experimented with between 0 deg. and 100 deg. C. Their resistivity ranged according to their origin between 0.02620 and 0.03037 and their temperature coefficient between 0.004353 and 0.003760. In both cases the first figures refer to purest metal and the second ones to the less pure. Taking advantage of the peculiar fact that the value $R \times a$ is constant, the author sets forth to measure the resistivity of aluminum by measuring the temperature coefficient. This method eliminates the delicate measurements of the length and the diameter of the wire.—*Science Abstracts, Section B,* February, 1919. (Abstracted from *Elettrotecnica,* Jan. 5, 1919.)

Telegraphy, Telephony and Signals

Loading of Telegraph and Telephone Poles.—E. NATHER.—Discusses the effect produced on the loading of telegraph poles by wind, snow and ice. The article has special reference to the conditions in Austria.—*Science Abstracts, Section B,* February, 1919. (Abstracted from *Elektrot. u. Maschinenbau,* Nov. 3, 1918.)

Calculation of Interference from Power Lines.—A. SURBT.—The author finds the methods of Schrottke (*Abstract* 977, 1907) and Breisig (*Theoretische Telegraphie*) clear but unsuitable for practical calculation. He develops a method employing Maxwell's potential coefficients and arrives at formulas giving close approximations to the induced voltages and currents. The paper is mathematical in nature and is illustrated by worked examples.—*Science Abstracts, Section B,* February, 1919. (Abstracted from *Elektrot. u. Maschinenbau,* Aug. 18, 1918.)

Miscellaneous

Review of the Manganese Situation.—C. M. WELD.—Uses, specifications and price schedules are contained in this booklet.—*War Minerals Investigations of Department of the Interior* (Bureau of Mines, No. 7), December, 1918.

Absorption of Water by Vulcanized Fiber and Erinoid and Consequent Change of Resistance.—R. G. ALLEN.—In an earlier paper the author has compared the effects on erinoid and vulcanized fiber of immersing them in water; in the present paper he gives results obtained on exposing samples to moist air for varying periods of time. From these he concludes that with vulcanized fiber the value changed from 2.2×10^{11} to 109 megohms per centimeter cube after eighty-two hours' immersion in nearly saturated air, and that with erinoid the value changed from 9.9×10^{11} to 0.49×10^{11} megohms per centimeter cube after eighty-three hours. The relation between temperature and resistance is a simple one, whatever the quantity of water absorbed by the sample, which supports Evershed's theory that electricity is conducted through insulating materials by means of water films.—*Science Abstracts,* February, 1919. (Abstracted from Royal Dublin Society *Proceedings,* October, 1919.)

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Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in the other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ALTERNATING CURRENTS, SMALL, MEASUREMENT OF.

Small alternating currents were successfully measured by means of a Rayleigh acoustic resonator. The resonator consisted of a brass cylinder closed at one end by a telephone receiver and open at the other end through a small tube in which a Rayleigh disk was suspended by a quartz fiber. Alternating currents sent through the telephone receiver set up vibrations of the air in the cylinder that caused the disk to rotate, the amount of rotation being noted by the deflection of a beam of light reflected from the disk. A 110-volt, 60-cycle alternating current gave readable deflections for currents of the magnitude of 1×10^{-5} amp. Later experiments indicated a greater sensibility.—*F. R. Watson, University of Illinois, Urbana, Ill.*

ALUMINUM AND ITS LIGHT ALLOYS.

All available information and bibliography concerning the physical and mechanical properties of aluminum and its light alloys have been collected and summarized. Commercial alloys have been investigated and compared. The corrosion and disintegration of aluminum and its alloys have also been considered. This information will shortly appear as a special circular.—*Bureau of Standards, Washington, D. C.*

CABLES, BURIED, HEATING OF.

A number of tests are being conducted on bitumen-insulated cables laid in stoneware troughs, lined with bitumen, as used for the low-tension supply of the Liverpool Corporation. The tests have been continued for a period covering an entire year, records of earth temperatures have been obtained, and the cables tested at a number of different current densities. This work is being conducted in connection with the research committee of the Institution of Electrical Engineers.—*E. W. Marchant, University of Liverpool, England.* [There should be such a research committee in the A. I. E. E.—EDITOR.]

CIRCUIT BREAKER USING NON-INFLAMMABLE LIQUID.

This circuit breaker, for voltages up to 70,000 and for currents up to 150 amp., has been developed to obviate the shortcomings of oil circuit breakers, namely, their high cost, large space needed, the blowing out of the oil on heavy short-circuits and fire risk. The circuit breaker has been designed along the lines of the well-known carbon-tetrachloride fuse, except that the liquid used has a much higher boiling point because the circuit breaker cannot be hermetically sealed. The device consists of a vertical Bakelite tube, at the lower end of which is the stationary contact. The movable contact is at the end of a spring-actuated operating rod, and the current is conveyed by flexible copper connections. The tube is filled with a non-inflammable fire-extinguishing liquid, and a funnel-shaped arrangement on the movable contact forces a powerful stream of liquid upon the arc. A latch holds the breaker in the closed position and is released by pulling on a cord. An overload or reverse power relay may be attached to the switch to make it trip automatically.—*N. J. Conrad, Chicago.*

COLORIMETRY OF NEARLY WHITE SURFACES.

By means of multiple reflection between two surfaces of the color to be analyzed, a greatly enhanced departure from white in the normal color of the surface has been obtained. This enhanced color is compared with light from the same illuminant mixed in a known proportion with light of a pure spectral hue. Thus the dominant hue and percentage of white of the light reflected from the nearly white surface are determined.—*A. H. Pfund, Johns Hopkins University, Baltimore, Md.*

MAGNET STEELS.

An investigation has been undertaken of a number of alloys intended to be used in connection with the construction of permanent magnets. The alloys have been subjected to special heat treatment at the Hadfield works in Sheffield, and the magnetic testing is being carried on in this laboratory.—*E. W. Marchant, University of Liverpool, England.*

NEON SPECTRUM, MEASUREMENTS OF WAVE-LENGTHS.

The lines in the neon spectrum are very sharp, a quality which recommends this gas as a standard light source wherever the lines have sufficient strength. The ultra-violet group between 3369A* and 3520A may be used for standards, and there are a few good infra-red lines, but the strength and distribution of the lines in the region 5852A to 7438A make the neon spectrum particularly useful as a comparison in this region. The wave-lengths of fifty-five lines in the region 3369A to 8495A in the neon spectrum have been measured by means of the interferometer. One hundred and eighty-nine faint lines in the visible and infra-red neon spectrum (5343A to 8783A) have been measured by means of a concave grating.—*K. Burns, W. F. Meggers and P. W. Merrill, Bureau of Standards, Washington, D. C.*

[Neon is a gas which has some promise of practical use for illumination purposes in electric lamps of the vacuum-tube type. Lamps of this type are in an experimental stage and have been shown on one or two occasions.—EDITOR.]

TRANSFORMATIONS, ELECTRIC, POSSIBLE WITH STATIONARY APPARATUS.

A mathematical investigation has been made of inherent limitations of current and voltage transformations possible by means of a network constituted of self and mutual inductors, resistors and condensers. Expressions have been derived for electrostatic and electromagnetic energies, Joulean heat dissipation and power, in complex quantities. The purely imaginary part of the expression for power in a static network is shown to be equal to 2φ times the difference between the mean electromagnetic energy and mean electrostatic energy, where $\varphi = 2\pi f$. Use is made of this new principle in considering the problems of power-factor correction and phase splitting. In general, for phase transformation by static apparatus both magnetic and electrostatic storage of energy are necessary, and it has been shown how the minimum amounts of each are determined by the load. The symmetry of the coefficients in the general equations for the steady state in a static network is demonstrated, and it is shown that limitations upon voltage and current transformations follow. The voltage regulation of any phase-splitting arrangement has also been considered.—*J. Slepian, Pittsburgh, Pa.*

*A stands for the Angstrom unit of length = 10^{-8} cm.

Suggestions for Research

CIRCUIT-BREAKERS, RECORDERS OF ABNORMAL CONDITIONS FOR.

(a) An automatic inexpensive instrument is needed which might be attached to the circuits of larger power systems and which would record the amperes, the volts and the power factor of abnormal current rushes. The results would be of inestimable value in the study and determination of ratings of oil circuit breakers. (b) An automatic instrument for recording the stresses produced in the arcs, oil bath and air chambers of oil circuit breakers when clearing circuits of abnormal current rushes. Such an instrument must be very sensitive and respond with a degree of quickness comparable with that of an oscillograph.—*Capt. Chester Lichtenberg, Washington, D. C.*

COMMUTATOR MOTORS, ALTERNATING-CURRENT.

Besides the usual methods of speed control of single-phase and polyphase commutator motors, speed regulation may be brought about by varying the permeance of the magnetic circuit. One way of accomplishing this result is by superimposing direct-current excitation upon the field circuit of the machine (see Osnos, *Elektrot. Zeits.*, 1918, p. 205.) Other methods may be possible, and a general study of this problem is timely in connection with the expected rivival of electrification of steam railroads.

FUSES, HIGH-TENSION.

A fuse adapted for 33,000-volt to 110,000-volt circuits and which will protect potential transformers is needed.—*Capt. Chester Lichtenberg, Washington, D. C.*

INSULATORS, STUDY OF STRESSES.

One method that has been used for mapping out three-dimensional electrostatic fields within insulators consists in using paraffin with lycopodium powder. The desired stress is applied while paraffin is in the molten state, and the particles of lycopodium arrange themselves along lines of force. Then the paraffin is allowed to solidify and the field is studied by making a cross-section along any desired surface. This or a similar method would necessitate making a paraffin model of an insulator and applying an electric stress to it while it is in the molten state, but this difficulty may not be insurmountable.

POLYPHASE SYSTEMS, SIGNS OF VECTORS.

Some confusion exists as to the signs of voltages and currents in polyphase systems, and these signs seem to be fixed arbitrarily in each problem, so that the student gets no definite rule for a new case. For example, in a delta-connected system the line voltages are usually considered positive in the order *AB*, *BC*, *CA*, forming a traingle. But if one transformer, say *BC*, be missing, the voltages in the resulting V-connected system are marked *AB* and *AC*, changing the angle from 120 deg. to 60 deg. Similarly, currents are marked on diagrams of conections with arrowheads to indicate the *positive* directions, and this is confusing because similar arrowheads are used in direct-current networks to indicate the *actual* directions of currents. What is needed is a definite notation and agreement for signs of vectors and also some suitable symbol to indicate alternating currents in conductors. This symbol must be such that the first Kirchoff's law could be written with the proper signs of individual vectors, and at the same time it should not indicate the actual directions of currents at some one instant.

POWER-FACTOR METER, INDICATING MINIMUM VALUE.

In many power supply contracts a clause is inserted penalizing the customer for a lower power factor. A power-factor meter is therefore needed in which the indicating hand can be originally set at unity or 100 per cent so that as the power factor of the load drops below unity the indicating hand will drop also. This hand should not rise again by itself even though the power factor became higher again, but an arrangement should be provided for resetting it at each monthly reading of the meter.—*C. F. Mathes, Trinidad, Col.*

TELEPHONE LINES, INDUCTIVE INTERFERENCE.

The possibility of danger to telephone employees and subscribers when service is established or interrupted on power lines paralleling the telephone lines may be worthy of investigation. A solution must be found which will enable a satisfactory operation of both power and telephone circuits in the same territory under all conditions of operation, without disastrous interference.

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Readers' Views and Comments

What Is Meant by Combined Efficiency?

To the Editor of ELECTRICAL WORLD:

SIR: Usually when the term efficiency is used in connection with a steam generating unit the combined efficiency of boiler, furnace and grate is meant. This is the ratio of the total heat in the fuel as fired to the heat converted into steam. Another efficiency is the boiler efficiency, which is the ratio of the heat actually supplied to the boiler to the heat which is converted into steam. Still another efficiency is the furnace and grate efficiency, and another the highest theoretical efficiency for the unit under consideration.

Granting, however, that we are trying to express combined efficiency of the boiler, furnace and grate, we are still far from accurate in our expression when we use the unmodified term "efficiency." Some stokers require auxiliaries such as steam jets, fans, clinker dumps and high-powered engines for driving the stokers, the total steam consumption of which runs up to a figure equal sometimes to from 3 to 10 per cent of the total steam generated. Other stokers may have auxiliaries which require only a very small fraction of 1 per cent of the total steam generated. On test calculations and reports the steam required for operating the auxiliaries is not deducted in any way from the calculated efficiency of the boiler, stoker and furnace, whereas in actual practice the steam cost or the cost per kilowatt-hour is appreciably affected by these auxiliaries.

There is no advantage in gaining 2 or 3 per cent efficiency if the equipment required to produce this result requires 4 or 5 per cent of the total steam generated. Engineers are therefore beginning to employ the terms of *gross* combined boiler and stoker efficiency and *net* boiler and stoker efficiency, or, as commonly expressed, gross and net efficiency. In some instances it is possible to determine what deduction should be made from the gross efficiency in order to arrive at net efficiency. For instance, the steam or electrical power required to operate the stoker can be determined with a fair degree of accuracy. The steam required to operate power dumps can readily be calculated. However, the steam required to prevent side-wall and bridge-wall clinkers is a variable item, depending on fuel and rate of firing. If ½-in. (1.27-cm.) steam lines are used to supply the jets along the side wall, the amount of steam used might easily be 10 per cent of the total steam generated. The question then arises as to whether it is in use continuously or only for a portion of the time. Similarly, in powdered fuel installations deductions must be made for the coal used to dry the fuel before pulverizing and the power for pulverizing.

After these deductions are made and a fairly accurate and reliable figure of net efficiency is obtained, there will be less disappointment in operating costs than exists at present with estimates based on gross efficiencies, as indicated by test reports. Engineers are therefore recommended to analyze all results and to reduce efficiencies to a basis of net, rather than gross.

T. A. MARSH,
Chief Engineer Green Engineering Company, East Chicago, Ind.

The Super-Power Transmission Plan

To the Editor of ELECTRICAL WORLD:

SIR: Owing to a rather extensive out-of-town schedule, I missed reading the very interesting editorial in your issue of March 29 having reference to the super-power transmission plan discussed at the recent meeting of the American Institute of Electrical Engineers, Boston, March 14. This editorial was brought to my attention, and at this rather late date may I offer the following comment?

Naturally I was very much pleased with your substantial general backing of the proposed plan. As brought out in my discussion published in the same issue, the adoption of the super-power transmission plan will be but the result of a logical sequence of power development, and nothing can stop it unless the people of the Northeast Atlantic seaboard are consciously willing to handicap their commercial efficiency by assimilating with their industrialism the enormous fuel, material and labor losses incident to the present method of power generation and application.

Power, in the matter both of facility and cost of production, in all forms of its application to industrialism, is of such prime economic importance that to ignore the opportunities offered in the plan suggested is to concede to our competitors in the world's markets the most important means by which we will win and maintain our supremacy in all the trades while maintaining the American standard of wages and living. The plan does not aim to reduce the application of labor, but rather to increase it, and with this increase to lift the efficiency of its application. In a word, more labor, but more production per unit of labor.

Your editorial touches upon two exceedingly pertinent inquiries—(1) that of the frequency of the proposed super-power transmission and (2) the government relationship.

As regards the first, let me entirely agree with you. I might have as well used the word "say" in mentioning 25 cycles as I did in speaking of 220,000 volts as a proposed potential of transmission. At the time of preparing the discussion the thought that was passing through my mind was in connection with the common application of 25 cycles to traction systems employing direct or alternating current as motive power, as, for example, in the case of the New York Central or the New Haven and the Pennsylvania. In the two latter cases, should the super-power transmission employ 25 cycles, this frequency, through static transformers, would be directly applicable to their propulsion rails and equally applicable for conversion to direct current. But, as you have pointed out, the prime consideration in deciding frequency will be the weighted average of frequency now in force, bearing in mind, of course, the economic value of the use of 25 cycles as against 60, even should 60 cycles preponderate, which at present, as we all know, for industrial power and lighting it does. The point raised is indeed most important, and the proposed investigation would be incomplete did it lack definite and conclusive recommendations upon it.

As regards the government relation to the plan, in submitting the proposed super-power transmission to Secretary Lane I gained not the slightest impression from him that the government was interested beyond the desire to determine the economies to be secured by the adoption of such a comprehensive system of power generation and transmission.

The Department of the Interior is the natural headquarters to which the citizenship of this country should look in the matter of the conservation of our natural resources. It is equipped as is no other interest or combination of interests to make such an investigation, and after the investigation and report have been duly made, should it be found that the territory involved, owing to the improper form of power application, is suffering an annual loss of $150,000,000 a year by the unnecessary use of coal and as much more on account of the high cost of maintenance of the present steam industrial and railroad power machinery, keeping in mind also that our rails are unduly congested with coal and with a multiplicity of trains due to the limit in traction having now been reached in steam locomotive practice, such an awakening, I believe, will, while offering the backing of government finance, if necessary, elicit immediate interest on the part of private money.

Let the waste once be shown, and it is a direct notice to the people of this territory to correct it or pay the price.

There are about three hundred working days in the year, and so we are robbing our incomes of approximately $1,000,000 a day. The government is in the best position to confirm or correct that figure, and the people can then say whether they want the private interests or the government to own or control the means by which the above-mentioned savings can be effected.

W. S. MURRAY,
New York. Consulting Engineer.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

INDUSTRIAL HEATING IS DISCUSSED IN OHIO

Power and Heating Section of Ohio Electric Light Association Has Meeting Characterized as Most Educational of the Year

The meeting of the power and heating section of the new-business coöperations committee of the Ohio Electric Light Association at Columbus on April 23 was characterized as the most instructive session of that body during the year 1918-1919. Papers on electric heating and electric welding were presented. R. T. Kaighin of the Cleveland Electric Illuminating Company had prepared a paper on the recent developments in industrial heating which related some of the experience of the Cleveland company and discussed commercial possibilities of electric heating and some of the problems that must be solved to get the load.

A discussion on brass furnaces was opened by A. E. Rhodes of the Detroit Electric Furnace Company. Mr. Rhodes went into the details of the operation of his furnace, which is a rocking type, the principle being that of the indirect arc. The rocking is to agitate the metal in order that the heat may be uniform, and at the same time all openings are sealed, thus making the furnace air-tight. The cycle of rocking motion is one in thirty-three seconds. The furnace requires about 210 kw.-hr. per ton of metal, and the average time per heat is one hour. The furnace sizes being built by this company are 500 lb., 1000 lb. and 2000 lb., respectively requiring 75 kw., 150 kw. and 300 kw. Working on the red brass, this furnace will require from 265 kw.-hr. to 275 kw.-hr. per ton. The power factor is from 85 per cent to 90 per cent. It is made for single-phase operation only and requires 4-in. electrodes. It is designed with an average reactance of 18 per cent.

Low-temperature heating was discussed by Mr. Reed of the Young Brothers Company, Detroit. He went into the japanning and core-baking proposition in detail, giving statistics relative to ovens, etc.

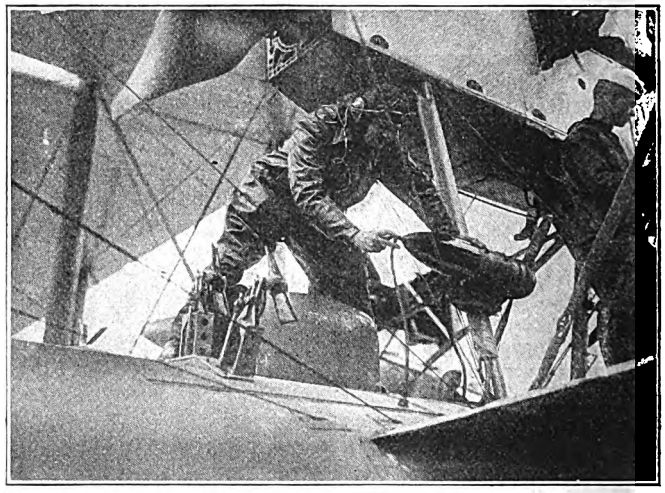
Future for Heat-Treating Ovens

Heat treating was discussed by Charles Foster of the Electric Furnace Company, Alliance, Ohio, who showed moving-picture views of heat-treating ovens now in operation. This subject was ably presented and disclosed the enormous future that can be expected for the electric heat-treating ovens. The principal point of interest was the uniformity of the product which a manufacturer can obtain and the consequent cutting down of rejections.

F. Von Schlegell of the Industrial Electric Furnace Company, Chicago, discussed the problems of demands, rates, etc., that have come into being since the signing of the armistice. It is a recognized fact that most of the steel companies using electricity were during the first month after the signing of the armistice burdened with very high bills for energy, due to the fact that they stopped night operation, bringing their rate per kilowatt-hour almost to a cost where use of electricity would be prohibitive in melting steel. It was clearly brought out that the central stations would not reduce rates to meet this business and that the cycle of steel furnace operation would have to be changed. This has been done by some companies. However, this is a matter which it is thought will have to receive very serious consideration from the standpoint of central-station companies and steel manufacturers.

At the afternoon session C. I. Crippen of Youngstown and C. H. Speer of the Lincoln Electric Company, Cleveland, presented papers on electric welding. There was very little discussion on either paper.

Seaplane on the Atlantic Flight



Lieut.-Commander Byrd is here examining the radio-dynamo and the small propellers which pump the gasoline into the engine of the United States Navy seaplane NC 3, which started on its projected transatlantic flight on May 8. The force of the wind drives the small propellers.

In the official description of the seaplanes these facts were given:

Complete wireless installation, including telegraph and telephone and wireless direction indicator, is provided. System should give a radius of about 300 miles (480 km.) while in the air and of 100 to 150 miles while on the water.

Electric energy is furnished by an electric generator operated by a wind-driven propeller. Energy is delivered to storage batteries. In addition to operating wireless set the storage batteries operate a complete lighting system for interior of the boat and for wing-tip and tail lights as well as lights for night landing.

The wireless operator and engineer are stationed in the main after-compartment just aft of the gasoline tanks. Each is provided with a complete instrument board. Each of these operators has a cylindrical upholstered stool with back rest weighing 5 lb. (2.2 kg.) complete, in the interior of which can be stored the small hand tools required for emergency work.

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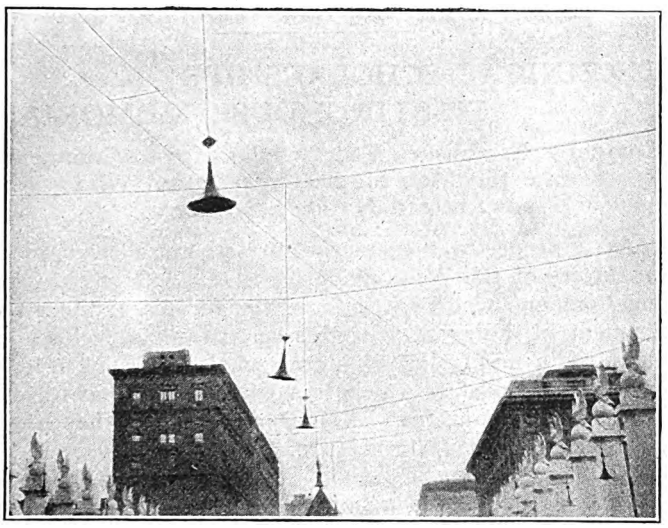
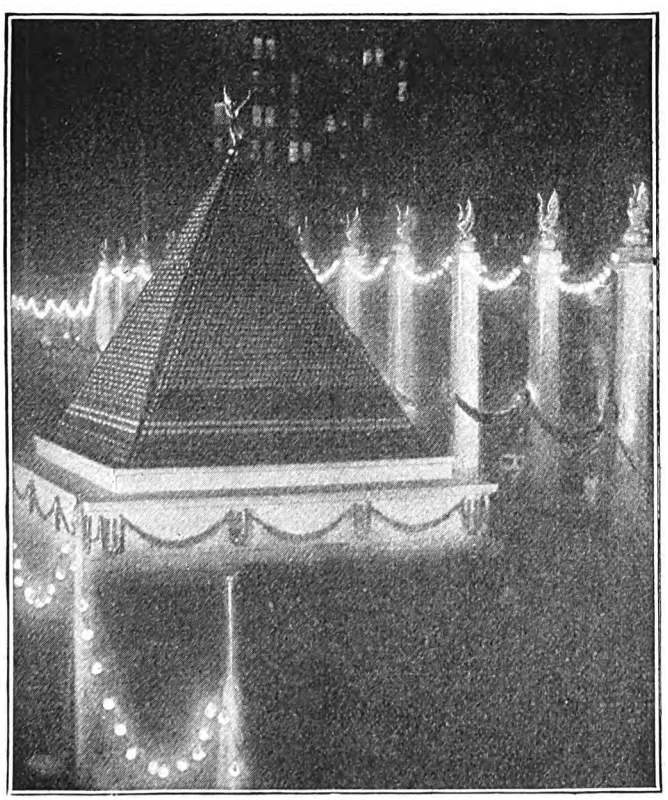
LOUD-SPEAKING TELEPHONE FOR VICTORY LOAN CAMPAIGN

Wireless and Long-Distance Telephone Messages and Speeches Relayed to 112 Receivers Covering an Area of About 60,000 Sq. Ft.

In order to keep the large crowds interested during speeches at Victory Way on Park Avenue between Forty-fifth and Fiftieth Streets, New York, an arrangement was made to enable a speaker to be heard for three blocks. This was done by means of three transmitters at the speakers' stand which picked up the sound waves, converted them to electrical ones and transmitted them to the telephone control room. Here they were amplified 7,500,000,000 times and then sent to 112 loud-speaking receivers. An area of about 60,000 sq.ft. (5500 sq.m.) was covered by these receivers, which were also utilized for allowing the crowd to hear speeches made over the telephone at some distant point by prominent men. In this instance a long-distance wire had been cut in from Washington, D. C. Over the speakers' stand was a special transmitter which allowed the man talking in Washington to hear the applause in New York. A wireless antenna was also installed near by, and wireless messages were received from airships and land stations and transmitted to the loud-speaking receivers.



THERE WERE TWELVE OF THESES RECEIVERS REPEATING THE MESSAGES TO THOUSANDS OF PEOPLE



STRINGS OF LIGHTS MAKE VICTORY WAY EFFECTIVE BY NIGHT—PYRAMID OF GERMAN HELMETS IN FOREGROUND

The expense of this project was borne by Theodore N. Vail of the American Telephone & Telegraph Company, and the instruments were installed by engineers of that company and the Western Electric Company. H. B. Wier was the chief electrical engineer for the installation. Mr. Wier recently developed an armature telephone receiver and transmitter which made the plan possible.

A problem in the elimination of inductive interference had to be solved. Subway trains run directly beneath the control room and cause inductive waves and vibration. These difficulties were overcome, however, by magnetically shielding the room with a metal covering on all sides, top and bottom, by grounding all conduit and metal wire covering and by supporting the amplifiers with rubber cords.

PACIFIC COAST PLAN FOR N. E. L. A. REORGANIZATION

Full Statement of the Ideas Expressed by Executive Committee of the Pacific Coast Section and Indorsed by the Section in Convention

In last week's issue of the ELECTRICAL WORLD mention was made of the plan of reorganization of the National Electric Light Association recommended by the Pacific Coast Section. This plan as adopted by the executive committee of the Pacific Coast Section and indorsed by that section at its convention at Coronado, Cal., is in full as follows:

At a meeting at Hotel del Coronado April 30, 1919, the executive committee of the Pacific Coast Section, N. E. L. A., went on record as in favor of decentralization of the activities of the National Electric Light Association.

It believes that each geographical section should be on an independent financial basis, maintaining its own organization so that its members may pay their dues into the geographic section and that payment of membership in the national association may be remitted from the geographic section.

It was suggested that some time in the future all representatives of the geographic sections meet and determine the amount to be allotted toward maintaining a national association. It was further suggested that the personnel and expense of the national office be kept to a minimum.

It believes that all direct communications to members should be delivered solely through the geographic section, and that no bulletins, handbooks or national convention proceedings should be furnished members of the geographic section, it being the thought that all matters of interest to the members will be supplied through the geographic section office.

It was also decided that the best policy would dictate the elimination of national conventions and that in lieu thereof geographic sections should hold annual meetings and send delegates to a general executive committee, these delegates consisting of the president of the geographic section and two delegates at large from each section.

This recommendation was adopted by the executive committee with the request that it be transmitted to the National Electric Light Association by R. J. McClelland.

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UTILITY COMPETITION TO END AT LANSING, MICH.

Property of Michigan Power Company, Valued at $1,124,805, Is to Be Taken Over and Operated by the City of Lansing

Judge Arther J. Tuttle, judge of the federal Eastern District court, has fixed the value of the Michigan Power Company, Lansing, Mich., at $1,124,805, after a long period of competition between the city of Lansing and the Michigan Power Company and after litigation leading up to the purchase of the privately owned company by the municipality.

The fixing of the valuation by the court is the result of a gentlemen's agreement between a special committee representing the city in the proposed purchase of the Michigan Power Company and David R. Thomas, receiver for the Michigan Power Company, and Mr. York, chairman of the bondholders' committee of the Michigan Power Company. Under the terms of this agreement it was understood that the plant should be appraised by experts to be picked by the court from lists submitted by the special committee and the bondholders. Appraisement was to be made on the basis of the fair, honest value to the owner, in the opinion of the appraiser, of the entire properties of the Michigan Power Company. The city reserved the right to exclude undeveloped water rights from the purchase. The appraisal was to be subject to review and approval by the court.

Another provision of the "gentlemen's agreement" was that the expense of all new equipment added to the property and installed by the receiver under direction of the court was to be added to the amount of the appraisal, including the cost of the appraisement. The present mortgage on the property, it was understood by the parties, was to be foreclosed and a new company formed to take over the property. It included the placing of new bond issues secured by mortgages on the property, based upon its appraisal value as finally determined by the court, with the cost of new equipment and of the appraisement added.

PLAN OF TWO BOND ISSUES

The parties to the agreement further agreed that there should be two bond issues, the first to be called "A" bonds, to cover cost and expense of new equipment and appraisement, to mature in five years, one-fifth each year, and to bear interest at such rate as money may be procured. The second issue, or "B" bonds, was to cover the amount of the appraisal bearing interest at 5 per cent and to mature not later than 1935, with the privilege on the part of the city of retiring all or a part of the bonds at interest due date at $101. The mortgage was to contain a provision for a sinking fund each year after the first five years on "B" bonds sufficient to retire them.

It was further understood that the holding company when organized and after taking over the property should turn the plant over to the city of Lansing or its authorized agent for the nominal sum of $1, subject to mortgages securing the bond issue.

The figure that was fixed by the court is less than the valuation made by the appraiser for David R. Thomas, receiver for the company, but is more than the amount which the city proposed to pay. The original appraisal made by Esselstyne, Murphy & Hanford, Detroit, was attacked by the city on the ground that it was made on the basis that the company was a growing concern when as a matter of fact the concern was in the hands of the receiver.

The city also claimed that the so-called "receiver's appraisal" was excessive on real estate valuations. This appraisal amounted to $1,253,076; the court reduced this to 75 per cent of that value, or $939,805. To this amount was added $185,000, as the price of a new turbine which has been added.

TECHNICAL SCHOLARSHIPS WESTINGHOUSE MEMORIAL

Company Establishes Four Scholarships to Commemorate the Men of the Organization Who Entered Nation's Service

As a proper war memorial to the more than 8000 employees of the Westinghouse Electric & Manufacturing Company who have entered the service of the government in the great war, this company has decided to establish a number of technical scholarships. The details of the plan by which this will be done have been given out by President E. M. Herr so far as they have been determined up to this time.

Four war memorial scholarships will be established each year under the general conditions stated in the following paragraphs:

(a) Candidates will be limited to sons of employees of the Westinghouse Electric & Manufacturing Company and its subsidiaries who shall have been employees in good standing for a period of five years.

(b) Two of such annual scholarships may be open to the younger employees of the company or its subsidiaries who have been in their service for a period of at least two years and who do not exceed the age of twenty-three.

(c) The selection is to be determined by competitive examination to be conducted annually by the company's educational department under the direction of the committee hereinafter provided. The examination is to take into account not only the applicant's academic training and preparedness but due consideration will be given to personal qualifications, general character and aptitude.

(d) Scholarships will entitle the successful candidate to pursue a four years' course in any technical school or college that he may select with the approval of the committee. The scholar may pursue a course in any branch of engineering that he may select.

(e) Scholarships will be granted for one year only but will be continued for the full four years provided that the scholar maintains the academic and other standards required by the college or institution in which he elects to pursue his course of study.

(f) Each scholarship carries with it an annual payment of $500 to be made in two installments, and the number of new scholarships will be four each year.

(g) The company will establish a memorial scholarship committee consisting of three vice-presidents of the company, to whom shall be referred the names and records of the candidates and who will select therefrom the four successful persons who, in its judgment, have most satisfactorily met the tests applied. The said committee will also be charged with the duty of establishing the detailed rules and regulations and such other matters of administration as have to do with this particular matter.

It is the intention of the company to continue these memorial scholarships from year to year, but the company reserves the right to recognize changing conditions and to modify the plan or discontinue it entirely if, in its judgment, it seems wise and expedient to follow this course.

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Work of Society for Electrical Development

Notwithstanding Serious Handicap of War, the Organization Has Accomplished Results in Spreading the Message of the Industry's Service to the Public—Report of James M. Wakeman, General Manager

NOTWITHSTANDING the handicap of war, the Society for Electrical Development reported to its members at the annual meeting on Tuesday of this week that much active work had been done for the industry. The meeting was held at the society offices in the Engineering Societies Building, New York. Its main feature was a review of the work accomplished during the trying conditions of war and a general presentation of the larger activities that expansion of the society will permit.

J. Robert Crouse, vice-president of the society, opened the meeting and presided.

DIRECTORS ELECTED

Members of the board of directors were elected as follows: Representing manufacturers, W. D. Steele, Benjamin Electric Manufacturing Company, four years; representing jobbers, E. C. Graham, four years; representing contractors, James R. Strong, four years, Fred B. Adam, two years; director at large, Charles W. Price, two years.

James M. Wakeman, general manager, then made his annual report, covering the activities of the society during the past year. The society went on doing its work, though with staff and expenses reduced, to the utmost of its ability with the funds at its disposal.

This work has been done largely through the daily newspapers, popular magazines and the trade press, the last mentioned being chiefly used to extend the application of the electric motor. Special electrical sections have been started in some papers, one of them a large export paper, the articles being prepared and supplied by the society, as were also the five pages of statistics published in the New York *World* Almanac under the heading of "Electrical Progress."

As an indication of the character of this work, Mr. Wakeman called attention to the fact that such a prominent daily metropolitan newspaper as the New York *Evening Post* has published special articles by Theodore Dwight, and so important a popular magazine as the *Ladies' Home Journal* has given a full page in one issue to contributions by Miss Grace T. Hadley, both members of the society's staff.

In addition to that method of educating the public, the society has published booklets, such as "Industrial Heating," "The Electric Range Handbook," "More than 3000 Uses for Electricity," "Useful Electrical Information for Architects, Contractors and Engineers," all of which serve a useful purpose in spreading desirable propaganda for the electrical industry.

In recalling the service rendered by the society in preparing and conducting national campaigns, Mr. Wakeman said that these, while not on so colossal a scale as "America's Electrical Week" or "Electrical Prosperity Week," served the purpose of stimulating public interest in electric service. The "Save by wire," the "Brighten up for the boys coming home" campaigns, and the one just closing, known as the "Electrify your home" campaign, have caught the industry just at the psychological time and given it the impetus it needed to keep going.

"We are indebted to the trade journals for their splendid coöperation in keeping these campaigns before their readers," Mr. Wakeman said, speaking further as follows:

> The special poster used in the "Save by wire" campaign and the three-piece window trim used in connection with "Electrify your home" were displayed in every town and city in the country, thus linking them up in a great national business-getting, attention-compelling electrical movement, which benefited everybody in the industry, either directly or indirectly. The effects of the "Electrify your home" campaign are now being felt, and will be felt for a long time to come, in every community where the local interests were sufficiently progressive to participate.
>
> It is unnecessary to relate to you the tremendous success and great value of these campaigns, or to burden you with a recital of the enormous numbers of pieces prepared, printed and distributed during the campaigns.
>
> You are familiar with the wonderful publicity obtained for the electrical industry, and every one acknowledges that no other industry ever succeeded in putting on such campaigns as those conducted by the society.

The report of the general manager then outlined the steady educational work carried on within the industry itself. The monthly sales service renders a particularly valuable assistance to the retail end of the business. Letters of appreciation were received from all over the country in regard to booklets such as "How to Sell an Idea," "Buying a Cause and Paying for Effect," "How to Make Your Show Window Pay Your Rent," "Wiring Your Share of 15,000,000 Homes," "One Hundred and One Successful Selling Suggestions," "Selling Better Fixtures to More People," "Housewiring Publicity Helps," "Why You Should Patronize a Responsible Contractor," "More Customers, More Sales, More Profits," et al. These booklets were prepared, issued and distributed in large quantities by the society.

A small item which proved very popular and of great convenience was the production of the so-called "dollar package" for contractors. It contains sixty uniform proposal blanks, thirty estimate sheets and ten sheets of typical floor plans.

CENTRAL-STATION PROBLEMS

Continuing, Mr. Wakeman said that special attention has been given to central-station problems. Such booklets as "Where Increased Rates Have Been Granted," "Customers Versus Population," "Customer Ownership of Public Utility Securities" and others, entailing a great deal of work in compiling the necessary data, were sent to central-station members, who found them extremely valuable and almost invariably asked for more copies for the use of their various officials or department heads.

Some of these books were useful to manufacturers and have been supplied to manufacturer members.

"The most important book published this year," declared Mr. Wakeman, "is the 'Electric Range Book,' which contains 216 pages of the most up-to-date infor-

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mation obtainable upon this subject, together with diagrams and charts. It is bound in flexible leather and is in the hands of practically every concern selling electric ranges. Although only recently issued, the second edition will be readily disposed of to manufacturers, central stations and dealers. It sells for $1.50, which covers the cost of production and distribution. It has been universally pronounced the best electric range sales help ever published. Incidentally it may be mentioned that Mr. Dwight of the society's staff has been specially invited to attend the National Electric Light Association convention to lead the discussion upon electric ranges."

The society coöperated with the National Committee on Gas and Electric Service in the fuel conservation program. It was also able to render assistance to the United States Fuel Administration which was acknowledged with thanks. It furnished information to the electrical appliance manufacturers for submission to the priorities committee of the War Service Board.

Another important feature of the work has been the daily rendering of "special services" to the members asking for them. These services save the members both time and money, the value of them depending upon the freedom with which they avail themselves of this opportunity to use the society's staff as an auxiliary to their own organizations.

As a well-worth-while educational accomplishment Mr. Wakeman mentioned the thousands of matrices and cuts asked for by members and newspapers for use in advertisements as proofs of appreciation, not only of the matrices and cuts themselves, but also of the value of local advertising, which has been encouraged and fostered by the society from the beginning of its activities.

"The society is thus doing a special work of great value to the industry," declared Mr. Wakeman in conclusion. "Various branches have their own organizations which work for their own interests. Such organizations are necessary, and equally necessary is a strong organization in which all the branches are represented and interested. The Society for Electrical Development is the one organization equipped to deal with problems common to all branches.

"It has been commended by men in every division of the industry for the excellent work it has done in educating the public to an appreciation of the important service rendered by the central stations and in promoting the use of electrical devices, resulting in a wider application of electric service by the householder, merchant, manufacturer, farmer and others whose knowledge of its possibilities has been extended through the efforts of the society.

"A plan of campaign has been outlined which would not only bring the society back to its former proud position in the industry, but would place it at the head of the industrial procession and make it an important part of the great national prosperity movement just getting under way. The plan, which has to do with the reconstruction of the industry, will be submitted to the board of directors. It calls for an expenditure of money upon a larger scale than the society has heretofore made and can only be undertaken through the coöperation of the entire industry. The society was formed to bring about such coöperation, and it should be possible, now that the abnormal war conditions no longer exist, to obtain the whole-hearted, enthusiastic support of those companies and individuals in whose interest the society was organized and for whose benefit it has persistently worked."

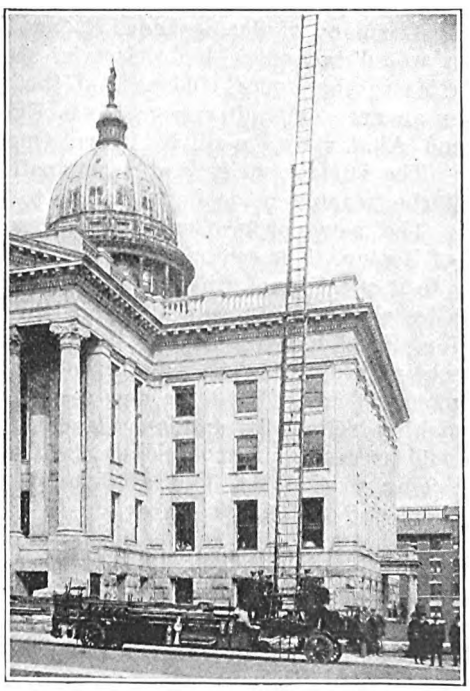
A supplemental report was also made by Mr. Wakeman on the results of the successful "Electrify your home" campaign. He showed that 596 cities requested material and each one was campaigning for house-wiring orders in one way or another. In these cities over 1190 individual companies have "enlisted," including the many newspapers which are coöperating.

Roy B. Woolley of the society staff stated that the cities where the campaign was conducted on a coöperative basis showed the largest results ever obtained. Mr. Woolley also spoke of favorable replies received from 300 newspapers to an inquiry whether they were interested in campaigns such as the society conducts. Only two newspapers expressed unfavorable opinions.

James H. McGraw, president McGraw-Hill Company, Inc., moved a resolution of appreciation of the work of Mr. Wakeman and the staff based on the fundamental purpose to advertise the electrical industry to the public. This was passed.

J. Robert Crouse said that the support given by the industry to the work of the society is altogether too small. Starting originally to get $200,000 annually, it was figured that this was the minimum on which the society could be conducted. Mr. Crouse said that he personally never had any idea but that the amount would grow gradually. He thought that $400,000 or $500,000 would be required to give adequate support to the work. He declared that the work done so far had produced excellent results and that it was absolutely logical that the industry should express itself as a unit.

Electric Fire-Ladder Trucks



To propel fire-fighting apparatus is one of the latest successful uses to which the electrical vehicle has been put. The above illustration shows a ladder truck owned by the city of Newark, N. J. The city of Paterson also has just ordered nine pieces of electrically propelled apparatus, after using twelve pieces of this type since 1916. These trucks were furnished by the Commercial Truck Company of America, Philadelphia.

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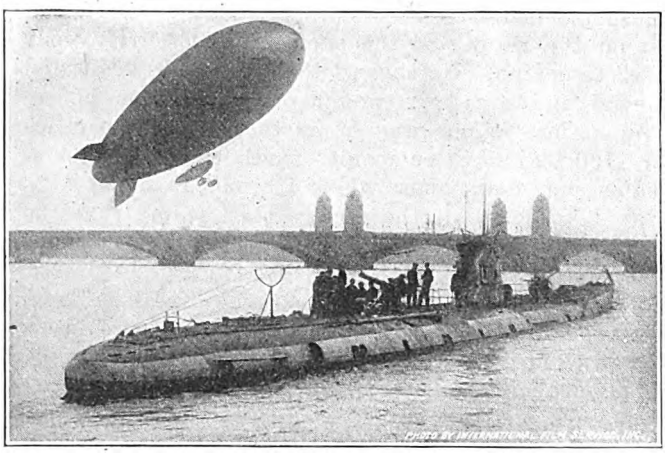
American Cooking Preferred



When the United States Navy took over the German submarine U 111, a Simplex electric range was installed and used on the twelve-day trip from Plymouth, England, to America. The submarine is here shown in the Charles River Basin, Boston, where it was open to visitors buying Victory loan notes. One of the navy dirigibles is hovering over the ex-terror of the seas.

NEW YORK STATE UTILITIES' PLANS FOR CONSOLIDATION

Application of Schenectady and Adirondack Companies Heard by Public Service Commission—To Eliminate Waste of Resources and Effort

The New York Public Service Commission, Second District, recently heard arguments in support of the proposed consolidation of the Adirondack Electric Power Corporation of Glens Falls and the Schenectady Illuminating Company of Schenectady, N. Y. The new corporation would take over hydroelectric, steam and gas properties in the upper Hudson and the Mohawk valleys over an area extending from Glens Falls south to Troy and Albany and west to Utica, Oneida and Canastota. The various cities and municipalities represented at the hearing made no objection to the consolidation. The new corporation was represented by Mr. Tyler of Boston. The commission reserved decision.

In reply to a question of Chairman Hill of the commission as to what the public would gain through the consolidation, F. L. Frothingham of Boston, chairman of the executive committee of the Adirondack Electric Power Company, declared that the new corporation, besides furnishing reliability and abundance of electric service, would proceed as fast as possible with the matter of reducing rates. Mr. Frothingham, who represented 110,000 out of 120,000 shares of stock favoring consolidation, said that the service of the Adirondack company had recently been so much improved as to entitle the company to be ranked as giving good service. He declared further that the stock of the Schenectady group of companies was in one control and that the stock of the Adirondack company, at present distributed among about 1400 holders, would be treated with equality.

Discussing the physical properties of the companies to be consolidated, Mr. Frothingham declared that he had been in favor of consolidation for a number of years. He said unified ownership and operation are demanded in the public interest. Reliable, abundant and cheapest service can be given only by eliminating waste of natural resources and operating effort, and he maintained that waste from separate operation was very large and entirely needless, saying that energy should be routed from point of production to point of consumption over the shortest possible line. Consolidation will permit enlarging physical facilities and increase service by additional expenditures beyond what the smaller systems would be able to do, and needless duplication of investment will be avoided. He stated that the aggregate capitalization, as worked out at former hearings, was $25,000,000, but he gave it as his opinion that the fair value could be placed at approximately $28,287,000.

The estimated earnings of the new corporation during the first twelve months following consolidation were placed by Walter S. Wyman, general manager of the Adirondack company, at approximately $678,500. He outlined increases in income resulting from changes in operation, etc., including savings due to reduced expense on account of the new transmission line from Amsterdam to Utica in place of the present steam plant, $250,000; adjustments with large power users, $100,000; sale of secondary power, $90,000; termination of a contract with the United Traction Company in 1922, described as a losing proposition, $325,000; increased value of East Canada Creek power by a new development at Inghams, Herkimer County, and sending the power to Utica, $100,000, and saving in miscellaneous and operating expenses, $100,000, making a total saving of $1,125,000.

H. W. Buck and Dwight T. Robinson also testified, submitting evidence in support of consolidation. The reproduction cost of the properties was placed by Mr. Buck at $24,446,194 and by Mr. Robinson at $26,251,000. In the opinion of Mr. Buck an expenditure of $500,000 on the Schenectady company and of $800,000 on the Adirondack company would put the property in first-class condition and make it to all intents and purposes as good as new.

Consolidation of the two companies has been under consideration for some time. The Adirondack company and those at Schenectady, Amsterdam and East Creek recently made application for consent to the Adirondack company to acquire the properties. This plan was abandoned, however, and the Schenectady Illuminating Company took over the Schenectady Power Company and the Mohawk Gas Company of Schenectady.

SATISFACTORY RESULTS OF INTERCONNECTION IN TEXAS

Since Three Large Companies Have Been Interconnected Reserve Generating Capacity Has Permitted Overhauling Prime Movers

To provide greater flexibility among Texas generating stations the lines of the Dallas Power & Light Company and the Texas Power & Light Company were connected on April 15, 1918. The Fort Worth Power & Light Company and the Texas Power & Light Company had been interconnected since 1914. The connection made in April, therefore, forms a link between three of the important companies in Texas. This last step in interconnection was accomplished by means of a 7.5-mile (12.6-km.) 60-kv. double-circuit tower line from Norwood to Dallas.

The increased load factor that resulted from the tie

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was the principal benefit. The Texas Power & Light Company's peak normally occurs at about 8 a.m. to 11 a.m., whereas the peak of the Dallas Power & Light Company normally occurs during the evening hours between 6 p.m. and 9 p.m. The advantage of power interchange under these circumstances is obvious. The available combined spare capacity on the system, which now enables shutdown of larger units for maintenance work, is another benefit of almost equal importance. Since the interconnection of the companies in April all prime movers of the three companies have been given clearance of from one to three weeks for complete overhauling of their equipment.

MEDAL FOR RADIO WORK OF E. F. W. ALEXANDERSON

Institute of Radio Engineers Award Is a Recognition of Original Research and Inventions in the Radio Field

The Institute of Radio Engineers at its meeting in the Engineering Societies Building, New York, on May 7, presented a gold medal to E. F. W. Alexanderson, consulting engineer of the General Electric Company, in recognition of his original research and inventions in the radio field.

Mr. Alexanderson declared, in his remarks accepting the medal, that the wireless telephone was the accidental result of a search for something quite different, the wireless transmission of power. Fessenden, he said, conceived the idea of sending power by radio waves. In the course of his work for Fessenden at the General Electric Laboratories the possibility of the transmission of the human voice without wires developed and was worked out.

The board of directors of the institute, which awarded the medal to Mr. Alexanderson, includes Dr. A. N. Goldsmith of the College of the City of New York; John S. Stone, consulting engineer; Donald McNichol, editor of *Telephone and Telegraph Age;* John V. L. Hogan, president of the institute; Warren F. Hubley, engineer, and Lloyd Espenschied of the Western Electric Company.

At Your Service Again!

OFFICERS ELECTED BY WESTINGHOUSE JOBBERS

F. E. Stowe of Philadelphia Chosen New Head of Organization at Its Annual Convention at Del Monte, Cal.

The Westinghouse Agent-Jobbers' Association held its seventh annual meeting at Hotel del Monte, Del Monte, Cal., May 5 to 9. The following officers have been elected for the ensuing year: President, F. E. Stowe, secretary-treasurer of the H. C. Roberts Electrical Supply Company of Philadelphia; vice-president, S. L. Nicholson, assistant to vice-president of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; secretary, C. C. Blackwell, manager electrical department Moore-Handley Company, Birmingham, Ala.; assistant secretary, H. T. Pritchard, Westinghouse Electric & Manufacturing Company; treasurer, J. E. McClernon, president Northwestern Electric Equipment Company, New York.

The newly elected executive committee includes J. C. Schmidtbauer, vice-president of the Julius Andrae & Sons Company, Milwaukee, Wis.; Samuel Adams Chase, special representative Westinghouse Electric & Manufacturing Company, East Pittsburgh; John J. Gibson, manager supply department, East Pittsburgh.

Membership committee—Samuel H. Taylor, president Electric Railway & Manufacturers' Supply Company, San Francisco, Cal.; S. H. Anderson, assistant treasurer Westinghouse Electric & Manufacturing Company, East Pittsburgh; J. S. Tritle, district manager Westinghouse Electric & Manufacturing Company, St. Louis, Mo.

Nominating committee—N. G. Harvey, vice-president Illinois Electric Company, Chicago; G. H. Cox, district manager Westinghouse Electric & Manufacturing Company, Boston; C. S. Walker, president Varney Electrical Supply Company, Indianapolis; G. H. Miller, manager Tel-Electric Company, Houston, Tex.

Advisory board—Chairman, Samuel A. Chase, Westinghouse Electric & Manufacturing Company; J. C. Schmidtbauer, vice-president Julius Andrae & Sons Company, Milwaukee; F. D. Phillips, president Central Telephone & Electric Company, St. Louis; F. W. Woolrich, secretary Commercial Electric Company, Detroit; Merrill C. Morrow, assistant to manager of supply department, Westinghouse Electric & Manufacturing Company; T. Julian McGill, district manager Westinghouse Electric & Manufacturing Company, Chicago office; Charles Robins, assistant sales manager Westinghouse Electric & Manufacturing Company, Pittsburgh.

Electricity Cheaper than Kerosene

The comparative cost of lighting by electricity at 10 cents per kilowatt-hour and by kerosene at 11 cents per gallon was recently determined by the Central Maine Power Company as follows:

Cost of maintenance of twenty-five kerosene lamps for one year:	
200 gal. kerosene at 11 cents	$22.00
1 gross lamp chimneys at 15 cents	21.60
5 doz. lamp wicks	1.20
15 doz. burners at $1.20	18.00
Glass lamps	24.00
Labor caring for lamps, average 60 cents per day	219.00
Total	$305.80
After installing twenty-five 40-watt tungsten lamps and estimating an average energy consumption of 240 watts per hour, or a total of 876 kw.-hr. per year, at 10 cents.	$87.60

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Western Massachusetts Engineers Organize.—The Engineering Society of Western Massachusetts has been formed with C. L. Newcomb, general manager Deane Steam Pump Company, Holyoke, Mass., as its president.

Northern California Association of Electrical Contractor-Dealers.—This organization recently held a meeting at Oroville, Cal., in the general interest of the electrical industry and to discuss matters of importance to the trade.

N. E. L. A., Iowa Section.—The 1919 convention of the Iowa Section, National Electric Light Association, will be held June 18, 19 and 20 at Colfax, Iowa, a health resort adjacent to Des Moines. M. G. Lynn of the Des Moines Electric Company is secretary-treasurer of the section.

Change in Dates of Arkansas Utilities Association Convention.—The Arkansas Utilities Association has changed the date of its annual convention, which is to be held in Fort Smith, Ark., from May 20-22 to June 10-12, thereby avoiding conflict with the dates of the N. E. L. A. convention at Atlantic City, N. J.

Joint Meeting of Cincinnati Engineers.—W. W. Freeman, president of the Union Gas & Electric Company, gave an address on "Power Problems of a Modern City and Their Solution" at a joint meeting of the Engineers' Club of Cincinnati and the Cincinnati Section, American Society of Mechanical Engineers, held on April 17.

I. E. S., New York Section.—The nominees in the election of officers of the New York Section of the Illuminating Engineering Society to serve during the year 1919-1920 are: Chairman, F. M. Feiker, editorial director ELECTRICAL WORLD; secretary, R. E. Harrington; managers, W. T. Blackwell, W. J. Clark, L. J. Lewinson, J. P. Radcliffe, Jr., and G. A. Sawin.

A. I. and S. E. E., Birmingham Section.—At the first regular meeting held by this section of the Association of Iron and Steel Electrical Engineers, J. E. Fries was elected chairman, F. M. Sturgess secretary, and W. H. Gilbert, J. H. Adkins and T. M. Moore members of the executive committee. W. C. Suppler presented a paper on "Electrical Department Organization and Its Duties" at this meeting.

A. S. M. E., Spring Meeting.—The American Society of Mechanical Engineers is to hold its spring meeting in Detroit from June 16 to June 19. Papers on industrial research are to be presented; addresses are to be delivered on the conditions necessary for industrial peace, and oil engines, powdered fuel and oil fuel are to be discussed at the meeting.

Joint Meeting in Detroit.—A. A. Oswald, research engineer, Western Electric Company, New York, addressed a recent joint meeting of the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers and the Detroit Engineering Society on the subject of "Wireless Telephony and Telegraphy in War."

A. I. and S. E. E., Pittsburgh and Cleveland Districts.—The Pittsburgh and Cleveland Districts of the Association of Iron and Steel Electrical Engineers will hold a joint inspection trip on May 17 to the Brier Hill Steel Company, Youngstown, Ohio, and after that a technical session at which the electrical installation of this plant will be discussed.

Annual Meeting American Society for Testing Materials.—The American Society for Testing Materials is to hold its twenty-second annual meeting in Atlantic City from June 24 to June 27. Among the subjects to be discussed at the sessions are preservative coatings, lubricants and containers; steel and wrought iron, corrosion and magnetic analysis, rubber products and textiles, and malleable iron and non-ferrous metals.

Youngstown Engineers' Club Reorganized.—The reorganization period of the Engineers' Club of the Youngstown (Ohio) district was completed at a meeting held on April 29. Since 625 applications for membership have already been received, it was voted to establish club headquarters and rooms. F. W. Funk is president and E. R. Rose of the Republic Iron & Steel Company, Youngstown, is secretary of the club. The district from which the club draws its membership embraces the territory within a 25-mile radius of that city and includes Sharon and New Castle in Pennsylvania as well as Warren, Niles, Grand and Youngstown in Ohio.

American Institute of Electrical Engineers

Pittsfield Section.—On April 24 Col. James M. Andrews addressed the section on "With the 105th in France."

Cleveland Section.—"Electricity Versus Air for Portable and Semi-portable Tools" was the title of a paper given at the April 21 meeting by E. L. Connell, chief engineer Van Dorn Electrical Tool Company.

Toronto Section.—This section held its annual meeting on April 25 and elected Ashton B. Cooper of the Canadian General Electric Company chairman and Daniel M. Fraser of the same company secretary.

Los Angeles Section.—"Radio Engineering" was the subject of a talk given by Lieut. Ellery Stone, U. S. N., in charge of the United States radio station at San Diego, to this section at its meeting on April 22.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Personal Service as Compensation for Energy.—A decision of the Idaho Public Utilities Commission affecting the Idaho Power Company says: "It appears from the evidence and is a fact that the Idaho Power Company has on file a schedule of rates for three classes of serving, namely, lighting, heating and cooking, so that in no interpretation of the contract can it be reasoned that this complainant is receiving a class of service which is not open to any other consumer who desires the same service. There therefore does not exist in this case any discrimination on the question of service. We find that there are tariffs of the Idaho Power Company on file with this commission naming specific rates for lighting, cooking and heating in American Falls; and the question arises as to whether or not this complainant, by reason of the fact that he was not paying his bills monthly in dollars and cents, is not being discriminated in favor of by the said defendant company. The evidence disclosed that the value of said service heretofore rendered was worth two or three times the value of any of the electrical energy furnished this complainant, or that might be furnished this complainant under any ordinary circumstances for use at his home. It is true that the medium of exchange used by the complainant herein in the payment for the electrical energy is quite different from the medium of exchange that is used in the ordinary transaction of business; yet in view of the fact that the value of such service so rendered by the complainant is equal to or greater than the value of the electrical energy that may be furnished by this defendant to said complainant, this commission cannot hold that the rates under such contract constitute undue discrimination. It must be understood that this decision refers specifically to contracts made prior to the enactment of the public utilities law. . . . The commission might suggest that it considers the service in this case to be service of a personal nature and the rights and benefits thereof cannot be transferred by the said complainant herein. The commission therefore finds that said defendant company should continue to render service to the said complainant under and by reason of said contract until such time as the same expires, and should credit its operating revenues with the value of such services so rendered computed at the regular schedule of rates on file with this commission."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Liverpool Officials to Study American Utilities.—A deputation of fifteen Liverpool city councilmen and engineers will leave England on May 31 aboard the steamship Caronia, according to advices received in New York, for the purpose of studying electric railways, lighting equipment and improvements in United States and Canadian cities.

Permanent Safety Exhibition in New York.—The city of New York has given to the Safety Institute of America the right to occupy the Arsenal in Central Park as a permanent exhibit of safety appliances for the prevention of accidents to working people. An expenditure estimated at $125,000 will be made by the institute to restore the building to its original condition.

Water-Power Legislation in New York.—The New York Legislature adjourned without passing water-power legislation or the enabling bill for public ownership of utilities. A statement issued by the caucus of Republican members said: "Our experience with government control and operation of railroad, telephone and telegraph companies has convinced us that municipal ownership of public utilities would be undesirable; but if it were desirable, the financial condition of the cities of the state is such as to preclude any thought of adopting such a policy at this time. The Graves bill, which commits the state to the ownership and development of water powers, will alone add millions to the tax budgets."

American-Swedish Scholarships.—The establishment of ten new scholarships has been announced by the American-Scandinavian Foundation, beginning with the academic year 1919-20. They are to enable American scientific students to complete their general study and research in the universities and technological schools of Sweden. It is the design of the foundation "to draw the American and Scandinavian peoples closer in bonds of intellectual kinship." Each scholarship will provide $1,000 for one year's study. Funds to maintain the scholarships have been pledged by Americans. Similar funds are being raised in Sweden to send ten Sweden students to this country. Applications are to be passed on by a committee which includes Capt. William Hovgaard, chairman, professor of naval architecture, Massachusetts Institute of Technology; Prof. H. P. Talbot, head of the department of chemistry, Massachusetts Institute of Technology, and Prof. A. E. Kennelly, head of the department of electrical engineering of Harvard University. Application papers must be filed with the committee before June 1 and announcement of the names of the successful candidates will be made about June 15. Applicants should request papers from the American-Scandinavian Foundation, 25 West Forty-fifth Street, New York.

Cure of Serious Burns.—A booklet, "Employee No. 1653," has been issued by the Utilities Mutual Insurance Company to describe a case of recovery from terrible burns. Charles E. Morrison, vice-president and general manager, writes that it shows "what may be done in the case of serious burns from either steam or electrical energy, provided intelligent, prompt and careful attention is given." The man was so severely burned by hot ashes and steam that it was problematical whether he would survive the shock, particularly as he was sixty years of age, and the remarkable results obtained were accomplished through the constant supervision of the consultant physician in the administration of the paraffin wax treatment. For the first ten days the patient received unremitting care and attention, and it is perhaps due to this early treatment, says the booklet, that recovery was made.

Compensation for Engineers.—The committee on compensation of the Chicago Section, American Institute of Electrical Engineers, has submitted the following schedule on compensation for the consideration of the section: For public utility corporations furnishing light and power to a population of 50,000 it is recommended that the general manager, preferably a technically trained man, should receive from $5,000 to $8,000 a year; that his assistant, with a technical education and ten years' experience, should receive $3,500 to $5,000; that a second assistant, with the same experience but working under directions, should receive $3,000 to $4,200, and that other assistants, with five years' experience and the same education, should receive $2,400 to $2,700. For office and field positions in which the men do drafting and instrument work the same remuneration is recommended as that named for similar municipal work in another section of the report, where salaries range from $1,200 to $3,000. Recommendations for engineers employed by state public utility boards are as follows for states with a population of 5,000,000: Chief engineer, $12,000 to $15,000 a year; assistant chief engineer, $9,000 to $10,000; chief of railroad division, $8,000 to $9,000; chief of gas division, $6,000 to $7,500; chief of telephone division, $6,000 to $7,500; chief of waterworks division and mechanical engineer, $6,000 to $7,500; chief of service division, $6,000 to $7,000. Assistant engineers reporting to the chiefs of these departments: Grade 1, $3,600 to $4,800 a year; grade 2, $3,000 to $3,300; grade 3, $2,400 to $2,700; grade 4, $1,800 to $2,100. Similar recommendations are included for telephone engineers.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Maximum Charge for Steam.—In a case where a franchise of a light and power company provided that rates for heat established were relative to cost of fuel at the time and that maximum rates should not exceed for power or light 14 cents per 1000 watts, for steam 45 cents per 1000 lb., and for hot water 18 cents per square foot of radiating surface per year, the Supreme Court of Michigan has held that the franchise does not limit the company to 45 cents maximum charge on each 100 lb. steam irrespective of the price of coal (171 N.W. 485).

Jurisdiction of Commission Over Municipal Public Utilities.—The Supreme Court of Illinois has held, in the case of the Springfield (Ill.) Gas & Electric Company vs. the city of Springfield that the clause which excepts municipally owned or operated public utilities from the definition of a public utility in Section 10 of the public utility act of the state is unconstitutional. The question argued in this case was whether or not a municipality of this state owning and operating an electric light plant for the production and sale of electricity to private consumers is subject to the supervision of the Public Utilities Commission. The city of Springfield owns and operates an electric light plant and sells electricity not required for city purposes to private consumers at about half the cost for which it can be procured from other sources. The Springfield Gas & Electric Company is a corporation engaged in the production and sale of electricity in the city of Springfield in conformity with the provisions of the public utilities act. It filed a bill against the city alleging that the city was engaged in the production and sale of electricity to private consumers, in violation of Section 35 of the public utilities act, without having complied with the provisions of Sections 33 and 34, which require the filing with the Public Utilities Commission and the printing, posting and keeping open to public inspection of schedules showing all rates, charges and classifications in force for any product furnished or service in connection therewith performed by any public utility. The city filed an answer, to which the appellant excepted. There was a hearing on the bill, answer and exceptions, and the court entered a decree dismissing the bill for want of equity, from which the complainant appealed and brought forth the opinion that has just been quoted of the Supreme Court of the State of Illinois.

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

John W. Lieb, vice-president of the New York Edison Company and past-president of the National Electric Light Association, the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, was operated on for appendicitis on May 8 at the New Rochelle (N. Y.) Hospital. His many friends will be pleased to learn that at the time of going to press Mr. Lieb had rallied finely, with every prospect that he will be able to be about in a few days.

Major Carroll H. Shaw, who was recently released from government service, has joined the commercial engineering staff of the New England Power Company, with headquarters at Worcester, Mass. Major Shaw received the commission of captain in the Engineer Reserve Corps in June, 1917, and was assigned to Camp Lee, Petersburg, Va., in January, 1918. Shortly afterward he was ordered to Washington and placed in charge of the New England district of the power section of the War Industries Board. In October, 1918, he was commissioned major of engineers. Until recently Major Shaw has been engaged in the preparation of a report for the War Department on the power requirements and resources of New England, which will serve as a basis for any future conservation that may be required. Previous to entering the government service Major Shaw held several responsible engineering and executive positions with central-station companies in the Middle West.

CARROLL H. SHAW

John V. Strange, who has been appointed assistant general manager of the Pacific Power & Light Company, Portland, Ore., has had thirteen years' practical experience in the utility business. Mr. Strange entered the employ of the Portland Gas Company in 1906, serving in the accounting department and also as private secretary to the general manager. In 1911 he was in the sales department of the same company, but resigned his position to become general storekeeper for the Pacific Power & Light Company at Kennewick, Wash. In 1914 he became local manager at Prosser, Wash., and he has been district manager at Hood River, Ore., and Pasco, Wash. In the Pasco district Mr. Strange had general supervision over a very wide territory in which the Pacific Power & Light Company serves approximately 500 hp. of irrigation pumping motors.

Travis H. Whitney, formerly acting chairman of the Public Service Commission of the First District of New York, will act as counsel for Messrs. Norton, Bird & Whitman, engineers, New York. In 1907 Mr. Whitney was appointed secretary of the Public Service Commission of the First District of New York, continuing in that capacity until 1916, when he was made a commissioner.

H. L. Draper, who was appointed commercial manager of the Western Light & Power Company on April 1, will be stationed at Boulder, Col. He was formerly connected with the commercial department of the Houston (Tex.) Lighting & Power Company and later held the position of commercial manager of the Birmingham Railway & Light Company, Birmingham, Ala. For the past year he has been in business for himself.

J. C. Rockwell has been promoted from local general manager to vice-president of the Manila Electric Railroad & Light Company, Manila, Philippine Islands, in charge of the general Philippine affairs of that company, which is under the operating management of the J. G. White Management Corporation, New York City. Mr. Rockwell was graduated in 1904 from Cornell University with the degree of mechanical engineer. In 1906 he became superintendent of transportation of the Syracuse (N. Y.) Lake Shore & Northern Railroad Company. He was appointed general superintendent in 1909 of the Charleston (W. Va.) Interurban Railroad Company and the following year was elected general manager of this company. In 1911 he joined the operating organization of the J. G. White Management Corporation, New York, and was assigned to the Manila Electric Railroad & Light Company as manager of the light and power department. He was made general manager of that company in the early part of 1918.

E. Hagenlocher, for the last four years a member of the electrical engineering staff of the J. G. White Engineering Corporation in New York City, has resigned to become associated with Frazar & Company, 30 Church Street, New York, exporters and importers.

John J. Gibson, manager of the supply department of the Westinghouse Electric & Manufacturing Company, is receiving expressions of sympathy from friends on the death of his eldest son, John J. Gibson, Jr.

E. F. McGee, heretofore resident engineer of the new electric plant of the Eastern Connecticut Power Company at Montville, Conn., has resigned that post because of illness. John F. McNamee of the Harry M. Hope Engineering Company of Boston has been appointed to succeed Mr. McGee.

Prof. Dugald C. Jackson has returned to the Massachusetts Institute of Technology to resume his duties as head of the department of electrical engineering after about a year of special service for the government in France. Professor Jackson was commissioned major in the Engineers' Reserve Corps early in 1918. During the absence of Professor Jackson Prof. R. R. Lawrence was acting head of the department.

DUGALD C. JACKSON

W. R. Putnam, recently advanced from sales manager to commercial manager of the Utah Power & Light Company of Salt Lake City, has resigned to take up the duties of vice-president and general manager of the Idaho Power Company, with headquarters at Boise, Idaho. Mr. Putnam succeeds W. T. Wallace, who is now identified with the Gulf Refining Company in New York City. Mr. Putnam is especially well known in the industry for his work as chairman of the N. E. L. A. electric range committee, the reports of which have been in no small way accountable for much of the interest shown by utilities in electric cooking. He is a graduate of the University of Minnesota and for a number of years was manager of the electric lighting company at Red Wing, Minn., and Rapid City, S. D. He later acted as general superintendent of the Wisconsin-Minnesota Light & Power Company at Menominee and Marinette, Wis.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

WASTEFUL DISTRIBUTION METHODS STILL IN USE

Extravagant Entertainment of Prospective Buyers Is Not Altogether Justifiable Under Present Conditions

To-day, when clamorings are heard on every side for lower prices, extravagances in distribution expenses seem more wasteful than ever. Still there are manufacturers in the electrical field who virtually spare no expense to get competitive business. Only recently there came to the attention of an ELECTRICAL WORLD representative an incident showing that some of the wasteful pre-war business and sales methods have again come into being.

A well-known Eastern buyer was visited by three sales representatives of one of the large appliance-manufacturing concerns. The salesmen spent the entire day with the buyer. They entertained him and some of his assistants at lunch and later insisted on entertaining them at an elaborate dinner. When the railroad fares of the three salesmen, their time and personal expenses and the entertainment bill were added up, it is doubtful if the expense was justifiable on any grounds. Repeat this many times and the total becomes sufficiently large to warrant attention at this time.

MOTOR AGENTS WANT NEW BASIS OF COMPENSATION

Present Discounts Considered Inadequate and Large Users' Rating Too Low—Protection Desired Commensurate with Service Rendered

Motor agents are expressing their dissatisfaction with the margin of profit being allowed them by manufacturers. It is contended that the present discounts were established at a time when the cost of doing business was but a fraction of what it is now. Furthermore, the large users' rating, which entitles a user of 200 hp. to a discount from the list price of some manufacturers, was put into effect when 200 hp. was comparable to about a 2000-hp. installation to-day. The manufacturers planned to sell to all large users direct, but now that many agents are selling and serving the so-called large users these agents feel that the manufacturer should pay the expenses involved plus a fair profit.

Agents who have competent engineers to advise their customers what motor they should buy and how it should be installed, and who also give their customers service after the motor is sold, state that the present discounts of all manufacturers are altogether inadequate. Manufacturers, on the other hand, refer to the agents who are not in a position to give the ultimate user proper advice or service, and the manufacturer does not feel like giving such agents any more than they are now getting. The better class of agents answer this by saying that the manufacturers have allowed any one to become a motor agent and they are entirely responsible for the class of dealers who have motor-agency agreements. If the manufacturers would be more particular and investigate each prospective motor agent before giving him a contract, they could eliminate the incompetent agents who often sit back, let the manufacturer do the work and then want to collect their discount. Both sides seem willing to admit that some changes are desirable, and a number of suggestions are being discussed.

Many of the leading second-hand dealers of the country became manufacturers' agents and handled new motors, especially in the larger sizes, when second-hand apparatus became scarce during the war. Many new motors of 100 hp. and above are in the hands of these dealers to-day, and carrying such a stock is a service in itself, apart from the engineering and maintenance service such dealers give to their customers. These stocks of large motors were bought on a rising market, but the dealers state they could not afford even to handle such motors under normal conditions, let alone carry them in stock. Engineer-dealers feel that they are entitled to protection on larger motors and that the manufacturers could well afford to give those who carry large stocks an extra discount.

Organized effort is being made to harmonize the ideas of all interests for the good of the industry, and there is a feeling of optimism over the outcome.

GERMANY'S ELECTRICAL MANUFACTURERS WORRIED

Their Former Policy of Investing Heavily in Foreign Enterprises in Order to Obtain Orders for Their Products Proves to Be a Boomerang

German electrical manufacturers are facing a serious situation, it was indicated in a statement by the general manager of Siemens & Halske addressed to the labor organization of that company's plant. In this statement, as reported from Zurich to the New York *Evening Post*, it is pointed out that the leading German electrical manufacturers, such as Siemens & Halske and the Allgemeine Elektrizitäts-Gesellschaft, were investment trusts as well as manufacturing companies and that their investments had all, or nearly all, been made abroad with a view to controlling electrical companies, especially power companies, in order to secure for themselves all the orders placed for equipment, accessory machinery and other apparatus and supplies required not only by the utility but by consumers of electric energy.

It was shown, however, that these companies are now suffering severely, owing to the great bulk of their investments having been placed in enemy countries. Before the war, for instance, the investments of the Siemens company alone in enemy countries amounted to 123,000,000 marks, or $30,750,000. Of this amount 45,000,000 marks, or $11,250,000, were lost in Russia; 34,000,000 marks, or $8,500,000, were expropriated in England; 17,000,000 marks, or $4,250,000, in France were sequestrated and probably will be expropriated to go toward war indemnities; more than 20,000,000 marks, or $5,000,000, were lost in Italy, and smaller amounts were lost in Portugal, in Rumania and in South America. The investment concerns in neutral countries controlled by Siemens & Halske fell into the hands of neutral competitors.

The statement further warned the workers against believing that the war prosperity would continue. It was shown that war orders had entirely ceased, as had the large profits resulting from the circumstance that 90 per cent of the submarines during the war were fitted out with an apparatus for electrical navigation manufactured by the firm.

At the conclusion of the war the number of workmen engaged in Germany by this concern amounted to 64,124. Only 30 per cent of the work carried out during the last war year was work for peace purposes, the other 70 per cent having been done exclusively for the War Office. But

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already in 1919 the possibility of competing successfully in the production of electrical goods had disappeared. To-day peace work for export purposes has yet to be resumed. The output and activity of the workmen during the month of November, 1918, was smaller by 40 per cent than the average output during the years 1917 and 1918.

UNIT DISPLACEMENT OF ELECTRICAL GOODS

Weight per Cubic Foot, Space per Short and Long Ton and Shipping Package Dimensions Compiled by Bureau of Standards

With the demand made upon the transportation and shipping facilities of this country in the recent times, the need for a classification of unit displacement of goods became urgent as a basis for making estimates as to the most efficient utilization of the existing facilities. Such a table has been prepared by the Bureau of Standards and but recently issued. Below are given such data as relate to electrical goods contained in the table:

Commodity	Weight per Cubic Foot, Lb.	Space per Short Ton, Cu.Ft.	Space per Long Ton, Cu.Ft.	How Packed for Shipment
Batteries, dynamite	30	67	78	
Battery jars, rubber	11–13½	147–182	166–235	
Battery plates or frames, burnt-out	57	35	40	
Battery wells	4	500	560	Three sizes: 8 ft. 8 in. by 4 ft. 10 in., 6 ft. 8 in. by 4 ft. 10 in., and 3 ft. by 4 ft. 10 in.
Cable, insulated copper wire	60	33	37	Reels, varying sizes; weight package, 600 lb. average.
Cable, steel-covered, electric	70	29	32	
Cable terminal boxes	10	200	224	
Car heaters, electric	20–26	77–100	86–112	
Conduit fittings, complete	69	29	32	
Conduit fittings, iron or steel parts	70	29	32	
Conduit, fiber	7	286	320	
Conduit, iron or steel	50	40	45	
Controllers, electric	26	77	86	
Dry-battery shells	12–24	83–167	93–187	
Dry cells, spent or worn-out	45	44	50	
Electrolytic cells	23	87	97	
Fuse wire	150	13	15	On spools packed in tin containers packed in boxes
Headlights, electric, for locomotives, sheet-iron body	7	286	320	
Headlights, electric, for street cars, cast-iron body	20–29	69–100	77–112	
Headlights, electric cars, sheet-iron body	16–25	80–125	90–140	
Headlights, incandescent, cast-iron body	25	80	90	
Insulating compounds	30–100	20–67	22–75	Casks, barrels.
Insulating material, hemp fiber	12	167	187	
Insulators, joint	75	27	30	Boxes.
Lamp guards, nested	25–30	67–80	75–90	Nested.
Lamp guards, not nested	7–10	200–286	224–320	
Lamp sockets, for electric lamps	34	59	66	
Lightning arrester, electric	20	100	112	5-gal. carboy, 13 by 15 by 31 in.; 10-gal., 19 by 21 by 35 in.; 15-gal., 20 by 21.5 by 40 in.
Ovens, electric	12	167	187	
Pike poles	20	100	112	Bundles, three or six, usually six; package of six is 4 in. by 6 in. by 14 ft.
Radiators, electric	13–18	111–154	124–172	
Rectifier bulbs	6	333	373	Slatted box.
Rheostats	25	80	90	
Stoves, electric disk heaters	35	57	64	
Stoves, electric	5–35	57–400	64–448	
Stoves, electric hot plates	19	105	118	
Tape, insulating	38–42	48–53	53–59	
Telephone cable, lead-covered, with jacks attached	20	100	112	Package, 44 by 44 by 23 in.
Telephone, transformers or loading coils	60	33	37	Average weight, 111 lb.
Transformer cooling coils, copper	30	67	75	Weight, 200-500 lb.
Transformers, telephone	55	36	41	
Wire, aluminum, bare	65	31	34	Boxes, casks, coils, reels.
Wire, aluminum, insulated	50	40	45	Boxes, casks, coils, reels.
Wireless-telegraph equipment	24	83	93	*

* Total space required, 86 cu.ft.; packed as follows: One case, 20 by 20 by 33 in.; one case, 30 by 20 by 10 in.; one crate, 30 by 30 by 48 in.; one bundle, 6 in. diameter, 13 ft. 6 in. long; one case, 36 by 25 by 25 in.; one case, 34 by 26 by 18 in.; one case, 41 by 25 by 19 in.; one case, 36 by 34 by 19 in.

EXPENSES OF JOBBERS CONTINUE TO INCREASE

Character of Sales Changes, with Socket Appliances Such as Vacuum Cleaners and Sewing Machines the Leading Feature

Now that one-third of 1919 is gone, jobbers are beginning to review the situation for the year with reference to their 1918 business. In some quarters the volume of business is reported to be practically the same as in 1918. These jobbers point out, however, that expenses of doing business are continuing to increase, largely on account of the fact that increases for labor were not made all at one time. Jobbing profits are not so high as they were last year, and of course as there are price changes stocks on hand must be depreciated. Other jobbers report that the volume is not quite so high as it was last year. All agree that the character of the business has changed considerably, from one in which construction materials were the leading feature to one in which specialties are of prime importance. Every one reports the market on vacuum cleaners, washing machines, sewing machines and devices of this type to be excellent.

Architects are busy for the first time in many months. Contractors who have not been buying at all are again becoming customers. Spring construction of pole lines by central-station companies is opening up in good shape. In the building construction field there appears to be more hesitancy than in any other line. The building permits do not appear to be a true index to business conditions in this field, as the situation stands now. Permits to a large amount have been taken out, but apparently after the permits are received and bids are solicited on construction material the prices which are quoted deter the actual starting of construction work.

WAR DEVELOPMENT WORK OF THE MANUFACTURERS

Many of the Articles Which Were Exhibited Recently at Washington Are Sure to Find a Market in Peace Times

That American manufacturers of electrical goods played no small part in the winning of the war through the development of apparatus and equipment has been known. Some indication of the extent of this development work was given at the exhibit of the Bureau of Standards, Washington, under the auspices of the American Physical Society.

Sixteen electrical manufacturers had special exhibits, and products of other electrical manufacturers were included

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in the various government department exhibits. Most of the electrical exhibits related to some phase of radio work. There were, in addition, field-signaling equipment, both telephone and other, gun lamps and a few industrial devices.

Developed essentially for war, a great many of these devices are sure to find their way into peaceful occupations. Already some of the manufacturers are trying to find some commercial outlet for these developments. In radio-telegraphy and radio-telephony, the use of which is expected to expand rapidly, virtually all of the war radio developments will probably find a commercial outlet. Some of the devices, on the other hand, have of course none but a war use.

Among the manufacturers with special exhibits were the Automatic Electric Company, James G. Biddle, Brown Instrument Company, Dubilier Condenser Company, Inc., General Electric Company, A. H. Greve & Company, Herman A. Holz, International Radio Telegraph Company, H. W. Johns-Manville Company, Leeds & Northrup Company, Manhattan Electrical Supply Company, Nela Research Laboratory of the National Lamp Works of the General Electric Company, Roller-Smith Company, Standard Scientific Company, Western Electric Company, Inc., and Westinghouse Lamp Company (engineering department).

METAL MARKET SITUATION

Steel Market Again Becomes Open—Copper Stronger with Better Outlook

The Industrial Board of the Department of Commerce, created about two months ago by the President, has ceased to exist. Secretary Redfield has announced the acceptance of the resignations of Chairman Peek and the entire board following a meeting on May 8 of steel interests with the Railroad Administration. At this meeting no agreement was reached on steel prices and an open market resulted.

Some steel interests are holding to the steel prices approved by the board several weeks ago, while other companies are reported as shading these prices to keep their mills in operation.

Copper has strengthened. The quoted price is 16 cents. Several of the large selling agencies have done business at this price for May, June and July deliveries. Sales since the first of May for home account have been estimated at an average of 1,000,000 lb. a day with indications of further improvement. This seems to be in line with an increase in sales of structural steel.

For the foreign copper market, it is reported that England, with her already large stocks, has purchased wire bars and Spain is reported in the market for 5,000,000 lb. of the metal.

NEW YORK METAL MARKET PRICES

	May 6	May 13
Copper:	£ s d	£ s d
London, standard spot	75 15 0	76 5 0
	Cents per Pound	Cents per Pound
Prime Lake	15.62½	16.00 to 16.25
Electrolytic	15.37½	16.00
Casting	14.90	15.37½
Wire base	17.25 to 18.00	17.25 to 18.00
Lead, trust price	5.00	5.00
Antimony	7.12½	7.12½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.35	6.40
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	31.00 to 33.00	32.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 14.00	13.50 to 14.00
Brass, heavy	7.50 to 8.00	7.50 to 8.00
Brass, light	6.50 to 7.00	6.50 to 7.00
Lead, heavy	4.00 to 4.25	4.25 to 4.37½
Zinc, old scrap	4.00 to 4.25	4.00 to 4.25

THE WEEK

IN TRADE

SALES booked are getting larger right along. The open market for iron and steel is a favorable factor for still greater activity.

Prices are very steady, and there appear to be no indications of any early breaks. New building is increasing, but the big volume of electrical business is coming from small jobs that the war held up.

Collections are holding up well from all directions.

NEW YORK

Conditions in the jobbing trade seem to be holding their own. Some jobbers report that May is opening up better than April, while others find no appreciable increase.

The market continues strong in flexible armored conductor, but the supply is still short. Transformers and feeder regulators of the distribution type, meters and lightning arresters are finding an increased market and this leads to the belief that central-station purchasing is becoming more active. This is strengthened by the report from a cable manufacturer showing recent orders for power cable for central-station distribution circuits.

Manufacturers and jobbers are strong in their opinion that the successful completion of the fifth and last Liberty loan will remove one of the deterrent factors from the new building industry. The necessity of the money-loaning institutions holding off on loans for new construction is passed because of the public's response to the government's appeal. The order for ihe convening of Congress this month and the end of the peace conference in sight are also stabilizing factors in industry.

RUBBER-COVERED WIRE.—Change in base by one manufacturer from 18 cents to 19 cents is the only development in the market. The 20-cent base still holds. An excellent movement for wholesale stocks is reported locally.

MOTORS.—An increasing number of orders for large motors has been reported by one manufacturer. Motors for the textile industry have been finding an increasing market. Fractional-horsepower motors are continuing in high demand. The market for motors around 5-hp. and 10-hp., two-phase and three-phase and also direct-current, appears to be especially favorable. Stocks are gradually building up, although frequently a large portion of a carload is sold before delivery.

BELLS.—An increase in demand has been noted due probably to the increase in home building which is under way in different sections of the country.

ATTACHMENT PLUGS.—Large orders are coming through, principally from manufacturers of fixtures and appliances.

TRANSFORMERS.—There has recently been found considerable movement in distributing transformers in capacities from 1 kva. to 100 kva. Stocks are in general becoming better.

LIGHTNING ARRESTERS.—Although this is the season for arresters and sales have been good, it appears that the market is going to extend over a longer period than normally. One manufacturer has stated that his company will make no price reductions during the present season unless conditions change to a considerable extent.

METERS.—There have been reported slightly increasing sales of integrating watt-hour meters. Stocks are sufficient for anticipated needs.

REGULATORS.—Feeder regulators are selling better. In fact, for some time there has been virtually no business in this line.

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HEATERS.—The unpleasant weather of the early part of the week just past has caused a slight movement in heaters.

CONDUIT.—The market for rigid conduit has been rather quiet of late. There have been no price changes, and jobbers have sufficient stocks to carry along at present needs.

CHICAGO

Manufacturers in the Middle West seem to be taking a very decided attitude toward what they consider unreasonable demands of labor. It was reported last week that an electrical manufacturer in Wisconsin closed his plant when demands he considered unreasonable were made. This week a similar situation at Toledo, affecting 16,500 men and women, has developed at the plants of the Willys-Overland company, the Auto-Lite company and other affiliated organizations.

The building permits taken out in Chicago this week total $1,366,700. Prices in general in the trade have shown no change.

Business with the jobbers continues about the same in volume, the central stations, telephone companies and dealers being among the heavier buyers. Central stations and dealers are buying large quantities of household devices, while central stations and telephone companies are purchasing some construction materials. The market for farm appliances still continues good. The telephone situation has been somewhat improved by the ending of the receivership of the Central Union Telephone Company.

The campaign for the Liberty loan has also retarded business somewhat. This, taken together with the fact that in honor of Chicago's home regiment, the 149th Field Artillery, a full holiday was observed, was the principal local factor affecting business.

COPPER WIRE.—There has been no change in the price or in the state of demand locally. Rubber-covered base is still 20 cents and the demand is fair.

IRON CONDUIT.—There is a fairly light demand for conduit with the price holding steady.

ELECTRIC RANGES.—While in past years major range activities have been thought of in connection with the Far Western States and in connection with the utilities in Boston, Minneapolis, St. Louis and Texas, there is at present a considerable range activity in the Southeast. This is based on careful cumulative work that has been done quietly during the past two years, in which time about 2000 ranges have been placed in this territory.

DISHWASHER.—Information is being collected as to the possibility of success in marketing through the electrical trade a dishwasher which will retail at $250 to $300.

FARM-LIGHTING PLANTS.—Another manufacturer has come on the market with a farm-lighting plant to sell through the electrical jobber and the electrical dealer. His plan is to sell to the jobber at a price which will make it possible for the jobber to conduct local publicity campaigns and to give the dealer a fair margin of profit in addition. Two jobbers in the Northwest have already contracted for a total of 2200 plants. Virtually all of the farm-plant manufacturers in the Middle West are interested in getting agencies to handle their products in foreign countries. Discounts around 40 per cent off list are quoted.

HEATING DEVICES.—The market is off on electric irons, toasters and the like just now, but the situation is not discouraging. Central stations have not been pushing these devices. However, the real months for iron campaigns are yet to come and are expected to bring the volumes back to normal. Manufacturers are convinced that prices are not the cause of the lesser volume.

CEDAR POLES.—Cedar poles are moving very actively in this territory. H. M. Byllesby & Company have bought poles for a 95-mile line, and the Indiana Traction Company bought fourteen carloads within the last week or ten days. Other concerns are buying in similar quantities. Some pole producers state that they have already done more business this year than they did during the entire year of 1918, excluding the government business.

LINE HARDWARE.—Apparently the builders of transmission lines are not favoring special construction material in high-tension line work so strongly this year.

WASHING MACHINES.—The washing-machine factories of the country still continue to report sales booked many months in advance. It is stated that wringers are the neck of the bottle on production. If the production of wringers could be increased, it is probable that more washing machines could be built in existing factories. It seems almost certain that there will be a wringer shortage when some of the larger factories now under construction or contemplated get into full production unless additional wringer-production capacity is provided. Prices on wringers show an increase of $1.50 each.

BOSTON

Trade maintains about the same volume as last week, business being particularly active in upper Connecticut. Prices are holding firm, and collections are still somewhat slow. With the passing of the Victory loan campaign to a successful termination conditions are expected to improve rapidly. Building operations are gradually increasing, though far from satisfactorily in view of the demand for homes.

Deliveries are well maintained and stocks are easily replenished Both manufacturers and jobbers have begun to buy somewhat more freely of raw materials and finished products respectively. Labor conditions in the electrical field are quiet. Contractors are actively engaged on small jobs, and a large amount of repair work is being handled. An instance of this is indicated in the fact that one electrical contractor in central New England is buying supplies from a local jobbing house at the rate of $4,000 a week.

FIXTURES.—A fair demand exists, notwithstanding the lateness of the lighting season. Here and there new stocking is being done.

FANS.—Little movement has yet occurred, but a tendency to "play up" the smaller sizes can be seen. The stage is set for rush business, but the ability of local stocks to go through the season appears dubious.

PORTABLE LAMPS.—A gratifying demand is maintained, and standardized, low-priced equipment is selling rapidly.

SCHEDULE MATERIAL.—Factories are buying more raw materials and the jobbers are sending in more orders. A representative manufacturer is increasing his labor account by taking on desirable employees. Full-time operation is noted. Foreign business is reported quiet, with the exception of Belgium. Factory stocks are increasing, and trade in the Middle West is said to be better than in the East.

MOLDED INSULATION.—The market is active, with substantial orders from the automobile and airplane makers. Foreign trade shows signs of life. Prices are firm and likely to remain steady.

FUSES.—The jobbers are probably considerably understocked. Fuse prices are at rock bottom, according to well-advised opinion. The market is dull and the factories are prepared for a building boom.

WASHING MACHINES.—The good work of taking orders keeps on, and an amazing demand for these equipments as well as for vacuum cleaners is noted. In appliances of this charcater a splendid momentum has been gained and the retailers are very active. The jobbers are hard pressed to supply the demand.

SIGNS.—Sign designers and manufacturers are making up for time lost in the restricted days and nights of the war period The lamp situation is greatly improved. Quite a demand for special illumination arises in connection with various patriotic causes, especially in the larger ceters.

ELECTRIC REFRIGERATING EQUIPMENT.—The volume of business is so large that the accumulation of factory stocks is almost impossible. Raw material is ample in supply. Prices are firm. Good deliveries are being secured on motors for this class of equipment.

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ATLANTA

The general trend of business is upward, and almost all lines in the electrical field continue active. The financial situation in this section is satisfactory. The banks appear to be in a position to take care of all legitimate requirements. The buying of lumber continues about equal to the output. Greatly increased activity has been noted in the real estate field A number of sections report a shortage of common labor. The output of pig iron shows a marked decrease, and only 50 per cent of the furnaces in the Birmingham district are active at this time. Of the twelve army camps sold by the War Department this week, comprising mostly National Guard camps, seven were in the Southeast.

ELECTRIC SIGNS.—Manufacturers report a gradual increase in business, which has come back slowly since the lightless night program. Prices remain fairly steady, except for a slight advance on special types Shipments are much improved.

FUSES.—Retail sales are well up to normal. Refillable fuses appear to enjoy an exceptional trade. There has been no change in price lately, and deliveries are prompt.

DRY BATTERIES.—Retail prices are steady at 55 cents and wholesale at 36 cents. The volume of business has slowed up considerably. Jobbers anticipate a price reduction soon and are not stocking heavily. Shipments from factories are good.

CONDUIT.—An improvement in business is noted. Shipments from Eastern points are excellent and prompt deliveries are being made from local stocks.

BELL-RINGING TRANSFORMERS. — Jobbers are enthusiastic over the future outlook for these, and where they placed orders in lots of 100 during the early part of the year orders now call for quantities of 500. Factory facilities have improved.

WIRE.—Both weatherproof and rubber-covered are moving briskly, and Southeastern stocks are ample to take care of current requirements. Weatherproof base is 18 cents and rubber-covered 20 cents.

BELLS AND GONGS.—This line has about passed through its dormant period, and reports from jobbers and dealers indicate that business is slowly improving. Apartment-house construction and a 5 per cent reduction this week have stimulated trade. Shipments are prompt.

VACUUM CLEANERS.—Steady prices and prompt deliveries from local stocks have materially tended to accelerate sales, and jobbers report a steady increase over the early spring months when trade was supposed to be at its height.

NON-METALLIC CONDUIT.—The last two months have witnessed a decline of 40 per cent from war prices. The demand is fairly constant; factory shipments are good, but local stocks are low.

WASHING MACHINES.—Sales are active. Jobbers are coöperating with dealers and central stations in campaigns throughout this section. Every one is doing a good business and optimism prevails. Car-load shipments are moving without difficulty.

MINIATURE LAMPS.—The call for all sizes is insistent, and the total volume of sales shows a steady increase. There has been no change in price lately. Manufacturers have absorbed the 5 per cent federal tax. Jobbers report that 85 per cent of their sales are for automobiles and the rest for flashlamps. Shipments are normal.

SEATTLE—PORTLAND

Seattle jobbers as a whole report business during the past week very slow, owing to the Victory Liberty Loan drive, scarcity of business building and uncertainty prevailing in steel shipyards regarding cancellation of existing contracts and awarding of new contracts for vessels calling for revised specifications. It is unofficially reported that the government may lift the embargo on construction of steel vessels for foreign account. If this is done, an enormous increase in the volume of sales from jobbers to yards will be noted immediately. At present both yards and supplying-industrial plants persist in hand-to-mouth buying. Seattle retailers state that business during the past week shows a considerable increase over the past two weeks. An increase in the sales of wire, wiring devices, lamps, fixtures and household appliances is reported by several of the largest dealers. This is due to the residence-building campaign, which is daily growing in momentum. Collections are good, especially in Seattle and Sound cities. Rural communities contiguous to Seattle report a bit slower collections. Collections from the government are prompt.

Sales of cord, lamp adjusters and house-wiring devices are increasing. Stocks are in excellent shape. There was a slight drop in price this past week. Telephone and telegraph apparatus is being sold for maintenance work only. Expected extensions and betterments have not materialized to date. Stocks are in good condition. Pole-line material is quiet at present, although a movement has been expected for some time. Jobbers have good stocks, but extensions to central-station service are being held back. Prices show no change.

Farm-ligting-plant sales during the past two weeks show an increase, particularly in eastern Washington and eastern Oregon. Stocks are in good condition and prices remain about the same. Washing machines, vacuum cleaners, irons and sewing machines are moving very well.

SAN FRANCISCO

The long-expected building boom is under way. Work has been started on the three-million-dollar power plant of the Sierra & San Francisco Power Company about 50 miles above Fresno, and the State Railroad Commission has just authorized the Great Western Power Company to issue $6,000,000 of bonds. A 40,000-kw. hydraulic plant for the latter company will be shortly begun.

General business conditions are good, and the feeling of uncertainty has been dispelled by the assurance of the Emergency Fleet Corporation that the state shipyards would not be dismantled. Credits and collections are good. Local stocks are excellent, and the time of shipment from the East and the time taken by Eastern factories to fill orders show favorable contrasts to the records of last year.

LAMPS.—Deliveries are good and in better proportionate shape than the demand, which has slacked off.

FANS.—An excellent season is predicted because of better factory deliveries and better salesmanship than last year. The fan is a recognized export item, and seasonal orders from that source are to be counted upon. Some complaint has been made about this season's prices, but the demand and the recognition of higher cost factors will sweep over this objection.

SWITCHES.—California, with its particular laws for the protection of motor-driven machines, has been a fruitful field for the sale of protected switches for several years. The completion of an inspection system should intensify this demand. Prices have been fairly constant for several months. Projected range campaigns will create a considerable demand for double-throw switches for separate control of ranges and water heaters.

INSULATING MATERIAL.—A new price schedule on fiberoid is announced, it being graded in such a way that the larger sizes mark a 10 per cent increase and the smaller sizes a slight decrease.

RUBBER-COVERED WIRE.—No. 14 single-braid solid has taken a slight stabilizing increase, but certain well-qualified authorities maintain that wire prices will be very constant for at least six months and that the peak of the demand for house-wiring sizes will be reached within the next three months and will be enormous.

LEAD-COVERED WIRE.—Certain small duplex lead-covered cables, previously reported as having considerably increased, have been restored to their old level, the advance having been due to the misinterpretation of a scale of factors used in figuring. Excellent lead-covered stocks are carried in San Francisco.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+20%
Coil to 1000 ft	List
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

	No. 14 Solid
Less than coil	$115.00
Coil to 1000 ft	100.00
	No. 12 Solid
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
⅜	$0.05½	1	$0.25
½	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$25.00	$18.00	$16.00
½-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
⅜-in.—	$60.00	$30.00	$26.00–26.50
½-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	½ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	½ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS
NEW YORK

List price	$7.00 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10-to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00—$36.00
Coil to 1000 ft	21.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S...	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$21.00–$24.15
1/5 to std. pkg	17.85– 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	List
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 10%
Std. pkg	8% to 23%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39–$0.41
No. 18, full spools	.35– .37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33 12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$17.50–$20.00	$9.50–$15.00	$9.50–$13.00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$24.00–$29.25
25 to 50 lb	24.00– 25.25
50 to 100 lb	23.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $35.75
25 to 50 lb	23.75 to 34.75
50 to 100 lb	23.75 to 37.35

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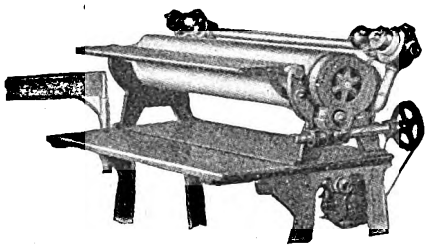
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Electrically Heated Ironing Machine

Instead of mounting the motor for operating the Simplex electrically heated ironer on the side of the machine, the American Ironing Machine



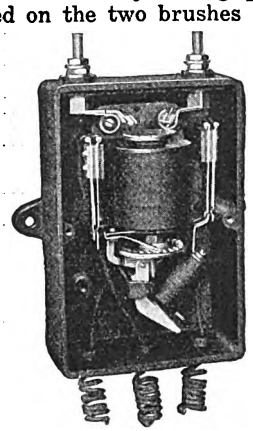
GREEN-TOPPED PILOT LAMPS PREVENT GLARE ON OPERATOR

Company of 168 North Michigan Avenue, Chicago, now places it underneath the machine where it is quite out of the way and where the belt is in no danger of getting entangled with clothes. This method of mounting cuts off 14 in. (36 cm.) from the length of the machine, and thus saves space in the laundry. Another improvement which has been made is the installation of pilot lights next to the three-heat snap switches controlling the heating units, which allows a complete indication of amount of heat being used. In the 32-in. and 37-in. (81-cm. and 94-cm.) sizes of these ironers there is only one heating unit but in the 42, 46, 48 and 56-in. (106, 116, 122 and 142-cm.) sizes there are two, one for each half of the ironing shoe. This divided heating element feature makes for economy in ironing small pieces, since only one side of the ironing machine need be used. The machine has been passed upon by the National Board of Fire Underwriters.

Remote-Control Double-Acting Automatic Switch

A remote-control, double-acting automatic switch furnished in ratings up to 15 amp., 110 volts, alternating and direct current, has been brought out by the Sangamo Electric Company of Springfield, Ill., intended for handling a light or power circuit. Remote control is effected by manually operated contact, dial or thermostatic control, and the operations both of opening and closing the switch are electrically controlled. Among the uses of the switch are controlling the operation of a small refrigerating set using a 2-hp. motor or one of smaller rating. In this case the thermostat contacts are completely protected from burning since both the opening and closing of circuits are performed within the automatic switch and not in the thermostat. The switch can be used with time-control systems for electric signs. A watchman outside the building can turn window lights on or off with a small key-operated remote-control switch in connection with the automatic switch; and where small motors are operated from a distant point, manually or by meter, clock or thermostat control, this automatic switch can be used.

The automatic switch consists essentially of a main closing solenoid designed to give a very positive closing of the circuit as the plunger is lifted. Contact is made by laminated phosphor-bronze brushes engaging the top of a copper disk carried on the solenoid plunger. Auxiliary arcing points are mounted on the two brushes to protect



MAY BE USED FOR REFRIGERATING SETS, SIGNS AND THE LIKE

the phosphor-bronze laminations. Both of the brushes give a strong wiping action, and at the same time a ratchet device, which operates whenever the switch closes, turns the contact disk slightly so that a new surface of the disk is presented to the brushes.

The switch is furnished in a substantial iron case with cast-iron cover, which is provided with a felt gasket, making the switch dustproof. A liberal design of all contacts of coils has been employed.

Electrically Controlled Synchronized Clock System

Operating on commercial lighting circuits with either alternating or direct current, the synchronized clock system developed by the International Time Recording Company of 50 Broad Street, New York City, is said to permit perfect timekeeping even if the current is interrupted, as it often is in the average factory which shuts down on Sundays. All use of primary or storage batteries is eliminated by this system.

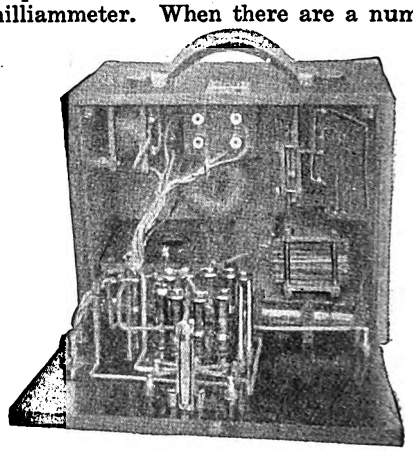
The entire outfit for a plant consists of a master clock of the weight-driven, self-winding type; a distribution or controlling cabinet, through which the current supply wires enter and in which the controlling relays are placed, and the secondary or recorder clocks. These latter are of the heavy type necessarily used to drive recording apparatus, are self-winding and are synchronized in a way which is said to permit a very wide range of correction.

Telephone Interference-Factor Meter

Based on the relation between voltage wave shape and interfering effect in telephone circuits, when power and telephone lines parallel each other, a unit called the telephone interference factor has been recently laid down by a committee of the American Institute of Electrical Engineers.

In order to make use of this factor apparatus has been developed by the committee and is being marketed by the Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, on which the ratio of current through one branch of network to the voltage applied at its terminals gives a measure of the telephone interference factor.

The measuring instrument of the apparatus consists of a vacuum thermocouple connected to a direct-current milliammeter. When there are a num-



MEASURES INTERFERENCE FACTOR DEFINED BY A. I. E. E.

ber of harmonics in the voltage wave applied to the apparatus, this instrument gives a reading proportional to the square root of the sum of the

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squares of the effects of the individual weighted harmonics. The network of this device, including auxiliaries, consists of the following parts: three condensers, four inductance coils, two resistors, one multiplier composed of a six-position dial switch and ten resistors, one vacuum thermocouple, one double-pole, double-throw switch, one voltmeter contact key and one fuse.

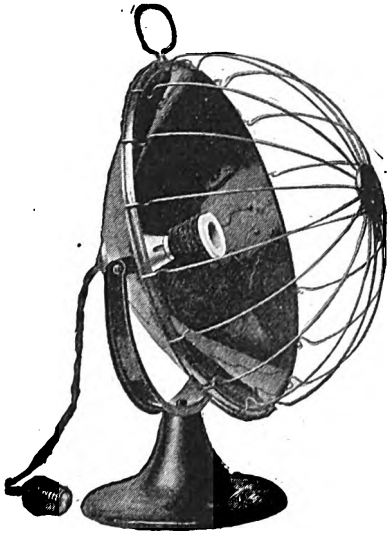
Battery Charger for Average-Size Garages

Capable of charging from one to sixteen 6-volt storage batteries or their equivalent in 12-volt or 24-volt batteries at one time, a battery-charging set of 1 kw. rating has been brought out by the Hobart Brothers Company of Troy, Ohio. A special feature is the HB universal automatic voltage control, which permits the charging of 6, 12 or 24-volt batteries at once.

It operates on two-phase or three-phase energy, but not on single-phase. There are two separate independent charging panels, each capable of carrying as many as eight 6-volt batteries. Each panel is complete, having its own ammeter, fuses, cut-outs, rheostat, etc., and with resistance for balancing the line and varying the charging rate.

Spherical Radiant Heater with Screw-Base Heating Element

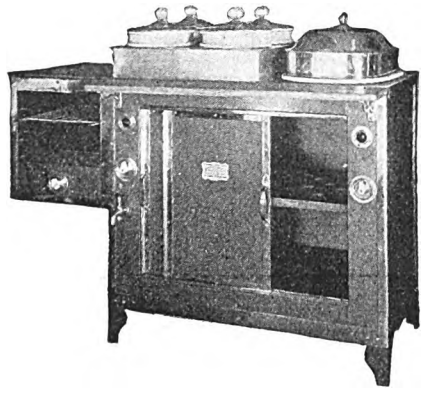
Designed to operate at an extremely high temperature, spherical-type radiant heater No. 99, rated at 600 watts, has been brought out by the Simplex Electric Heating Company, 85 Sidney Street, Cambridge, Mass. A coil-spring heating element is employed and is so placed as to project its heat rays with the greatest concentration. It is securely mounted on a porcelain form and may be easily unscrewed from the radiator just as a lamp bulb is removed from a socket. The reflector disk is of solid copper and is suitably protected.



COIL-SPRING HEATING ELEMENT CAN BE UNSCREWED FROM RADIATOR

Combined Electric Steam Table, Broiler, etc.

An electrically heated steam table, broiler, plate warmer, griddle and carving table have been combined in a unit just developed by the Duparquet, Huot & Moneuse Company of 108 West Twenty-second Street, New York City, for service in diet kitchens of hospitals The fixture measures 52 in. (132 cm.) long and 20 in. (50 cm.) wide. The copper-tinned steam table, which is 36 in. (91 cm.) long, contains a meat dish and four 1½-gal. (6-l.) white china vegetable jars, all fitted with tinned covers. Frying, toasting and other culinary operations may be performed on the griddle top, the dimensions of which are 20 in. (50 cm.) by 16 in. (40 cm.). The broiling and toasting area of the fixture is 12 in. (30 cm.) by 15 in. (38 cm.). The plate-warmer body is constructed of polished iron with nickel-plated trimmings and has two perforated shelves and sliding doors on the front. The warmer and carving table are controlled individually by three-heat switches mounted on the front of the warmer with indicating pilot lights. The switch controlling the broiler or toaster is mounted underneath it and is arranged to supply two heats.

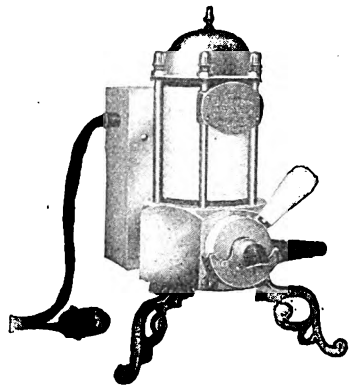


STEAM TABLE AND PLATE WARMER HAVE INDIVIDUAL THREE-HEAT SWITCHES

The steam table has an energy consumption of 2000 watts, the plate warmer one of 1500 watts, and the broiler one of 3000 watts. The total connected load of the fixture is 6½ kw. Its approximate weight is 350 lb. (159 kg.).

Electric Water Heater for Portable and Stationary Use

No extra wiring is required to install the "Little Wonder" electric water heater, manufactured by the Feldman Manufacturing Company, Times Building, New York City, for use in homes, doctors' and dentists' offices, soda fountains, barber shops and so forth. It can be attached to the ordinary cold-water pipe by making the electrical connection and screwing the heater on the pipe. In addition to the stationary use of the heater, it may be made portable by connecting a rubber hose from the faucet to the heater and screwing the plug into any lighting socket. A by-pass is provided in the heater so that ordinary cold water is obtained by turning its handle in the reverse direction to that used when hot water is desired.

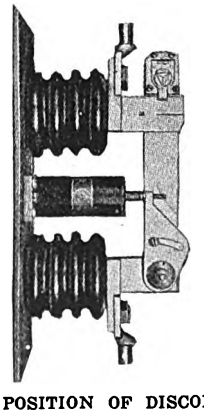


TURNING HANDLE TO LEFT GIVES HOT WATER, AND TO RIGHT COLD WATER

The faucet of the heater is connected with the current supply switch, so that upon turning the faucet handle to the left the water supply and current supply are simultaneously turned on and the heated water is drawn off at the faucet. About 22 gal. (83 l.) per hour is the capacity of the heater, which is made for 110 volts, alternating and direct current. The weight of the heater is 14 lb. (6 kg.), its height is 12 in. (30 cm.), its depth is 7½ in. (19 cm.), and its width is 4½ in. (11 cm.). Three legs are attached to the heater in portable use, but these are removed when the heater is fastened directly to the water pipe and when it is packed in a grip or bag for traveling.

Safety Auxiliary Switch for Disconnecting Switches

In installations where the operator does not have a clear view of the disconnecting switches he must leave the switchboard to determine whether the "disconnects" are in open or closed position before closing the oil switch. However, if the disconnects are equipped with an auxiliary switch operated by the main blade, colored pilot lamps can be installed on the switchboard and so connected that the disconnecting



INDICATES POSITION OF DISCONNECTING BLADES AT REMOTE POINT

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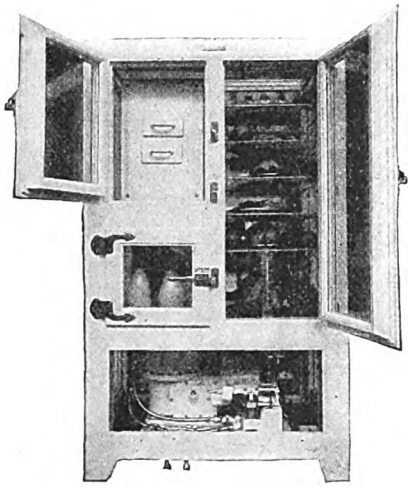
switch position is indicated. Such an auxiliary mechanism, consisting of a plunger insulated switch placed as shown, and equipped with contacts for wiring to the pilot lamps, has been brought out by the Delta-Star Electric Company, 2433 Fulton Street, Chicago. In the illustration this disconnecting switch is shown in closed position, and therefore the corresponding lamp on the switchboard would be lighted.

Self-Contained Automatic Iceless Refrigerator

Operating on a principle similar to the so-called compression system used in large cold-storage plants, a household-size, self-contained, automatically operated iceless refrigerator, known as the "Frigidaire," is being marketed by the Frigidaire Corporation of Detroit, Mich., and 1760 Broadway, New York City. In addition to maintaining food at the proper temperature, this machine can also make 150 small ice cubes for table use and special purposes.

A brine tank in the upper left-hand portion of the refrigerator is maintained at a temperature of approximately 15 deg. Fahr. (—9 deg. C.), and this promotes a rapid circulation and cooling of the air in the food compartments. The tank absorbs heat from the air and in turn the expansion coils in the tank absorb the heat from the brine. Refrigeration is supplied by sulphur dioxide, which is readily liquefied at room temperature and at low pressure. The liquid sulphur dioxide is evaporated in the expansion coils and is then sucked down by a pump into a condenser, where it is changed from a gaseous state into a liquid and the process repeated. In this way the brine is kept in constant circulation. The pump used is a two-cylinder piston type driven through a four-to-one spiral gear reduction by a



AN AUTOMATIC CONTROLLER MAINTAINS A CONSTANT TEMPERATURE

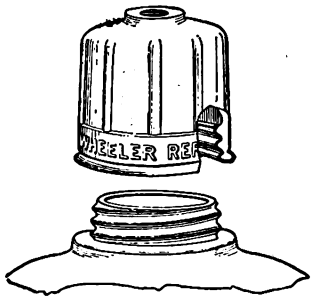
¼-hp. electric motor whose bearings are automatically oiled from a large supply in the gear case.

The temperature of the cabinet is maintained constant by an automatic controller which starts the motor when the air temperature rises above normal and stops it when the temperature goes below normal. Water is used instead of air for the condenser, thus keeping the working pressures low.

Fixtures for Exposed Positions

A canopy which serves as a universal fitting for either a medium or a mogul base multiple socket and supports any one of six different groups of porcelain-enameled steel reflectors, in all sizes, to accommodate all multiple tungsten lamps from 25-watt to 1000-watt sizes, is a feature of the "1300" line of fixtures developed by the Wheeler Reflector Company, 156 Pearl Street, Boston, for the lighting of railroad properties and other exposed locations.

The canopy or socket housing is of galvanized cast iron and has a copper screw ring rolled around a bead on the lower edge of the skirt to engage the enamel threaded collar of the reflectors. These canopies are obtainable in styles with cross-arms and ¾-in. (19-mm.) thread, without cross-arms and ½-in. (13-mm.) thread, with insulated loop



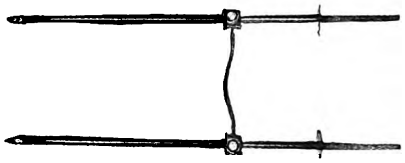
CANOPY TAKES SIX DIFFERENT STYLES OF REFLECTORS

suspension, with cross-arms and suspension loop, a style with ¾-in. (19-mm.) side posts for lyre pole tops, and a style in porcelain-enameled steel for locations less exposed to the weather than where the cast-iron styles are used.

The reflectors for use with these canopies are made of porcelain-enameled steel and have a white reflecting surface and a green outside finish. They may be had in six styles with various light distributions and for different services.

High-Voltage Detectors

A simple arrangement of special incandescent lamps connected in series with a carbon-tetrachloride fuse and carborundum resistance are the principal parts of the high-voltage detectors being manufactured by Schweitzer & Conrad, 4431 Ravenswood Avenue, Chicago. When the terminals of this device are placed across the line or other apparatus to be tested, the glowing of the lamps indicates the presence of potential. The detector illustrated may be used for either overhead or underground work. It is supplied in three different sizes for operating at maximum potentials of 7500 volts, 15,000 volts and 25,000 volts respectively. A switching arrangement is provided so that either one or two lamps may be used in the detector circuit, making it possible to obtain maximum indication



GLOWING OF LAMPS INDICATES PRESENCE OF POTENTIAL

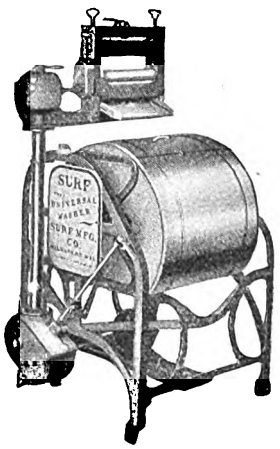
of the lamp at full voltage or half voltage. The manufacturers claim that these devices add greatly to safety in testing high-voltage apparatus and lines.

Vacuum Cleaner with Adjustable Handle

A belt-driven spiral brush, heavy cast aluminum handle bale, rubber carrier wheels and a handle-adjusting spring that facilitates operation on long-nap rugs are the features of the Model B "America" vacuum cleaner marketed by the Wise-McClung Manufacturing Company of New Philadelphia, Ohio. Other features are a well-balanced aluminum fan and an efficient lubricating system.

Electrically Driven Suction Clothes Washer

The false bottom of the tub used in the electrically operated washing machine being placed on the market by the Surf Manufacturing Company, 588 Clinton Street, Milwaukee, Wis., is raised and lowered to create a suction motion and thereby force water through the clothes. This action of the false bottom is repeated seventy-two times per minute. Some of the advantages which the manufacturers claim for this machine are that it is of all-metal



FALSE BOTTOM OF TUBS CREATES SUCTION AND FORCES WATER THROUGH CLOTHES

construction and has cut gears running in an oil-tight case, direct drive with flexible motors, flexible couplings between the motor and the driven shaft,

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swinging wringer and a patented drive which imparts a smooth motion to the tub. The machine is made in only one size, the extreme width being 25 in. (63 cm.). It is finished with either a copper or a galvanized tub.

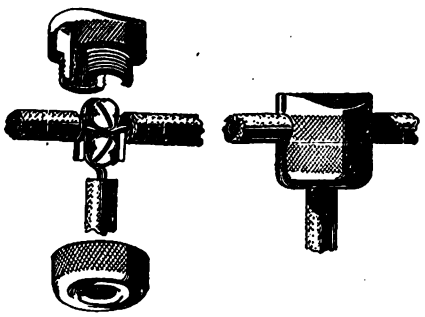
Vacuum Cleaner with Rapid Revolving Brush

The brush of the Federal electric vacuum-cleaner model "19," recently developed by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, makes four revolutions to one turn of the casters. It is said to remove all surface dirt thoroughly, lift the matted nap of the carpet and loosen the dirt lodged in the fabric, all without injuring the rug or carpet. The brush is of the tufted spiral type, placed inside the nozzle.

The cleaner weighs 10 lb. (4.5 kg.) and is made of cast aluminum. The motor is of the universal type, is set vertically, is air-cooled and has a speed of 10,000 r.p.m. The fan is a one-piece aluminum casting 4 in. (10 cm.) in diameter, is directly connected to the motor shaft and has six 1-in. (2.5-cm.) blades. The nozzle has a mouth 12 in. (30 cm.) wide and 1 in. (2.5 cm.) across the opening. The air passage from floor to dust dag is short and direct, of large capacity, without angles or dust pockets. The bag is double-lined and of closely woven texture. The neck extends upward, allowing passage of air, but preventing the dust from dropping back into the machine. By a quarter turn the bag is detached for emptying. The pistol-grip handle has a snap switch handily placed to the operator's fingers. The cord is looped up on two hooks on the handle when not in use.

Three-Way Connector for Condulet and Tap Joints

A solderless, tapeless three-way connector for condulet connections and tap joints has been brought out by the Walger Connector Company and is being marketed by C. Jackson of 22 College Street, Toronto, Canada. As



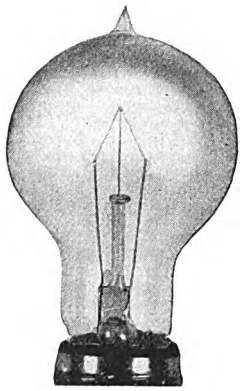
UNASSEMBLED AND ASSEMBLED VIEWS OF CONNECTOR

can be seen from the illustration, it consists of three pieces—the insulating cap and shell and the connector proper. The three wires are gripped to the metal conducting plate by screws, thus doing away with the inconvenience of tape and solder. The upper part of the insulating shell is then fitted over two of the wires, part of the shell being cut away for this purpose. It is finally screwed to the cap, which is slipped over the third wire before that is attached to its screw.

Gas-Filled Lamps for Farm-Lighting Plants

With the increasing use of low voltage farm-lighting plants, there is a demand not only for vacuum-type lamps but also for the gas-filled variety. Accordingly the Independent Lamp & Wire Company of 1737 Broadway, New York City, has developed and standardized two gas-filled lamps for 32 volts, one being of 25 watts and the other of 15 watts, both made in the G18½-size bulb.

The filament of this bulb is made of a very fine wire and consists of two parts. These two parts are arranged



FILAMENT CONSISTS OF CLOSELY WOUND HELICAL COIL

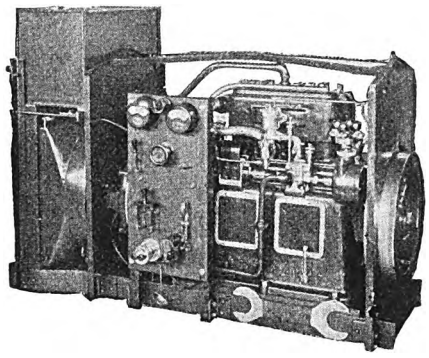
in a V-shape as shown in the accompanying illustration. The lamps are marketed under the trade name of "Tungsol," and the makers say that all parts are manufactured in one factory.

Gasoline Electric Generating Sets

Ease and inexpensiveness in operation are the two claims made for the gasoline electric generating sets which the B. F. Sturtevant Company of Hyde Park, Boston, has placed on the market.

The sets are intended to be used directly on lighting and power circuits and not through a storage battery, although battery installations can be made if desired. Accurate governor control is said to insure a constant voltage through wide variations of load. These sets can be used to supply light and power to homes, hotels, estates, amusement parks and electric signs and to supply arc lighting for small districts. Power, lighting and energy for wireless telegraphy may also be obtained through their use on shipboard.

A gasoline engine directly connected to a direct-current generator forms the main part of these sets. The engine is a four-stroke cycle, water-cooled, vertical type, with either four or six cylinders, depending on the unit's size.



ALSO FURNISHED WITHOUT FAN, RADIATOR, TANK OR SWITCHBOARD

Both generator and engine are capable of operating successfully under an overload of 25 per cent, it is declared. The sets are built in three sizes, of 5, 10 and 15-kw. capacity, capable of lighting 200, 400 or 600 20-cp. tungsten lamps.

The accompanying illustration shows a self-contained unit developed for war purposes but now offered to the general trade. A generating set is mounted on a substantial iron base together with an automobile type radiator, a cooling fan, gasoline tank and switchboard. All the working parts are completely inclosed in a sheet-metal case similar in design to an automobile engine hood.

NOTES ON RECENT APPLIANCES

Cream Separator

An electrically driven cream separator is being made by the Rock Island Plow Company of Rock Island, Ill.

Automatic Coal Scale

For continuously weighing coal in power plants the James A. Brady Foundry Company of Chicago has developed the Reliance automatic scale.

Chronometric Precision Tachometer

The Central Scientific Company, 460 East Ohio Street, Chicago, is marketing the Van Sickler-Elgin chronometric precision tachometer.

Iceless Refrigerator

Iceless refrigerators with electrically driven refrigeration systems using chloride of ethyl are being made for homes and stores by George Spalt & Sons, Inc., Albany, N. Y.

Pole Hook and Rope Clamp

For holding the lowering chain or rope of street-lighting fixtures which are suspended from poles or street spans, the Line Material Company, South Milwaukee, Wis., is manufacturing a pigtail pole hook and rope clamp.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The manager of a general business agency in Spain (No. 29,286) wishes to purchase electric sky signs. Correspondence may be in English.

A manufacturer in Bohemia (No. 29,215) desires to purchase electric carriage lamps. Catalogs and price lists are requested. Correspondence may be in English.

Various kinds of domestic electric lighting plants are required by a man (No. 29,255) from Colombia who will soon arrive in this country for the purchase of same.

A man in Italy (No. 29,259) wishes to secure the representation of firms for the sale of electrical supplies and electrical machinery. Correspondence may be in English.

The proprietor of a firm in Norway (No. 29,191) wishes to purchase and secure an agency for the sale of electrical apparatus and supplies. Payment to be made through a New York bank.

The representative of a firm in France (No. 29,188) who is in this country for a short time desires to secure an agency from manufacturers for the sale in France and Morocco of electrical appliances.

A firm in Norway (No. 29,278) wishes to purchase electrical apparatus and supplies, installation service, household appliances, wire and cable. Quotations should be given f.o.b. New York. Terms, cash against documents at New York, or destination.

Exclusive representation is desired by a company in India (No. 29,263) for the sale of electrical goods, motors, dynamos, electrical lighting sets, pumps and elevators. It is requested that triplicate sets of catalogs, price lists and samples where necessary be forwarded.

A man in India (No. 29,216) wishes to purchase high-class machinery for a laundry capable of handling about 3000 articles a day. It is desired that separate quotations be given for machinery necessary for generating and distributing electricity at the laundry. Terms, cash on delivery.

The director of the equipment section of the naval aviation service of a European country (No. 29,258) desires to purchase electrically driven machine tools, for metal and wood, and to be used for hand drills, hand grinders, etc. This machinery is needed for the maintenance of the equipment of the service, and for the construction of new equipment. Catalogs, prices, and general information should be forwarded. Correspondence may be in English.

An engineering firm in Italy (No. 29,205) wishes to purchase single-phase and three-phase motors, direct-current motors and dynamos, electric machinery for ships and mines, automatic safety signal devices, electrical measuring and recording instruments and bulbs for gas-filled lamps. An agency is also desired for the sale of "Argentana" wire or other materials for electrical resistance, special small plates for the construction of motors and transformers, copper wire, diameter 3 mm. to 8 mm., for electrical transmission lines, and copper braid, 6 m. to 10 mm. in diameter. It is stated that if advisable one of the members of the firm will visit this country in order to furnish additional information. Correspondence should be in Italian or French

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DAMAGE TO FRENCH TELEPHONE LINES.—It has been reported that the enemy destroyed or rendered useless 1976 miles of telephone and telegraph lines in the invaded regions.

STRAITS SETTLEMENTS ELECTRICAL IMPORTS.—Imports of electrical machinery into the Straits Settlements in 1916 and 1917 from the United Kingdom decreased from $162,000 to $139,000. There was an increase from Japan from $9,000 to $40,000 and an increase from the United States from $11,000 to $84,000.

PACIFIC COAST CREDIT MEN ELECT OFFICERS.—At the fourteenth annual meeting of the National Electrical Credit Association of the Pacific Coast, held on April 3, the following officers were elected: President, H. H. Sweifel, Electric Appliance Company, San Francisco; first vice-president, R. J. Holtermann, Holabird Electrical Company, San Francisco; second vice-president, J. J. O'Reilly, Western Electric Company, Seattle; third vice-president, H. G. Chapman, Pacific States Electric Company, Los Angeles.

RADIO DETECTOR LICENSE AGREEMENT.—Announcement was made at the De Forest Laboratories at High Bridge, New York City, recently, that as a result of a license agreement with the Morehead Laboratories at San Francisco, which are operating under the Fleming valve license issued by the Marconi company, the three-electrode vacuum-tube detector, otherwise known as the De Forest audion, which is used in radio apparatus for receiving, is once again on the market for amateurs after court litigation covering a period of two years. Following the injunction proceedings brought both by the De Forest company and the Marconi company against each other, the manufacture and sale of the audion was held up and the Marconi company was restrained because of conceded infringements on the three-electrode device.

F. E. STOW HEADS WESTINGHOUSE AGENT-JOBBERS.—F. E. Stow, secretary-treasurer of the H. C. Roberts Electric Company of Philadelphia and Syracuse, has just been elected president of the Westinghouse Agent-Jobbers' Association at its annual convention at Del Monte, Cal., succeeding J. C. Schmidtbauer, vice-president of the Julius Andrae & Sons Company, Milwaukee, Wis., who has held the office for the past two years. Mr. Stow is a graduate of Sheffield Scientific School, Yale University. For the past fifteen years he has been closely affiliated with the H. C. Roberts Company. Previous to his connection with this company he was a member of the Peck, Stow & Wilcox Company, dealer in hardware, of Southington, Conn. As a charter member, always active and thoroughly conversant with affairs of the Agent-Jobbers' Association, Mr. Stow is a most logical selection as head of this enterprising organization.

INCREASING MARKET FOR ELECTRICAL APPARATUS IN SCANDINAVIA.—In countries which produce much cheap electricity by means of water power other kinds of motor vehicles are being hard pressed by electric vehicles. The wear and tear on the engines of the latter is smaller, and they are easier to run and therefore more practical in crowded thoroughfares. The *Berlingske Tidende* reports that the Danish postal service has ordered thirty electric vehicles and the Norwegian government has ordered fifty electric trucks for transportation of foodstuffs, etc. Electric vehicles are also being used very much lately for private purposes. As soon as shipping becomes again free there will be an almost unlimited demand from Norway and Sweden for hydraulic and electric machinery. The lack of coal in all Scandinavia will tend to promote the electrification of railroads and the general replacement of steam engines and oil motors by electric motors throughout industrial establishments. Cables will probably be laid from Norway and Sweden to transmit electric power to Denmark. (There is already a small transmission in existence from Sweden.)

CAPT. J. A. M'INTOSH, who has been in the service overseas with the Tank Corps, has returned to his former position in the engineering department of the Ohio Brass Company.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, announces the appointment of L. L. Goding as sales manager, to take effect immediately. Mr. Goding has formerly been connected with the Fairbanks-Morse Company, the Century and the Wagner sales organizations.

THE ELECTRIC FURNACE CONSTRUCTION COMPANY, Philadelphia, reports a repeat order from the Ford Motor Company for a Greaves-Etchells electric furnace installation. The initial furnace was installed last year, and it is reported that it has given extremely good results.

A. E. ARTHURS has been appointed as special representative in the Pittsburgh territory by the Bussmann Manufacturing Company of St. Louis. His many friends will be pleased to learn of his safe return from duty with the American Air Service in France, where he was decorated with the Croix de Guerre.

THE REICHMAN-CROSBY COMPANY, Memphis, Tenn., is the latest addition to the Westinghouse Electric & Manufacturing Company's agent-jobber family. The Reichman-Crosby Company, organized in 1894, specializes in sawmill machinery and supplies.

THE CHICAGO PNEUMATIC TOOL COMPANY announces the election of Allan E. Goodhue as managing director of its English subsidiary, the Consolidated Pneumatic Tool Company, Ltd., with offices at 170 Piccadilly, London. Mr. Goodhue will also be in charge of European sales for the Chicago Pneumatic Tool Company. Mr. Goodhue is to sail for England May 13.

PAUL E. FOLLICK and Roy F. Trimble, Bloomington, Ill., have formed a new electrical supply house, to be known as the Trimble & Follick Electric Company. Mr. Trimble has been head electrician for the Bloomington & Normal Railway & Lighting Company for the last six years. Mr. Follick has just been discharged from the aviation service of the army, where he served for eighteen months as an electrician. The new firm's offices will be at 320 South Main Street. It will make a specialty of farm lighting.

THE VULCAN STORAGE BATTERY COMPANY, Brazil, Ind., announces the election of William Petschel as vice-president and general manager. Mr. Petschel was formerly president and manager of the Atlas Electric Storage Battery Company, Greenville, Mich. The Vulcan company will move into new quarters as soon as the government vacates, and it excepts to be ready to make deliveries about June 1, 1919. The new catalog showing improvements in storage batteries will be completed soon, it is announced.

L. M. COCHRANE, who has been associated with the Northern Electric Company, Ltd., in Calgary, Alberta, and Winnipeg, Manitoba, for the last eight years, has resigned his position of district sales manager of the Winnipeg district to enter into business for himself. Mr. Cochrane is opening a sales office in Winnipeg, which will be his headquarters, and he will represent manufacturers of electrical and automobile accessory products. He will cover the western territory from Port Arthur and Fort William to the Pacific Coast, and will work with jobbers and distributers exclusively. Mr. Cochrane is visiting manufacturers in eastern Canada and the United States completing arrangements in connection with his business and expects to open his office about June 15.

THE ANDERSON ELECTRIC CAR COMPANY, Detroit, Mich., has had its manufacturing divided into three companies. The Anderson Electric Car Company manufactures bodies for the Packard Company and the Detroit Electric Car Company. M. S. Towson is president and Gordon Fairgrieve is general manager. The Elwell Parker Company, Cleveland, Ohio, under the same officers, manufactures industrial tricks under the direct management of M. S. Towson. The Detroit Electric Car Company manufactures electric pleasure cars. W. C. Anderson is president, G. M. Bacon vice-president and chief engineer, F. E. Rice treasurer and general manager, A. C. Downing vice-president and sales manager. The New York office is called the Detropolitan Detroit Electric Automobile Company. Sam Menefee is in charge as secretary-treasurer, but F. E. Price of the parent company is president.

THE THOMPSON ELECTRIC COMPANY, manufacturer of electric lighting equipment, Cleveland, Ohio, makes, through a form letter, the following announcement: "Believing that a large part of the present general disinclination to buy is due to uncertainty as to the future of prices, with a probable tendency in many lines toward lower prices, we are going to attempt to do our bit toward stabilizing the situation by making a rather sweeping reduction in our prices at this time. We also agree to protect you with respect to any further reduction by refunding the difference between prices paid and the reduced prices on all orders for thirty hangers or more from now until Sept. 1, 1919. That is to say, we assume the risk of lower prices so that our customers may feel free to purchase now and be assured that they will get the benefit of the lowest prices prevailing during that period. Should there be no further reduction until Sept. 1, the chances are there will not be any during the rest of the year. We do not, however, guarantee that there may not be an advance in prices within the period mentioned."

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THE DESPATCH MANUFACTURING COMPANY, INC., Minneapolis, Minn., announces that, owing to the constantly growing demand for electric ovens and heating appliances, it has moved to larger quarters at 116 to 122 First Avenue, North, Minneapolis, Minn., where an acre of floor space is utilized.

R. SANFORD RILEY, president of the Sanford Riley Stoker Company, Worcester, Mass., and the Murphy Iron Works, has returned to his private interests after having completed the organization of a performance section of the Emergency Fleet Corporation. The performance section has charge of all trial trips and follows up the defects developed in service.

THE BOOTH HALL COMPANY, designer and builder of electric furnaces, has moved its executive and sales offices to 1007 Hearst Building, 326 Madison Street, Chicago, from 565 West Washington Boulevard, Chicago. The change, it is announced, was necessitated by new arrangements which will make for increased facilities for turning out standardized furnace equipment in larger volume.

THE ST. PAUL ELECTRIC COMPANY, St. Paul, Minn., announces the appointment of M. R. White as manager of its reorganized machinery department and in charge of engineering, service and sales work in connection with machinery and power apparatus. Mr. White has had ten years' experience in installing central station plants, high-tension transmission lines and industrial machinery.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., announces that H. S. Lyons, who for two years prior to his entry into the aviation branch of the service had charge of the sales of the company s push-button specialties and wiring devices in the territory covered by the Chicago office, has returned to the company. Mr. Lyons is now engaged on sales work in the magnetic shift department.

THE VAN DORN ELECTRIC TOOL COMPANY, Cleveland, Ohio, announces that the new Chicago office is at 527 South Dearborn Street. William Cottrell, sales manager at the Chicago branch, says that the phenomenal increase in business enjoyed by the company is the result of the insistent demand to-day for mechanical devices of proved efficiency and economy. He emphasizes the imperative need of the increased accommodations.

THE PACKARD ELECTRIC COMPANY, Warren, Ohio, has opened a New York office at 141 West Thirty-sixth Street, Room 501, Herald Square Building, with Capt. J. E. Erickson as district manager. During the war Mr. Erickson was in Washington in charge of the transformer division for the government. The Packard company expects to branch out in the East, having supplied a great many of the electrically furnished steel plants throughout that district.

THE MITCHELL-RAND MANUFACTURING COMPANY, after extensive alterations to the building at 18 Vesey Street, New York City, has brought together its general offices, laboratory and warehouses under the one roof at this address. Founded over thirty years ago, the firm until quite recently dealt exclusively in waxes, asphaltum and compounds manufactured therefrom—sealing waxes, waterproofing and roofing cements, etc.; later electrical insulating compounds were produced, and to these were added insulating paints, varnishes, soldering paste, varnished tubing, manufactured mica, varnished materials and papers. As Eastern representative of the Hope Webbing Company the Mitchell-Rand Company carries an extensive stock of tapes.

THE CROWN ELECTRIC MANUFACTURING COMPANY, St. Charles, Ill., manufacturer of indoor lighting fixtures, is reported to the Department of Labor as having locked out its employees. According to the report sent to the department, the company has required overtime work from 5 to 9 o'clock three nights a week, but with pay at the usual rate. The employees presented demands for an eight-hour day, an increase in wages of 20 cents an hour, and time and one-half for overtime. The demands were ignored and the employees refused to continue overtime work. The company thereupon declared discharged all who failed to return for overtime. The workers have been paid at the average rate of 40 cents per hour. One-half of the jobs in the factory are government contracts. Commissioner Oscar F. Nelson has been assigned to investigate conditions at the plant and to attempt an adjustment of the controversy.

Trade Publications

ELECTRIC IRON.—The Duo Point electric iron made by the Central Flatiron Manufacturing Company of Johnson City, N. Y., is described in a leaflet of recent issuance.

COMPRESSION COUPLINGS.—Imperial compression couplings for garages and automobile dealers are covered in a circular from Asch & Company, 1779 Broadway, New York City.

AUTOMOBILE SPECIALTIES.—Asch & Company, 16 West Sixty-first Street, New York City, have issued a catalog of automobile specialties, many of them being electric accessories.

WASHING MACHINE. — The Remmert Manufacturing Company of St. Louis, Mo., has issued an illustrated booklet about its new "Locomotive" washer in which the washing tub reciprocates on a horizontal plane.

IRONING MACHINES.—The American Ironing Machine Company, 166 North Michigan Avenue, Chicago, is circulating catalog No. 39, Section A, about the Simplex electrically driven ironers for laundries.

WASHING MACHINES. — The Victor Manufacturing Company of Leavenworth, Kan., has printed a folder called "Taking the Rub Out of Washday" to set forth the advantages of the Wonder electric washer.

CONCRETE POSTS. — "Star" concrete posts for street-lighting service are illustrated and briefly described in an attractive booklet published by the Chicago Concrete Post Company, 608 South Dearborn Street, Chicago.

VACUUM CLEANERS.—"Magic Cleaning," a colored circular issued by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, for dealer distribution, has for its subject the Federal vacuum cleaner.

RANGES AND APPLIANCES.—"Cook the Electric Way" is the title of a booklet issued by the Rutenber Electric Company, Marion, Ind., to tell about its electric ranges, hot plates, table stoves, toasters, irons and radiators.

SCREWDRIVERS. — Strong's "Hyvoltage" screwdrivers with insulated handles and "Hyfield" emery-wheel grinders are described in an illustrated booklet that the Hyfield Manufacturing Company, 21 Walker Street, New York City, has issued.

MOTOR STARTERS.—Fused-oil motor starters with attachments are completely described in bulletin No. 432, which is being circulated by the Condit Electrical Manufacturing Company of South Boston, Mass., to supersede advance sheet No. 432.

BATTERY-CHARGING METER.—The Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, Ohio, has issued a small leaflet about its electric "Chargometer" for automatically determining rate of charge of batteries of industrial trucks, tractors, etc.

GASOLINE-ELECTRIC GENERATING SETS.—B. F. Sturtevant Company, Hyde Park, Boston, is circulating a well-printed and illustrated booklet containing complete descriptive matter on its new gasoline-electric generating sets. The publication is known as catalog No. 255.

LAUNDRY WASHING AND WRINGING MACHINES.—The American Ironing Machine Company, 166 North Michigan Avenue, Chicago, is distributing bulletin No. 39-13, containing descriptive matter on the Simplex electrically operated clothes washers, extractors and wringers for laundry use.

CONDENSER. — In a well-written and illustrated thirty-two-page booklet the Dubilier Condenser Company, 217 Center Street, New York City, gives a history of the Dubilier mica condenser, together with its uses. Other condensers for radio work are cataloged and a section of the publication deals with overhead-line protection.

FURNACES.—Booklet 5-B, which has been prepared by the Electric Furnace Company of Alliance, Ohio, contains descriptive matter on Baily electric furnaces for melting non-ferrous metals. Typical installations of these furnaces are shown as well as a special transformer and selective oil-break switches for furnace control.

MOTORS.—Bulletins No. 215, 216, 217, 219, 220, 221, 222 and 223, issued by the Electric Specialty Company, Stamford, Conn., describe respectively type R direct-current motors, type D-5 direct-current motors, type B alternating-current bipolar motors and generators, type J direct-current motors, type H and K direct and alternating-current interchangeable motors, motor-generator sets and back-gear drive for low speed. All these bulletins are illustrated.

New Incorporations

THE SEYMOUR (TEX.) POWER & ICE COMPANY has been incorporated with a capital stock of $50,000 by George Burkhalter, C. B. Morris and others.

THE OAK PARK (ILL.) ELECTRIC COMPANY has been incorporated with a capital stock of $5,000 by F. K. Holland, P. B. Holland and F. M. Stuart.

THE ETHICAL X-RAY CORPORATION of New York, N. Y., has been incorporated by M. Spencer, A. H. Barnett and J. A. Gettenberg, 55 Liberty Street, New York, N. Y.

THE DAILIE ELECTRIC COMPANY of Springfield, Ohio, has been incorporated with a capital stock of $10,000 by W. F. Dailie, F. C. Reed, Walter F. Ross and others.

THE ROVERTAFT ELECTRIC APPLIANCE COMPANY of Binghamton has been chartered with a capital stock of $25,000 by A. B. Rover, J. O. Taft and L. C. Rhodes.

THE STAR ELECTRIC COMPANY of Johnson City, Tenn., has been incorporated with a capital stock of $5,000 by S. W. Carter, G. C. Sanders, W. F. Kipling and George W. Keys.

THE ACME LAMP WORKS, INC., has been incorporated with a capital stock of $1,000 by Nathan Schwartzer, A. Berrenberg and I. C. Mondshain, 424 Hopkinson Avenue, Brooklyn, N. Y. The company proposes to manufacture lamps and electric and gas fixtures.

THE ARROW FLEXIBLE CONDUIT COMPANY of New York, N. Y., has been incorporated by H. Ginsberg, A. Rappaport and M. Janiger, 2346 Eighty-fifth Street, Brooklyn,. The company is capitalized at $6,000 and proposes to manufacture flexible conduit box cable.

THE ABERCROMBIE-BOCK ELECTRIC COMPANY of Bridgeport, Conn., has been chartered with a capital stock of $10,000 to manufacture electrical specialties. The incorporators are Francis J. and Harry C. Abercrombie of Bridgeport and Fred W. Bock of Hartford, Conn.

HULBERT MOTORS, INC., of New York, N. Y., has been incorporated with a capital stock of $225,000 by F. X. Carmody, M. J. Moon and G. A. McLaughlin, 680 West End Avenue, New York City. The company proposes to manufacture auto vehicles, electric and other motors.

THE SOLSVILLE ELECTRIC LIGHT & POWER COMPANY of Utica, N. Y., has been incorporated with a capital stock of $10,000 to generate and distribute electricity for lamps, heaters, motors, etc. The incorporators are Louis F. Joerissen, Mary A. Ownes and Lillian J. Horrigan of Utica.

THE HOLGATE (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $20,000 by W. P. Wallace, E. T. Howell and John F. Deatrick of Defiance and Thomas R. Wickenden of Toledo. The company has taken over the municipal electric light plant.

THE CAROLINA ELECTRIC & MACHINERY COMPANY of Greenwood, S. C., has been incorporated with a capital stock of $25,000 to deal in electrical apparatus and machinery. The officers are: E. S. Moorer, president and manager; J. B. Walton, vice-president, and E. O. Bass, secretary and treasurer.

THE SOUTHERN ELECTRO STEEL COMPANY, Scott Building, Lynchburg, Va., has been incorporated with a capital stock of $200,000 to establish a steel foundry in Lynchburg. The officers are: Joseph N. M. Keyzer, president and designing engineer; A. P. Montague, vice-president, and W. W. Ruble, secretary and treasurer.

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New England States

SPRINGFIELD, VT.—Contract has been awarded by the Colonial Power & Light Company to McDonald & Joslyn of Boston, Mass., for the construction of a new substation and office building on Clinton Street. The plans also provide for the erection of an outdoor substation and the installation of considerable new equipment.

SOMERVILLE, MASS.—The installation of an ornamental lighting system in Somerville is under consideration.

SPRINGFIELD, MASS.—Arrangements have been completed by the United States government for the erection of an addition to the engine plant at the Arsenal Hill shops and for alterations and improvements to the existing works, to cost about $25,000. The A. E. Stephens Company, 318 Main Street, Springfield, is contractor.

WESTFIELD, MASS.—The Crane Paper Company has made arrangements with the municipal electric light department to secure energy to operate its plant on Mill Street from the town. The company will retain its present plant for use in emergencies.

NEW HAVEN, CONN.—Plans have practically been completed by Brown & Von Beren for the erection of a new office building on Temple Street, just south of Chapel Street, for the estate of Edward Malley, and a large lighting and heating plant in the rear. The cost of the building is estimated at $150,000 and that of the power plant at $50,000.

Middle Atlantic States

ALBANY, N. Y.—Bids will be received by Lewis Nixon, superintendent of public works, Capitol, Albany, until June 3 for furnishing, testing and delivering electric capstans and trolley hoists at various barge canal terminals, under terminal contract No. 113; also for furnishing, testing and delivering battery-charging motor-generator sets with switchboard panels for barge canal terminals in New York City, under terminal contract No. 117. Plans may be seen and specifications, engineer's estimate of quantities, proposal blanks, etc., may be obtained at the office of the superintendent of public works at Albany, at the office of the assistant superintendent of public works for the Middle Division at Syracuse, at the office of the assistant superintendent of public works for the Western Division at Rochester, and at the canal office, Spaulding's Exchange, Buffalo, N. Y.

AMSTERDAM, N. Y.—The Adirondack Electric Corporation of Glens Falls is planning to erect an electric transmission line from Amsterdam to Little Falls, to cost about $45,000.

ANTWERP, N. Y.—Plans have been prepared by the Antwerp Light & Power Company for a water-power development on Indian River, to consist of a reinforced dam, flume and power house, electric transmission line and the installation of generating units. Joseph A. Baumert is president and manager.

NEW YORK, N. Y.—Plans have been completed by the New York Telephone Company, 15 Dey Street, for the erection of a new telephone exchange building at 167th Street and Grand View Place, to cost about $391,000. McKenzie, Voorhees & Melin, 112 Broadway, New York, are architects.

WARD'S ISLAND, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until May 20 for furnishing laundry machinery and motors for the Manhattan State Hospital, Ward's Island. Drawings and specifications may be consulted at the above institution, at the New York office of the Department of Architecture, Room 1715 Tribune Building, and at the Department of Architecture, Albany. L. F. Pilcher, Capitol, Albany, is state architect.

WATERTOWN, N. Y.—Bids, it is reported, are being taken by James F. Brownell, 19 Strickland Block, Carthage, N. Y., for the construction of a power plant, dam and canal on the Black River, in Watertown, for the Northern New York Utilities, Inc., to cost about $250,000.

WATERVLEIT, N. Y.—Announcement has been made by the Ordnance Department, Washington, D. C., that plans are under way for extensions and improvements at the Arsenal at Watervliet. The plans, it is understood, include the acquirement of about 35 additional acres of land and the erection of a number of large additions, sections of which will be devoted to the manufacture of 14-in. guns.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

The cost of the proposed work is estimated at about $10,000,000. Colonel Mettler is engineer in charge.

NEWARK, N. J.—Preliminary plans are being prepared by the Independent Lamp & Wire Company for the construction of a large plant on Runyon Street, between Hillside and Belmont Avenue. Nathan Hofheimer is president.

ALLENTOWN, PA.—The ordinance creating a division of lighting in the Water Department and authorizing the installation of a municipal electric light plant has been adopted by the City Council. The committee is also authorized to buy or condemn the street-lighting system of the Lehigh Valley Power & Light Company.

EPHRATA, PA.—Plans have been prepared for the erection of a one-story power house, 39 ft. by 43 ft., in connection with the new factory of the Harry Eby Shoe Company. W. E. S. Dyer, Land Title Building, Philadelphia, is architect.

HARRISBURG, PA.—The Public Service Commission has granted the following companies permission to issue securities for proposed extensions and improvements as follows: The Bradford (Pa.) Electric Light & Power Company, $400,000 in bonds; the Citizens' Electric Company of Williamsport, $250,000 in bonds; the Penn Central Power & Transmission Company, $119,000 in bonds, and the Penn Central Light & Power Company, $119,900 in bonds, both of Altoona; Erie (Pa.) Lighting Company, $1,850,000, and the Beaver Valley Traction Company of New Brighton, $100,000.

MEADVILLE, PA.—Bids will be received at the office of Fred C. Klebort, city clerk, Meadville, until May 27 for building approximately 2 miles of sanitary sewers and also for construction of sewage pumping station and equipment, including two 12-hp. motors, two air compressors, one air tank and one 200-gal. ejector. Separate bids to be submitted on sewers and station. Plans and specifications may be obtained from the city engineer of Meadville upon deposit of $10.

PHILADELPHIA, PA.—Two ordinances providing for an appropriation of $35,000 for the installation of additional electric lamps in various sections of the city have been introduced by the finance committee of the Council. Of this amount it is proposed to use $25,000 for the installation of electric lamps in the main streets bounded by Seventh, Thirteenth and Johnson Streets and Oregon Avenue, where the government has erected 600 houses, and $10,000 for additional lamps in the outlying sections during the last half of the year.

PITTSBURGH, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 2 for the installation complete of a hoistway and electric dumbwaiter in the United States post office and court house at Pittsburgh.

WILKES-BARRE, PA. — Preliminary plans are being prepared for the erection of a new boiler house at the bakery of the Achesin Bread Company at 554 South Main Street. Frank H. McCafferty is manager.

CHURCH HILL, MD.—A franchise has been granted to Harry D. Massey to install and operate an electric light plant in Church Hill.

HAGERSTOWN, MD.—The Crossnickle mill property has been acquired by the city for about $25,000, and, it is understood, will be remodeled into a subsidiary electric power plant and operated in connection with the present plant. A large dam for power purposes will also be built.

HILLSDALE, MD. — The Baltimore County Water & Electric Company, 100 West Fayette Street, has awarded contract for the erection of a booster station on Forest Avenue to the Price Construction Company, Maryland Trust Company, Baltimore. Wehr & Walden, 100 West Fayette Street, are architects.

CHARLESTON, W. VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 19, for furnishing, under Specification 3670, cranes for armor plates and forgings at Charleston, W. Va. The cost is estimated at $1,805,000. A deposit of $10 will be required for plans.

CHARLESTON, W. VA.—Bids will be received by the State Board of Control, adressed to J. S. Lakin, member of State Board of Control, Charleston, until May 22 for construction of sewage-treatment works for the Weston State Hospital, Weston, W. Va. The proposed work will include the construction of a sewage pumping station equipped with two electric motors, two centrifugal pumps and automatic control equipment; also sewage sedimentation tank, sprinkling filter, sludge bed and chlorinating plant. Charles E. Collins, Drexel Building, Philadelphia, Pa., is consulting engineer.

FAIRMONT, W. VA.—The Monongahela Valley Traction Company of Fairmont has been granted permission by the United States Engineer Department to erect a new high-tension transmission line over the Monongahela River near Hoult.

HAMPTON ROADS, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 26, under Specification 3872, for installing motor-generator sets and switchboard at at the local submarine base, to cost about $60,000. A deposit of $10 will be required on plans and specifications.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 29 for bronze and cast-iron lamp standards, lamp brackets and lanterns for federal buildings under the control of the Treasury Department.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C,. for furnishing at the various navy yards and naval stations supplies as follows: Until May 27, Washington, D. C., Schedule 3956—for miscellaneous electrical railroad material and miscellaneous round hard-drawn copper trolley wire; Schedule 3962—46,000 "Siemens-Martin" galvanized strands. Bids will also be received in the near future as follows: Brooklyn and Mare Island, Schedule 3963—Thirty 6-in. watertight bells, four direct-current, 120-volt dynamotors; spares. Brooklyn, N. Y., Schedule 3979—3500 ft. armored lighting cable, miscellaneous lighting and power wire; Schedule 3963—miscellaneous telephone equipment, one pneumercator system for drainage tank system, miscellaneous telephone switchboards. Mare Island, Cal., Schedule 3963—one pneumercator system for drainage tank system, miscellaneous revolution-indicator shaft system and spares, miscellaneous ship's service telephone system. Puget Sound, Wash., Schedule 3966—four electric ship hoists; spares. East and West, Schedule 3969—miscellaneous steel sockets for Morse taper shank. Applications for proposals should designate the schedule desired by number.

North Central States

DETROIT, MICH.—Application has been made to Dearborn Township by Henry Ford of Detroit for a blanket franchise to operate a traction line in that town. The proposed line will be about 4 miles long.

DETROIT, MICH.—Plans are being prepared by C. W. Brandt, architect, Kresge Building, for a building, 80 ft. by 100 ft., and power plant for the C. B. Bohn Foundry Company, Hart Avenue, to cost about $25,000.

DETROIT, MICH.—Bids will be received by the Lighthouse Superintendent, 341 Post Office Building, Detroit, until May 23 for furnishing one directly connected, electrically operated air compressor for Fort Gratiot light station.

LAPEER, MICH.—The city of Lapeer is contemplating the installation of an ornamental lighting system on the paved streets. For further information address the Lapeer Gas-Electric Company. C. W. Smith is secretary and treasurer.

CINCINNATI, OHIO.—Plans are being prepared for the erection of a new plant for the Rapid Electrotype Company on McMicken Avenue for the manufacture of electrotypes. The plans provide for equipment of power plant.

CLEVELAND, OHIO — The National Lamp Association, Nela Park, is planning to erect a new plant, to cost about $250,000.

KENT, OHIO.—Bids, it is reported, will soon be asked by the Mason Cotton Fabrics Company for the construction of a mill, to cost with equipment about $700,000. Lockwood, Greene & Company, 60 Federal Street, Boston, Mass., are architects and engineers.

MASSILLON, OHIO—Bonds to the amount of $12,000 have been authorized for the installation of an underground police and fire-alarm system.

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PLYMOUTH, OHIO.—Contract has been placed by the Fate-Root-Heath Company for extensions to its plant with the Ferguson Company of Cleveland. The work will include the erection of a foundry, warehouse, addition to power plant and an office building, which with equipment will cost about $200,000.

WHITING, IND.—Bids will be received by the Board of Public Works, City Hall, Whiting until June 2 for water filtration plant and centrifugal pumping equipment. Contract No. 1 includes construction of mechanical water filtration plant of the gravity type with a rated capacity of 4,000,000 gal. per twenty-four hours, including an aërating basin, coagulating basin, filters, filtered water reservoir, head house, piping connections with city mains, erecting motor-driven centrifugal pumps under Contract No. 2 and all appurtenances. Contract No. 2 includes the furnishing of motor-driven centrifugal pumping equipment and appurtenances. Pearse & Greeley, 39 Adams Street, Chicago, Ill., are engineers.

CUDAHY, WIS.—The Cudahy Brothers Company is planning to enlarge its power house and install a 600-hp. generating unit and two 400-hp. boilers. Michael F. Cudahy is president and general manager.

JOHNSON CREEK, WIS.—Bids will be received by the Village Board until May 20 for a motor-driven pump of 500 gal. to 700 gal. capacity for the municipal waterworks.

RACINE, WIS.—The Webster Electric Company is planning to erect an addition to its plant, most of which will be used for power-plant and boiler-house purposes. The company maunfactures ignition devices for automobiles, trucks and tractors. Walter Brown is superintendent.

TWO RIVERS, WIS.—Bids, it is reported, will soon be taken by the board of education of Two Rivers for the construction of three units of the Two Rivers High School, including one 48 ft. by 70 ft., two stories, for manual training. John D. Chubb, 109 North Dearborn Street, Chicago, is architect.

WEST ALLIS, WIS.—The Gerlinger Electric Steel Foundry Company of West Allis has purchased the property of the Radcliffe Manufacturing Company, adjoining its foundries, consisting of two large buildings, one of which will be converted into a machine shop, laboratory, pattern shop and flask shop, and the other will be used as a private garage and service shop. Walter Gerlinger is secretary.

ELDORADO SPRINGS, MO.—Plans are being considered by the Park Board for the installation of ornamental lamps in Spring Park. Large cement posts, 7 ft. high, carrying single electric lamps are to be used.

ST. LOUIS, MO.—The Columbia Taxicab Company is contemplating the erection of a garage and repair plant for its own use, to cost about $100,000.

GREGORY, S. D.—The proposal to install a municipal electric light plant in Gregory will be submitted to the voters.

VERMILION, S. D.—At an election held recently the proposal to issue $60,000 for the construction of a new electric light plant and firemen's building was carried.

BEATRICE, NEB.—The Beatrice (Neb.) Power Company, recently incorporated with a capital stock of $300,000, is building a hydroelectric plant at Barnestown, 20 miles south of Beatrice. The proposed plant, it is understood, will supply electricity in Blue Springs, Wymore and other towns.

OHIOWA, NEB.—The installation of an electric light plant and waterworks system in Ohiowa is under consideration.

YORK, NEB.—Bids will be received by the board of directors of the Lutheran Hospital Association, York, until May 27, for erection of an addition to the present hospital building and power house, and alterations and repairs to same. W. F. Gernandt, Omaha, is architect.

TOPEKA, KAN.—The State Legislature has appropriated $120,000 for improvements to the State House, work on which will begin in the near future. Of this amount $50,000 will be used for a new heating plant and $10,000 for new lighting fixtures. An expenditure of $1,500,000 on new buildings and improvements is contemplated by the state during the next two years. Plans are now being prepared for six new structures, to cost $56,000, at the Hutchinson State Fair Grounds, also for new barracks at Fort Dodge, to cost $85,000 and an addition to the engineering building at the State Agricultural College, to cost about $190,000. R. L. Gamble is state architect.

Southern States

ATLANTA, GA.—At an election held recently the proposal to issue $1,000,000 in bonds for municipal improvement was defeated. Of this amount $300,000 was to have been used for a municipal electric light plant.

COCHRAN, GA.—The City Council is considering issuing bonds for improvements to the municipal electric light plant.

MOULTRIE, GA.—The Council is considering calling an election to submit the proposal to issue $150,000 in bonds for extensions to the municipal electric light plant.

UNADILLA, GA.—The installation of a municipal electric light plant in Unadilla is under consideration.

CORDOVA, ALA.—The construction of a large cotton mill, to cost about $1,500,000, is under consideration by the Indianhead Mills. Lockwood, Greene & Company, Healy Building, Atlanta, Ga., are engineers.

BARTOW, FLA.—The Morris Fertilizer Company is contemplating hydraulic mining operation at Bartow, including the installation of a 2000-kw. electric generating unit, pumping station and distribution system. The Scofield Engineering Company, Commercial Building, Philadelphia, Pa., is consulting engineer.

DAYTONA, FLA.—The Daytona Public Service Company is contemplating improvements to its plant, including the installation of two 300-lb. Stirling high-pressure, water-tube boilers and the erection of a brick smokestack, 152 ft. high, 8 ft. in diameter, to replace the present three metal stacks. The cost is estimated at about $30,000.

COTTER, ARK.—Plans are being considered by the Dixie Power Company for the construction of a hydroelectric power plant on White River to develop 60,000 hp.

HEBER SPRINGS, ARK.—The proposed hydroelectric development on Little Red River near Heber Springs by the Arkansas Hydro-Electric Development Company will include the construction of three dams, each 50 ft. high, to include 67 miles of Little Red River with a fall of 170 ft. The company is preparing to make tests for the first dam site. The cost of the initial dam and equipment is estimated at $500,000. The proposed dam will be 400 ft. long and 40 ft. high, costing $192,000, and will generate 2000 kw. without auxiliary; with later storage dam at Higden it will develop 19,000 kw. The total cost is estimated at $5,000,000. Dickinson & Watkins of Little Rock are engineers.

NEW ORLEANS, LA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is considering the installation of electrical and mechanical equipment at the local power plant (Specification 3882).

BLANCHARD, OKLA.—Bonds to the amount of $15,000 have been voted for the installation of a municipal electric light plant, and $45,000 for construction of waterworks system.

CHEROKEE, OKLA.—Plans are under consideration by J. E. Busch, P. O. Box 416, and others to establish an electric plant in Cherokee to furnish electricity for lamps and motors for the farming district.

HOMINY, OKLA.—Arrangements have been made for the installation of an ornamental lighting system in the business district.

GALVESTON, TEX.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 2, under Specification 3864, for developing a naval air station in Galveston. The cost is estimated at about $750,000. A deposit of $100 will be required for plans and specifications.

Pacific and Mountain States

BREWSTER, WASH.—Work, it is understood, will soon begin on the construction of a large dam and power plant on the Similkameen River, a short distance from its present power plant. The new dam will be about 200 ft. high and will develop about 5000 hp. The main office of the company is at 521 First Avenue, Spokane. Eugene Enloe is president.

SEATTLE, WASH.—Appropriations for extensions and improvements in the municipal lighting system, aggregating $36,709, have been approved by the finance committee of the City Council. The improvements include the erection of a 15,000-volt transmission line to the university and Eastlake districts, to cost $15,132; transformers for two outdoor substations for the university and Eastlake districts, $2,750; a 15,000-volt line to the south water front and industrial district, $9,765; a 15,000-volt tie line from the Lake Union steam plant to Valley and Westlake, $2,585, and various short extensions of primaries and buses with small transformers to serve new consumers and to remedy poor service, $6,477.

ROSEBURG, ORE.—The City Council is considering the establishment of a municipal electric light plant in Roseburg.

COALINGA, CAL.—The City Council is reported to be considering the purchase of the local electric light plant, to be owned and operated by the municipality.

SAN FRANCISCO, CAL.—The State Railroad Commission has granted the Great Western Power Company permission to issue $6,000,000 in bonds and $1,500,000 in capital stock to finance the proposed hydroelectric development of the Great Western Power Company and the City Electric Company, both of which will be taken over by the Great Western Power Company of California. Work, it is understood, will start on the construction of a hydroelectric plant on the North Fork of the Feather River, within 6 miles of Belden, which with transmission system calls for an expenditure of about $6,000,000. The proposed plant will have a generating capacity of 40,000 kw.

WOODLAND, CAL.—The Yolo Water & Power Company, recently reorganized, is contemplating an additional water supply from Indian Valley. It is proposed to impound the waters of Little Indian Valley by the construction of a dam to be distributed by the company for irrigation purposes in Yolo County. Arthur C. Huston is president of the company.

MESA, ARIZ.—The Water Users' Association is remodeling the hydraulic portion of the Chandler electric generating plant, 1½ miles northwest of Mesa, for the purpose of adding another power generating unit to the electric system of the association.

PHOENIX, ARIZ.—The Arizona Power Company of Prescott is planning to erect a 4000-volt electric transmission line from its power station near Highball to Phoenix, a distance of 70 miles, to provide auxiliary power to the Pacific Gas & Electric Company at Phoenix. Other important extensions to its transmission system, it is reported, are under consideration by the Arizona Power Company.

LANDER, WYO.—Bids, it is understood, have been asked for the construction of a hydroelectric power plant on the Big Popo Agie River in the canyon, to cost about $100,000. Energy generated at the proposed plant will be purchased and distributed by the Lander Electric Light & Power Company.

Canada

WINNIPEG, MAN.—Tenders will be received by J. Schofield, architect, Room 459, Union Station, Winnipeg, until May 26, for the construction of an addition to power house for the Canadian National Railways.

LONDON, ONT.—Tenders, it is understood, will soon be asked by B. Jones, representative of the Republican Motor Truck Company, 76 Church Street, Toronto, for the construction of a factory, to cost about $500,000.

QUEBEC, QUE.—Plans are being prepared by the Montreal Tramways Company for double-tracking 10 miles on Lawrence St. to Gouvain Boulevard and through the village of Bordeaux to Park Avenue. J. E. Hutcheson is general manager.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 23 for an incinerator plant, overhead crane, wagon platform scale, iron or steel sheets, vanadium steel springs, brass, copper, monel metal, copper and brass tubing, zinc, blueprinting machine, exhaust-type blower, arc lamps and globes, motor-generator sets, electric fans, insulators, watt-hour meters, receptacles, sockets, switches, steel and copper wire and cable, steel and iron rope, upright boilers, anchor lights, etc. Blanks and information relating to this circular (1276) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

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(Issued April 22, 1919)

1,301,457. LAMP SOCKET; Oscar Kupferman, Brooklyn, N. Y. App. filed May 1, 1918. Pull chain.

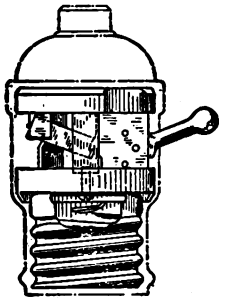
1,301,465. SAFETY INCLOSED FUSE; William D. Ligon, Montclair, N. J. App. filed June 21, 1915. Terminals attached within casing.

1,301,471. ENGINE STOP; George H. McFeaters, Johnstown, Pa. App. filed Sept. 25, 1908.

1,301,473. REFLECTOR FOR USE IN WIRELESS TELEGRAPHY AND TELEPHONY; Guglielmo Marconi and Charles S. Franklin, London, Eng. App. filed Feb. 26, 1919.

1,301,478. STARTER FOR INTERNAL-COMBUSTION ENGINES; Albert H. Midgley, Acton Vale, Eng. App. filed Feb. 20, 1915.

1,301,493. THEFT ALARM FOR AUTOMOBILES; William H. Niemeyer, Los Angeles, Cal. App. filed June 25, 1917.



1,302,415—Toggle Socket.

1,301,499. ELECTRIC WINDING MECHANISM FOR CLOCKS AND THE LIKE; Eugene Pons, Schenectady, N. Y. App. filed July 25, 1912.

1,301,524. MAGNETO-ELECTRIC MACHINE; Bertram J. Turner, New Southgate, London, Eng. App. filed Aug. 25, 1917.

1,301,525. RADIO TRANSMISSION; Hendrik Johannes van der Bijl, New York, N. Y. App. filed Aug. 30, 1915.

1,301,546. ELECTRIC FITTING; Julius O. Eis and Edward J. Knauff, Chicago, Ill. App. filed Aug. 29, 1917. Connecting plug.

1,301,581. RECTIFIER; William B. Lucas, Oak Park, Ill. App. filed July 31, 1916. Inductive regulating means controls voltage.

1,301,584. COMBINED AUTOMATIC AND MANUAL TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Nov. 14, 1906.

1,301,585. SHIP'S LOG; Charles P. Maxson, West Mystic, Conn. App. filed April 3, 1918. Repeats readings at the navigating officer's station.

1,301,595. MAGNETO-ELECTRIC POCKET LAMP; Marc A. Pattay and Eugene Jaquemot, Geneva, Switzerland. App. filed Nov. 2, 1918. Mechanism is contained within a casing composed of two side sheets.

1,301,622. SYSTEM OF ELECTRICAL REGULATION; William A. Turbayne, Niagara Falls, New York. App. filed Sept. 26, 1912. For use on cars having excessive load.

1,301,632. SPEED CONTROL OF INDUCTION MOTORS; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed March 17, 1917. Rotary converter electrically interposed between the induction-motor secondary and a direct-current dynamo electric machine.

1,301,636. HIGH-VOLTAGE-CURRENT TRANSFORMER; Lyman Arnold, Lynn, Mass. App. filed Oct. 28, 1916. Consists of an insulating tube, a support, a winding threaded through tube, and supports for the exterior loop.

1,301,640. SYSTEM FOR THE TRANSFORMATION OF ELECTRICAL ENERGY; David Basch, Schenectady, N. Y. App. filed April 2, 1917. Means for automatically varying the excitation of the field of the synchronous motor.

1,301,644. DIRECTIVE SENDING SYSTEM; Oliver E. Buckley, East Orange, N. J. App. filed Sept. 13, 1915.

Record of Electrical Patents

Notes on United States Patents

1,301,647. TELEPHONE SYSTEM; Wilson L. Campbell and Talbot G. Martin, Chicago, Ill. App. filed April 23, 1907. Commutator machine is concatenated with the secondary winding of the induction motor.

1,301,735. AIR-BLAST TRANSFORMER; Edwin R. Pearson, Pittsfield, Mass. App. filed Aug. 27, 1915. Complete and thorough cooling of the parts.

1,301,739. SPEED CONTROL OF INDUCTION MOTORS; David C. Prince, Springfield, Ill. App. filed March 17, 1917. By means of rotary converters.

1,301,763. POWER TRANSMISSION ON RAIL AND ROAD TRAINS AND THE LIKE; John G. P. Thomas, Kensington, London, Eng. App. filed Dec. 12, 1916.

1,301,780. STORAGE BATTERY; John L. Lotsch, Brooklyn, N. Y. App. filed Aug. 14, 1918. Has reserve tank of distilled water and specific gravity can be visually determined.

(Issued April 29, 1919)

1,301,827. TEST CONNECTOR; William L. Flye, Glen Ridge, N. J. App. filed Oct. 2, 1917.

1,301,832. DEVICE FOR CARRYING OUT CHEMICAL PROCESSES BY ELECTROLYSIS; Viktor Gerber, Baden, Switzerland. App. filed Jan. 14, 1919.

1,301,844. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Pittsburgh, and Ralph E. Farris, Swissvale, Pa. App. filed Feb. 8, 1916. System of ventilation.

1,301,845. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Feb. 4, 1916. Maintained at uniform temperature.

1,301,848. INDICATOR FOR CARTRIDGE FUSES; Slaughter W. Huff, Brooklyn, N. Y. App. filed Aug. 21, 1914. Miniature gun indicator.

1,301,887. SUPPLY OF ELECTRICAL ENERGY TO FURNACES OR OTHER APPLIANCES; William Travis, Sheffield, England. App. filed Feb. 13, 1919. Supply phases have balanced loads.

1,301,922. VARIABLE-SPEED MOTOR; Charles Endorf, Jr., Chicago, Ill. App. filed April 22, 1915. One brush adjustable.

1,301,932. ELECTRIC FURNACE; Henry A. Greaves and Harry Etchells, Sheffield, England. App. filed Feb. 18, 1919. Means of varying the transformer connections.

1,301,966. CONTROLLER FOR MOTOR-DRIVEN MACHINES; Charles W. Parkhurst, Johnstown, and Francis J. Burd, Wilkinsburg, Pa. App. filed Feb. 8, 1917. Saw machines.

1,301,986. CIPHER-PRINTING MECHANISM; Ferdinand J. Tillman, St. Louis, Mo. App. filed Aug. 13, 1917. Automatic.

1,301,991. MAXIMUM-TIME RELAY; Albert Aichele, Baden, Switzerland. App. filed Nov. 17, 1915. Operates on feeble overload current.

1,301,995. ELECTRIC WATER HEATER; Guy Arthur, Ritzville, Wash. App. filed Nov. 4, 1916. Used externally on the tank.

1,302,013. INSULATING MATERIAL FOR ELECTRICAL CONDUCTORS; William E. Cook, New York, N. Y. App. filed April 24, 1917.

1,302,035. RELAY DEVICE; Arthur J. Hall, Wilkinsburg, Pa. App. filed June 13, 1917. Torque-motor type.

1,302,040. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed March 23, 1914. Obviates vibration of the core teeth.

1,302,041. CONTROL SYSTEM; Rudolf E. Hellmund, Swissvale, Pa. App. filed Sept. 25, 1914. Prevents "flash-over" in machines.

1,302,057. OUTLET BOX; Julian G. Knight, New York, N. Y. App. filed Feb. 26, 1914. Top wall serves as anchor for the fixture support.

1,302,068. SYSTEM OF CONTROL; Hurd T. Morris, Wilkinsburg, Pa. App. filed Dec. 29, 1915. Voltage supplied to the inducing field windings varied with current.

1,302,089. SWITCH; Benjamin K. Read, Detroit, Mich. App. filed June 26, 1916. Shaft frictionally transmits movement of plate.

1,302,129. SENDER FOR HERTZIAN WAVES UTILIZING POLYPHASE GENERATORS; Victor Bouchardon, Paris, France. App. filed July 27, 1914. Has as many circuits of discharge as there are phases.

1,302,137. ELECTRIC TERMINAL BOX; Irvin M. Cook, Cleveland, Ohio. App. filed Dec. 27, 1917. Weatherproof housing.

1,302,158. INSULATOR; John R. Harris, Chartiers Township, Allegheny County, Pa. App. filed July 11, 1917. Insulator mounted on nail.

1,302,229. LIGHTNING ARRESTER; Edmund O. Schweitzer and Nicholas J. Conrad, Chicago, Ill. App. filed Oct. 18, 1917. Multi-gap arrester having individual blow-out means for each gap.

1,302,230. MAGNETIC RIVET HEATER AND SPOT WELDER; Thomas J. Shea, Portland, Ore. App. filed Sept. 24, 1918. Magnetic holding-on frame.

1,302,284. ELECTROMAGNETIC DEVICE; C. R. Beall, Swissvale, Pa. App. filed Feb. 2, 1916. Operable by alternating current but immune to operation by direct current.

1,302,296. DIRECTION INDICATOR FOR MOTOR VEHICLES; Levi M. Bowman, Tulsa, Okla. App. filed April 20, 1917.

1,302,304. DRY CELL; Charles F. Burgess, Madison, Wis. App. filed March 16, 1916. Zinc electrode with a tin bottom.

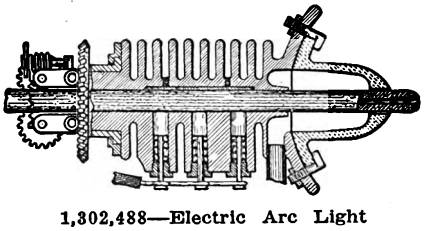
1,302,309. COMBINED WATER HEATER AND DRIPPER; Herbert W. Christian, Detroit, Mich. App. filed Aug. 19, 1918. Easily regulated.

1,302,386. ELECTRODE FOR ELECTRIC ARC WELDING; Emile Languepin, Paris, France. App. filed Nov. 13, 1917. Electrode sheathed.

1,302,391. HIGH-FREQUENCY APPARATUS; Antonio Longoria, Cleveland, Ohio. App. filed June 2, 1916. Even and effective discharge.

1,302,400. MOTOR STARTER; Giovanni Mascarini and Angelo Contardi, Milan, Italy. App. filed Jan. 3, 1914. Iron sulphide resistance.

1,302,401. TELEGRAPH KEY; James J. Mason, Cisco, Cal. App. filed May 23, 1917.



1,302,488—Electric Arc Light

1,302,413. METHOD OF ELECTRIC WELDING; Thomas E. Murray, Jr., Brooklyn, N. Y. App. filed Feb. 12, 1919. Presses plates together.

1,302,415. TOGGLE SOCKET; William J. Newton, Bridgeport, Conn. App. filed March 12, 1918. Double-break single-pole type.

1,302,424. ELECTROMAGNETIC TUBE-TESTING DEVICE; Alonzo Paquin, Montreal, Quebec, Canada. App. filed Aug. 29, 1918. For locating the presence of projecting edges, lumps or other imperfections.

1,302,440. METHOD OF ELECTRIC WELDING; Robert Sarazin, Carrières sur Seine, France. App. filed Jan. 2, 1919. Concentrates lines of electric force.

1,302,471. THREE-CONDUCTOR PLUG; Morten B. Richter, Copenhagen, Denmark. App. filed Oct. 16, 1915. Telephone contact plug.

1,302,488. ELECTRIC ARC LIGHT; Elmer A. Sperry, Brooklyn, N. Y. App. filed Nov. 11, 1914. Automatically fed rotating electrode.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, May 24, 1919 *Number* 21

The Victory Convention

THE Victory Convention of the National Electric Light Association has passed into history. Underlying every activity at Atlantic City were a glorious sense of triumph, a joyful renewal and enlargement of friendships, and a deserved satisfaction that in our country's time of need the electrical industry contributed in unstinted measure its part to the epoch-making outcome.

The solidarity and worth of the association have met the test of war, and the return to more normal conditions is being rapidly achieved. The proceedings were rich in interest and reflected alert contact with the problems and thought currents of the new era. Conscientious work for the good of the industry bears ripe fruit on such occasions. Delegates went away with a new conception of their united power to carry the electric utility industry to higher planes of public service, with a new determination to live by President Wells' all-embracing psychological equation, "The revenue from contented customers must equal a satisfactory return for capital and labor."

The spirit of helpfulness and loyalty exhibited in the relations of employer and employee in the association augurs well. The educational opportunities offered to member-company employees, the application of bonus systems and the encouragement of initiative reflected in the convention proceedings index the attitude of those in responsible command toward their valued helpers, whose enthusiasm and loyalty evidence sound conditions in company families.

In large undertakings some mistakes are inevitable. Hostile critics magnify defects which, though irritating, detract but little from the sum total of accomplishment. Time is required to clear away the débris of constructive effort and to remove minor difficulties in the functioning of new or reconstructed enterprises. As for the electrical industry, it has done more than well in meeting post-war problems and will continue its good work toward attaining the new normal of activity.

William Dixon Weaver

A GRACIOUS tribute was paid to W. D. Weaver, former editor of the ELECTRICAL WORLD, at the meeting of the American Institute of Electrical Engineers last week. It is not often that men have such honors paid to them while still in the flesh, but then Mr. Weaver is an exceptional man and well deserving of the homage of the profession for which he labored so well and for so long. Modesty totally unbecoming a master builder and yet so rich and so rare caused him to shrink from public gaze; but a beacon cannot be hid; his work and worth became known, and in a lasting and fitting tablet the electrical profession records its appreciation. Those who have labored beside him and who know him best rejoice in this recognition and are proud to have been associated with him.

Now is the time to drive home by the best possible service the conception that under private ownership and management public utilities can hit a pace which unwieldy and near-sighted government management can never overtake. To-day we can capitalize a brief but significant period of public mismanagement of great utilities, and to the lasting benefit of the people and the electrical industry.

The Edison Medal to Benjamin G. Lamme

THE Edison medal has properly come to be regarded as an engineering "distinguished service medal" for electrical achievement. The history of this medal is very interesting to read, and the deed of assignment to the administration of the American Institute of Electrical Engineers is a most remarkable document in its originality and incisiveness. A number of the leaders in electrical engineering have already received the medal, and there has never been any question as to the validity of the awards.

This year, at the recent annual meeting of the American Institute of Electrical Engineers, the Edison medal was tendered to Benjamin G. Lamme, who has been the chief engineer of the Westinghouse Electric & Manufacturing Company of East Pittsburgh since 1903, and who has been in the engineering service of that company since 1889, a continuous period of thirty years. Altogether apart from the acknowledged merits of Mr. Lamme's engineering inventions and developments, it is a great satisfaction to see the medal given to a man with such a record of faithful and continuous service. On this side of the Atlantic the restlessness of spirit which frequently serves us well in kindling ambition too often serves us ill by inciting to change of purpose or mere vagrancy of effort. It is therefore the more desirable to see persistence of endeavor and steadiness of purpose come into the possession of the rewards which they tend to attain.

In addition to this notable achievement of loyal service to the industry, in which he entered as a youthful aspirant, Mr. Lamme's reception of the Edison medal will be acclaimed by all who know of his work. He has shown great insight into scientific principles, great patience in applying them, great courage in developing them and great tolerance to adverse criticism at all times.

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Underground Construction and Electrolysis

AT THE convention in Atlantic City of the National Electric Light Association an interesting report was presented from the committee on underground construction and electrolysis. The technical data obtainable by the committee, as they appear in the report, are much more extensive than would have been possible a few years ago. No doubt, the various companies with extensive underground systems are finding it advantageous to study these systems carefully.

A remarkable set of data appears in the report concerning the current-carrying capacity of various sizes of duct cable under the streets at different seasons of the year. It appears that the continuous ampere loading that is possible in winter is roughly about 50 per cent greater than that which can be tolerated in summer. This is the more fortunate when it is remembered that the peak load for the year in city central-station systems usually occurs near Christmas. If the greatest demand of the year occurred at midsummer, when the ground is hottest, the result would be economically most unfortunate for the companies. Some central-station men contend that the existing relation is a distinct evidence of the influence of a beneficent Providence in the affairs of men and cables. In any event, it is a great boon.

The committee makes a number of useful specific recommendations of a very practical nature, and the report will be well worth studying by all classes of electrical men.

Money expended on heat-value determinations and chemical analysis of fuel yields a high return. It is no longer necessary to accept inferior grades of fuel forced into the bunkers by war necessities or by profiteering mines. Combustion engineering is a vital factor in plant operation with advanced fuel prices, and the chemist is needed in boiler-plant service no less than the efficient stoker.

Report of the Pacific Coast Public Policy Committee

WE ARE presenting this week the report of the public policy committee of the Pacific Coast Section of the National Electric Light Association. This document has a very direct application not only on the Pacific Coast but elsewhere, for it deals with the fundamentals of the relations between public utilities and the public. The Coast, like the rest of the country, found itself under the pressure of tremendous industrial stimulus, bearing particularly on shipbuilding and on agriculture. If we remember correctly, some records were established in the former industry on the Coast which will stand long before they are surpassed in peace or war. The demands of agriculture were no less strenuous and are particularly associated with the work of public utilities, because perhaps nowhere else in the world is agricultural effort more closely connected with electrical development. Not only is the distribution of energy peculiarly widespread and efficient, but the origin of this energy is definitely correlated with the irrigation work on which successful agriculture so largely depends.

Were we to pick out one vital point forced to the front by the report before us, it would be the necessity of liberal action on the part of the government if electrical transmission is to be of the most direct and potent aid to the community. Much was done on the Coast during the war in the interconnection of transmission systems, until the various networks there operating have been so thoroughly tied in that there are but four small gaps to fill to complete a busbar from Oregon to Mexico. But the government still interposes such grave obstacles in the way of the development of power upon the public lands that the great resources of the Coast, instead of being worked to their utmost, establishing reservoirs for power and irrigation alike, are still handicapped, enterprise is stifled and the resources of the country remain only partially developed. The last Congress, wasting its energy in futile debate, adjourned before it passed the water-power bill, a bill not altogether what might be desired, but still helpful. The fact is that a certain Bolshevik element in Congress so recoils from the idea of rewarding private enterprise in its effort for the country's benefit that it willfully prohibits the development of hundreds of thousands of horsepower that are now running seaward unutilized. The electrical utilities of the Coast are doing all that they can to conserve power. It is estimated that the interconnections now made or planned will preserve to the uses of mankind over 100,000,000 kw.-hr. per year, a quantity which could be enormously increased were decent opportunity offered for utilizing the waterfalls that are running to waste. The engineers on the Coast—and they are second in ability to none in the world—hold that under the intensive development of hydraulic resources for power and irrigation the Coast States alone could be made productive enough to feed the whole country. It is time for Congress to realize that it must not subordinate public gain to a frenzied effort at preventing private gain.

It is fortunate indeed that this distorted view of duty has not extended to the commissions on the Coast. They have seen the burdens imposed on the public utilities by the greater costs of material and labor and have responded by authorizing the addition of surcharges in a form permitting of future adjustments. These, of course, bear the impress of a war measure, but they are and probably will be adjusted in a spirit of fairness to conditions as they from time to time exist.

The report shows how keenly the utilities feel their close relation to the public and their common interest with their employees in rendering the maximum service possible. There is a feeling abroad that there can be closer coöperation between the management of utilities and those who labor to make them effective, a feeling that the worker should be a partner in the business and should realize that his prosperity, like the prosperity of the public, is bound up with efficient service by the utility of which he is a vital part. Pursuant to the general patriotic duties of employers, the committee recommends as a universal policy the reëmployment of all workers who have served their country during the war, even though it should temporarily contravene the ambitions of managers to keep down to the lowest possible limit the costs of operation. In other words, this committee stands for a square deal with employees and the recognition of those who have thrown aside their means of livelihood to serve their country. It feels that the possibilities of electric distribution on the Coast are almost limitless, and that when Congress abandons its dog-in-the-manger policy with respect to powers on public lands the greatest possibilities can be realized. To accomplish this it is necessary not only to have enlightened legislation but a campaign of education which will

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show to the people at large the full benefits to be obtained and the determination of the public utilities to realize these benefits and to share them with the public they serve. Such is the import of the notable document which we here place before our readers. It brings a broad-minded spirit of coöperation and a realization of duties and responsibilities that leave little to be desired, and it deserves the most thorough consideration both by those who are charged with a great and important public duty and by those whom they serve.

The amount of nursing required by the transatlantic airplane power plant emphasizes by contrast the superior reliability of electric motor driving in fields where an appropriate energy supply is available. The precautions taken before "hopping off" are wise and right—but how the electrical men aboard must think "My kingdom for an induction motor!"

The Report on Electrical Apparatus

TO SUMMARIZE adequately the valuable report of the committee on electrical apparatus to the National Electric Light Association is almost an impossibility. The report contains more than 100 pages of valuable material which must be read in full to grasp its real importance. The most that one can do is to direct attention to some specific things which seem to point the way of progress. The first matter to strike one's attention is fire protection for generators. Setting aside the general protection of stations, there have been reported by thirty companies more than eighty fires occurring within the last three or four years. These arose within the generators, in about equal measure from causes external to the insulation and those chargeable to the conductors themselves. Dirt, mechanical defects, short circuits and grounds were the chief causes, and from all combined the fire menace seems to be sufficient to justify special means of protection. Primarily these are designed to cut the endangered generator clear of the system so that the fire may be treated; secondarily they deal with extinguishment as such. Protective equipment means in many instances the installation of relays specifically to protect the generator and its leads and to cut out automatically the main switch, the neutral switch, and finally the field switch.

Then comes the extinguishment problem, which generally speaking comes down to the employment of water or steam, the preference lying rather with the latter. In both cases the protective apparatus is carried inside the end bells of the generator and can be turned on at short notice. As a matter of practice it is found that the damage done to the insulation by steam or water is trivial compared with that already accomplished by the starting of a fire. As in generating apparatus so also in switchboards, the tendency is toward playing for safety and the use of more and better protective precautions. Circuit breakers and switches are, in the opinion of the committee, on the whole provided with too small factors of safety, especially where automatic reclosing devices are applied to the circuit breakers. One valuable suggestion is that the committee should gather data on the actual use of circuit breakers after a short circuit, with a view of obtaining information as to the real duty which may be imposed upon them, so that a better determination of the factor of safety may be had. With air-break switches there is still greater need for a sound basis for ratings, especially since any tendency toward overheating largely increases the risk.

Transformers are now fairly well standardized for all the moderate voltages, but it is believed that extensions should reach out for larger capacities both in total output and in voltage. A significant sign of the times is that the three-phase transformers now standardized rise to 30,000 kva. capacity, while suggested voltage ratings reach up to as high as 220,000 volts. This leads directly to modern substation practice, drifting more and more to outdoor types, and a strong tendency is noted of late toward the use of three-phase transformers rather than the single-phase types hitherto the more familiar. The substations are commonly protected against overload by oil circuit breakers, although in the smaller capacities fuses are often used and considerable recent experience has been gained with automatic air-break circuit breakers, of which many are in use up to 44,000 volts and a few at 110,000 volts. In the case of one company the transformer is deliberately treated as part of the line, and the only protection is on the low-tension side. Much progress has been made in the direction of automatic substations, of which about forty are recorded as in use, chiefly for railway purposes. Stations here referred to are those containing rotating apparatus of one kind or another, besides which there are many automatic or semi-automatic alternating-current stations which hardly need particular notice. Great ingenuity has been shown in the working out of motor-operated controllers for the substations, in which a remote-control motor in a perfectly orderly manner puts the machines into full operation.

It is worth noting that in synchronous converters the tendency is drifting more and more to 60-cycle apparatus, which seems at present, particularly when properly equipped with flash guards and rapid circuit breakers, quite as reliable as that for lower frequency, while it is, of course, much more desirable if part of a general distribution system doing all classes of work. The use of synchronous apparatus with special reference to correcting the power factor is assuming large importance, whether it takes the form of synchronous motors adapted incidentally to power-factor correction or that of unloaded synchronous condensers used purely for regulative purposes. Both are in large use, the tendency being perhaps to use the synchronous motors wherever possible and the more highly specialized machines when in the absence of proper motor load they become necessary. The revival of the static condenser as a power-factor regulator is an interesting recent development. Used more than a quarter of a century ago in connection with induction motors, it dropped out of sight for a long period, but it has now returned and is in use to a total capacity of about 3500 kva. In small units at least it appears to be less costly than synchronous condensers and promises to be a useful addition to present resources for power-factor control. Of the importance of such control the committee has much to say, giving data on the costs of meeting the necessary requirements by static and synchronous condensers or by synchronous motors and giving important information regarding the power factors to be expected in various special classes of work, particularly the electric furnaces now in large use.

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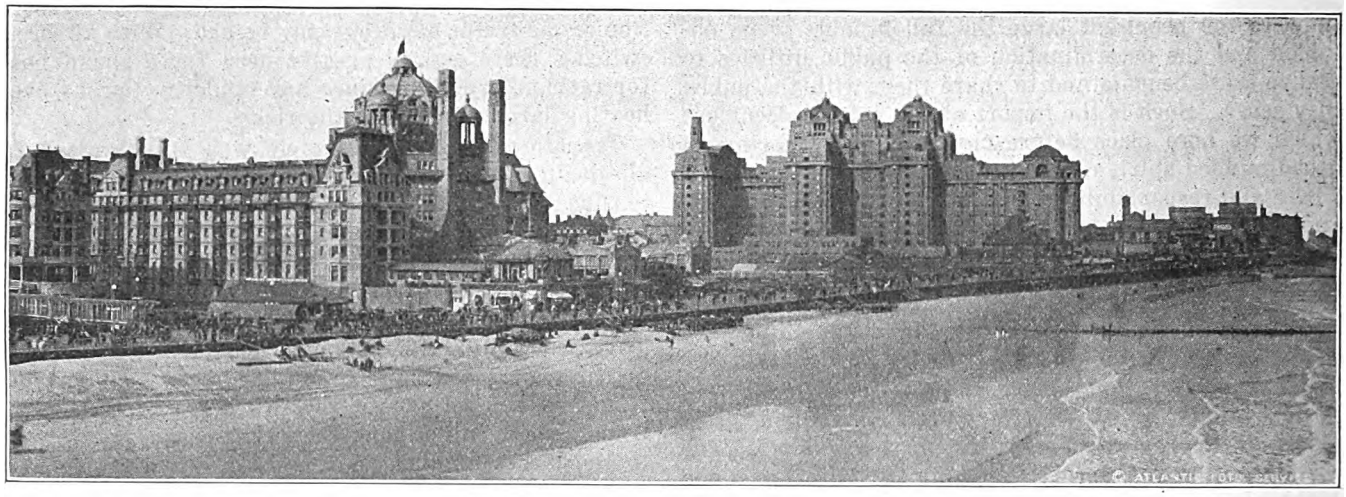

Plans for the Future in N. E. L. A. Convention

Large Gathering at Atlantic City This Week for the Forty-second "Victory" Meeting Combines the "Old-Time" Convention and the New Outlook—R. H. Ballard of Los Angeles Elected President

IT WAS an "old-time" gathering that the interested members of the National Electric Light Association planned for their forty-second convention at Atlantic City this week. They succeeded well in accomplishing what they had planned, and they also reached out to grasp firmly the new problems which are arising with the new times now developing. Outside of the weather, which they could not help, conditions were auspicious. Registration, attendance at meetings, study of the fine exhibits, were gratifying. From the address of President Wells and the election of R. H. Ballard, the first Pacific Coast president, stimulation was obtained. Dr. George Otis Smith gave a closer view of the program of Secretary of the Interior Lane for study, conservation and development of the nation's power resources, which received the indorsement of the convention. The outline of "The Importance of Electrochemistry," by Prof. Joseph W. Richards, pointed a way to development which will undoubtedly have more intensive consideration. Socialism and its growth of municipal-ownership propaganda are to be combated. Labor questions, including profit sharing, will be taken up by a committee to be appointed in the coming year. All in all, it is clear that the convention outlined much useful work for the new administration which will be under the executive head of the association's first president from the Pacific Coast.

Opening Session

President W. F. Wells called the opening general and executive session together a few minutes after 10 o'clock on Tuesday morning. He spoke of the cordial welcome which had always been given to the association by Atlantic City and then introduced Mayor Bacharach. The Mayor referred to the delegates as representatives of a great industry who have done a most wonderful work during the war period. He called for 100 per cent Americanism and expressed the opinion that the war will be followed by a more easy settlement of the question of labor and capital. His patriotic remarks were received with great applause.

Vice-chairman R. H. Ballard then formally presented President Wells, who read the annual address. Mr. Wells was followed by the delegates with close attention as he spoke of the sweeping change between the conditions of last year and those of this year.

"To-day we cannot honor too highly," he said, "the brave men who offered their lives nor the brave mothers who offered their sons in the great cause, nor should we fail to give due credit to those who gave up their vocations to serve their country or to profesional men and others who devoted their entire energy to the work behind the lines."

Since the armistice was signed the industry has been working to readjust its business, not to the pre-war basis, but to an entirely new basis in which there are many unknown factors. "As we were able during the war to meet and solve the unforeseen problems presented," added Mr. Wells, "so we will now go forth in the same spirit and cope with those that are to come."

President Wells announced that at a recent executive committee meeting consideration was given to the need of the association for a managing director or some similar permanent officer with a limited technical staff to handle the important problems arising all over the country. A committee will report on this matter to the incoming administration. The association has joined the National Industrial Conference Board.

Mr. Wells then discussed the rising cost of operation, covering supplies and capital. He referred to the authority given to some companies for increased rates and said that other companies have been able to meet the requirements by intensive development of existing plant, by curtailment of extensions for other than war purposes, and by using reserves. The conclusion expressed by Mr. Wells was that experience, thought and judgment will be required to determine future policy regarding development. The uncertainty of the future makes a short-term note at high interest rates probably the most favorable competitor of tax-free investments.

The speaker thought that it would be unwise to belittle the strength or power of the radical socialistic

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element. From this point he led to a discussion of municipal ownership. As the association is educational in character, President Wells expressed the opinion that its efforts should be devoted, during the coming year, to showing the taxpayers the danger of incurring debts for the purchase of public utilities and the bankers and investors the dangers of marketing large blocks of municipal bonds to acquire utilities that can be administered more economically under government regulation by private interests than by public officials selected by the popular vote. In conclusion Mr. Wells said:

"From now on our particular duty is to the people. Our duty to that part of the people who are our customers is to render them satisfactory service. Our duty to those who are our employees is to maintain loyalty by fair treatment. To those who own our securities it is to maintain the integrity of their investments. Our duty to others of the commonwealth under whose rules and regulations we operate is to furnish convincing information that we are giving them a better service for less money than can be obtained in any other way. Our business is founded on an economic basis, and, if wisely administered and not hampered by unfair treatment, can continue mutually beneficial to the customer, to labor, to capital and to the commonwealth."

PRESIDENT-ELECT BALLARD

Vice-chairman Ballard appointed the following committee on the president's address: Charles L. Edgar, John F. Gilchrist and J. E. Davidson.

Acting Secretary S. A. Sewall read a telegram from President Wishon of the Pacific Coast Section conveying felicitations and a cordial invitation to members to attend the convention of that section in April, 1920. Mr. Wishon expressed the feeling that the contact between the East and West among members of the electrical industry is of vital importance.

Secretary Sewall also read a telegram to Mr. Wells from Samuel Insull expressing regret that owing to delay in his return home from Europe it was impossible for him to be at the convention.

W. H. Johnson, in speaking with much regret of the absence of John W. Lieb on account of illness, moved the appointment of a committee of three to telegraph sympathy and good wishes to Mr. Lieb. President Wells appointed as the committee Mr. Johnson, W. H. Atkins and Martin J. Insull.

Acting Secretary S. A. Sewall then made his report referring to the work done by committees during the year.

As the representative of the N. E. L. A. on the electrical committee of the National Fire Protection Association, W. H. Blood, Jr., insurance expert, stated that he had opposed injurious rules proposed for inclusion in the National Electrical Code and that in general his suggestions had been given due consideration by the committee. He also assisted member companies in settling damage suits where fires were attributed to electrical causes, not one decision being rendered against a member company in a suit in which he had been summoned.

RATE RESEARCH

Alex Dow, chairman of the rate research committee, reported verbally. During the last year as in the year immediately preceding this committee held no stated meetings. It continued the publication of *Rate Research* and the "Rate Book" and answered such questions as were received by the chairman or members by direct correspondence. *Rate Research* has justified its existence. Without actually expressing the opinion of the committee as a committee, but voicing the opinion of a number of members of the committee, Mr. Dow said that they would rather see the "Rate Book" continued for another year or more on its present general plan and under normal business conditions before an attempt should be made to either better it or withdraw it.

In the very rapid action regarding rates which has characterized the last two years, due to war conditions, the only thing the committee could do to good purpose, said Mr. Dow, was to watch and record and study the evolutions of the subject that was changing in color and scope almost daily and which would likely have a temporary value and not lead to permanent results. Mr. Dow said that he looked for no new rate theory or method of any kind. The intent of the surcharge is to make it clear that the commission considers conditions only temporary.

"That the conditions which surround these increases shall be temporary is our hope," he said, "but I may remind you that costs have not gone down and that the conditions that warranted these numerous rate increases and the addition of surcharges remain with us and that this period of readjustment is not likely to be a period of retrogression in costs."

How the coal clause has worked during the year is a matter of interest, but how it will work in continuing contracts in peace times is a matter of still greater interest, added Mr. Dow. The position of companies in adjusting coal clauses where they are loaded with supplies bought under contracts at high prices and which complicated their coal cost by purchases in open market or through the product of their own mines is not going to be so simple as that of the companies which buy by contract in a well-established market.

In concluding, Mr. Dow said that much work is to be done for the coming year. There is the further study of rate problems. Nothing is in view that will be revolutionary. It will be rather a determination of what progress has been made and to get an indication of

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the possible progress in the future than the announcement of any new discoveries.

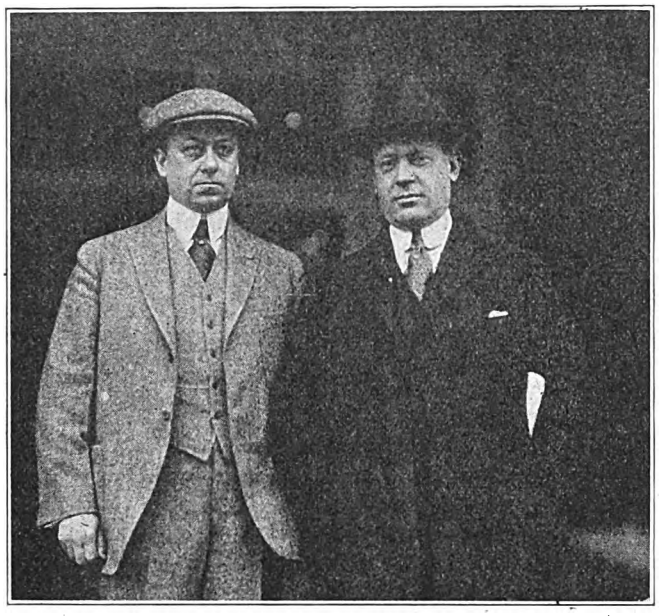
Frank W. Smith said that the members should support the publications of the rate research committee and make them entirely self-supporting.

M. C. Ewing, F. S. Price, R. H. Ballard, W. L. Abbott and Stephen Bennis discussed the report. Mr. Dow answered the various questions raised.

SECOND GENERAL AND EXECUTIVE SESSION

Sale of Company Securities—Public Policy Report—Activitied of National Committee on Gas and Electric Service

As at other conventions, the public policy session was different in character from the regular business sessions. It was held on Tuesday evening and the meeting place was changed on account of inclement weather from the Million-Dollar Pier to the Hotel Traymore. The room was filled to both standing and seating capacity. It was the same room in which the "win the war" convention was held last year. In the absence of W. H. Hodge, chairman of the committee on sale of company securities, to customers and resident citizens, the report of this committee was read by John G. Learned.



PAST-PRESIDENTS TAIT AND FRUEAUFF

PUBLIC POLICY REPORT

W. W. Freeman, as chairman of the public policy committee, then presented as an oral report on behalf of that committee. In explaining why the report was informal in character, Mr. Freeman said that the committee had already made an interim report regarding reconstruction matters. The committee was in session during the evening up to the time the meeting was called.

Mr. Freeman spoke of the striking contrast between conditions of a year ago and those prevailing to-day. At the last convention the dominant purpose was the winning of the war, and every consideration not tributary to that result was brushed aside as of no importance. It seemed then that a long struggle was ahead, with vast sacrifice of life and property. The determination was to make any sacrifice to win the victory. Thanks to the indomitable bravery of the men in service and a plan of preparedness late in starting but overwhelming in scope and importance, the spirit of determination of months ago has been crowned with success. Now that the war is over, it is time to start afresh to renew business activities, said Mr. Freeman.

Mr. Freeman then discussed the subject of socialism. One element in socialism which affects the interest of member companies most directly is the advocacy of municipal ownership. This is not particularly a danger in the view of many people, but it should be watched. Mr. Freeman called attention to the difference between the man who advocates municipal ownership as a question of economics and the one who advocates it because he believes in socialization of the country. The former can be reached by argument and a showing of the of socialism and of municipal ownership is urged by facts. The latter will continue to advocate socialization irrespective of any financial considerations. The spread of socialism and of municipal ownership is urged by an active propaganda which receives support in many quarters.

The problem of a counter propaganda has had the thought of the committee almost continually, said Mr. Freeman. The committee was not prepared then, however, to outline any specific plan of action. It desired, however, to point out to the member companies the importance of action by them to inform themselves on the questions involved.

The announcement was made by Mr. Freeman of the fact that the association some months ago added F. G. R. Gordon of Haverhill, Mass., to its staff. Mr. Freeman spoke on the personal and strong conviction of Mr. Gordon on the subject of socialism and municipal ownership. Mr. Gordon as a member of the staff is at the service of members in investigating and writing on the subjects to which he has given such long study.

NATIONAL COMMITTEE ON GAS AND ELECTRIC SERVICE

In the absence of John W. Lieb, Charles L. Edgar presented an outline of the report of the National Committee on Gas and Electric Service. When the United States declared war on Germany, the difficulties under which the gas and electric companies were operating were very great, and still more serious conditions were imminent. The dependence of practically every important industry in this country upon gas and electricity, which had been steadily growing, came to be more thoroughly realized after the outbreak of the world war in the summer of 1914. The new demands upon these utilities during the two years that followed taxed the capacity of the existing plants throughout the country to the utmost. The heavy demands of the large manufacturing establishments filled with work for the different European nations engaged in the war were met successfully in spite of the increasing difficulties to be overcome. Growing congestion in transportation became still worse when the mobilization of our armies took place. More than ever must all factories producing war material be kept going. Additional factories would have to be supplied with power by the electric plants. These conditions led to the formation of the National Committee on Gas and Electric Service, whose services were placed at the disposal of the government.

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"To recite the activities of the National Committee on Gas and Electric Service," says the report, "is to tell of the patriotism shown and the loyal service that through its guidance and direction was rendered by the utilities companies of the country. The men of the gas and electric companies formed an army of defense which contributed its full share toward winning the war."

THIRD GENERAL AND EXECUTIVE SESSION

Company Sections Report—Amendments to Constitution—A Discussion on Power Resources of the Country

After concluding his presentation of the review of the report, Mr. Edgar said that the report reflected the modesty of the chairman. He thought that no one had ever done as good work for any industry or any government as Mr. Lieb and George W. Elliott, the secretary, had done for the committee.

F. G. Gordon then made an address on "The Trend of Socialism." He discussed the menace in the world-wide active socialist movements and pointed out many illustrations of waste in government expenditure and operation in this country. Mr. Gordon spoke with great earnestness and was followed intently by the large audience which crowded the room. He was frequently applauded, and in its enthusiasm the audience rose to its feet at the conclusion of the address.

Before this session adjourned Mr. Freeman offered a resolution, which was adopted, expressing appreciation of the service rendered by the National Committee on Gas and Electric Service and providing that its report be printed.

After calling the third general and executive session to order on Wednesday morning, President Wells asked Frank W. Smith to present his report as treasurer. Mr. Smith showed that the association is in a satisfactory financial condition notwithstanding the somewhat detrimental effect of the war. The report was accepted.

Nominees for the nominating committee were then made. The following were duly elected: L. A. Ferguson, Henry L. Doherty, J. B. McCall, W. W. Freeman and Charles L. Edgar.

Walter Neumuller, chairman of the membership committee, made the report of that committee. This showed the decrease in membership which continued during the war period. The largest single factor was the static condition of the company sections. Some of these sections had been disbanded, and others had been doing nothing as a result of the war. Mr. Neumuller said that it was not at all improbable that a substantial increase would be recorded in company members and that with the return to normal activities in the geographic and company sections the committee is confident the turning point has been reached and the membership will show a satisfactory increase.

F. A. Birch, chairman of the committee on company sections, read the report of this committee.

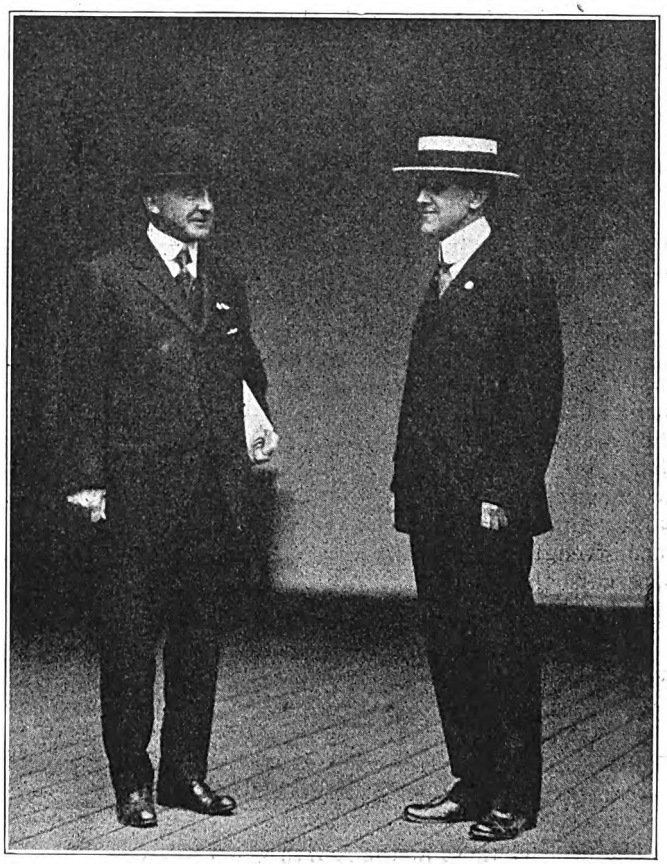
Two amendments to the constitution were brought up for action by the committee on company sections, of which Frank A. Birch is chairman. The objects were to afford a legitimate standing for those employees of central stations who cannot or will not spend $5 to become a Class B member of the national association, and to dignify Class B membership and make it a distinction and an honor.

William C. L. Eglin, M. S. Seelman, Jr., and H. W. Stevens discussed the report. Mr. Eglin felt that it was on the company sections that the future of the association depends. Mr. Seelman believed that it would be desirable to work out some method which would be at once educational, instructive and entertaining for members. Mr. Stevens said that it was important to adopt methods that would attract individual members to the meetings.

William C. L. Eglin, chairman of the committee on constitution and by-laws, read the report of this committee. Two amendments were suggested dealing with company sections. The ommission of the word "fixed" in connection with yearly dues in Acticle 17 was also suggested. The proposed amendments were adopted.

PLANNING FOR POWER

An address was then made by Dr. George Otis Smith, director of the United States Geological Survey, on



T. I JONES AND PRESIDENT WELLS

"Planning for Power." Dr. Smith discussed the ideas underlying the proposal of Secretary of the Interior Lane for an investigation of power resources in the entire country and in the Atlantic seaboard district. Dr. Smith said that during war time the remedy advocated for power shortage was restriction of industry. Electrification is the peace cure. He showed the possibilities of saving in power cost through electrification by saying that motive power accounts for fully 30 per cent of the expense of operating steam railroads and for about

The figures presented by the Alabama Power Company in its comparison of steam plant with hydro plant show the ratio of men employed as eighty-four to one. It is time to count the rising costs of labor in the steam plant where the coal miner as well as the fire-

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man is an employee in fact. To the 1000 kw. capacity, twelve and one-half men in the steam plant and coal mine adjacent compare with one-sixth of a man in the hydro plant. Dr. Smith directed consideration to the recognition of cheap power as one of the peace needs in France and Great Britain. From the proposed power system in the so-called Boston-Washington district would flow the energy to serve a score of railroads, hundreds of public-service companies, thousands of manufacturing plants and millions of homes.

Directly upon the conclusion of Dr. Smith's address, W. W. Freeman voiced appreciation of the courtesy of the speaker in coming to address the association. The address, said Mr. Freeman, was a message of immediate possibilities in store for the industry in the development of power business. It was also interesting to note, said Mr. Freeman, that to-day there is an appreciation on the part of the government of what the industry can and will do in the conservation of national resources. A very large part of the activities of the association in the last year were directly in coöperation with the government. Mr. Freeman said that he felt sure that the message would receive a very hearty response from the industry. He moved a hearty vote of thanks to Dr. Smith and of willingness of the association to coöperate along the lines proposed.

In seconding the resolution, John F. Gilchrist expressed full appreciation of what Dr. Smith had done in giving the address, which would do a world of good. It will give the industry new heart in going through what with many companies has been a period of great stress. Mr. Gilchrist saw an evidence in the address that the government and the general public are beginning to appreciate the position the public utilities occupy in the prosperity of the country. The public utilities are seeing the dignity of the position which they occupy as public utilities. Mr. Gilchrist said that the public utilities are the workhorses of the farm and no farmer ever thought of economy by starving his work team. The utilities must be allowed to acquire such strength and resources as will enable them to keep pace with the growth of this great country.

The motion was carried by a rising vote.

FOURTH GENERAL AND EXECUTIVE SESSION

Report of Lamps Committee—Election of Officers—Form of Annual Report to Commissions—Billings and Doherty Prizes

The first business at the fourth general and executive session on Thursday morning was the report of the committee on safety rules and accident prevention. This was divided into two parts. William C. L. Eglin presented the general report as chairman. The report of the sub-committee on accident prevention, Charles B. Scott, chairman, followed.

REPORT OF LAMP COMMITTEE

Frank W. Smith read the report of the lamp committee, of which he is chairman.

Statistical information on lamps sales and development formed a very interesting part of the written report presented by the lamp committee, of which F. W. Smith was chairman, but the committee considers that the lamp exhibit afforded at Atlantic City was its principal work. Comments on industrial lighting codes, company lamp policies and new avenues of lamp distribution were also included in the report.

According to the report, the total sales of incandescent lamps for domestic use (excluding miniatures) amounted to 186,000,000 in 1918, of which nearly 90 per cent were tungsten-filament lamps and the rest carbon and "gem." About 24,000,000 units were of the gas-filled type. Since the last report of the committee the demand for gem lamps has ceased, and about the first of this year the manufacturers discontinued entirely their production so that no gem lamps are now available. The use of carbon lamps (excluding "gem" lamps) still seems to be confined to places where service is severe, where their use is temporary or where protection from theft cannot be afforded.

More than 82 per cent of all lamps sold during 1918 were of the 110-125 volt group, and nearly 75 per cent of these lamps were of the three standard voltages which have been heretofore recommended—namely, 110, 115 and 120—so that it is apparent that much has been accomplished along the line of voltage standardization.

The average candlepower of all lamps sold during 1918 was 51.5 cp., the average wattage 52.7, and the average lumens per watt 10.3 (more than three times that of 1907, when the tungsten lamps were first introduced). Of the vacuum-type tungsten lamps the 40-watt, 25-watt and 60-watt rank in popularity in the order named. Of the gas-filled multiple lamps the 100-watt, 75-watt and 200-watt rank in the order named. While lamps of this type of the voltage group given show but 13.4 per cent in numbers of lamps, the wattage output is 36 per cent; that is, over one-third of the wattage of the 110-125 volt lamps sold during the year were of the gas-filled type.

During the year the average candlepower of street series tungsten lamps was 157 cp., a decrease of nearly 2 per cent over 1917, due to the lesser number of 400-cp. and 600-cp. lamps used. Excluding the 250-cp. and higher-candlepower lamps, which are largely used in place of carbon-arc lamps, the average candlepower in 1918 was 74 cp., an increase of nearly 3 per cent.

About the only developments in lamps during the war were the introduction of the mill-type vacuum tungsten lamp, the reduction in number of sizes of bulbs and the production of motion-picture projector lamps.

The change in policy of companies handling lamps is given in the table on page 1081, based on reports that were secured from 50 per cent of the N. E. L. A. membership.

Discussion

This report was discussed by John Howell, L. A. Ferguson, R. H. Ballard, W. H. Johnson, Arthur Williams, Mr. Cushing, M. S. Seelman, Jr., and, in closing, Frank W. Smith. Mr. Ferguson strongly favored the continuance of the policy followed by the Commonwealth Edison Company, Chicago, of handling the renewal of lamps as the main point of contact with customers rather than letting this pass to other branches of the industry which, he said, want to make a profit out of the central-station customers. Mr. Williams explained the New York Edison Company policy, saying that probably 1000 distinct electrical centers have been built up in New York City where customers can buy standard tungsten lamps. In the next two or three years, he added, the largest growth will come from home de-

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vices and the substition of central-station for isolated-plant service.

In connection with the lamp committee report President Wells read telegrams from John W. Lieb, acknowledging the greetings of the association and saying that he is on the "high road to recovery."

ELECTION OF OFFICERS

L. A. Ferguson, chairman of the nominating committee, presented the report of that committee. Its nominees were: President, R. H. Ballard, Southern California Edison Company; first vice-president, Martin J. Insull, Middle West Utilities Company; second vice-president, M. R. Bump; third vice-president, Frank W. Smith, United Electric Light & Power Company, New York; fourth vice-president, Walter H. Johnson, Philadelphia Electric Company; treasurer, H. C. Abell, American Light & Traction Company; members of the executive committee to serve three years: W. H. Atkins, Edison Electric Illuminating Company, Boston; P. G. Gossler, A. B. Leach & Company, New York; D. H. McDougall, Toronto Power Company, Ltd.; member of executive committee to serve two years, R. J. McClelland, Electric Bond & Share Company. The secretary was instructed to cast one ballot for the nominees, and they were declared duly elected.

Mr. Edgar and Mr. Williams escorted Mr. Ballard to the chair, and the president from California received a most cordial greeting from the delegates.

Expressing himself as deeply grateful for the honor, Mr. Ballard said that he was not unmindful of the fact that his election was a tribute to the Pacific Coast and an expression of a real desire for a united industry in one common purpose, service to the public. It should be service satisfactory in every point of contact with the public, service even before profits. Mr. Ballard also expressed the hope that affairs would so shape themselves that all members of the association would feel that it would be profitable for the next convention to go to Southern California.

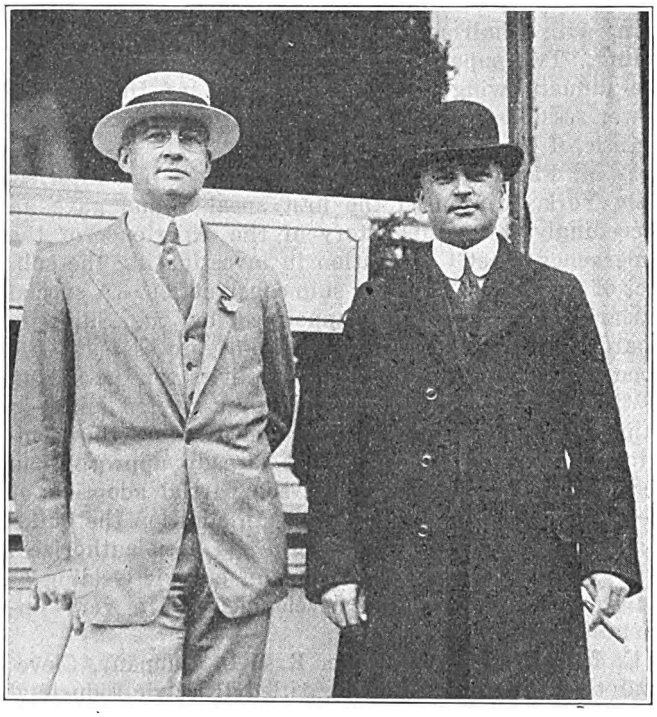
PRESIDENT-ELECT BALLARD

R. H. Ballard, the newly elected president of the N. E. L. A., is vice-president of the Southern California Edison Company, at Los Angeles, Cal. Mr. Ballard was born at Hamilton, Ontario, in 1875, and when a boy of fifteen entered the employ of the Thomson-Houston Electric Company at Chicago. In 1894 he went to Schenectady on the consolidation of the Chicago with the General Electric Company. There he was employed in the treasury department. In 1897 he left the General Electric Company to enter the employ of the West Side Lighting Company at Los Angeles as bookkeeper. Three years later he became cashier and office manager of the Butte (Mont.) Electric & Power Company, where he remained until 1904, when he returned to Los Angeles to accept a position as auditor of the predecessor of the Edison Electric Company. Since then he has passed through successive stages to the position he now holds with the Southern California Edison Company. Mr. Ballard is one of the leading figures in Pacific Coast utility work and was the first president of the Pacific Coast Section of the N. E. L. A.

IMPORTANCE OF ELECTROCHEMISTRY

Prof. Joseph W. Richards, Lehigh University, secretary of the American Electrochemical Society, then made an address on "The Importance of Electrochemistry." Professor Richards was given close attention as he outlined the large scope and purpose of the electrochemical industries.

In moving a vote of thanks, which the delegates passed by rising, E. W. Lloyd said that member companies should give much more consideration to the electrochemical industries than in the past. T. E. Bibbins, chairman committee on memorials, read the report of that committee.



J. E. DAVIDSON, PRESIDENT NEBRASKA SECTION, AND MAJOR D. S. MICHELSON, CHICAGO

A. S. Loizeaux, chairman, read the report of the committee on the Billings and Doherty prizes. The awards were: Doherty prize, "Distribution Engineering Economics," G. M. Armbrust, Commonwealth Edison Section; Billings prize, "Inspection Engineering," A. F. Bronwell, Commonwealth Edison Section; honorable mention, "Methods of Cooling Transformers," V. E. Alden, Baltimore Gas & Electric Company Section.

Charles L. Edgar read the report of the committee on the president's address. It directed the special attention of companies to the features of the address of

CENTRAL-STATION COMPANIES REPORTING VARIOUS LAMP POLICIES

(Figures indicate per cent of companies reporting in each group)

Company Lamp Policy	Number of Lighting Consumers Supplied — Less than 1000		1001 to 5000		5001 to 10,000		10,001 to 50,000		Over 50,000		Total	
	1917	1919	1917	1919	1917	1919	1917	1919	1917	1919	1917	1919
Free renewals only	0	0	0	1	2	0	2	0	0	6	1	1
Merchandise only	85	80	63	80	32	83	32	71	17	59	63	79
Free renewals and merchandise	12	2	31	9	56	11	56	13	66	35	30	8
Do not handle lamps	3	18	6	10	6	6	6	16	0	0	5	12
Give renewals — make lamp service charge	0	0	0	0	4	0	4	0	17	0	1	0
Total	100	100	100	100	100	100	100	100	100	100	100	100

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Mr. Wells. In presenting the report Mr. Edgar also recommended that the executive committee be directed to take up the question of combating the menace of socialism. This was approved by the convention.

Arthur Williams moved that the president be requested to appoint a committee to consider the question of what is ethical and just in the relations of the companies with labor for the guidance of the industry. He urged that if possible Mr. Edgar be enlisted to take an active part in this. William C. L. Eglin, in seconding the motion, asked that the entire broad scope of labor relations be considered, together with methods of profit sharing. The motion was adopted.

Arthur Williams then presented the usual resolutions of appreciation to those who had helped in the convention activities.

POWER SALES BUREAU AND COMPANY SECTIONS' MEETINGS

Investigation of Electric Welding by Emergency Fleet Corporation—Problems of the Local Company Section

More than 125 members of the Power Sales Bureau gathered Wednesday night in the Rose Room at the Hotel Traymore for the annual banquet of the power man, with Chairman G. H. Jones, Philadelphia, presiding. Two papers were scheduled for presentation at the dinner owing to the curtailment of the regular power sessions, instead of the formal addresses characteristic of former years.

F. M. Farmer of the Electric Testing Laboratories, New York, introduced the first speaker and gave an exceedingly interesting story of the experience of the Emergency Fleet Corporation in investigating the subject of electric welding for ship construction. A special research committee was appointed by the Shipping Board to study electric arc welding processes in the hope that it might develop opportunities for the saving of time and increase of strength over riveted joints in ship hulls. The armistice was signed before this committee completed its work, but already approval had been secured from Lloyds for the partial adoption of electric welding in shipbuilding. In addition the building of an electrically welded ship had been authorized. Mr. Farmer discussed the future of electric welding at length and predicted the development of a very important load.

E. J. Bartlett of the Baker R. & L. Company, Cleveland, then presented a paper entitled "Electric Industrial Trucks and Tractors and Their Relation to the Central-Station Load," in which the author dwelt at length on the opportunities ahead of central stations in promoting storage-battery transportation.

COMPANY SECTIONS' DINNER

Two past-presidents of the N. E. L. A., Henry L. Doherty, the originator of the company section idea, and William C. L. Eglin, who put the Doherty plan into effect, delivered addresses at the section's dinner Wednesday night. The gathering was under the auspices of the committee on company sections, and its chairman, F. A. Birch of the Philadelphia Electric Company, presided. There were about fifty present, including chairmen of company sections from every state of the Union. These men had come to discuss with the sections committee and with the officers of the association the problems of industrial sections and the broader questions which affect them all. This dinner was to bring all those interested together informally for an interchange of ideas, and it served its purpose well. Joseph B. McCall, president of the Philadelphia Electric Company and past-president of the N. E. L. A., could not be present, but he sent a message in which he said: "I am convinced that in coming years our executives and the leaders in our industry must of necessity come through the avenue of the local company section of the N. E. L. A."

POWER SALES BUREAU MEETING

About 100 delegates attended a meeting of the Power Sales Bureau Wednesday afternoon at the Hotel Traymore and discussed the effect of the war upon isolated-plant costs, electric furnaces and power factors in customers' installations. I. Lundgaard, Rochester, N. Y.; N. T. Wilcox, Keokuk, Iowa,; Morse Dell Plain, Hammond, Ind., and R. H. Knowlton, Philadelphia, led the discussions. It was brought out by data from the field that the isolated plant has been hard hit by the war as to increasing costs, and that the time was never better to secure this class of business. The growing usefulness of the electric furnace was also emphasized and the superior quality of its products reiterated. Development is proceeding toward the standardization of furnace practice to insure increased reliability of linings, and recently equipment for the use of smaller foundries has been placed on the market. The intensive use of electric furnaces at Detroit was also featured in the discussion. Power-factor improvement was discussed at length from both theoretical and practical angles.

SECTION PROCEEDINGS

Features of Technical, Commercial, Electric Vehicle and Accounting Sessions

In his opening address before the Technical and Hydroelectric Section, Chairman R. J. McClelland expressed the opinion that the engineer is the best-equipped man in the world to handle economic, political and industrial problems, because he has been imbued with the necessity of analyzing actual facts and has learned by experience that if conclusions are not based on definite considerations and physical facts the results may be of far-reaching seriousness. If engineers have not received recognized confidence of financial men so far, it is because some very few individuals have brought discredit upon the whole profession by recommending operations and undertakings which are commercially unsound. However, this objection can be removed if all will more closely consider the financial side of problems in the future. In this connection it is a hopeful sign that engineers are now more prominent in public, civic and administrative positions. More can be done if local sections of the N. E. L. A. will make a determined effort to induce broader study of economic and political situations.

The first session of the Technical Section opened promptly at 2 p.m. Tuesday, with Chairman R. J. McClelland presiding, and adjourned at 5.30. The interest displayed by all those who discussed the report of the committee on prime movers, which was the only topic of the afternoon, was in keeping with the vast amount of information which that report contained in its 160

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pages. The committee in arranging the material in its report took up steam turbines first and proceeded to the coal pile, dealing in separate steps with the intervening apparatus. Mr. N. A. Carle, chairman of the committee, outlined the work done during the year and the plan followed in preparing its report, which was read in abstract only so as to allow a maximum amount of time for discussing it.

R. H. Ballard and Thomas Sproule presided at the second session, at which the principal topics of discussion were construction of underground and overhead lines. Inductive interference and joint use of poles were two timely topics covered.

About 200 were present at the third technical session Wednesday afternoon, the interest remaining high enough up to 6 p.m. to necessitate a number of those present standing throughout the meeting for lack of seats. Two reports were submitted for discussion—electrical apparatus, by R. F. Schuchardt, and meters, by F. V. Magalhaes.

At the close of the session a unanimous ballot was cast for the following officers of the Technical and Hydroelectric Section for the coming year: Chairman, I. E. Moultrop; vice-chairmen, N. A. Carle and A. H. Lawton, and executive committee, R. F. Schuchardt.

VEHICLE SESSIONS

Gas cars and animals are still widely used for transportation purposes, because the public has not yet accepted the facts about the electric vehicle which electric men know to be true. Chairman E. S. Mansfield referred to this condition in his opening address, analyzing conditions which might be expected to influence the future progress of the industry. An investigation revealed that the numbers of service stations and garages should be increased. There are insufficient to care for machines after they become the property of the public. Either independent transportation engineers of high class should be induced to study the problems of prospective customers who are willing for them to do so or else the manufacturers should add such experts to their selling forces. A certain amount of publicity is also necessary and a campaign of simple, direct and conclusive elucidation should be engaged in.

Mr. Mansfield pointed out that if the electric vehicle is to fill the sphere of greatest usefulness central stations and manufacturers must work together in full accord. The manufacturer must be allowed to design and construct unhampered; he must be the judge of the selling price; he should be willing to increase his plant capacity to permit of quantity production, and while relying on the central stations for moral support should not expect the central station to use electric cars where they will not meet with success.

The papers presented at the two sessions dealt with the operating experiences of the buyer and the merchandising problems of the seller of electric vehicles. Trucks were discussed more than pleasure cars, but industrial tractors were also considered at length.

For the coming year officers for the Vehicle Section were elected as follows: Chairman, George B. Foster, Commonwealth Edison Company, Chicago; vice-chairman, Frank W. Frueauff, Henry L. Doherty Company, New York; treasurer, H. M. Edwards, New York Edison Company; secretary, A. Jackson Marshall, New York. The new executive committee for this section, to serve for a period of three years, is made up of Walter A. Johnson, Philadelphia Electric Company; Frank W. Smith, New York; E. H. Mansfield, Boston, and C. K. Chapin, Memphis, Tenn.

ACCOUNTING SESSIONS

Paul R. Jones, vice-chairman of the Accounting Section, in opening his address at the first accounting session, held in the Million-Dollar Pier Tuesday, urged closer coöperation between the Accounting Section and the other sections of the association. Such coöperation is necessary, he said, if the section is to achieve the best results, and for this purpose he suggested that an invitation be extended by the Accounting Section to all other sections to appoint a member to each of the accounting committees. If this policy could be inaugurated, and the other sections coöperated, he thought closer unity would be obtained between the operators and accountants, and solutions to problems could be arrived at from a broader viewpoint.

Mr. Jones further suggested that to avoid duplication of work the chairman of the Accounting Section of each state or geographical section be invited to become a member ex officio of the executive committee of the Accounting Section.

In this way the accounting problems of each state could be presented more readily and difference of ideas on principle in a measure eliminated. In the speaker's opinion the preparation of the yearly budget should be in the hands of the treasurer of the section for submission by the chairman to the executive committee. The formation of two additional committees, one to make a thorough study of credit and collection departments and one to deal with such accounting questions as affect public policy, was also recommended.

Mr. Jones emphasized the need for all member companies to insist upon the personnel of their accounting organizations taking an active interest in the section's affairs. If the best results are to be obtained, the work should not be left to a comparatively few to do.

The second and closing accounting session opened with the report of the committee on operating records, C. A. White, Boston, chairman, followed by a paper on operations of the Motor Transport Corps, a report on purchasing and storeroom accounting and the establishment and growth of the ordnance finance section.

COMMERCIAL SESSIONS

The activities of the Commercial Section were brought before the convention in a series of five sessions, so great was the interest in this phase of central station business. It was pointed out that electric lighting of all kinds should now go forward since all forms of curtailment have been abandoned. The greatest prospects, however, appear to lie in the development of electric furnace loads, particularly for steel making. Electric ranges, it was said, would soon come into general use, following a vigorous campaign of education. The training of salesmen and their equipment with the necessary data was also given considerable attention.

The Commercial Section will be guided, during the next year, by John G. Learned, Public Service Company of Northern Illinois, Chicago, who has been elected chairman. M. S. Seelman, Brooklyn Edison Company, and Henry Harris, Wilmerding, Pa., were elected vice-chairmen, and R. H. Tillman, Consoliated Gas, Electric Light & Power Company, of Baltimore, is the new secretary.

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TECHNICAL SECTION

Advisability of going to still larger turbines, cable rating and testing of instrument transformers were given careful consideration by this section.

THE entire first technical session was devoted to the 160-page report of the committee on prime movers. Comments were made on the different sections of the report, taking up steam turbines first and proceeding to the coal pile, dealing with the intervening apparatus and the problems of operation associated therewith. Unusual interest was taken in this session as indicated by the fact that every available seat in the meeting room was filled until the close of the session.

At the second session two important reports were presented. The first was the report of the committee on underground construction and electrolysis, and the second report was that of the committee on overhead lines and inductive interference. Those who discussed the subject considered relations with the telephone companies of first importance, especially in the matter of joint use of poles and the disposition of overhead lines to prevent disturbances in the telephone circuits.

Standardization of transformer polarity, establishing a proper basis for rating oil switches and extinguishing generator fires were among the principal subjects of interest at the third and last technical session. Marked attention was also given to methods of training metermen, the applicability of the Warren timing device, accuracy of current transformers and fusing of potential transformers. Both manufacturers and users of equipment showed by their expressions of opinion that they fully recognize the value of coöperating in developing new equipment and correcting present designs that may not be giving the best service.

TENDENCIES IN USE OF PRIME MOVERS

Steam, Water and Gas Power Considered—Progress in Development—Relation of Size of Units to System—Storage and Handling of Fuels

The discussion of the report of the committee on prime movers, which will be found on pages 1106-1109, was opened by W. L. Abbott, Chicago, who pointed out that, although there has been considerable concern regarding the operation of large turbines, there is nothing in the situation that warrants distrust in large turbine units or in the present design of these machines. Troubles have not been confined to any one feature, and the corrective measures which are being applied make it possible to contemplate with confidence even larger turbines than have been used in the past.

H. M. Cushing, Buffalo, N. Y., stated that out of 2780 machine days the turbines in the new station of the Buffalo General Electric Company were out of service only 260 days. Most of the difficulties have been due to high temperatures ranging from 650 deg. to 700 deg. Fahr.

W. S. Finlay, Jr., Interborough Rapid Transit Company, New York, commented on the operation of the large turbines in the company's Seventy-fourth Street station, details of which were given by him in the May 10 issue of the ELECTRICAL WORLD. In this station, he said, there is a maximum installed rating of all generating equipment of 190,000 kw. and in the Fifty-ninth Street station 210,000 kw. These stations operate in parallel.

Because the details of operation have been worked out on a careful basis, considering all the conditions which are met, all units now in operation have made a creditable showing. The generating system is now laid out on the basis of a 30,000-kw. unit and operating conditions and connections are such that 15,000 kw. is floating on the lines and available at all times, so that a 30,000-kw. unit can be taken out at any time without a disturbance in plant operation. Mr. Finlay agreed with the other speakers that improvements now being made point toward better turbine performance in available designs.

Philip Torchio, New York, explained the conditions of speed and size taken into consideration in the design of turbines and pointed out that, although certain designs do not lend themselves to high speeds, this does not mean that they cannot be satisfactorily built. He referred to the work of the power station committee of the A. I. E. E. and to papers which will be presented on turbine design at meetings in the coming fall.

E. H. Sniffen, East Pittsburgh, Pa., expressed the need for more coöperation between manufacturers and operators and between manufacturers themselves in order to establish design standards for turbines in the same way as already worked out for electrical apparatus through the A. I. E. E.

Higher Steam Pressures.—On the subject of boiler operation the different speakers seemed to agree that higher pressures must come at an early date. Richard H. Rice, West Lynn, Mass., suggested the construction of a plant with a rating of 2000 to 3000 kw., which might be operated with a steam pressure at 500 lb. to 600 lb., so as to determine the practical limitations and the needed developments in design for higher pressures. He pointed out that results secured with pressures of 250 lb. to 300 lb. have been successful with only slight changes in layout of power-plant equipment.

A. L. Meyer stated that by the use of low-carbon high-tension steels a boilermaker can now construct a boiler for pressures beyond 350 lb. He mentioned the construction of boilers in England in which steel with a tensile strength of 74,000 lb. per square inch is used.

I. E. Moultrop, Boston, said higher steam pressures seem to be the most feasible method of combating higher coal and labor costs.

Percy C. Idell, New York, in commenting upon tendencies in boiler construction stated that particular attention is now being given to ventilated walls. Manufacturers are working on steam pressure problems outlined by the committee and already have installations operating satisfactorily at 350 lb. per square inch pressure and many at 200 lb.

Robert Wyld, New York City, in commenting upon the subject of superheaters covered by the report, stated

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that the superheater is a good indicator of the condition of the boiler. In case the boiler throws over solid material the trouble should be corrected at its source. John Primrose, New York City, added that in furnishing a superheater it is important to know the type of fuel, how it will be burned and the operating conditions on the boiler. He stated that the Power Specialty Company is working on a surface for superheaters that makes use of radiant heat.

O. F. Junggren, Schenectady, N. Y., said that superheating of steam is not as advisable as going to higher pressures, pointing out that the greatest economy is in the pressure and not in the temperature increase.

H. Herlan, Boston, referred to experiments which are being started and are expected to lead to results that will strengthen economizer construction and increase both transmission rates and scraper rates. Present scraper troubles he said are due mainly to inattention and pitting and ruptures, in many cases to chemical action resulting from the coal used, especially when high in sulphur. In one case where coal high in sulphur is used the company is trying a process of dipping the moving parts in a silica solution. A much harder iron is also being tried. W. S. Messler, Beacon, N. Y., in commenting on economizer operation stated that installations are now in satisfactory operation on 350-lb. pressure.

Stokers and Grates.—On that part of the report dealing with stokers and grates the following offered comments: H. M. Cushing, Buffalo, N. Y.; C. B. Grady, New York; T. A. Marsh, E. B. Ricketts, New York, and John Dallas, Philadelphia. The last speaker mentioned interesting results secured by means of waterbacks installed to help out in troubles with clinker grinders and to utilize heat for raising the temperature of feed water. Mr. Dallas stated that with long water backs from 4 to 5 per cent of the heat generated in the furnace was absorbed by the water passing through the waterbacks. With short waterbacks this rate of heat transmission was reduced approximately 60 per cent.

Burning Powdered Fuel.—Chairman McClelland outlined in some detail developments by a Seattle company in burning powdered fuel. He pointed out that the burning of the fuel is now perfectly practicable. The greatest problem is in the powdering and the grinding of the fuel. This fuel is delivered in closed tank cars and closed wagon tanks at a cost of about $7 per ton. A charge of about $1.50 per ton is made for powdering and grinding the coal.

W. S. Finlay, Jr., Interborough Rapid Transit Company, New York City, described a special induced fan which is now being used to take care of cinders. By this means he has been able to eliminate 70 per cent of the cinders from gases.

W. L. Abbott, Chicago, described a device which is being tested at the University of Purdue to burn ground coal rather than pulverized coal. This device is made up with a circular furnace arranged so that the coal can be fed in tangentially and burned while it is whirling on the inner surface of the circular furnace. The ash melts and runs out at the bottom. This device burns about 3000 lb. of coal per hour and it is said to operate at high efficiency. Following his remarks on this subject, Mr. Abbott took up at considerable length the details under which he has found it possible to store coal out of doors without the customary troubles from fires. He pointed out that it is essential that all fine and coarse coal be evenly distributed on a storage pile so that circulation of air may be cut off and combustion prevented. He referred to outdoor storage of coal in piles which had remained untouched as long as eight years without any evidence of heating.

The burning of lignite was discussed at considerable length by S. B. Flagg, Philadelphia, and T. A. Marsh, Chicago, Ill.

An interesting discussion was contributed by G. J. Foran, New York City, on the subject of ejectors and vacuum pumps. He referred to examples outlined in the report of the committee and compared the use of ejectors with vacuum pumps using the data furnished.

E. B. Ricketts, New York, recommended the use of standard boiler and turbine room instruments but emphasized the need of attention by men familiar with their operation.

OIL SWITCH GUARANTEES AND GENERATOR FIRES

Transformer Practice and Standardization as Well as Substation Practice Discussed by Electrical Apparatus Committee

While the electrical apparatus report, presented by A. H. Lawton of Jackson, Mich., digested quite fully on pages 1100 to 1105, covered a variety of subjects, the discussions in which the greatest number participated centered around standardization of transformer polarity, construction of substations which can be easily enlarged, automatic substations, difficulties with oil and airbreak switches, basis for oil-switch guarantees, and protection of generators against internal troubles. In these discussions, as in all the others, the value of coöperating with manufacturers to acquaint them with operating troubles and performance was continually emphasized.

Difference of opinion regarding the advisability of standardizing transformer polarity existed, some saying that subtractive polarity should not be adopted for distribution transformers, while others sided with the committee report by upholding such standardization. On the motion of H. B. Gear, Chicago, the subject was referred back to the sub-committee for further consideration.

Too many outdoor substations are constructed so they cannot be easily extended, said J. C. Martin, Allentown, Pa., thus requiring the rebuilding of stations when they outgrow their load. Where this is true it is due to lack of imagination regarding future growth, contended R. J. McClelland, New York. One company's way of avoiding this objection was fully explained in the ELECTRICAL WORLD recently, remarked H. L. Wallau, Cleveland. R. J. Wensley, Pittsburgh, referred to the use of automatic substations for serving three-wire loads as a means of saving investment in large feeders.

Various topics regarding oil and air-break switches were touched on, such as the disadvantages of alternating-current control of oil switches, moisture entering outdoor switches, oxidation of air-break switches under heavy load, etc. While some persons contended that the duty on which oil switch performance is guaranteed does not approach the severity of actual practice, Mr. Smith of Schenectady said that it is only a bench mark on which to base ratings. A. S. Loizeaux, Baltimore, suggested that oil-switch explosions are sometimes due to explosion of oil fumes, in which case they may be

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prevented by proper scavenging of the air, one method being described. This involved the use of two large check valves, one at oil level and one at top of case to permit air circulation. Compilation of information regarding performance and breakdown of apparatus with attending conditions was particularly encouraged by Mr. Smith.

Generator Fires.—The subject of extinguishing fires in generators was a very lively one, the use of steam or water or both being advocated for this purpose, although preference was shown for water. H. R. Summerhayes, Schenectady, said that immersion of armature coils in water if not prolonged is not permanently injurious, but they should be dried as soon as possible.

Aside from those already mentioned, the following took part in the discussion: G. F. Morrison, A. S. Albrecht, Detroit; A. A. Meyer, Detroit; N. L. Pollard, Newark, N. J.; Mr. McNeil, Pittsburgh; H. B. Pope, Brooklyn; W. L. Abbott, Chicago; C. I. Crippen, Youngstown, Ohio, and N. H. Stahl, Pittsburgh.

UNDERGROUND CONSTRUCTION AND ELECTROLYSIS

Rating of Cables, Dielectric Loss in Mineral and Rosin Oil Compounds, Causes and Location of Cable Failures and Ventilation of Manholes

Underground construction is discussed under fourteen headings in the report of the committee of which E. B. Meyer is chairman, carrying capacity of cables, dielectric losses and cable failure being treated most extensively. Among other subjects covered are fault location, fireproofing of cables, selection of duct size, installation of subway transformers, joint-filling compounds, three-wire and street-lighting circuits, junking of cable and transformer primary cut-outs.

The rating of cable should depend, says the committee, on the temperature actually obtained during operation. To facilitate determining this rating, operating companies are urged to keep accurate records of the load on their transmission cables, measurements of temperature and data on characteristics of the duct line.

One company has developed a plan by which the cable is given a seasonal rating based on the average temperature of an idle duct (see Fig. 1). Another company reports that the temperature of a bad local hot spot in a duct line was reduced from about 160 deg. Fahr. (71 deg. C.) to about 75 deg. Fahr. (24 deg. C.) by uncovering the conduit line for a distance of about 20 ft. (6 in.) and backfilling the excavation with heavy clay to replace the sandy fill which had been causing the trouble. Where local conditions do not permit the use of this method a specially ventilated manhole may be installed at the point where the temperature is excessive.

RELATIVE VALUES OF ROSIN AND MINERAL OILS, AS DETERMINED BY THE COMPANY

(See accompanying curves also)

Dielectric Leakage Current.—At 25 cycles and 20 deg. C., was more than twice as great in cables using rosin oil as in those using mineral compounds, and at 100 deg. C. was over four times as great.

At 60 cycles and 20 deg. C., rosin oil was 25 per cent higher, and at 100 deg. C. about 130 per cent higher.

At both 25 and 60 cycles the current was only about 12 per cent higher at 100 deg. C. than at 20 deg. C. in the mineral compounds, while it increased over 100 per cent in the rosin-oil compounds.

In the rosin-oil compounds the leakage current was practically constant from 0 deg. to 60 deg. C., but above this critical temperature it increased very rapidly. The mineral compound showed practically a straight line increase through the whole temperature range.

Power Factor.—The power factor is slightly greater at 25 than at 60 cycles for all temperatures. It is less in the rosin cables for the lower temperatures, but above 40 deg. or 50 deg. C. is greater in the rosin cables than in the mineral oil cables.

Insulation Resistance.—The insulation resistance on direct-current test is uniformly less for the rosin compounds, and decreases for both compounds as the temperature increases, but while it falls to an extremely low value at 90 deg. C. for rosin compounds, it is still in the order of megohms for the mineral-oil compounds.

There seems little reason to doubt the superiority of a mineral-oil over a rosin-oil base as far as dielectric losses are concerned. However, some mineral-oil compounds might possibly become too fluid at high temperatures, leaving the insulating material dry in certain sections and thereby liable to breakdown. Until the results of additional investigations are available the committee is not prepared to give its unqualified approval to the use of mineral-oil compounds to the exclusion of all others.

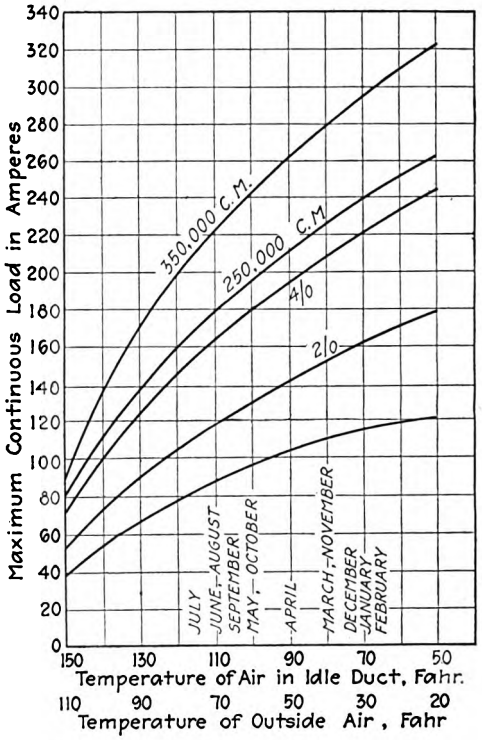

FIG. 1—EFFECT OF TEMPERATURE ON UNDERGROUND CABLE RATINGS

Graphic chart for determining the maximum continuous loading of 13,200-volt underground cables at different air temperatures. Maximum two-hour overload rating may be taken as 10 per cent above the continuous rating obtained from the curves. These tests were conducted by Public Service Electric Company.

It seems to be firmly established among member companies that cement is superior to the various types of asbestos covering used for fireproofing cables in manholes. However, there is a considerable difference of opinion regarding the comparative merits of rope and metal lath for reinforcing the cement covering. It is generally agreed, however, that the covered cable in the manhole has a better chance to radiate its heat than the uncovered cable in a conduit line.

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The opinion was expressed that it is not desirable to concentrate more than 7000 kva. to 8000 kva. in a single underground circuit, and that 3-in. (7.6-cm.) (outside diameter) cable is about the largest now in use. The committee recommended that the size of a single conduit be limited to from sixteen to twenty ducts and repeated a previous recommendation that not more than 35,000 kva. be carried in a single-duct line.

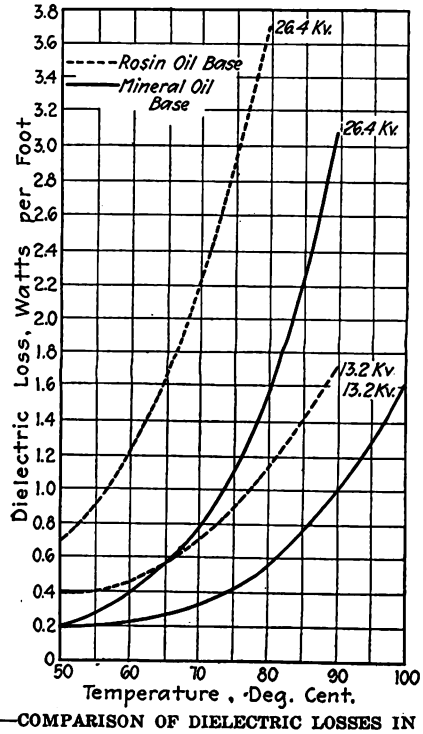

FIG. 2—COMPARISON OF DIELECTRIC LOSSES IN CABLES

The dielectric energy losses are shown for cables identical in size and construction, but one was impregnated with rosin oil and the other with mineral oil. The loss in the 26,400-volt rosin cable at 80 deg. C. is more than 2 watts per foot in excess of the loss in the mineral-oil cable. The tests were conducted on a 60-cycle circuit.

Statistics obtained from eight of the larger member companies show that subway-type transformers are being used in sizes of from 1 kva. to 150 kva. in manholes and vaults. The transformer rating per manhole is usually limited to 200 kva., reaching 300 kva. as a maximum. The amount of heat dissipated through the walls, roof and floor of a dry manhole varies from 3.7 watts to 4.8 watts per square foot (40 watts to 51.5 watts per sq.m.) with manhole air temperatures of from 100 deg. Fahr. to 120 deg. Fahr. (38 deg. C. to 49 deg. C.). Practically all companies use manholes with ventilating covers, and a few use standpipes to promote air circulation. The use of forced ventilation is not recommended except in extreme cases.

Some companies criticise severely the use of paraffin for filling high-tension joints, and other companies equally large and of as wide experience will use no other material. The disagreement, however, appears to be due not so much to the compounds as to the manner in which they are used.

To establish a neutral connection it is suggested that a tap from transformer windings be used at substations, etc., instead of balancer sets. This will reduce investment and operating cost. It is only necessary to have taps from two converter sets in each substation in order to insure continuity of service.

Since four companies operate satisfactorily with neutral mains having only 50 to 60 per cent the cross-section of one outside leg, it seems likely that the others could do so and thereby effect a considerable saving in cable cost.

In series underground street-lighting systems lead-covered rubber-insulated cable is used more extensively than paper-insulated cables for lamp connection. Three companies ground the lead sheath to the pole bases for safety of pedestrians while a few companies use insulating transformers with grounded secondaries to serve a few lamps in places.

The wasteful practice of selling mixed lots of junk by gross weight only, and not by the weight of the component parts, was condemned. Stripping machines have saved substantial amounts for companies which dispose of very large quantities of scrap yearly. Metal salvaged by this means brings about 80 per cent of the market price of new metal.

With one exception, all companies which have used the inclosed-fuse type of primary cut-outs report that this device is a failure in underground transformer installations. It was said that there is no inexpensive and satisfactory transformer primary cut-out on the market at the present time. The companies which have condemned the inclosed-fuse type of cut-out are experimenting with oil-immersed and other types of fuses. The development of a cheap and reliable primary cut-out offers an attractive field of endeavor for the inventor.

In discussing the committee report the members agreed that great advantages would result from further standardization of manhole and duct-line construction. Several members felt that the standard duct size might well be 4 in. or 4½ in. instead of 3½ in. This would facilitate changes and repairs. There is yet considerable difference of opinion regarding the relative merits of protecting cables in manholes with cement (over metal lath or rope) and disposing of them on shelves. R. O. Bentley, Newark, N. J., advocated more uniform spacing of manholes in the interest of reducing the number of cable lengths which must be kept on hand. J. B. Noe, New York, said that the practice of winding rope under the cement on cables in manholes had resulted in much damage to cables. The rope

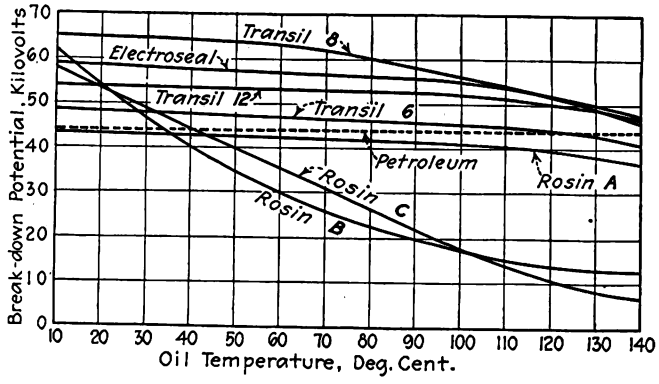

FIG. 3—DIELECTRIC STRENGTH OF ROSIN AND MINERAL OILS

The curves were plotted from tests conducted by one company. As a result of these tests the cable specifications of the company now require the use of either a mineral-oil compound or a compound containing less than 15 per cent of rosin oil.

soon burned away in case of fire and left space about the cable in which cable fires readily started. The use of metal lath, however, while facilitating the removal of cement for repairs, was not damaged by fire and thus protected cables adequately from external sources of trouble. J. W. Sylvester, Philadelphia, H. Goodwin, Schenectady, N. Y., and Messrs. Brundige, Wallau and La Due also took part in this discussion.

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OVERHEAD LINES AND INDUCTIVE INTERFERENCE

Present Status of Important Problems and Future Policies in Connection Therewith—Joint Usage of Poles, and Insulator Deterioration

The greatest single activity concerning inductive interference has centered about the California joint committee order in the form of further technical studies and steps to improve the former rules, according to the committee on overhead lines and inductive interference (A. E. Silver chairman). This order, while framed in a coöperative spirit and indicating a better mutual understanding of the difficulties encountered, still appears to lack much of representing a satisfactory solution of the inductive interference problem. It does regulate the kind, arrangement and methods of operating power lines and apparatus, but relatively little attention is given to the corresponding conditions for telephone lines and apparatus or to the establishment of an equitable and economic balance between the corrective measures to be applied to the respective systems.

With the increasing use of the electric arc furnace, which tends to distort the wave form of the system from which it is supplied, another factor has been brought into the interference problem that will need serious consideration.

Clearly, the situation requires continued and increasing coöperative efforts between the interested parties, both in the way of engineering analysis to gain a better mutual understanding of the factors contributing to disturbances and in so laying out and coördinating any extensions of lines or equipment as to guard against objectionable disturbances. The indispensability of both classes of work makes such coördination doubly important, but in effecting it there is real danger of an undue share of the responsibility falling on the system which contributes the distributing influence—an influence, however, which is harmful to no other than the peculiarly sensitive telephone apparatus.

Joint use of poles by power and telephone companies is of much concern to the industry and public as a whole for reasons of conservation and convenience, and every reasonable effort should be made to further its general application along sound lines. However, prevailing telephone practice thus far definitely discourages extensive joint-pole usage, it being limited to circuits not exceeding 5000 volts and no suitable provision being made for the higher voltages which are required in the development of power-company business.

Among the many war-time suggestions made by manufacturers for the purpose of facilitating production was a new standard for cable stranding which is based upon utilizing a minimum number of strand sizes and designating each cable in terms of the number and diameter of strands composing it, rather than in terms of circular mils as at present. By doing this it is claimed that the problem of manufacturers' stocks will be much simplified and that the manufacturers, particularly those who do not draw their own wire, can make more prompt deliveries.

Insulator depreciation, particularly in higher voltage usage, is believed to take place at too rapid a rate, although so far as the committee has been able to learn there has been very little effort made during the war period to analyze the causes further. Therefore renewed activity in the form of comprehensive insulator analysis and research is greatly needed, particularly in connection with design and manufacture of insulators.

In the appendix of this report John B. Taylor discusses telephone disturbances by induction.

H. B. Gear of the Commonwealth Edison Company emphasized the need of expert advice in regard to inductive interference. He added that there should be some way of measuring noises induced in telephone circuits and that standards giving the amount of permissible noise should be established. A number of specific instances of inductive interference and solutions were given by B. E. Morrow, Jackson, Mich., and G. F. Morrison, New York City, F. D. Nims, Seattle, Wash., cited a case of interference with a telephone circuit 30 miles from the power circuit in the Puget Sound region. There appears to be no agreement as yet showing just what constitutes a parallel circuit. Paul Spencer, Philadelphia, gave an interesting account of relations with the telephone companies in Pennsylvania.

TESTING THE METERS AND TRAINING METERMEN

Instrument Transformer Test Practice and Performance, Fusing of Potential Transformers and Periodic Schedules for Meter Tests

Instrument-transformer performance and testing and an outline of several companies' methods of training meter testers are discussed very completely in the report presented by the committee on meters (F. V. Magalhaes chairman). In addition, recent developments in meter practice are mentioned, maximum demand meters being especially emphasized. In summarizing the results of the investigation on instrument test practice, the committee said that the manufacturers' laboratories and the commercial standardizing laboratories incline toward the use of primary test methods; whereas operating companies quite generally use methods in which a transformer is tested by comparison with a standard transformer that has previously been tested by a primary method.

Of the primary methods, the one most frequently used is the so-called shunt or potentiometer method. For potential-transformer tests by this method a non-inductive resistance of large value is connected across the primary of the transformer to be measured and the secondary voltage is balanced against the voltage drop across a portion of this resistance.

For current-transformer tests by this method a fixed non-inductive resistance is inserted in the primary circuit of the transformer under test and an adjustable non-inductive resistance is placed in the secondary. The test is made by adjusting the secondary resistance until a balance is obtained between the voltage drop across this resistance and across the primary resistance.

At least three different kinds of instruments are used to determine balance in the potentiometer or shunt method. The Bureau of Standards employs a vibration galvanometer—*i.e.*, a galvanometer sensitive to alternat-current—and the Electrical Testing Laboratories employ a direct-current galvanometer with a synchronous contactor in its circuit, the function of this contactor being to reverse in direction each half-cycle. The third kind of indicator reported was a separately excited dynamometer connected to a phase-shifting transformer.

One large manufacturing company reported the use of the mutual inductance method for testing current

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transformers. This method resembles very closely the potentiometer method referred to, except that inductances are introduced in the primary and secondary respectively of the transformer under test, that for the secondary circuit being adjustable, and a balance is obtained for the voltage induced on the secondary of these inductances.

One operating company has developed a secondary method wherein comparison is made between a transformer under test and a standardized transformer of the same nominal ratio by measuring the vector difference in current or voltage on a separately excited dynamometer of high sensitivity. This method is inexpensive and affords an accuracy that is sufficiently high for all commercial purposes.

Discussing the practice of using potential transformer fuses with watt-hour meters, the committee reported that they are liable to be light and fragile, and the loss of a fuse would either mechanically or electrically cause the loss of the element of one phase. With an inductive load that particular phase might be carrying a relatively small percentage of the total load and the blown fuse thus remain undetected for a considerable period with a significant loss of revenue. Of the companies from which reports were received, 80 per cent use unfused potential transformers on circuits of 6600 volts or less. The suggested use of a limiting resistance in the primary in place of the fuses is of questionable value because of the possibility of introducing errors.

On account of war conditions central stations have had considerable trouble in maintaining a meter-testing force and increased efforts have been made to expedite the training of meter testers. Moreover, many companies had to resort to the exclusion, suspension or entire abandonment of various periodic schedules of testing and inspecting. In the report the committee gave in detail the methods used by several companies in training new men as testers. Mention was made too of the meter-testing course of the Iowa State University.

Education for Metermen.—Several delegates mentioned metermen's courses which their companies have based on their experience during the war, the opinion in general being that better results are obtained by training the men under an instructor and conducting reading courses and questions and answers than by allowing men to study under several men's guidance as is generally done. Such courses help considerably to weed out the misfits. Some spoke highly of the employment of women in meter laboratories, while others were not so commendatory. It was brought out that small companies are in need of a meter-testing service because they cannot perform it very economically.

All agreed on the importance of testing instrument transformers because revenue is so closely related thereto. Mr. Gibbs of Pittsburgh pointed out that aging has not been noticed with silicon steel now used in transformers, but it may be appreciable in older types not made of this material. Possibly line short circuits are more responsible for inaccuracy than aging, said C. H. Ingalls, Boston, while C. S. Van Dyke, Schenectady, contended that the change in accuracy of transformers that his company has used for thirteen years is not worth considering. Need of some testing method which is less cumbersome than the Bureau of Standards rotating-standard method was pointed out by W. H. Fellows of Washington, D. C.

The discussion regarding the Warren timing device related to the operation of the device, its applicability and desirability. The accuracy is very high compared with other timing devices, and the device can be easily applied wherever a clock mechanism has formerly been used. It has been found particularly effective where textile mills are being served, because maintenance of a uniform frequency prevents breakage of threads or reduction of output. However, it was brought out that operation of clocks from alternating-current sockets will necessitate the maintenance of more uniform frequency than is commercially necessary or required by most commissions.

Transformer Fuses.—Fusing of potential transformers is still an open question, some following this practice while others have found it more advantageous not to do so. Different voltage limits are set by companies abcve which fuses are used, 22,000 volts being the highest mentioned, this being at Youngstown, Ohio. In connection with this discussion it was brought out that protection of two kinds has to be considered—transformer protection and system protection.

The following men also took part in the discussion: W. L. Wadsworth, Minneapolis, Minn.; G. A. Schneider, Toledo; Warren Partridge, Clearfield, Pa.; J. J. Reilly, Philadelphia; L. M. Meckler, Newark, N. J.; S. G. Rhodes, New York; F. J. Murmann, Mount Vernon, N. Y.; H. J. Blakeslee, Hartford, Conn.; H. E. Warren, Ashland, Mass.; W. J. Mowbray, Providence, R. I.; J. H. Sturge, Newark, N. J., and C. A. Harrington, Youngstown, Ohio.

MAGNETIZATION OF CURRENT TRANSFORMERS

	% Current Rating	Form K28, %	Form K48, %	Form K65, %	Form W2 %	Form 3 %	Type KA, %	Type KB, %
Magnetization caused by opening secondary:								
Change in ratio.....	10	+0.41	+0.25	+0.12	+0.18	+0.17	+0.17	+0.16
Change in ratio.....	100	+0.24	+0.14	+0.10	+0.03	+0.14	+0.09	+0.10
Change in phase angle.....	10	+2′	+3′	+2′	+2′	+11′	+3′	+6′
Change in phase angle.....	100	+1′	+2′	+1′	+1′	+6′	+2′	+2′
Magnetization caused by current overload:								
Change in ratio.....	10	+0.22	+0.32	.....	.....	.....	+0.57	+0.54
Change in ratio.....	100	+0.08	+0.05	.....	.....	.....	+0.15	+0.15
Change in phase angle.....	10	+5′	+1′	.....	.....	.....	+12′	+8′
Change in phase angle.....	100	+2′	+1′	.....	.....	.....	+5′	+3′
Magnetization caused by passage of direct current:								
Change in ratio.....	10	+0.42	+0.22	.....	.....	.....	+0.47	+0.50
Change in ratio.....	100	+0.12	+0.09	.....	.....	.....	+0.19	+0.15
Change in phase angle.....	10	+11′	+4′	.....	.....	.....	+13′	+7′
Change in phase angle.....	100	+3′	+1′	.....	.....	.....	+4′	+4′

Magnetization due to an excessive current overload with the secondary closed, or due to the passage of direct current through the windings, is more severe than that caused by opening of the secondary in the load.

RATE AT WHICH METER INITIALLY CORRECT WOULD RUN IF CONNECTED TO SECONDARY OF CURRENT TRANSOFRMERS

	Type of Transformers D-20	E-18	K-5	K-28 K-48	K-55
No. of transformers tested.....	62	40	54	83	149
Full Load:					
(a) Average accuracy.....	101.5	101.5	100.1	100.8	100.7
(b) Average deviation from (a)....	0.4	0.2	0.1	0.1	0.2
(c) Maximum deviation from (a)..	1.0	0.5	0.6	0.7	0.5
No. of transformers.....	62	40	54	83	149
10 per Cent Load:					
(d) Average accuracy.....	101.5	101.4	100.2	99.8	100.2
(e) Average deviation from (a)....	0.6	0.3	0.4	0.3	0.2
(f) Maximum deviation from (d)..	1.7	1.1	1.5	2.7	0.8
Power Factor 0.5 Full Rating Current:					
(g) Average accuracy.....	102.0	102.3	101.1	100.8	101.1
(h) Average deviation from (g)....	0.7	0.6	0.5	0.4	0.5
(i) Maximum deviation from (g)	2.2	1.1	1.1	1.5	1.5

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COMMERCIAL SECTION

Particular attention given to relations with customers, improvements in wiring devices, stimulation of store lighting and use of electric ranges and water heaters.

THE end of the war has been the signal for renewed activity on the part of the central-station men to secure all kinds of new lighting business, as brought out in papers and discussions in the Commercial Section. This is especially true of display and advertising lighting, curtailed during the war. In the interest of proper illumination for streets and highways it was proposed that the central station in each city install in a conspicuous locality one block of model street lighting, thus showing the citizens of each community the difference between good, bad and indifferent street lighting.

The use of the electric furnace for steel and brass making is rapidly increasing, and power salesmen are taking full advantage of the opportunity to press their advantage in this tremendous field for the sale of electrical energy. Range business which could not be supplied during the war should now be developed by an educational process for which both central station men and the manufacturers should be responsible.

It was said that in the Northwest, where hydroelectric energy is largely used, 75 per cent of the homes are equipped with electric ranges and water heaters.

A great deal of valuable information was brought out for the instruction of salesmen and technical data for their use in selling operations. The isolated plant was described as being "on its last legs."

STIMULATION OF LIGHTING BUSINESS

Opportune Time for Developing Lighting of All Kinds Has Arrived—Suggestions for Campaigns Are Included in Committee Report

Store lighting is of especial importance at the present time, in the view of the committee on this subject (A. L. Powell chairman), since it is in this field of lighting that increased business can be secured quickly and easily. For this reason campaigns of an educational nature, supplemented by local effort, should be conducted in the trade and the popular press to emphasize the relation between good lighting and sales.

From the lighting point of view stores can be divided into three classes—(1) the large department and dry-goods stores, which can usually afford to engage consulting illuminating engineers; (2) the distinctive shop in which individuality is the keynote (these should not be handled by the campaign method since it is the suggestion of artistic or novel methods of lighting which appeal to them most), and (3) small stores, which, though of little importance individually, are of great importance collectively and are best adapted to campaign treatment.

In a campaign directed at the latter the first step is to adopt one or two fixtures which can be obtained and stocked easily, to reduce the selling expense. Then a meeting should be called with local contractors to outline the campaign and decide on the price of wiring per outlet, terms of payment, method of financing, etc. This step can be followed by local advertising news stories on the value of good lighting, lantern-slide lectures before local merchant associations, mailing booklets to prospective customers, etc. It might be possible to standardize window-lighting outfits of metal molding having two, three or five sockets per strip which can be wired in advance. Stage-lighting effects can be used to advantage and color effects can be produced by varying the direction of the light. These can be studied with shadow boxes.

Norman Macbeth, New York; Leon Scherck, Poughkeepsie, N. Y., H. C. Sterling, Atlantic City; J. C. Disrael, Philadelphia; D. E. Peck, Schenectady; Joseph Becker, New York, and E. A. Mills, New York, discussed the paper.

STREET AND RESIDENCE LIGHTING

A plan for inviting all central stations to install a block of model street lighting was presented by C. E. Durfee, chairman of the committee on lighting of streets and highways. The aim was that there might be a conspicuous demonstration of modern lighting efficiency in every city. The need for better lighting on interurban highways for the encouragement of motor traffic was urged, and the development of farm load and factory sign load along these highways to help finance the extensions was recommended. Preston S. Millar, New York, W. D'Arcy Ryan, Schenectady, and Daniel Haggerty, Worcester, Mass., took part in the discussion. Mr. Ryan exhibited a number of interesting slides.

The average gross revenue from residence consumers continued on about an average basis during the past two years, according to the sub-committee on residence lighting (C. W. Johnson chairman). Active selling of electric merchandise and the elimination of empty sockets are the principal methods of keeping up this revenue.

The average cost of securing old house-wiring contracts, including the expense of carrying the account, was approximately $5 per contract in 1916 and 1917. Under the stress of financial conditions it was deemed advisable by one company to make this soliciting cost a part of the contract price. By this plan the company in question expects to save approximately $20,000 during 1919.

F. B. Pembleton, Newark, N. J.; L. D. Gibbs, Boston; C. G. Dufree, Rochester, N. Y.; G. H. Stickney, Harrison, N. J., and N. H. Boynton, Cleveland, discussed the paper.

The possibility of applying outdoor illumination to night work or recreation, monumental structures, pageants and festivals, flags and displays, is once more open. This load is not only desirable as a revenue producer, points out the committee on outdoor lighting (H. H. Magdsick chairman), but as a means of focusing attention on the subject of lighting and keeping it alive in the minds of the people. The extension of outdoor lighting will, no doubt, stimulate higher standards of intensity in commercial lighting installations.

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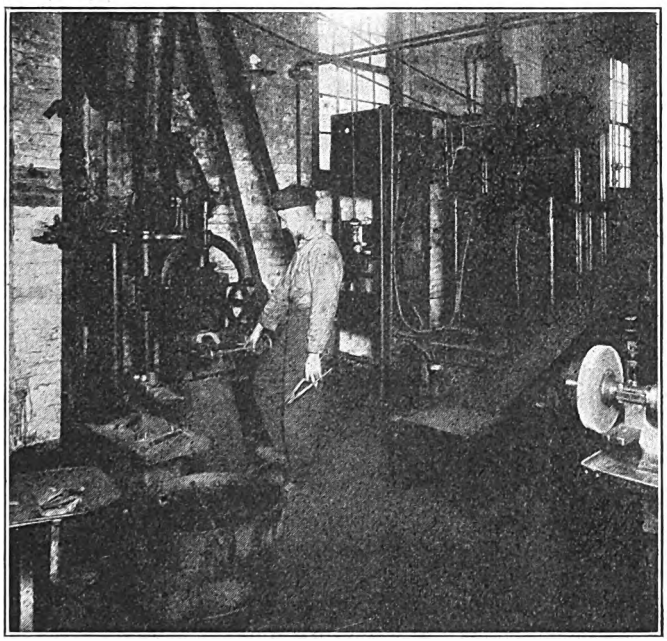
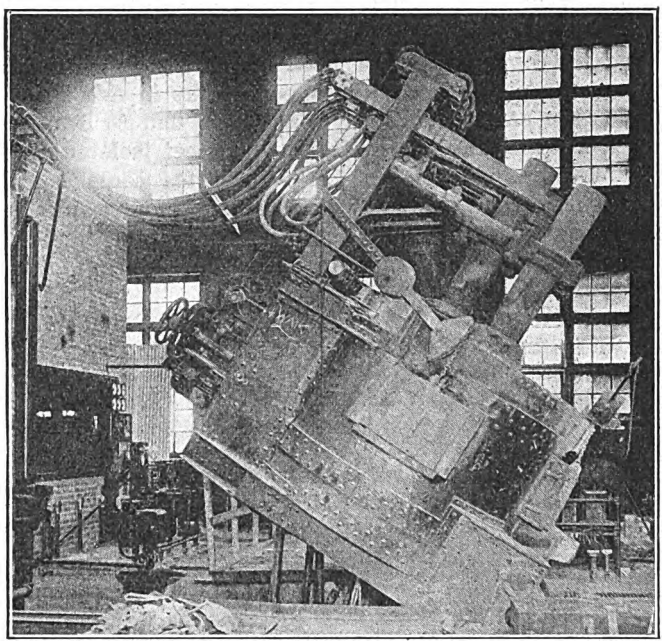
Norman Macbeth, L. E. Brown, Niagara Falls; G. H. Stickney, and W. D'Arcy Ryan, Schenectady, took part in the discussion of this paper. Mr. Ryan exhibited slides of the jeweled-arch displays in New York and Chicago.

A marked interest was shown in the address given by William A. Durgin, Chicago, on Thursday on "Our Manufacturing By-product" during which he demonstrated the proper method for illuminating industrial plants. Mr. Durgin showed how correct lighting has affected production in a number of industrial plants where he has conducted tests. His tests were carried on at much higher illumination values than those proposed by the I. E. S. and showed that with a 5 per cent increased investment in lighting the plant production could be increased from 15 to 27 per cent.





ELECTRIC FURNACES, ELECTRIC WELDING AND OTHER COMMERCIAL APPLICATIONS OF ELECTRIC HEAT OFFER EXCELLENT FIELDS FOR POWER-SALES ACTIVITY *

Two fields for the extension of electrical advertising which present themselves at the present time were considered by the commitete on electrical advertising (E. A. Mills chairman)—signs, darkened by the edict of the Fuel Administration and still standing inoperative in front of their owners' establishments in some cases, and new signs or, more properly, new sign prospects.

Central stations and every other agency dealing in electrical advertising should encourage the sign owners to brighten up their old signs, install new lamps and take such measures generally as will add to the appearance of their signs.

With regard to new business, indications seem to point to a prosperous post-bellum period as soon as the various problems of reconstruction and reorganization have been solved. Factory advertising in the form of electric signs has not been considered extensively before, but is full of possibilities because it will help educate others to the use of electrical advertising.

Considerable discussion followed the presentation of this report, in which L. E. Brown, Niagara Falls; G. H. Stickney, and H. C. Sterling, Atlantic City, took part.

To help develop new lighting business, to improve existing lighting and to promote the satisfaction of present customers by giving them more effective lighting are the three commercial purposes of illuminating engineering in the central-station industry, according to the sub-committee on lighting of public buildings (J. Bertram Regar chairman). To help achieve these purposes the Commonwealth Edison Company of Chicago has just prepared a list of architects, builders and contractors to whom will be sent the schedule of rates of the company and information sheets on Edison service, information on modern methods of interior wiring, interior and exterior lighting, electric motor drive, etc.

For a similar purpose the Philadelphia Electric Company prepared a very attractive illustrated booklet on church lighting.

The paper was discussed by W. P. Blackwall, New York; Bassett Jones, New York; Joseph Stickney, Indianapolis,: and Joseph D. Disrael. Messrs. Jones and Stickney cited conspicuous cases of installations ruined by glare and emphasized the importance of immediate action in this field.

LAMP EQUIPMENT

Very few departures have been made during the last two years in the design of equipment to provide better and simpler means of controlling and redirecting light, according to the committee on commercial aspects of lamp equipment, (D. R. Hogue, chairman). The big problem has been to furnish the proper equipment for gas-filled lamps.

As a means of helping the introduction of good lighting central-station men should foster the movement to introduce electrically equipped furniture. Many houses and apartments were wired before the day of portable lamps, and in such places the wired furniture often fills a long-felt want.

The features of lighting equipment that have been brought out recently are described in this report.

This report was discussed by G. H. Stickney, Harrison, N. J., O. L. Johnson, Chicago and others.

*Photo on left supplied by Society for Electrical Development.

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PROMOTION AND INCREASE OF POWER SALES

Effect of the War on Isolated Plants and Possibilities Afforded for Profitable Business in the Industrial Field

"The Effect of the War on Isolated-Plant Costs," as discussed by J. W. Meyer, Philadelphia, at the meeting of the Power Sales Bureau, appears in increased expenses and less satisfactory service. The author described the inability of the isolated plant to take advantage of cyclical price reductions and pointed out the difficulties of securing high-class attendance under present economic conditions. Examples were given of coal cost advances and operating expense increases, with data as to the competitive rates necessary to meet former and present expense levels. It appears that in five typical cases the central stations would have had to decrease their rates 22.2 per cent in 1916 to meet isolated-plant competition, whereas in 1918 the rates could be increased on the average 37.3 per cent without losing the business. The conclusion seemed irresistible that the isolated plant's days are numbered, in the opinion of the author.

S. Bennis, New York; R. H. Knowlton, Philadelphia; M. S. Seelman, Brooklyn, and M. Dell Plain, Hammond, Ind., discussed the paper.

ELECTRIC FURNACES

Col. C. F. Hirshfeld, Detroit, gave a résumé of the 1917 report of the Electric Heating Bureau on "Electric Heating of Non-ferrous Metals." J. D. Noyes, Detroit, then described electric furnace applications in that city. Twenty were added to the Detroit Edison system last year, aggregating about 6000 kw., and 2000 kw. in brass furnaces is now on order. About 12,000,000 kw.-hr. were sold in 1918 at Detroit for furnace service, and two or three times this business is in sight. Data from specific plants were given, with over-all energy consumptions per unit of output.

E. L. Crosby, Detroit, presented operating results with furnaces in various places, including a Connecticut rolling mill handling sixty-forty brass on 210 kw.-hr. per ton. About seventy-five electric brass furnaces are now in operation in the country, the speaker said. He also outlined the advantages of electric smelting. E. F. Collins, Schenectady, N. Y., emphasized the value of the electric furnace in securing improved quality of products, notably in producing non-porous castings. He maintained, with examples from practice, that the energy rate is of less importance than the quality of yield.

STEEL-MAKING ELECTRIC FURNACES

C. B. Gibson, Pittsburgh, referred to the stimulation of the market for electric steel by the war. Steady growth in demand is anticipated, especially from the automobile and airplane industries. Another promising field is the foundry. On Jan. 1, 1919, there were installed in this country about 330 furnaces with a yearly producing capacity in ingots and castings of about 1,400,000 tons and requiring 750,000,000 kw.-hr. An Electric Furnace Association has recently been organized to popularize electric furnace products, etc. Ferroalloys afford a remarkable example of the value of electric smelting. A. C. Smith, Buffalo, instanced the purchase of electric steel in the United States Shipping Board's work after open-hearth steel had failed to meet requirements.

R. H. Tillman, Baltimore, looked for a more stable demand for electric alloy steel in future. Crucible steel for tools is gradually being supplanted by electric steel on account of the superior uniformity of the latter. It is not practicable to manufacture ahead on alloy steels because the average customer specifies the desired analysis.

W. E. Moore, Pittsburgh, thought that large open-hearth furnaces for general service would not as yet be displaced on a large scale by electric furnaces, but that the demand for the high-grade product of the latter will increase. The yield is greater with the electric furnace, and there is a gain of about 15 per cent in tensile strength and ductility. In one plant 80 per cent of the castings from a converter failed on a bending test, the first of a set of tests required, while 95 per cent of the electric steel castings passed all five tests. Electric steel is being preferred in many specifications to-day.

POWER-FACTOR CORRECTION

R. H. Tillman, Baltimore, outlined the need of making the meaning of power-factor clear to customers. He favored a power-factor clause in all rate schedules for large power installations and urged doing everything feasible to improve conditions.

Robert Treat, Schenectady, N. Y., presented a written discussion with cost curves showing the economic aspects of various methods of power-factor correction and outlining the spheres of synchronous condensers and other equipment for this service. Automatic control of static condensers by time clock is a recent subject under engineering consideration.

B. H. Gardner, New Britain, Conn., cited a case where the power factor in an industrial plant was so low that it was impossible to operate all the motors and where day and night shifts had to be run to meet the situation. The installation of a synchronous motor raised the power factor to about 90 per cent and eliminated all the trouble. Wiring losses increase with low power factors and often justify a substantial investment to keep the motors well loaded and the power factor high. On a load of 100 kw. it is estimated that in one case a difference of 5 per cent in line losses would occur between 85 and 60 per cent power factor, amounting, at 2 cents per kilowatt-hour, to $200 per year. The writer described the evil effects of low power-factor upon lines and generating plants.

Will Brown, Minneapolis, advocated a bonus to customers maintaining good power factors. Joseph McKinley, Pittsburgh, and W. R. McLeod, Jersey City, also contributed to the discussion.

STANDARDIZATION OF WIRING ACCESSORIES

Increased Use of Appliances Should Follow the Interchangeability of Plugs—Salesman Should Be Instructed and Equipped with Data

Several independent subjects were discussed in the report of the wiring committee (R. S. Hale chairman), chief among them being standardization of plugs, safety devices on flatirons, shortcomings of safety codes and the deterioration of rubber insulation.

The chief progress that has been made in standardi-

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zation of appliance plugs and housings is due to the consolidation of three of the large manufacturers who have adopted standard prongs and standard housings on their appliances, these being arranged to take interchangeable plugs or even plugs which have been designed for flat or round prongs which may differ slightly in dimensions and in the distance separating them.

However, the standardization of appliance plugs and of the prongs and housings should not be pushed too fast, the committee believes, because it may work out that different distances and dimensions should be used for articles that have heavy duty. All plugs and receptacles hereafter made should be designed for polarity use in the committee's opinion.

Since about 75 per cent of the flatirons, etc., are used from sockets, any rule that would require any special safety device on the wiring would not be apt to increase safety, but to decrease it, because people would connect their devices to lamp sockets to save the expense of safety devices. The most ecective way to reduce the losses by fire is to educate the public against carelessness.

In the opinion of the committee there are many safe forms and methods of wiring which are in effect not permitted by the codes. This is commercially a very unfortunate situation and is something which is seriously hindering the growth of the central-station industry as compared with what the growth would be if the use of electricity were allowed to develop freely by means of all safe methods. The condition particularly hinders the wiring of old houses.

Discussion

In the discussion of Chairman Hale's report, F. D. Pembleton, Newark, N. J., emphasized the importance of educating the public in the proper and safe use of electrical appliances, and called attention to the booklet "The Safe Use of Appliances" just issued by the publications committee.

A. G. De Clercq, Chicago, declared that it would be a mistake to have conductors smaller than No. 14 go into a modern job, and Mr. Platt, Middletown, Conn., also advised against the use of too small wire.

W. H. Blood, Boston, Mass., complimented the work of the wiring committee, but declared that at several points in its report he detected evidences of "intellectual Bolshevism, all the more insidious because intellectual." The wiring code, said Mr. Blood, is primarily the property of the Underwriters, who enforce it to reduce insurance risk. Concerning concentric wiring, Mr. Blood said he was formerly an advocate of this form of construction, but he found he was misled and now wanted to apologize publicly to the association for his former stand. The practice across the water with concentric wiring was, he said he had since found, not applicable to conditions here.

Louis Kalischer, of Brooklyn, N. Y., pointed out that one owner's failure to observe the code affects not only his own insurance rates but those of his neighbor next door. The difference between poor and good wiring, he said, is barely one per cent of the cost of any building.

HANDBOOK

The committee of which R. H. Tilman is chairman has recommended that the "Electrical Salesman's Handbook" be divided into three sections only, one of which would be given to each member of the Commercial Section. Additional subjects have been suggested for inclusion, chief among them being ice and refrigeration, isolated plants, electric welding, electric furnaces, electric heating and drying, cement manufacture and the manufacture of cotton goods.

ELECTRIC RANGES AND WATER HEATING

The Future of Electric Cooking, and How Companies Are Charging for This Service and for Water Heating Only

The sale of ranges in 1918 about equaled that of 1917 according to the electric range committee, of which C. E. Michel was chairman. During the war increase was hindered because manufacturers could not get needed materials, while central stations did not have access to the capital required to make extensions and systems had all they could do to carry war loads alone. Future development of the range business will be seriously hindered in the localities where restrictions are placed on extensions and where the rates for electricity do not permit it to compete with fuel energy. Furthermore, the public must be convinced through united effort that first cost and cost per kilowatt-hour are but a part of the story. The fact should be recognized that gas rates have in many cases advanced faster than those for electricity, and indications are that the ratio will be greater in the future.

WATER HEATING

Heating water by electricity is receiving more consideration than usual at the present time, according to the sub-committee on water heating, especially in conjunction with electric cooking. There have been a few developments in apparatus, such as the plastic-type heater for clamping around the base of the boiler, the rugged bayonet-type heater which can be used as an external circulation, immersion or interior circulation heater, and the carbon-electrode heater.

One company, reporting 724 water heaters in use Jan. 1, 1919, has established a combination rate for energy supplied through one meter for lighting and cooking or heating that makes the rate for cooking about 3.5 cents per kilowatt-hour and for water heating about 2 cents. Another company has a sliding scale of 4, 2 and 1½ cents per kilowatt-hour for the first 30 kw.-hr. per month of active load, the next 90 kw.-hr. and the remainder respectively.

The discussion on the electric range and subcommittee reports was led by J. F. Killeen, Chicago. J. E. Davidson, Omaha, Neb., expressed the belief that education of the public by the central station and manufacturer is the most important thing to be done at this time; one method is to instruct housekeepers how to use electric ranges economically. He also predicted that the electric range would eventually be the primary load of the central station. C. E. Greenwood, Boston, said that in the small communities of New England there are 1500 ranges on the lines and in Boston alone there are over 2000. R. E. Sard, Albany, N. Y., said that the electric range has been proved to be entirely practicable and it is now merely a commercial proposition to develop a load of this nature.

The most optimistic talker of the meeting was D. A. Hegarty of Colorado, who said that the volume of the electric range business does not depend in the least upon the rate of energy supplied. On the other hand

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M. S. Seelman, Brooklyn, N. Y., said that the average householder in Brooklyn cannot afford to use an electric range at the prevailing rate. Paul Clayton Mattoon, Ill., said that his company was able to show the utility commission that rates of cooking should be comparable to rates for power. He also warned against providing too large transformers and meters for electric ranges. Among others who discussed this question were Messrs. Kilt, Clark and Anderson. M. C. Osborn, New Britain, Conn., gave a comprehensive survey on the development of electric water heaters in the Northwest. In this section 75 per cent of the homes equipped with electric ranges also have electric water heaters.

COMMERCIAL SERVICE AND SALES METHODS

Co-ordination of Advertising Considered Excellent Means to Obtain Better Results—Merchandising and Electrical Advertising

The creation by the N. E. L. A. of a bureau of commercial relations is recommended by the committee on commercial devices and relations with customers (R. F. Bonsall chairman) so that men specializing in this class of work may have an opportunity for exchange of views and an intimate discussion of papers on these subjects. The committee also suggests that member companies either organize a department to formulate and apply efficient methods of conducting relations with customers or form a committee of members of departments engaged in this work.

Since customers gage a company more by the treatment received at each point of contact than by the actual supply of energy to their equipment, it is important to train employees dealing with customers in the art of securing and maintaining good will. Furthermore, more attention should be given to the method of securing credit information. To facilitate this a standard form should be adopted for exchange between companies of credit information concerning customers who move from one city to another.

In opening the discussion of Mr. Bonsall's report, H. W. Peck, Schenectady, N. Y., explained the plan for the exchange of credit information employed by the Empire State association, which has been found very useful. Mr. Peck advised against returning customers' meter deposits at the end of twelve months, since some customers leave town without ceremony after several years' patronage of the electric company's service.

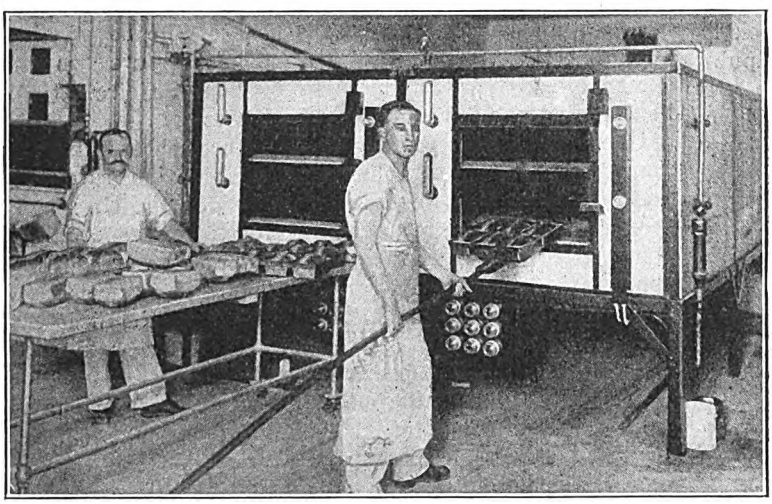
Henry Harris, Pittsburgh, Pa., advised paying the customer interest on his meter deposit each year, instead of waiting until it is asked for. Since losses through bad collections total only one-fifth of 1 per cent, said Mr. Harris, it might be advisable to accept this as an operating charge and eliminate the trouble and expense of collecting customers' deposits or securing credit information.

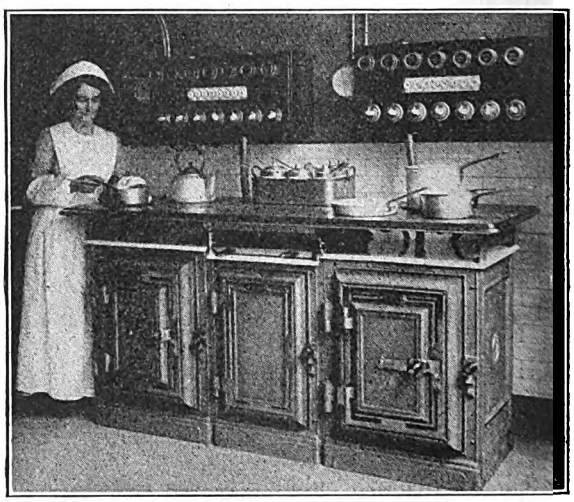
J. B. Seaman of Philadelphia urged the use of cyclometer or figure-reading dials on customers' meters.

In an effort to eliminate the present duplication of effort and expense by manufacturers and central stations in producing literature on show-window, store and sign lighting, the publications committee (F. D. Pembleton chairman) has asked various manufacturers to coöperate with the committee in the production of literature of this nature. Only one manufacturer considered the matter and he declined to join in such an effort.

Cost accounting, coöperation according to the Goodwin plan, standardization of plugs, margins of profit and merchandising of lamps are the principal subjects discussed in the report of the merchandising committee (E. R. Davenport chairman). No two central stations that are supposed to know the cost of operating their appliance departments were found to agree as to the details. The committee recommends that central stations develop branches of the electrical industry where team-work and coöperation do not exist at present.

Central stations are urged to give special attention to pushing the sale of table and floor lamps, which constitute a very profitable phase of the appliance business.





HOMES, RESTAURANTS AND COMMERCIAL ESTABLISHMENTS ARE ALL USING ELECTRIC RANGES

The coördinating of advertising and sales effort, instead of the haphazard display of a full line of products with little information that will appeal to the general public, is bound to bring benefits, the committee on coördinate advertising and sales campaigns (Henry Harris chairman) reported, because of the intensity of such a campaign and the fact that the public's attention can be focused on specific articles by definite appeals in terms of human interest. Therefore the committee recommends the simultaneous advertising of an electrical leader nationally by all manufacturers, accompanied by campaigns that will bring customers.

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VEHICLE SECTION

Unusual interest shown in all of the vehicle subjects, particularly in the growing field for trucks and tractors—Factors that will develop this business.

THE Electric Vehicle Section of the N. E. L. A. laid plans at Atlantic City to increase the use of electric vehicles by the aid of educational propaganda. Engineers, preferably independent of the association, will study the transportation problems of prospective truck buyers and attempt to show the public that in its field the electric vehicle is more satisfactory and economical than either gas cars or animals.

Both sessions were devoted to the study of commercial vehicle problems as far as they could be separated from those of the pleasure cars. Comparative operating figures compiled from the records of 5-ton electric and 5-ton gas trucks showed that whereas twenty-five electric trucks cost on an average $13.28 per day over a period of one year, an average of eight users of gas trucks paid out $29.20 per day per truck. Some even more remarkable savings were shown for industrial tractors. In one case the installation of this method of handling freight enabled the Emergency Fleet Corporation to save 450 men who were previously required for loading ships. At another point the government saved $40 per day on each of forty-three industrial tractors, and what was more important at the time released ten men per tractor for other duty.

FEDERAL AND MUNICIPAL TRANSPORTATION

Electric Vehicles Adopted Extensively for Use on Piers, and in Warehouses, Munition Plants, Etc., During War

During the war the government purchased many hundred industrial trucks directly, and many manufacturers of war materials bought and applied industrial trucks. The committee on federal and municipal transportation, of which James H. McGraw was chairman, asserted that, while it may not be generally known, it is fair to say that the industrial electric truck played a most important part in getting our Expeditionary Forces overseas and aded in no small way to the increased production in war munitions plants by speeding up the handling of materials in process of construction.

The introduction of the industrial electric truck into the transportation system in both war and peace times often brings about an overhauling of the transportation methods employed before. The truck itself is capable of handling much larger loads, and as a consequence production will often be automatically speeded up to meet the facilities offered by the introduction of the truck.

In the municipal applications of trucks no particularly new departures have been made during the year, but the electric vehicle continues to be used for street-cleaning work, and both New York and Columbus have added more trucks for street-cleaning purposes. In Columbus a tractor is employed with a trailer and a two-section side-dumping body capable of handling 10 tons gross. The Post Office is using up second-hand army gas trucks. Electrics may be bought later by the government.

Discussion

Van C. Brandt, Philadelphia, said in discussing this report that at one place in New Jersey the government saved $40 per day on each of 43 industrial tractors and, what was even more important at the time, released ten men per tractor for other work.

George B. Foster, Chicago, said he thought that industrial tractors would be the means of putting storage batteries into industry. The number of employees trained in the care of batteries would tend to increase the general use of electric vehicles. One concern with an inside loading platform changed from gas to electric trucks, left the cars at the loading platform at night and saved the garage expense.

Transportation Engineering

The two main points that the transportation engineering committee desires to get before the industry, according to its chairman, F. M. Feiker, are, first, that the electric truck as a method of transportation was never more in favor by the truck users of the country; second, that the use of electricity in transportation is a development commensurate only with the size of the problem and the ability of the men in the transportation branches of the industry to see that electricity is applied in every way possible to solve this problem economically.

Through a sub-committee under the chairmanship of A. A. Norris, correspondence is being carried on with educational institutions, with the idea of coöperating in the establishment of transportation engineering courses and the furnishing of data on the place of the electric trucks in commercial and industrial fields.

Discussion

Chairman E. S. Mansfield referred to this report as a progress record, the importance of which had not been emphasized by the chairman.

F. W. Smith of New York said that his company placed its vehicle records at the disposal of all member companies, although some other companies were not equally liberal.

George B. Foster of Chicago believed that all the records should be made available to the industry, but asked that the figures be carefully checked and apparent inconsistencies explained before records were allowed to go out.

R. B. Grove of New York City and D. H. McDougal of Toronto also contributed to the discussion.

Status of the Electric Vehicle

"The outlook of electric truck manufacturers has never been brighter than it is at present," said Rodney K. Merrick, in a paper entitled "The Present and Future Status of the Electric Vehicle," "and the next five years should be banner ones in the history of the industry." There are several reasons for the increased

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popularity of the electric truck. First, and perhaps most important, the modern electric truck is a vast improvement over its predecessor of eight or ten years ago. Besides, the modern battery lasts longer, is cheaper to buy, cheaper to maintain and has a higher capacity for a given weight. Motors, controllers, axles, frames and steering gears have all been improved, and a rugged, sturdy but lighter truck has been the result. Hence greater mileage range, fewer troubles and lower operating costs.

Electric truck manufacturers, where they are on the job, will get business, and with intelligent coöperation between the manufacturer and the central station, both doing their part in giving service, the electric truck industry will develop tremendously in the next few years.

Discussion

Frank C. Reilly, New York, said that the high speed of the gas trucks is a liability rather than an asset as it causes high maintenance costs. Two smaller electric trucks will give better service than one 22-mile to 25-mile per hour gas truck. The operators of electric cars can be obtained for $5 or $6 per week less than the wages paid to gas-car drivers. Several speakers mentioned the need for a larger number of electric garages and service stations.

NEEDED LEGISLATION AND STANDARDIZATION

More Favorable Tax Being Sought for Electric Vehicles —Garage Rates and Battery Charging Becoming More Uniform

No state laws, so far as they have come to the notice of the committee on legislation (G. A. Freeman chairman), have been passed which are dangerously discriminatory against the electric vehicle, although several states have very high-license fees in comparison with other states. Therefore it is rapidly becoming desirable to have a uniform vehicle tax law. The National Automobile Chamber of Commerce is working toward this end, and the committee suggests coöperating with this association, taking care to obtain, if possible, a differential in favor of electric vehicles because of the smaller amount of road wear caused by them compared with other power-driven vehicles.

STANDARDIZATION

Very little standardization of vehicles occurred during the war, according to the standardization committee (E. R. Whitney chairman), although a number of other features closely related thereto were under consideration. For instance, it was decided that in order to sell the maximum number of vehicles it is desirable to make the batteries in various makes of trucks interchangeable. This plan would require standard dimensions, arrangement of cells in trays, arrangement of trays, location of polarity of terminals and method of changing batteries. In turn the last feature would require consideration of side loading, permanent frame truss rods, possibility of removing a single individual tray, and ability to put battery directly into the truck or remove it from the truck with one handling. In addition, lightness, over-all dimensions, compactness, cheapness, simplicity, ability to keep out dirt and hold heat in cold weather, ventilating in hot weather and ability to change quickly have to be considered.

GARAGE AND RATES

Electric garage rates are reported by the committee on garage and rates (C. H. Miles chairman) to be largely standardized at the present time. Most member companies are providing a rate that is favorable to the electric vehicle, and garages are being established wherever the demand seems to be sufficient to warrant them.

The need of garage facilities, especially for commercial vehicles, has been felt particularly during the war period, and two more large electric garages have been provided in New York and another in Chicago. A large one is now in the process of building in Boston, and still another is being considered.

POSSIBILITIES OF ELECTRIC VEHICLES

Ten or twelve manufacturers are now making industrial vehicles, E. J. Bartlett reported, about one-half of them producing the majority of the machines sold. The others are building in a smaller way and are developing to a point where they can enter the field more aggressively. The total of the manufacturing capacity at the present time is about 5000 machines per year. The battery manufacturers are wide awake to the opportunities in the industrial-vehicle line and deserve much of the credit for the aggressive work done. Manufacturers of charging equipment are also specializing on apparatus suitable for industrial vehicles. It is interesting to note that new factory buildings, terminals, warehouses and similar buildings are being constructed with a view to utilizing electrically propelled vehicles for handling materials.

Different authorities have placed the quantity of electric industrial vehicles in use at the present time all the way from 6000 to 15,000. Allowing for the older machines discarded and the considerable number exported, Mr. Bartlett believes the number in use in this country to be approximately 8000 machines of all types, a large percentage of these having been built during the past two years.

Some of the common types of vehicles, such as the industrial tractor, three-wheel and four-wheel tractor, industrial truck, utility truck, baggage truck, low-platform truck, lift truck and special industrial truck, are described in the paper by Mr. Bartlett.

Discussion

George Drake Smith, Orange, N. J., referred to the success of the industrial tractors and said that out of nine inquiries recently received for electric trucks seven were from users of industrial tractors.

In reply to a question by W. P. Kennedy, New York, Chairman Mansfield said that in his opinion central stations are interested in the sale of electric trucks even though used by isolated plant operators. Service necessary for charging electric trucks at night often leads to the shut down of the isolated plant.

COÖPERATION

In its report on coöperation by manufacturers and central stations, the committee, of which George B. Foster is chairman, pointed out that, owing to radical changes in the cost of manufacture and operation, it is imperative to accumulate data which are suitable for application to to-day's conditions and to place this information in the hands of engineers, both operating and consulting, and in all institutions where engineers are trained.

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All of the vehicle manufacturers are enjoying an abundance of business, notwithstanding the sudden curtailment of the so-called war industries by the signing of the armistice. Most of this business is confined to a comparatively few leading lines of industry, as, for instance, express companies and foodstuffs.

Discussion

In opening the discussion George Drake Smith said it was significant that gas-truck manufacturers are now featuring transportation and service rather than details of construction. In the opinion of the speaker there should be more electric vehicle manufacturers, and they should all push the transportation idea.

F. M. Feiker, New York, said that a good appearance, which so often sells pleasure cars, carries little weight with the buyer of trucks. Business men buy trucks and tractors on an efficiency basis, and if the electric vehicle man only gets a hearing the economy of his machine should do the rest. The public at large is apt to discount the work done by "electrics" because there is no puff and blow to indicate when they are pulling a heavy load.

D. H. McDougal of Toronto, Canada, said that the opinion is often expressed that the weather in Canada is too severe for electrics, but that his own experience in the use of electric trucks in Toronto has shown them to be eminently satisfactory.

Chairman Mansfield said that during the severe winter of 1917-18 one concern in Chicago had to tow into the garage twenty-seven gas trucks and twenty-five electrics. All the gas cars had to be sent to the shops for repairs, but the electric trucks only needed recharging. Some spectacular performance was thought to be necessary to overcome the apathy of the public towards electric vehicles, and this may be forthcoming shortly.

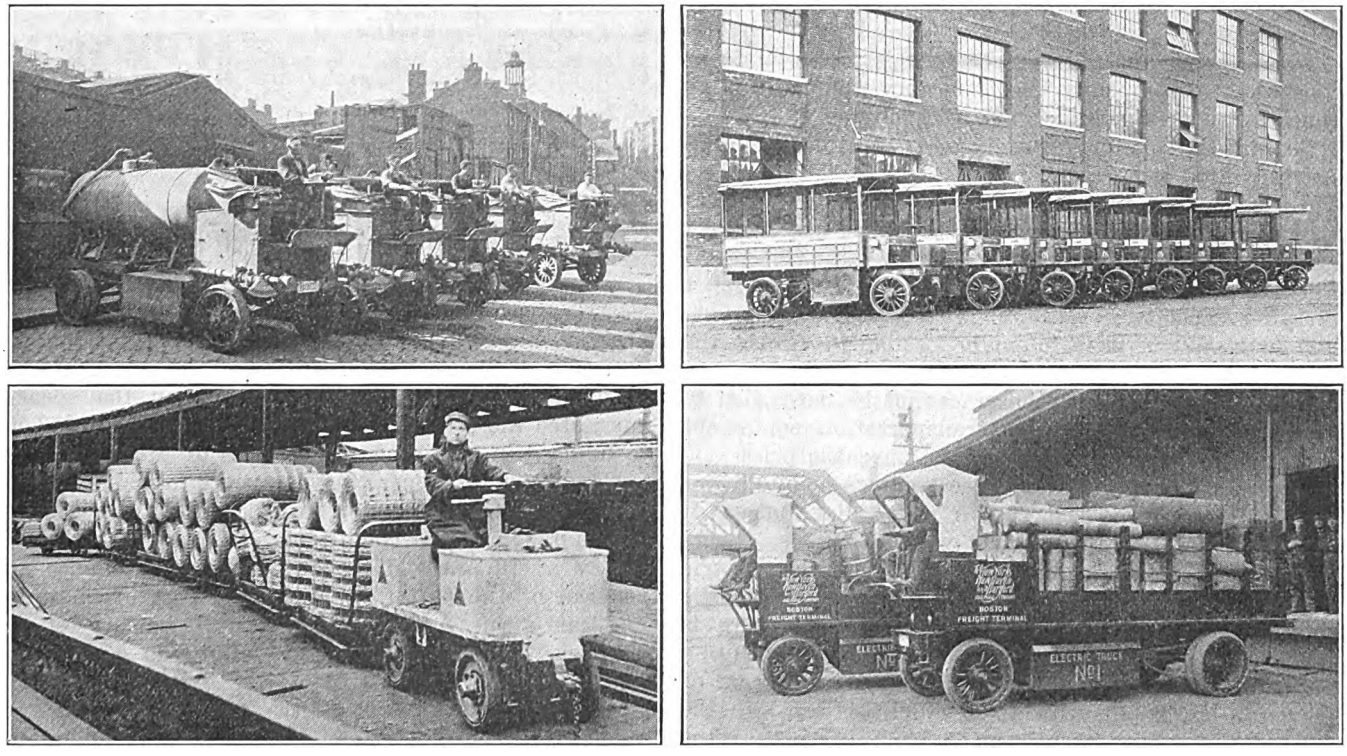
TRUCKS AND TRACTORS AND PROPER APPLICATION

Relation to Central-Station Load—Some Views Taken by Users and Salesmen Regarding Electric Vehicles

The most important of all motor-trucking questions, said E. E. La Shum in his paper entitled "The Electric Truck in Modern Transportation," is the proper selection of equipment; after this is done careful attention must be paid to its proper operation, especially regarding routes, drivers, helpers, loading and unloading facilities, maintenance and battery charging.

Electric vehicles are not affected by extreme weather conditions, and the American Railway Express Company has found them entirely capable of operating on heavy grades as are to be found in Kansas City, St. Louis, Minneapolis and other equally hilly places.

The fact that the electric vehicle is inherently free from excessive speeding diminishes the number of probable accidents. Small possibility of fire hazard is also one of the advantages of the electric truck. Its life is very long, some having been in operation for eleven years.



ELECTRIC VEHICLES AND TRACTORS ARE COMING TO BE USED EXTENSIVELY AT TERMINALS, IN INDUSTRIAL PLANTS AND FOR GOVERNMENT AND MUNICIPAL SERVICE

The average of a compilation of costs received from several cities in the Eastern, Central and Southern States are given in the table:

AVERAGE EXPENSES PER VEHICLE FOR ONE MONTH

	Days in Service	Total Mileage	Electricity	Battery Repairs	Tires, Repairs and Renewals	Painting	Body Repairs	Chassis Repairs	Garage Expense	Total Expense
Boston.....	23	490	$9.50	.....	$7.34	$0.65	$5.15	$33.07	$36.95	$92.64
Cleveland..	23	495	10.09	$12.39	4.33	1.38	4.75	25.39	14.28	72.61
Memphis...	26	607	23.87	7.85	5.84	1.31	6.67	3.88	18.22	67.64

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Discussion followed in which W. H. Blood, Jr., Frank W. Smith, George Drake Smith, A. B. Cole, John F. Gilchrist and Frank C. Reilly took part.

THE USER'S VIEWPOINT

Letters giving the experience of users of electric vehicles were the basis of a paper presented by George B. Foster. In this paper it was pointed out that many of the less up-to-date laundries are still using horses and are therefore good "prospects" for electric vehicles. One creamery using electric trucks said that its deliveries could not be made by gas trucks so quickly nor with such satisfactory results as with electric trucks.

PROPER APPLICATION

Considering the proper application of the commercial electric vehicle, F. F. Sampson said that, unfortunately for the electric vehicle and for persons who are striving to reduce the cost of transportation, a number of misapplied installations have retarded its general adoption. The misapplications may be generally divided into five classes:

First—When the mileage required is too great to be covered by the capacity of the battery and there is no opportunity or time for a boosting charge.

Second—When, for a variety of reasons, it is impossible to justify the cost on account of local conditions. This is usually in extremely congested districts, as around docks and piers, where the vehicle may be kept waiting in line for hours.

Third—When the vehicle used is not of the proper carrying capacity.

Fourth—When it is found impossible to garage the vehicle satisfactorily.

Fifth—Where the purchaser cannot be persuaded to invest in dependable motor transportation equipment and buys solely on the basis of the purchase price.

The solution of the first three troubles is intelligent selling; that of the last two, a wider distribution of facts and data on the electric vehicle.

Assuming fairly good road conditions, the electric vehicle may be used economically wherever any vehicle may be used—provided that energy for charging is available at reasonable rates—on any work within a radius of operation of 45 miles (72 km.) in the case of the ½-ton and 1-ton vehicle; 40 miles (64 km.) in the case of the 2-ton; 35 miles (56 km.) in that of the 3½-ton and 5-ton, and where the running time is not less than two hours per day. These mileage limitations may be increased provided that there is an opportunity for a boosting charge, or, in some cases, where road conditions are exceptionally favorable, as in many of the large cities.

According to W. M. Halsey, Newark, N. J., maintenance contracts for electric trucks should not be necessary. In his opinion, the electric vehicle has passed the stage where such guarantees are necessary, and it may appear to competitors that there is a lack of faith in the electric vehicle.

F. C. Taylor, Rochester, N. Y., called attention to cleanliness of the electric truck in dealing with bakeries, dairies and other dealers in foodstuffs. He also pointed out that the electric can be taken into a building and loaded for the night, ready for the driver in the morning. This cannot be done with gas cars on account of insurance restrictions.

Considering the electric vehicle from the salesman's viewpoint, J. B. N. Cordoza outlined obstacles salesmen will encounter. Reliability is no longer questioned, as the electric truck, when it has proper attention and is used within its scope, is the most reliable transportation device known. The electric truck is beginning to receive deserved recognition in the shape of large sales, but they are far from what they should be, partly because the average buyer does not believe the low cost of operation claimed by the various manufacturers is possible. To correct this impression the speaker suggested the establishment of a fund of about $50,000 to be used in retaining the services of three unbiased, nationally known consulting engineers to make a report on the average cost of operating electric and gasoline trucks under similar conditions.

COST OF OPERATION OF SOME TRUCKS IN NEW JERSEY FROM AUG. 25 TO SEPT. 25, 1916

Truck No.	Capacity of Truck, Tons	Route	Average Daily Mileage	Gals. Ice Cream Delivered in 31 Days	Average Daily Energy Consumption, Kw.-hr.	Average Daily Cost Power at 2.66 Cents, Kw.-hr.	Average Daily Total Cost	Average Cost per Gal. Ice Cream for Delivery
78	5	Elizabeth and Elizabethport	20.8	4031	41.3	$1.09	$8.98	$0.069
79	3½	Irvington, Hilton, Maplewood, Millburn, Summit, Chatham, New Providence and Berkeley Heights	29.7	1456	53.5	1.42	8.60	.183
80	3½	Elizabeth, Cranford, Westfield, etc., to Fanwood	35.0	1800	46.9	1.25	8.43	.145
81	5	Irvington, Newark and the Oranges	20.9	....	30.8	.82	8.71	.082
82	5	Newark (South End)	15.8	3285	19.9	.53	8.42	.082
84	3½	Elizabeth and Elizabethport	22.7	3163 2295	32.4	.86	8.04	.109
86	3½	Newark, East Orange and Bloomfield	23.6	2362	24.9	.67	7.85	.103
88	3½	Newark, Belleville, and Nutley	24.2	1862	26.2	.70	7.88	.131
89	5	Newark (East End)	16.5	2502	29.9	.80	8.69	.108
90	2	Irvington and Hilton (2 trips)	14.8	2538	22.9	.61	6.92	.085
91	2	Newark (West End) (2 trips)	15.1	1756	21.1	.56	6.87	.121
93	3½	Newark (North End)	21.0	2562	19.4	.51	7.68	.093

To correct this impression the speaker suggested the establishment of a fund of about $50,000 to be used in retaining the services of three unbiased, nationally known consulting engineers to make a report on the average cost of operating electric and gasoline trucks under similar conditions.

New users are told to charge the maintenance and renewal of the battery to the daily cost of operation and carry this fund at interest until battery-renewal time arrives. However, many fail to do as directed, and then are faced with a big expenditure which prejudices them against electric vehicles.

Discussion

H. H. Smith of Orange, N. J., pointed out that central stations might profitably assist electric vehicle users in financing needed converting apparatus where only alternating current is available. What now appears to be a low rate for electric service is often made prohibitive by the losses and overhead expense of the transforming apparatus.

A. Jackson Marshall, New York, referred to operating records of eight users of 5-ton gas trucks which showed the average operating cost as $29.20 per day. A year's record on twenty-five electric trucks of the same size which average 25.2 miles per day showed a cost of only $13.28 per diem, which is less than half the cost of the gas truck. These figures cover all costs including delays, overhead, etc.

W. Van C. Brandt said that many people do not know that a 5-ton electric truck cost less than half as much to operate as a gas truck of the same size.

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ACCOUNTING SECTION

Education of utility accountants and reducing the burden on the companies involved in preparing commission reports were two of the subjects most discussed.

STIMULATING and enjoyable sessions of the Accounting Section marked the convention program. At the opening session on Tuesday much interest was aroused in the educational program of the section, which has found fruit in the preparation of elementary and advanced courses in electric utility accounting, now available at moderate cost to employees of member companies. The high plane that modern accounting should take in relation to the changing era in which the industry finds itself was also voiced by a number of speakers, and the advent of the accountant as a man of larger affairs in future was predicted.

Considerable attention was given at the opening session to the importance of spreading the gospel of accounting as set forth in the N. E. L. A. classification. This, it was shown, is adaptable to large and small companies, as well as intermediate properties, and it is greatly to be desired that the public utility commissions and the association accountants take common ground in its application. The recently completed arrangement for full discussion of accounting classification between representatives of the N. E. L. A., the American Gas Association and the National Association of Railway and Public Utility Commissioners is encouraging evidence of the prospects of closer coöperation toward the laudable end of standardization. Accounting service to member companies is also growing in value and scope.

War service and efficiency problems were featured at the second session, which closed the program. The accountants' war work lacked spectacular aspects, but not a few N. E. L. A. Accounting Section members performed tasks of very high value and importance in the cause of the Allies.

UNIFORM CLASSIFICATION OF ACCOUNTS

Cost Accounting and Statistics—Commission Accounting Rulings—Accounting Service to Member Companies

Hope of securing a standard classification of accounts acceptable to public utility commissions was expressed in the report of the committee on the uniform classification of accounts, presented by chairman William Schmidt, Jr., Baltimore.

The committee's work was severely handicapped during the past year by war conditions, owing to the reduction of forces. Since hostilities ceased the outlook has been improving, and further efforts are now being made toward the adoption of a national standard of classification. The present standard of the association was adopted in 1914 and has remained unchanged. Some of the state commissions have adopted this, and a committee of the National Association of Railway and Public Utility Commissioners has been appointed to confer with representatives of the N. E. L. A. and of the American Gas Institute. President C. E. Elmquist of the Commissioners' Association, Washington, is greatly interested in this work. Exhaustive comparisons have been made between the N. E. L. A. and various state systems. The principal differences are in the rules prescribed for the retirement of property and the treatment of the depreciation account.

Considerable difficulty has been experienced in carrying out the provision of the commission's classification of fixed capital. The rule as prescribed makes it necessary, when retiring property, to obtain the date on which the property was put in service. If prior to the adoption of the commission's classification, then the original cost of the property retired must be credited to the fixed capital account; if subsequent thereto, it must be credited to one of the sub-accounts of the fixed capital account prescribed by the commission. Piecemeal development renders this most difficult to do.

Discussion

S. B. Cushing, Chicago, said that each public utility expects company managements to use their best judgment in regard to plant cost at the time of installation prior to the adoption of the standard classification. He questioned the practicability of accurate age determinations. E. H. Davis, Williamsport, Pa., questioned how many companies actually determine the age of displaced equipment. H. M. Edwards, New York, said that while accounts should truthfully exhibit events, it is most difficult to determine where property stood as to cost prior to the adoption of the standard classification. Others recognized the necessity for using estimates in such cases. S. J. Palmer, Chicago; E. C. Scobell, Rochester, N. Y., and W. C. Bingham, Buffalo, also discussed the report.

Cost Accounting Statistics

Because of the complex nature of cost accounting, the committee on cost accounting and statistics (A. D. Spencer chairman) suggests that its work be carried over and that the object of the committee be changed to the following: "To study principles of cost accounting for electric light and power companies and to recommend to the association methods and sytems that may be of value to the member companies."

Commission Accounting Rulings

A classified list of all public utility commission accounting rulings issued up to the present time is being compiled by the committee on this subject (H. E. Addenbrooke chairman) in order to permit a comprehensive study of them. The committee believes that the time is at hand when the subject of the cost of issuing bonds, notes and obligations and the discount in connection therewith should be given most careful consideration, since the rulings of the various commissions on this subject appear to be contradictory. Depreciation, too, should have particular study, from an accounting point of view, not only for the reasons which have heretofore existed and which to-day continue with undimin-

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ished force, but also for the further reason that the Internal Revenue Department of the United States government recognizes, and perhaps emphasizes, the importance of the subject. Another subject that should be given careful study is that of reserves for replacements, sinking funds, etc.

EDUCATION IN ACCOUNTING

During the past year effort has been made by the committee on accounting education (H. B. Lohmeyer chairman) to bring before the industry the value and importance of the accounting courses and to complete all the lessons of the advanced course. The advanced course, now almost completed, is not the usual accounting course, such as offered by the various schools and universities throughout the country, but applies particularly to the public utility business. Its equal would be hard to find because it has been written by men who are specialists in the various subjects embraced. The scope is such that it will meet the needs of the operating man and the commercial man as well as the accountant.

The preparation of the thirty-six lessons in the advanced course is nearly complete. Sixteen authors and nine editors have been engaged on this work, all being accountants and utility men of wide experience in the industry and in educational work. So far, 700 elementary and seventy-four advanced courses have been sold. Considering the war, good results have been obtained from the three months' campaign of nation-wide scope which was run last year. A joint educational campaign is now under way with the coöperation of the Commercial Section. The advanced course is unequaled in the United States in its usefulness to the electrical industry, and it is designed to appeal to the operating and commercial man as well as to the accountant.

Discussion

Douglass Burnett, Baltimore, expressed his great interest in the educational courses and pointed out how the need of standardizing instruction had led to their preparation. Every author responded to the committee's request for coöperation. These courses bring young men into contact with operating and executive problems and represent a notable forward step in the work of the section. The lessons should now be exploited to the full and executives should see to it that their employees know about them. Pay-roll slips should be utilized to bring the matter to the attention of employees. H. M. Edwards, New York, said that these lessons typify what the association should do for its young men. Any young man who will take these courses and complete them thoroughly will be fitted to run an accounting department, and young women should not be overlooked either. P. R. Jones, New York, paid a tribute to the work of Mr. Burnett on behalf of the educational courses, in the absence of Captain Lohmeyer.

ACCOUNTING SERVICE TO MEMBER COMPANIES

Owing to the unsettled conditions prevailing during the war and the resulting inactivity of most of the committees of the Accounting Section, the committee on accounting service to member companies (Frederick Smith chairman) served as an emergency committee, rendering service to member companies irrespective of their size. Now that conditions are returning to normal, it is the opinion of the committee that it should confine its work to those inquiries dealing with subjects not specifically covered by any of the other committees. The committee repeats the recommendation made in its 1917 report that the association employ a high-grade man well versed in all phases of accounting to visit the small central stations and assist them in initiating a system of accounting suited to their requirements.

Discussion

In the discussion representatives of small companies were particularly urged to criticise the N. E. L. A. standard classification, but few or no adverse points were brought forward. W. A. Jones, Joplin, Mo., said that many small companies have practically no accounting system, or such poor ones that they are unsatisfactory. Lack of familiarity with the N. E. L. A. system has led in some cases to criticisms against its supposed "elaboration," whereas it is flexible enough to fit all sizes of companies and need not be utilized in detail unless desired. Many small companies have been too busy eking out an existence under war conditions to pay attention to proper accounting. Mr. Jones believed that it would be helpful to send an accounting representative to the smaller companies from association headquarters, to facilitate the understanding and use of the association classification. Something also could be done through correspondence. H. Sylvester, Detroit, said that the Michigan Section desires the services of a representative of this kind.

F. E. Webster, Haverhill, Mass., and formerly with the New Hampshire Public Service Commission, praised the association classification, which is the basis of the New Hampshire system. The only troublesome question appears to be that of accounting for additions to and withdrawals from property. H. M. Edwards said that no business lends itself toward standardized accounting so well as the central-station industry. He felt that the differences between the association system and those of many state commissions are complicated, ridiculous and absurd. It is not to the credit of the accountant as a professional man that the statisticians of the commissions marked out so many different systems of accounts. "We must at least agree among ourselves," said the speaker, who pointed out the usefulness of the national classification for both large and small companies.

William Schmidt, Jr., Baltimore, said small companies that subscribe to the educational courses on accounting will have no difficulty in understanding the classification of the association. W. A. Jones, Joplin, Mo., it was announced, volunteered to attend the Iowa Section convention in June on behalf of standardized accounting development.

OPERATING RECORDS

A set of forms which is intended to be universally adaptable to transportation cost accounting has been developed by the committee on operating records, of which C. A. White is chairman. These forms represent composites of forms used by several operating companies and can be printed for member companies at a small price. The size and purpose of each form and the method of filling it out are given in the committee's report.

Discussion

E. J. Fowler pointed out that such forms had been of great value in bringing to light serious overcharging of batteries when it was found that one company was

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using twice the kilowatt-hours required by another. He stated also that these forms could be readily abbreviated to suit the needs of smaller companies. William Schmidt, Jr., Baltimore, and H. A. Snow, New York, also took part in the discussion.

Motor Transportation in the Army

H. B. Lohmeyer, recently a captain in the ordnance department of the army, read a paper "Motor Transportation in the United States Army." Using many slides to illustrate his points, he showed how army trucks were cared for at the base shops. The system of accounting by which all useful information was obtained regarding the life and cost of maintenance of trucks and their parts was fully explained.

Purchasing and Storeroom Accounting

The most important work undertaken by the committee on purchasing and storeroom accounting during the last year has been the development of the billing machine for stock-record work, according to its chairman, W. F. Stevens. When the machine is in use the proof-sheets are left in it until full of entries; the various cards are inserted and removed for each entry.

It is yet too early, the committee believes, to determine whether women will ever permanently displace men in any of the strictly warehouse positions, although it is fairly well established that they can be employed more extensively than formerly in the office. The Edison Electric Illuminating Company of Boston, which at one time during the war employed as many as 55 per cent women in the combined warehouse and office of its supply department, found it comparatively difficult to get for stock-room work women who had sufficient physical strength, education and mentality and the desire to learn the work.

CUSTOMERS' AND STORES RECORDS

Development of Billing Machine—Female Labor and Accounting Service to Member Companies Are Discussed

The number of complaints which member companies received last winter was 70 per cent in excess of the previous season's record, according to data compiled by the committee on customers' records and billing methods (H. C. Schlegel chairman). During the same period the number of customers increased only 5 per cent. A large turnover in meter reading, billing and bookkeeping forces was the principal cause of the difficulties and errors which resulted in the increased number of complaints.

It is recommended that ways and means be provided for the betterment and advancement of employees in their own or in other departments of the company. Educational work should be carried on by the companies, preferably during working hours.

Women have been successfully employed and have shown marked ability in several branches of central-station work.

Discussion

That accountants are under great responsibility in the matter of seeing that bills rendered are accurate and that complaints are promptly attended to was pointed out by E. J. Fowler, Chicago. He also said that making out bills by machine was cheaper than hand work.

Work of Ordnance Finance Section

In dealing with the "Establishment and Growth of the Ordnance Finance Section," Col. Herbert A. Gidney, Boston, pointed out that prior to the trouble on the Mexican border there was stationed at Washington one officer and six civilians who kept appropriation and allotment records for the Ordnance Department. At this time the total annual appropriation for this department aggregated less than $10,000,000 annually. Since that time appropriations for ordnance have increased to $8,042,041,786. The work of accounting was greatly augmented by the system of separate appropriations in use, although the adoption of a budget system is in sight. The paper contained an interesting account of how these enormous funds were handled.

The Need of Better Accounting

W. B. S. Winans, of Henry L. Doherty & Company, New York, in a paper entitled "The Importance of an Efficient Accounting Department to a Business," pointed out the need of better accounting in eras of expansion and change. Growing exportation problems demand accurate accounting also. An accounting department is as important to a utility as its electric generating equipment, in the writer's opinion. There is a great shortage of accountants at present, due in part to the war, and intensive training is essential. Besides recording operations, the modern accountant should protect a business against unwarranted expense, help make as well as to write history, undertake research work in rate cases and commission hearings along broad lines and exhibit executive ability. The company executive should not assume that because his accountant agrees with everybody and thus gets along without friction he is a top-notch man in his line, or that a desk full of papers signifies progress and achievement. Hard workers laboring long hours at the head of accounting departments are not necessarily giving companies the best possible service. The accountant should not be a mathematical drone, without appreciation of perspective, but a man whom men of affairs and those in the college world will take at his true professional worth.

Bonus Systems for Office Employees

An informal discussion of bonus systems for office employees was participated in by E. C. Scobell, Rochester, N. Y.; H. M. Edwards, New York; H. E. Addenbrooke, Chicago, and Capt. H. B. Lohmeyer, Baltimore. Mr. Scobell said that three years ago a bonus system for meter readers, bookkeepers, application counter clerks, etc., was inaugurated at Rochester, and the results have been very satisfactory. The volume of work done has been increased and lower costs per account handled have resulted. The bonuses are applied in group work, and if an employee does not qualify and thus holds back the group effort, he is soon eliminated. Mr. Addenbrooke said that for seven or eight years a bonus system for bill clerks has been used successfully in Chicago. This is available above a stated wage, and it often yields $15 to $20 per month extra to the clerk. More bills are put through and space for clerks and machinery investment and space are saved. The bonus system is now in effect also in the meter and bill delivery departments. In each of these divisions a penalty is enforced in case of error.

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Electrical Apparatus Development

The Installation of Fire Extinguishing Equipment and Balanced Relay Protection of Generators Gain Favor—Trend Is Toward Automatic Operation and Standardized Design of Substations—Electric Steel Furnaces Offer Chance for Load Development

A VAST amount of valuable information is given in the report of the committee on electrical apparatus, of which R. F. Schuchardt is chairman. Progress is shown in the protection of generators against fire and in the application of balanced-relay protection. Tendencies in substation practice point toward some standardization in design and increase of automatic operation. The importance of power-factor correction has received serious consideration and static condensers appear to offer advantages for the smaller installations. Industrial loads are growing rapidly, and the supply of electrical steel furnaces, in particular, appears to offer enormous possibilities for central stations. In the year 1918 there was an increase in the number of electric steel furnaces of fifty-four, making the total in this country 287. When it is understood that there were only about twenty such furnaces in the United States on July 1, 1913, the rapid growth of the industry will be appreciated.

EXTINGUISHING GENERATOR FIRES

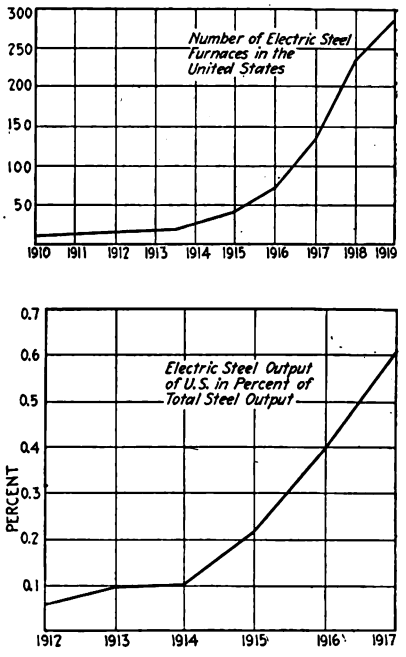
Considerable attention has lately been given and is now being given to the matter of fires originating within the generator shell of turbo-generators of the inclosed type with the object of (a) determining means of minimizing the occurrence of such fires, (b) limiting the extent of the damage to as small a section of the generator as possible, and (c) providing fire-fighting equipment which can be applied quickly where it will be most effective.

The total number of fires referred to by the thirty companies returning the questionnaire was eighty-one, their occurrence being within the past three or four years. Twenty-one fires, about equally divided between 25-cycle and 60-cycle units, were specifically described, occurring in units ranging from 3300 kw. to 35,000 kw. and 2300 volts to 13,200 volts. The various fires have been attributed to many causes. About one-third of the number reported appear to be due to short circuits between conductors and a greater number to grounds, while the remainder are divided among mechanical causes, eddy currents, corona and moisture from faulty operation or from freezing of air-washing apparatus, condensation, etc.

Every precaution should be taken to limit the amount of dirt and oil which may enter the generator, and many companies, particularly on the larger units, have standardized the installation of air washers. Even with the best possible condition of cooling air, however, it is evident that dirt will lodge within the generator, and if a certain amount of oil vapor is also carried into the machine, the coil surfaces and other parts may become coated with grease. Good practice, therefore, would seem to indicate that machines should be opened up periodically for thorough cleaning and possibly for painting. It would pay to give attention to the matter of cleaning at least once a year.

One company feels that additional insulation on the armature coils of generators is as satisfactory a method of reducing the fire hazard as any that has so far been suggested. In some units it can be applied for such a small increase in price that it may be the cheapest of all methods of reducing fire hazard.

In the methods thus far adopted for extinguishing electrical fires, water, steam and carbon-tetrachloride have been used. Water and steam are looked on at present with favor. Large volumes of carbon-tetrachloride would be required for any but very small fires, thus involving great expense, with the added possibility of detrimental effect on the insulating materials and injury to operators from contact with the fumes. Some companies opposed to the use of steam have expressed fear regarding the possibility of detrimental effects of high temperature on the insulation, particularly



GROWTH OF ELECTRIC STEEL INDUSTRY

where steam is applied for a long period of time or where it impinges directly on the windings. The destruction of the japanning on the core laminations by the high temperature is also feared.

With the advent of permanently installed fire-extinguishing provisions in generators, the use of steam has received very serious consideration, and there is at the present time a wide difference in opinion as to the relative merits of water and steam for this purpose. Of the thirty companies reporting, the use of water is definitely favored by nine and opposed by eight, and the use of steam favored by seven and opposed by twelve. Eighteen generators of four companies are now provided with permanent steam equipment, as against nine units of three companies with water equipment.

With generators discharging air at the top into the turbine room, indication of fires within is promptly given to attendants by sparks, smoke or flame emerging from the unit. The tendency lately, however, in generator design, particularly in the larger units, has been

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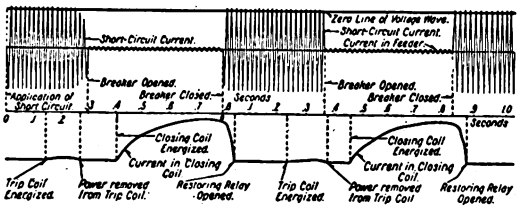
toward bottom discharge into ducts leading to the boiler room to eliminate noise and to take advantage of the heat in the air. This design brings up a serious problem with regard to visibility of distress. Manufacturers and operators would do well to give serious attention to this matter.

BALANCED-RELAY PROTECTION

It is also rapidly becoming standard practice, particularly on larger units, for the manufacturer to bring out both ends of each phase winding to the generator



OSCILLOGRAPH RECORDS SHOWING OPERATION OF SERVICE-RESTORING RELAY SYSTEM ON A PERMANENT SHORT CIRCUIT
Breaker is shown closed twice—further operation not recorded

terminal boards, so as to permit the installation of current transformers between the terminals of the phase windings and the neutral of the coils. These current transformers can be connected differentially with respect to instrument current transformers in the leads between main oil switch and generator, so that in the event of a fault in the generator or its leads the balanced relay will immediately open the main oil switch, the neutral switch (if closed), and after a slight delay the field switch. Twenty-four of the thirty reporting companies approve the installation of balanced-relay protection and have adopted it as standard practice on all new generator installations and on older generators where the expense involved is not too great.

RATINGS OF OIL CIRCUIT BREAKERS

The A. I. E. E. tentative definition of "Interrupting Capacity" reads as follows (see 1918 Standardization Rules, Article No. 753):

"By interrupting (breaking or rupturing) capacity is meant the highest r.m.s. current at normal voltage which the device can interrupt under prescribed conditions, at stated intervals, a specified number of times."

The manufacturers are basing their ratings at present on no definite prescribed conditions, but on an assumed duty that the circuit breaker will interrupt its rated r.m.s. current twice at a two-minute interval, and then be in condition to be closed and carry its rated current until it is practicable to inspect it and make necessary adjustments.

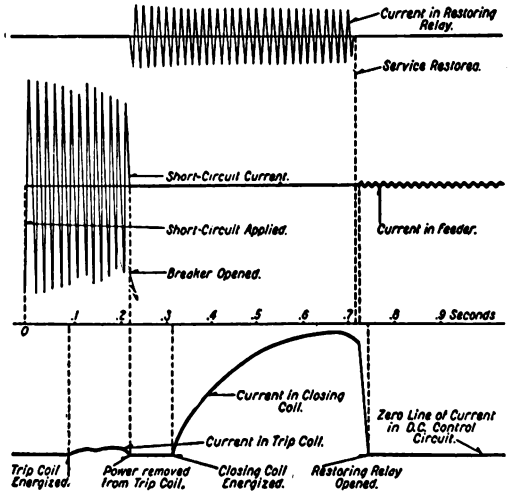
Any such assumed duty should be consistent with usual operating practice, and it is the opinion of the committee that the requirements of operating practice would not permit a time interval as long as two minutes to elapse before a circuit breaker is reclosed. The time interval would probably range from something considerably less than two minutes, under ordinary operating conditions, down to a few seconds, when automatic circuit-breaker reclosing devices are used, toward the adoption of which there is a growing tendency.

The committee suggests that the manufacturers work toward establishing curves for each type and size of circuit breaker, showing the interrupting capacity for various numbers of interruptions and for various time intervals, from that incident to the use of an automatic reclosing device up to a two-minute interval. With such curves there might readily be selected a breaker which would be most suitable for the conditions under consideration.

TENDENCIES IN SUBSTATION DESIGN

While each system seems to follow its own ideas on the details of substation practice in the main, the tendency is toward as simple and inexpensive an arrangement as possible, and invariably toward the use of outdoor-type equipment throughout. Some companies prefer to recommend the outdoor-type substation wherever practicable. These conditions are probably due to the extent of the territory covered by the different companies. In the larger cities it is comparatively easy to give close supervision to each job. In the scattered territories, however, this close supervision is not possible; hence it is more or less necessary that a standard design for a given capacity be followed by the construction force. On outdoor installations some companies use self-contained outdoor metering outfits and report no particular difficulty with them.

Although seven direct-current railway substations of 1000 kw. and above and over thirty of between 300 kw. and 600 kw. capacity have been in automatic operation for some time (not including one 3000-kva. synchronous condenser and one 1500-kw. hydroelectric generating plant which operate entirely automatically), only one lighting company reports substations operating semi-automatically on 115/230-volt direct-current network. This company has had five 500-kw. rotary-converter substations successfully operating semi-automatically for some time. Each substation is located on the fringe of the 115/230-volt direct-current system and is started and stopped by remote control from another substation



OSCILLOGRAPH RECORDS SHOWING OPERATION OF SERVICE-RESTORING RELAY SYSTEM ON A TRANSIENT SHORT CIRCUIT

as the load demands, the voltage being controlled by induction regulators installed at the main substation.

From conference with manufacturers, the committee felt justified in venturing the opinion that provided any company desires to operate automatically a substation supplying a 115/230-volt direct-current network, the equipment can be procured.

NEW TYPE OF ROTARY CONVERTER

A new departure in rotary-converter design has been reported which may be of interest. The equipment

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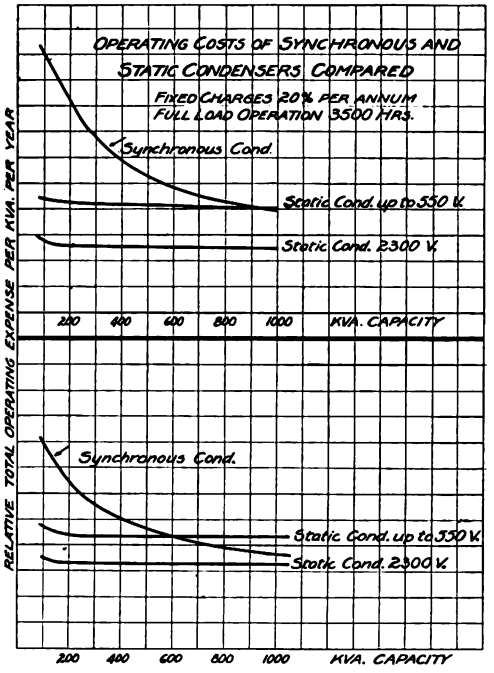
consists of a three-unit set of two ordinary 1330-kw. synchronous converters operating at 900 r.p m., including a revolving-field booster of sufficient capacity for both machines. The three units will be directly connected, comprising a four-bearing set, all mounted on a common base, the booster being located between the two middle bearings. The couplings and booster rotor are of such design as to permit disconnection of one converter armature, leaving the other one free to operate with the booster should accident to first



RELATIVE OPERATING COSTS OF SYNCHRONOUS AND STATIC CONDENSERS

one make this necessary. The booster also may be disconnected, leaving both converters free to operate without means of voltage regulation. The booster is provided with two separate armature windings and the transformer is also arranged with two distinct secondary windings, so that the three-unit equipment may be operated without any electrical connection between the two units on the alternating-current end. This type of unit has the advantage of being much lighter to handle than the ordinary two-unit set, the heaviest part being approximately 40 per cent lighter in weight.

Two companies report that they are experimenting with automatic reclosing oil-circuit-breaker arrangements on feeder circuits. A third company has a small-capacity transformer indoor-type distributing substation with induction feeder regulators and automatic reclosing oil circuit breakers These circuit breakers are provided with special control relay equipments designed to reclose a circuit breaker immediately after it opens on overload. Should the circuit breaker reopen, it will again be reclosed for a total of three operations, all of which take place within a few seconds. After three such operations the main control relay opens the circuit of closing coil of circuit breaker, and thereafter it is necessary to close it by hand. Through the successful operation of this equipment, the length of interruption to consumers is reduced.

More attention than ever is now devoted to means of power-factor correction, according to the committee report. The benefits frequently to be obtained by operating companies from even a slight gain in power factor are very desirable, and it may be advisable for many companies to undertake a power-factor survey of their systems to determine its value at the generating plant, at the various substations, at the more heavily loaded industrial circuits, and finally at the larger consumers' installations, with a view toward ascertaining whether certain remedial steps should not be considered.

Low-speed synchronous motors are suited for direct connection to compressors, refrigerating machines and loads of similar characteristics and have marked advantages in weight and efficiency over corresponding induction motors. High-speed synchronous motors are suited for direct-current generator drive and for general industrial drives where the load is reasonably uniform and the starting and stopping requirements not severe.

STATIC CONDENSERS FOR SMALL INSTALLATIONS

The static condenser has no moving elements and lends itself to smaller installations in which the load and power factor are reasonably constant and at which attendants are not provided. The device is highly efficient, the losses being approximately 1 or 2½ per cent. The manufacturers have recently announced a price revision which will make the first cost of this type less for small capacities at low voltages than the corresponding cost of synchronous condensers, while for the higher voltages the cost will be less than synchronous condensers up to some point beyond 300 kva.

In the past two years there has been in successful operation an automatically controlled 3000-kva., 4000-volt, 720-r.p.m. synchronous condenser connected to the system of the Interstate Light & Power Company at Hazel Green, Wis. The generating station—12,000-kva. connected capacity—is located at Galena, Ill., and the high-voltage lines extend a distance of 70 miles (112 km.) with six substations along the line.

The high-voltage lines traverse a mining district, and the main load is chiefly induction motors. Along the high-voltage lines are many small towns with lighting loads. Induction motors have a definite power factor depending on their loads, and owing to the various applications of this type of motor to mining loads, the system power factor was reduced to an average value of approximately 0.75. The problem of excessive line drop and consequent poor line regulation, also diminishing generating capacity, demanded solution.

The usual method of improving power factor, by means of a synchronous condenser to correct line drop, poor regulation and loss of station capacity, was decided upon, and in order to effect further economy it was decided to make the equipment automatic, using the same simple and rugged type of drum controller as is used in the automatic railway station, to function the equipment in and out of service.

OPERATING DATA FOR HAZEL GREEN PLANT

Kw. Load on Station	P. F. Without Condenser	Kva. Load Without Condenser	Kva. Wattless Without Condenser	Condenser Load, Kva.	Wattless Station Load with Condenser	P. F. of Station with Condenser	Kva. Station Load with Condenser	Increase in Station Capacity
7500	0.825	9100	5150	3000	2150	0.96	7810	1290
7000	.81	8650	5080	3000	2080	.959	7300	1350
6000	.78	7700	4820	3000	1820	.957	6270	1430
5000	.753	6650	4370	3000	1370	.963	5200	1450
4000	.725	5520	3800	3000	800	.98	4080	1440
3000	.695	4320	3100	3000	100	.999	3000	1320
2000	.670	2985	2220	2220	0	1.	2000	985

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In observing the results obtained in automatic operation four points stand out prominently:

First—The ease and uniform accuracy with which the equipment is placed on the line

Second—The minimum labor item entering into the cost of operation, this being periodic cleaning and inspection.

Third—The operation of the set in starting only when it is needed, variation of input being dependent upon demand for power-factor improvement.

Fourth—Obtaining uniform smooth voltage charts on numerous small towns tapped from the high-voltage distributing system, by careful adjusting of the voltage regulator correcting power factor at the synchronous condenser substation. It is gratifying to see the splendid voltage charts obtained from these towns contrasted with the charts previous to the installation of the condenser.

The application of automatic condenser stations need not necessarily be confined to long transmission lines. They could be used in many large industrial plants where inexpensive housing may be provided and a careful cycle of operation worked out to insure their use only when desired.

Growing Importance of Electric Furnace

The last few years have shown a great increase in the number of electric furnaces in operation throughout the country, as shown by the committee report. Their superiority over former methods of production may be summed up as follows: (1) Better and cheaper product; (2) adaptability; (3) simplicity; (4) comparatively low installation and maintenance costs; (5) effective and simple control; (6) safety.

A metallurgist and manager of a large reduction company gives the following figures as to power consumed by electric furnaces for several different products:

Products	Kw.-hr. per Ton
Steel	600 to 800
80 per cent ferro-manganese	3,500 to 5,000
Ferro-silicon alloy	7,000 to 9,000
Tungsten or molybdenum	8,000 to 10,000
Metallic chrome (60 to 70 per cent alloy)	10,000 to 14,000

The majority of the steel furnaces installed at the present time range from 1 ton to 6 tons in capacity of metal, the installed transformer capacity for furnaces ranging from 300 kva. to 1500 kva. However, several furnaces of larger size are in operation, the largest being of about 25 tons holding capacity, with transformer equipment of from 3500 kva. to 4000 kva.

Most furnaces are now equipped with regulators which automatically maintain the power input at the desired value, except for the momentary fluctuations which occur when a piece of metal falls against the electrode or something of that sort. These regulators have been developed to a high degree of perfection and give excellent results.

Ferro-alloy and calcium-carbide furnaces are of the arc type, usually three-phase, and vary anywhere from 300 kva. to 20,000 kva. of transformer capacity installed per furnace. Probably the largest single furnace installation which was put into operation in 1918 is the calcium-carbide plant erected by the government at Muscle Shoals, Ala., in connection with the nitrate development. In this plant twelve furnaces are installed, each having about 8000 kva. in transformer capacity.

On account of the serious disturbance to the line voltage of suddenly applied furnace loads this problem is receiving much consideration. One company reports: "We have adopted a rule that in the future all furnace installations must have a reactance such that no more than twice the full normal current will flow even with a short circuit. This has been found necessary, as the substations from which these furnaces are supplied are fed by long transmission lines."

Regarding nitrogen-fixation furnaces, this class of furnace offers good opportunities for the sale of off-peak power, as the furnace may be started and stopped at any time without affecting the character of the product. As the process consists in the formation of nitric oxide from the combination of nitrogen and oxygen at the electric arc, there are no metals to freeze when power is suddenly discontinued. Large amounts of power are usually consumed by an air nitrate factory, the average size requiring approximately 10,000 kw.

Electric Welding Is Developing

It is estimated by the welding committee of the United States Shipping Board, Emergency Fleet Corportaion, that:

1. A saving is effected of (a) 60 per cent in riveting minor parts of a ship; (b) 25 per cent in riveting the hull plates of a ship.

2. Spot welds can be made stronger than the plates joined.

3. Butt-welded joints have 90 per cent of the plate strength and over 100 per cent with butt straps, whereas triple-riveted joints have only 70 per cent or less.

4. As more confidence in the welded joint is demonstrated by actual experience at sea, a 20 per cent saving in steel required may be made in reducing the strength of members of the ship due to the higher efficiency of the welded joints.

5. Greater speed and uniformity on the straightaway parts of ship joints will be secured by the use of automatic welding machines which partially eliminate the human element.

One experimental spot-welding machine built by one of the electric manufacturing companies is supplied from a 2000-kva. transformer, power for which is supplied through a motor-generator set of 6000 kva. capacity. Three 1-in. (2.54-cm.) plates were successfully welded, consuming 72,000 amp. at 20 volts and a pressure of 15 tons.

Electrification of the Oil Fields

As an indication of the increasing favor which electric drive is finding with oil-well operation, one of the largest producers in Oklahoma and Kansas, after an extended survey of operating conditions, placed an order for 700 equipments to be added to thirty former ones.

A few instances are cited to show economies effected in the California field by the installation of electric drive, a large part of the economy being in the decrease effected in the number of interruptions of production. Thus a 22 per cent saving was effected on twelve oil wells, a 36 per cent saving on eight, a 24 per cent saving on twelve, a 40 per cent saving on 107, and a 63 per cent saving on a group of wells (twelve boilers discarded).

During the last year the increased requirements of some of the California deep wells resulted in the development of a heavy-duty oil-well motor. This new motor is of 50/20-hp., three-phase, 440-volt, 900/450 r.p.m. This type of double-rated motor uses the low speed for pumping and the high for pulling.

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Tendencies in Prime-Mover Practice

Continuity of Service Must Be Safeguarded as Steam Turbines of Great Size Are Adopted—Boiler and Turbine Room Instruments Show Growing Usefulness—Hydroelectric Developments Should Now Go Forward

ALTHOUGH engineering development of prime movers for power-plant service has been somewhat hampered by the necessity of high speed of production, much valuable experience has been gained. This experience, as pointed out by N. A. Cario, chairman of the committee on prime movers, should have an important bearing on power-plant practice. It was shown that the consideration of service continuity may call for less than the maximum size of steam-turbine unit in many cases. Hydraulic turbines, on the other hand, may well be built in larger sizes than heretofore, especially for such great plants as those now planned at Niagara Falls. The use of boiler and turbine room instruments is rapidly gaining favor among operating engineers, who look forward to the operation of steam and hydraulic equipment from a centralized location similar to the electrical switchboard. Higher steam pressure and other engineering problems are now receiving the combined attention of manufacturing and central-station engineers.

Operating Economy Versus Reliability of Service

During the past two years there has been a marked increase in the number of large units in operation, particularly the horizontal, single-shaft type of approximately 30,000 kw. capacity. It would appear, however, that with the present constructional problems of prevailing frequencies and speeds and the recognized factors of safety, efficiency and cost the size of system to-day will hardly warrant units of more than 30,000 kw. capacity. While every one appreciates the reduction in overhead charges due to the low investment cost per unit installed for these large machines, the low operating cost due to their increased efficiency and the low attendant labor and maintenance costs, yet operating companies must not forget for an instant that continuity of service is the bed rock of any central-station company's reputation and that the truly successful public service company must give the community it serves the best and most reliabie service possible.

Just how far it is safe to go in the installation of large generating units each company must of course decide for itself, but since units of over 20,000-kw. capacity are a rather recent development and since the service factor or ratio of hours available to total hours for some of these units is 90 per cent or less, as compared with 97 to 99 per cent for some of the older units, the importance of giving this matter careful consideration is evident.

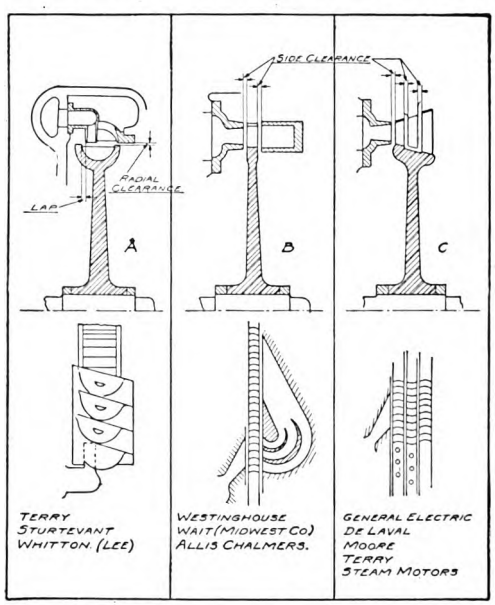
Tandem Versus Cross-Compound Turbines

In dealing with the design of large units a prominent manufacturer states the case as follows:

"The accompanying figures give information regarding our tandem and cross-compound turbines:

Type	Weight	Length	Width	Height	Rating, Kva.
Tandem.....	1,200,000	72 ft. 9 in.	20 ft. 9 in.	20 ft. 9½ in.	35,300
Cross-compound...	1,360,000	47 ft. 8 in.	42 ft. 2 in.	18 ft. 9 in.	47,200

"The cost per kilowatt of the two sizes may be assumed to be practically identical. The steam end of the tandem machine is somewhat more expensive, while the two generators on the cross-compound will exceed the cost of the single generator about enough to equalize. The difference in efficiency between the two types is within 2 per cent. . . . Whatever there is to be said about the two types bears more particularly upon the operation side, and on this question opinions will differ. There are some engineers who seem to prefer the single-shaft unit, as they feel that the single generator best fits the operating conditions. The tandem machine has the merit of dividing the cylinder structure into two parts, which removes the problem of design that comes with an excessively large single-cylinder structure with its possibilities of instability. It also confines the high temperatures to a small steel



DESIGN FEATURES OF VARIOUS TURBINES

cylinder, a point of particular importance as we approach the question of higher temperatures of steam. It is true that a mishap in either cylinder would be likely to disable the whole machine.

"Our own view has rather favored the use of two separate elements in these larger sizes, and we have gone to three elements in the 60,000-kw. size. We think that the cross-compound offers the maximum assurance of operating reliability. We do not see anything in the operation of a 40,000-kw. cross-compound that presents any new problems over operating two 20,000-kw. single units."

Ejectors for Steam Condensers

The last two years have taxed the condenser builders in the same difficult way as other manufacturing establishments. The necessities of war have restrained development to a certain extent. During this period, however, there has been developed the steam air ejector,

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which has come into a very prominent place in marine work and is rapidly coming to the front in its application to power plants. Its unqualified success at sea has shown that it is an apparatus that will soon occupy a very prominent place in future condenser installations.

Recently a number of large condensers installed on General Electric turbines in power stations have been put on spring supports without expansion joints. This method seems to be very satisfactory.

The Westinghouse company recommends hanging the condenser from the turbine foundation, which method is also satisfactory, as it accomplishes practically the same results as the spring. In one case, where the condenser was located 50 ft. (15 m.) below the turbine and there was an unusual amount of expansion in the exhaust piping, the expansion joint was of the mercury type. This expansion joint is nothing more than a mercury seal in the exhaust line, and it allows absolute freedom of expansion. It seals against any vacuum and is even capable of sealing against 5 lb. (0.35 kg.) back pressure.

CENTRAL-STATION SYSTEM CAPACITIES AND LARGE UNIT INSTALLATIONS AS OF MAY 1, 1919

Company and Location	Generating Capacity, Total Kva.	Capacity in 20,000 Kva. and larger Kva.	Per Cent of Total Kva.	Capacity of Largest Unit, Kva.	Per Cent of Total Kva.
Buffalo General Elec. Co. Buffalo, N. Y.	105,555	105,555	100.0	38,889	36.8
Con. Gas, El. Lt. & Pr. Co. Baltimore, Md.	81,500	40,000	49.1	20,000	24.6
Boston Elev. Ry. Co. Boston, Mass.	122,500	35,000	28.5	35,000	28.5
Edison Electric Illg. Co. Boston, Mass.	143,000	30,000	23.8	30,000	23.8
Alabama Power Co. Birmingham, Ala.	140,233	58,333	41.6	33,333	23.8
Edison Electric Illg. Co. Brooklyn, N. Y.	121,500	52,000	42.7	30,000	24.7
Bklyn. Rapid Transit Co. Brooklyn, N. Y.	139,850	51,000	36.6	30,000	21.5
Commonwealth Edison Co. Chicago, Ill.	498,510	227,910	45.7	35,300	7.1
Cleveland Electric Illg. Co. Cleveland, Ohio	208,000	150,000	72.1	31,250	15.0
Union Gas & Elec. Co. Cincinnati, Ohio	84,400	50,000	59.3	25,000	29.6
Northern Ohio Traction Co. Cuyahoga Falls, Ohio	67,000	44,444	66.3	22,222	33.2
Detroit Edison Co. Detroit, Mich.	193,000	105,000	54.4	45,000	23.3
Pennsylvania R.R. Co. Long Island City, N. Y.	78,000	41,100	52.7	21,100	27.1
Twin City Rapid Transit Co. Minneapolis, Minn.	65,000	20,000	30.8	20,000	30.8
Moline & Rock Is. Mfg. Co. Moline, Ill.	50,600	20,000	39.6	20,000	39.6
Interborough Rapid Transit Co. New York City	389,000	256,000	65.8	70.000	18.0
New York Edison Co. New York City	286,000	111,000	38.8	30,000	10.5
Public Service Electric Co. Newark, N. J.	265,100	105,000	45.0	35,000	15.0
United El. Lt. & Power Co. New York City	124,900	65,900	52.8	25,900	20.7
Philadelphia Electric Co. Philadelphia, Pa.	279,700	153,900	55.1	35,000	12.5
Narragansett El. Ltg. Co. Providence, R. I.	85,500	67,500	78.9	47,500	55.5
Duquesne Light Co. Pittsburgh, Pa.	168,000	47,200	28.2	47,200	28.2
N. Y. C. R. R. Co. Port Morris and Yonkers, N.Y.	60,000	20,000	33.3	20,000	33.3
Reading Transit & Light Co. Reading, Pa.	25,000	25,000	100.0	25,000	100.0
Union El. Lt. & Pwr. Co. St. Louis, Mo.	83,000	25,000	30.1	25,000	30.1
United Electric Co. Springfield, Mass.	45,020	20,000	44.4	20,000	44.4
Toledo Ry. & Light Co. Toledo, O.	88,000	45,750	47.0	23,500	26.7
Worcester Electric Light Co. Worcester, Mass.	43,000	20,000	46.5	20,000	46.5
Wheeling Electric Co. Windsor, W. Va.	69,000	60,000	87.0	20,000	43.5

Proper application and limitation regarding the use of insulating brick in boiler settings are becoming better understood, although there is still much widely divergent practice regarding this matter. There is a feeling on the part of operators who have had experience in this matter, particularly in connection with high boiler ratings, that the walls of the furnace should be built of as few different kinds of material as possible and that the walls should be solid, well bonded and homogeneous. The present-day demand is for a furnace lining which will withstand the high furnace temperatures and blow-torch action, the constant heating and cooling effect and the abrasive action of the fuel bed. A furnace lining to which clinker formations would not adhere is very much to be desired, but if this is impossible, it must have the mechanical strength to withstand the necessary barring or breaking off of the clinkers. There are, however, a considerable number of various and diversified means in use for preserving furnace linings.

Boiler-Forcing Rates

In recent large central-station designs maximum boiler ratings of from 250 per cent to 400 per cent have been used in the basic calculations and carried out to a practical conclusion in the plants when put in operation. This tendency toward higher boiler ratings in modern new plants has led many operators to feel that boilers in general should be operated at much higher ratings than in the past, which in a large majority of cases was perhaps a justifiable conclusion if not carried too far. A boiler is often spoken of as being overloaded, when in reality it is the stoker under the boiler which is being forced beyond its proper limit. Generally speaking, the capacity which can be developed by a boiler and stoker unit is limited only by the amount of coal which can be burned by the stoker equipment. Properly speaking, the capacity of the boiler is mainly a question of how high a flue temperature may be tolerated.

The problem of draft loss at high boiler ratings is by no means a small one and is frequently underestimated in connection with increasing the capacity of boiler plants already installed. This may be readily understood when it is considered that the draft loss through a setting increases as the square of the velocity.

The character of the boiler-feed water may readily become a limiting factor in boiler ratings developed, and as a matter of fact this is not infrequently the case. This may occur either through the water containing a troublesome amount of scale-forming ingredients or through the presence of ingredients which cause it to prime or foam.

A concentration test has been developed by the Babcock & Wilcox Company for the detection of priming which is described in detail in the committee report.

Although there has been little or no improvement during the past year in methods of cleaning external heating surfaces, there has been a very broad movement on the part of operators toward the use of mechanical soot blowers. This movement has doubtless been aided by difficult labor conditions, which have made it almost necessary to resort to mechanical methods of soot removal.

Recent labor conditions have also turned the attention of operators toward the subject of feed-water regulators, with the result that for average boiler-plant conditions and for plants containing more than three

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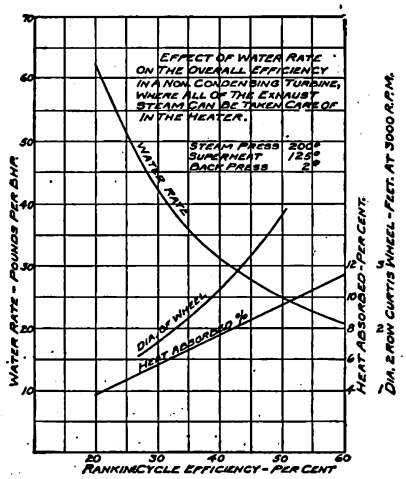
or four boiler units a wise selection of feed-water regulators may now be regarded as standard practice, although there are possible exceptions in which the use of regulators may be inadvisable, such as, for instance, where extremely fluctuating load conditions prevail.

SUPERHEATER REQUIRES DRY STEAM

In connection with a discussion of superheaters it was pointed out that the superheater as such is a very



WATER RATES AND HEAT BALANCE OF A SMALL TURBINE
Shows that a wide range of water rates has a relatively small effect on heat balance of station

efficient piece of apparatus, but as a boiler or evaporator it not only becomes a source of loss through loss of superheat but may be the cause of high maintenance as well. It may be interesting to note that at 200 lb. (17.5 kg.) pressure and 100 deg. Fahr. (56 deg. C.) superheat 1 per cent of moisture in the steam entering the superheat causes a loss of 17 deg. Fahr. (10 deg. C.) of superheat. This discussion brings to light the need for taking every possible precaution to insure steam as nearly dry as possible entering the superheater.

It is thought that the most important developments in the underfeed type of stokers are the power dump grates and the clinker grinders, both of which are coming into more general use. Of these, it is believed that the clinker grinder is the more important, as it eliminates all dumping, with consequent changes in furnace conditions and loss of boiler capacity during the dumping period; and reduces the combustible in the ash to a very low figure.

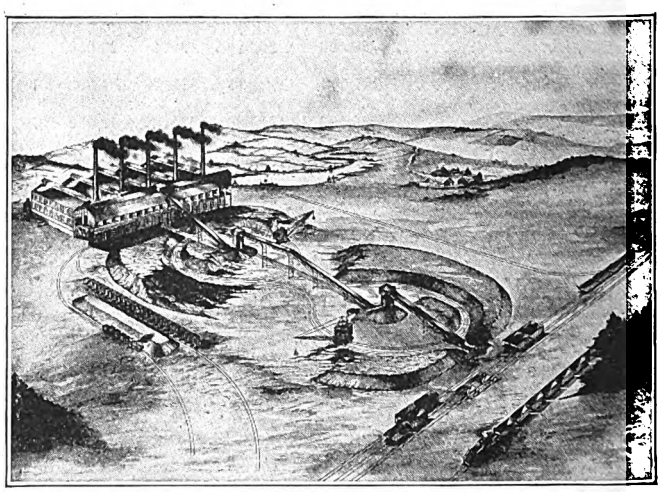
ANALYSIS OF ECONOMIZER PROBLEM

The last extensive discussion of economizers in a prime movers committee report was contained in the 1915 report, in which detailed data were given concerning the practice of the Commonwealth Edison Company of Chicago. In the last three or four years some progress in economizer practice has been made in the United States and abroad; types have been developed for pressures of 300 lb. (21 kg.) or higher, using extra heavy cast-iron or "semi-steel" tubes and improved designs for headers, joints and other details. A few high-pressure steel economizers are in use in this country and a large number abroad. With the higher fuel costs economizers will come into much wider use.

In the operation of economizers it has been accepted almost without argument that to obtain maximum benefit the water should enter the economizer at the lowest possible temperature, the minimum limit being set by external corrosion difficulties. To obtain this low temperature, electric drive is in general adopted for most of the station auxiliaries, and this introduces factors which to some extent offset the advantage gained from feeding the lower temperature water to the economizer. With steam-driven auxiliaries, assuming that the exhaust is all used in the feed-water heater, 1 kw.-hr. of energy supplied to the auxiliaries costs 5000 to 6000 B.t.u., and hence for each kilowatt-hour of auxiliary steam energy displaced by electric drive, in order to keep the feed-water temperature at the entrance to the economizer down to the minimum, about 20,000 B.t.u. are sacrificed. In order, therefore, to realize a net saving on the station operation, the increased efficiency of the boiler economizer plant due to the reduction in feed-water temperature must be more than sufficient to offset this sacrifice.

ECONOMICAL OPERATION OF AUXILIARIES

It has been pointed out that in a modern type of steam auxiliary using 30 lb. (13.6 kg.) of steam per brake-horsepower-hour the cost per brake-horsepower of auxiliary power will be about 4500 B.t.u., provided that all steam is absorbed by heater; also that the excess steam which cannot be absorbed will cost eight to ten times this amount; also that electric auxiliary power from modern prime movers will cost 22,000 to 25,000 B.t.u. per kilowatt-hour. A careful analysis of a given operating condition with these figures in mind will show that the smallest thermal cost for auxiliary power is expended when steam auxiliaries having a minimum consumption per brake-horsepower-hour are used up to the limit of feed-water absorption capacity and the balance of auxiliary power required is taken from the main busbars. The installation of economizers will reduce the desirable limit of absorption by feed water



COAL-HANDLING EQUIPMENT AT UNITED STATES GOVERNMENT EXPLOSIVES PLANT "N" AT OLD HICKORY, TENN.
By a system of belt conveyors and silos the coal is stored or delivered to the bunkers as desired

on account of the greater savings effected by economizers when feed water is supplied to them at lower temperatures than 212 deg. Fahr. (100 deg. C.).

Regarding water rates of auxiliaries the report is quoted:

"It may be well to emphasize again the fallacy of arguments in the past that the water rate of steam-driven auxiliaries is not an item deserving much consideration. The results obtained by some of the more modern plants in the matter of auxiliary power cost

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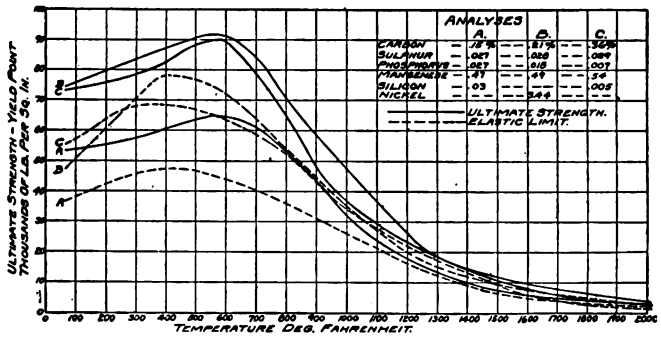
will certainly show the importance of looking into the question of division of auxiliary drive, particularly in the smaller plants."

Writers on the subject of coal storage show very little tendency to agree as to the cause of heating and deterioration of coal in storage. There is considerably more agreement, however, on the results to be expected under certain conditions than there is in the theories offered as to their causes. Among the principles which are backed up by extensive experimental data and widely accepted by the authorities on the subject are:

(1) Coal does not deteriorate seriously unless it heats sufficiently to fire in some part of the pile.

(2) If the pile fires in one or more places, all of the coal in the immediate neighborhood of the fire is absolutely ruined as far as gas and coke making is concerned, though it can still be used as fuel for boilers.

The storage of coal is a local problem. When it is decided that storage is necessary, the best procedure is to determine the quality of protection necessary for the coal one expects to use, if possible, from the experience



EFFECT OF HIGH TEMPERATURES ON STEEL USED FOR BOILERS

Three-cylinder, 1800 and 1200 r.p.m. Comparative performance at 45,000 kw. when supplied with steam having total heat (above 32 deg. Fahr.) of 1280, 1300 and 1320 B.t.u. per pound at pressures from 200 lb. to 600 lb. absolute.

of those who have stored coal from the same district, and then, with the local conditions in view, provide in the cheapest way possible the protection which this experience has shown to be necessary.

GROWING USE OF TURBINE AND BOILER ROOM INSTRUMENTS

Regarding the use of boiler and turbine room instruments which have been rapidly coming into favor it is said:

"Good over-all efficiency does not necessarily follow from good combustion efficiency, since it is affected by the condition of the surfaces of the boiler, and as an indication of this condition it is necessary to use a flue thermometer in conjunction with the CO_2 recorder. A temperature standard may then be obtained at different ratings by a test upon a clean boiler using proper combustion, and by reference to this in subsequent operation the flue temperature will indicate when the boiler is dirty. A steam-flow meter then also becomes a necessary part of the outfit. . . . Also if the relationship between the amount of air and the boiler output is determined once for all when the boiler is clean and operated at maximum efficiency, this relationship will subsequently serve as a standard by which to operate the boiler."

For the measurement of this flow of air many methods have been devised. In some cases it has been determined by means of Pitot tubes, in some cases by orifices in the pass to the air chamber, and in others by using the boiler setting as an orifice.

Remote control of boilers from a central point does not seem to be out of reach. The method utilizing steam-flow and air-flow meters and flue thermometers offers a most promising solution to the question of boiler operation at the present time. If it is perfected to a greater degree, it will develop the principle of the remote control of boilers.

CHOICE OF FLOW METERS

The steam-flow meter has progressed greatly since the last report of this committee, and its accuracy as now designed can easily be maintained within 2 per cent. These meters then may be depended upon for a perfect indication in the boiler room and also may be used in many cases for the sale of steam.

There are two principles used in the measurement of steam by the best-known steam-flow meters. One is based upon the orifice method and the other upon the Pitot tube. Both of these are accurate in results. The Pitot tube has but one disadvantage compared with the orifice. If foreign material is being carried along in the steam, it is apt to clog the openings and cause the meter to read in error. However, where there is no danger from this element, the Pitot tube is just as accurate and reliable as the other.

The orifice type of meter, which includes the Venturi type, is also an accurate means for measuring hot water and is extensively used. The V-notch weir, which has greatly advanced in recent years, is pressing the Venturi meter for a place in this field, and its accuracy and practicability have become unquestioned.

The burning of pulverized fuel for industrial work has developed to a point where the difficulties have been largely overcome, but the committee had very little to report on the successful use of pulverized coal as fuel under steam boilers for central-station work.

While minor troubles have been encountered at all of these installations, such as might be anticipated when the pressure and temperature of the steam system are increased, the committee was advised that in each instance the installation is considered generally satisfactory. While it may be possible to increase the boiler pressure to almost any desired point by changing design, there is to-day a very definite limit to the maximum temperature which it is safe to use. That is fixed by the steels now in commercial use, and appears to be between 600 deg. and 700 deg. Fahr. (315 and 371 deg. C.).

WATER POWER SHOULD BE DEVELOPED

Owing to the fact that steam plants could be built more quickly than hydro plants, construction of the latter has not been pushed during the war. Manufacturers now, however, report very lively interest and inquiries regarding the necessary machinery for large hydroelectric developments.

Some plant designers for large interconnected systems incline toward layouts of few but large units, contending that operating and maintenance costs increase almost proportionately with the number of units and that a few large machines can be brought back into service more quickly after disturbances than a larger number of small machines. The greater the number of plants that are interconnected into one system, the less is the number of units considered necessary to be held as spares.

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Melting of Non-ferrous Metals and Alloys*

Complete Domination of Brass-Melting Industry by Electric Furnaces Is Indicated by Data on Saving in Cost of Electric Over Fuel-Fired Furnaces—Many Other Advantages of Electrical Method

EVIDENCE of the great advantages and low cost of melting brass in the electric furnace, compared with fuel-fired furnaces, has been rapidly accumulating. Extensive data are now presented to show that a saving of 100 per cent or more, depending upon the local conditions, may be expected from the electrical method. It is also shown that the danger from gas absorption is greatly reduced since the melt is not exposed to extraneous gases introduced through various kinds of fuel. Thus the product of the electric furnace

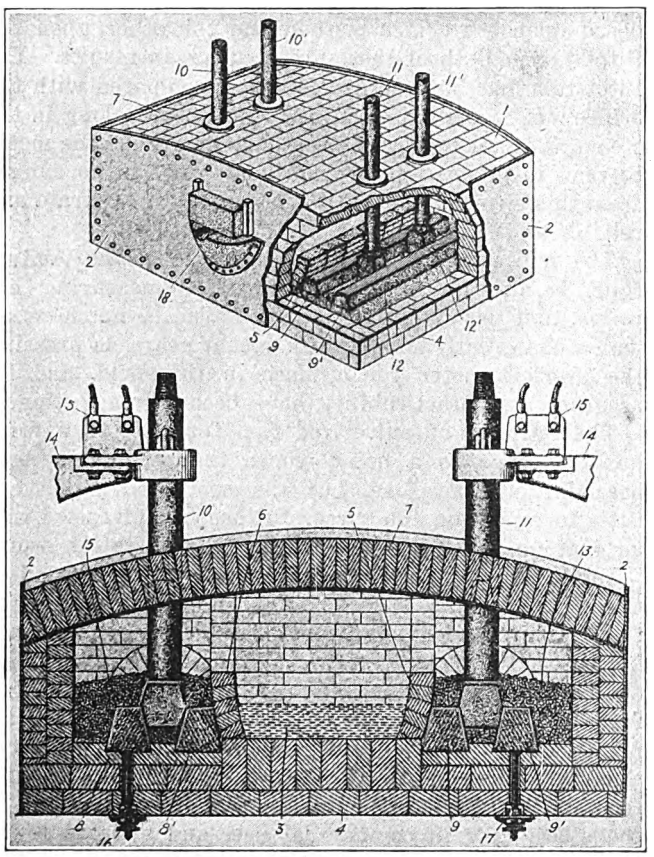

FIG. 1—ELECTRIC FURNACE PARTICULARLY SUITABLE FOR BRASS MELTING

is of a superior quality. The accuracy of electrical control, furthermore, makes possible a minimum loss of metal due to high temperature. For the full realization of advantages inherent in the electrical method a type of furnace with which excellent results have been attained is described in some detail.

CLASSIFICATION OF ELECTRIC FURNACES

It is first desirable to consider the characteristics of electric furnaces and to see how completely they meet the requirements for melting the non-ferrous metals and their alloys.

Class I.—Furnaces in which heat is developed by the passage of current through a solid, laminated or granular conducting medium or resistor.

(A) The conducting medium may consist of material that is to be treated.

(B) The heat developed in the "resistor" is transferred to the charge by conduction or radiation or both; a wall may or may not intervene between "resistor" and charge.

(C) A readily controllable amount of heat is generated between a fixed and movable carbon electrode, their distance apart being maintained such that the granular carbon lying between the faces gives rise to many chains of series and multiple contact or resistance arcs, enveloping adjacent electrode faces.

Class II.—Furnaces in which heat is developed by the flow of current through a liquid or solid conductor: (A) Electrolytic; (B) non-electrolytic.

Class III.—Furnaces in which heat is developed by flow of current through gas or air, for example, arc furnaces in which arcs play between two or more electrodes near material to be heated or between one or more carbon electrodes and charge to be heated.

In the making of brass furnaces each of the three classes has been tried out. Furnaces in classes I and II lend themselves readily to the generation and control of a mild "soaking" heat such as is required for melting volatile alloys. As illustration the common resistance furnace is in class I and the induction furnace in class II. Furnaces in class III generate too intense and burning a heat to be used with even questionable success in melting volatile alloys without the use of much unnecessary manipulation and watchfulness requiring much skill. Control of the electric arcs in atmospheres high or low in volatile gases, freedom from surging, low power factor and high metal loss are some of the serious problems confronting the man who would melt volatile alloys in the class III arc furnaces. Their employment had best be left for steel.

Several years' experience with furnaces falling in class I and type C and results gained from many tests as well as from commercial operation in the foundry constitute the basis of this paper. The design and construction of this type of furnace are therefore given in some detail, and its suitability for melting the non-ferrous metals and their alloys is pointed out.

DESCRIPTION AND DESIGN OF FURNACE

This furnace is shown in section in Fig. 1. It will be noticed that it consists essentially of a refractory lined case, within which are contained in the same chamber the heating units lying on either side of the melting hearth (3). The source of heat is (13) and lies in a duct separated from the bath by carborundum walls (5 and 6). This duct is fitted with cross electrodes 9 and with wearing blocks 12 under each of two vertical electrodes projecting through the arched roof. These cross-electrodes in bottom of duct, as well as the wearing blocks between them and the vertical electrodes, are carbon. The whole duct is filled with granular coke to the height of the bridge wall (5 and 6) on

*Abstract of paper by E. F. Collins, General Electric Company, read before recent meeting of Cleveland Engineering Society.

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either side of hearth. Neutral electrodes (16 and 17) make contact with cross-electrodes (8 and 9). This neutral electrode is for the sake of automatic control as will be seen later. The vertical electrode carries a water-cooled ring where it emerges from the top arch; also the cable clamp for electrode (15) is water-cooled. The two vertical electrodes (11) are terminals of one phase, while those marked 10 are terminals of another. In other words, the furnace is inherently

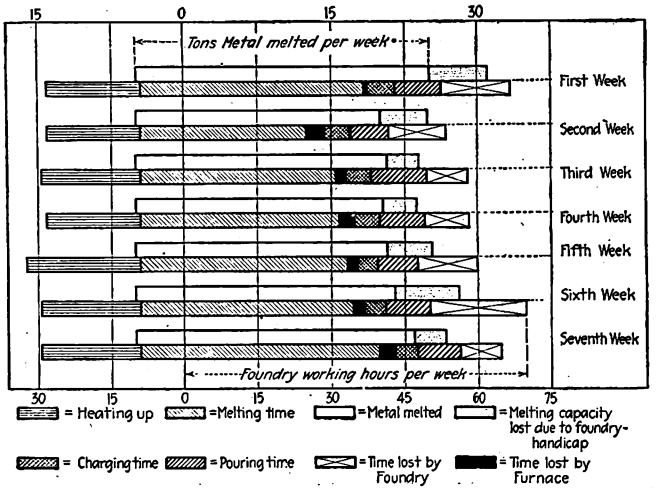

FIG. 2—CHART SHOWING CONTINUITY OF SERVICE OF ELECTRIC FURNACE IN COMMERCIAL BRASS MELTING

two-phase. By multiplying the two phases, however, it may be operated single-phase, or by using Scott transformer connections it may operate from a three-phase source. The phase voltage most satisfactory has been found to be 60 volts to 70 volts.

Referring to Fig. 1, the detail arrangement of the electrodes, etc., in the resistor duct is evident. The operation of the furnace in generating heat is as follows:

When current is supplied to vertical electrodes of phases, it flows through vertical electrodes (10 and 11), through a short space filled with granular carbon, to the wearing block (12), into cross-electrodes (9), into second wearing block (12), and out to line through second granular coke strata and second vertical electrodes. The value of the current is regulated automatically by varying the distance between vertical electrodes and wearing block. In other words, by means of a current-controlled relay the distance between 11 min. and 12 min. is governed; also by means of a voltage-controlled relay connected to neutral bottom electrodes and vertical electrode (11) the distance between electrode (11) and wearing block (12) is held to correspond to one-half the phase voltage; *i.e.*, 30 to 40 volts. A rheostat on the control panel allows of setting control for any current value required, and when one is set for a given value such value is held until the rheostat position is changed by the furnace operator. Hence the power input is automatically held constant and is subdivided equally between the vertical electrodes.

Starting with a cold furnace, heat is generated first in the granular carbon separator lying under the bottom face of vertical electrode. This immediately becomes incandescent by virtue of current carried by carbon granules and also heat generated in a multitude of contact arcs enveloping the lower end of vertical electrode. Heat is at once taken from this source by the granular coke in the trench and its whole surface becomes heated to the desired point.

This heat is radiated principally to the roof, since it is generated largely in the upper surface of the coke body. In addition to serving as the inclosing wall of the furnace the roof is so shaped that it acts as a highly efficient reflector, throwing the heat received from the incandescent coke ducts on either side of the hearth uniformly on the hearth or bath. This heat is very uniform and what is called a mild "soaking heat," and hence it lends itself well to the melting of brass or volatile metals. Especially is this a fact since part of the heat is supplied to the bath from bottom and sides.

To enumerate briefly some characteristics of the above-described furnace which make it essentially suited to melting non-ferrous metals and their alloys, we have the following:

(1) Temperature of heat-generating source controllable at will.

(2) Heat generated is of the mild "soaking" type uniformly distributed, and any workable temperature gradient may be maintained between charge and heat source.

(3) Heat received by charge, from above, on sides and through bottom.

(4) Bath is comparatively shallow and large surface exposed to receive heat (bath depth approximately 6 in. in 1500-lb. furnace).

(5) Furnace has normally a reducing atmosphere, which may readily be made neutral or oxidizing.

(6) Automatic control of power, requiring little attendance.

(7) Furnace atmosphere free from contaminating gases.

(8) Dead atmosphere practically restrained from escape exists normally in furnace.

(9) Temperature controllable, so that slags do not

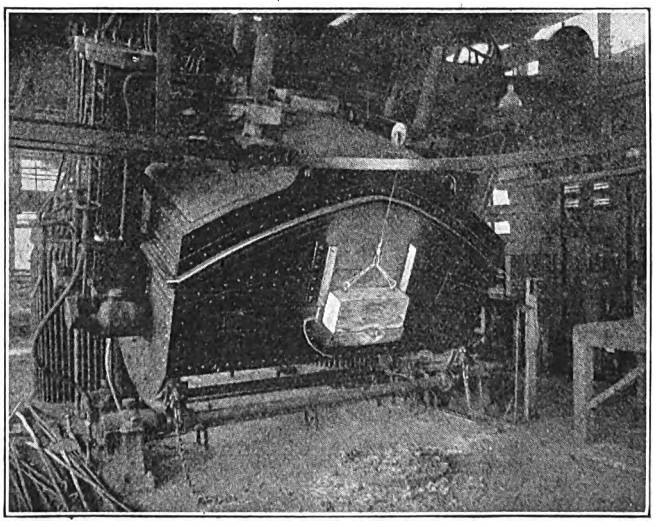

FIG. 3—1500-LB., 300-KW. BRASS-MELTING FURNACE IN OPERATION

form in melting brass; hence simplicity of metal recovery from dirt skimmed from top of bath in furnace.

(10) Furnace may be "forced"; *i.e.*, heat may be fed to metal as fast as it is absorbed, and a high rate of melting results, with all its advantages and none of the disadvantages met with in fuel-fire furnaces.

(11) Dependability of furnace and continuity of operation under commercial conditions are illustrated

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in Fig. 2. The delays here due to the furnace are of short duration when compared to the time the furnace was delayed because of foundry conditions. In other words, little melting capacity was here lost and chargeable to the furnace as compared to that lost from delays for which the foundry alone was to blame.

Cost of Electric Melting vs. Fuel-Fired Furnaces.—Attention is now directed to certain characteristics and losses which influence the over-all cost of melting and must be considered in making up true melting costs. (See tabulation of costs in Table V.)

SOURCES OF METAL LOSS IN MELTING

	Electric	Fuel-Fired
(1) Temperature control.....	Excellent.....	Indifferent
(2) Size of charge.....	Controllable.....	Controllable
(3) Gas flow from furnace....	Negligible.....	Large volumes if combustion gases must pass out
(4) Furnace atmosphere; chemical condition.....	Free from oxygen and injurious gases	Contaminated by impurities of fuel; protection against oxygen only through excess fuel supply
(5) Speed of melting.....	Much greater than fuel fired	Much less than electric

The above tabulation is a statement of the principal losses in melting brass alloys. It will be noted that conditions are under absolute control in the case of the electric furnace, whereas in fuel-fired places the control is not so good.

First Source of Loss in Melting.—In a given electric furnace the weight of metal lost in melting increases as the temperature for forming alloy lies above the melting point of the alloy.

As illustrating how lack of temperature control may increase metal losses in melting brass, the following test is presented: First, 70:30 brass was made in the electric furnace, taking 420 lb. (190 kg.) of copper and

TABLE I—RESULTS OF MELTING TEST

Yellow Brass Metal, Lb.	Temperature of Alloying	Pouring Temperature	Alloy Recovered, Lb.	Per Cent Zn Loss	Per Cen Metal Loss
(a) 420 Cu 180 Zn	1170° C. 2140° F.	1150° C. 0050° C.	565	19	5.8
(b) 420 Cu 180 Zn	1100° C. 2010° F.	1100° C.	590	5.6	0.6
(Chemical Analysis, Test Corresponding to Above)					
(a) Cu 70 Zn 30	1170° C.	1150° C.	Cu 75.9 Zn 24.1	24	7.3
(b) Cu 70 Zn 30	1100° C.	1100° C.	Cu 71.3 Zn 28.7	5.5	1.6

melting down and then adding 180 lb. (80 kg.) of zinc, at 1170 deg. C., pouring at 1150 deg. C.; second, 420 lb. (190 kg.) of copper was melted down and 180 lb. (80 kg.) of zinc added at 1100 deg. C. and pouring at 1100 deg. C. with the results given in Table I. The results in this table show the narrow limits of temperature within which these operations should occur.

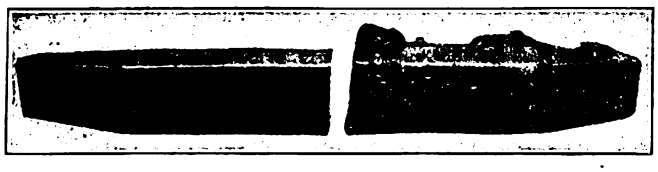

FIG. 4—BAR MADE FROM SCRAP COPPER IN ELECTRIC FURNACE—EFFECT OF SULPHUR ABSORPTION AT RIGHT

Second Source of Loss in Melting.—The weight of metal lost on melting is independent of the charge in a given electric furnace, free from ventilation.

Third Source of Loss in Melting.—In the fuel-fired furnace the magnitude of loss from this source is influenced by the speed of melting pressure and volume and the velocity of gases flowing over the melting metal. Thus increasing the atmospheric pressure in the furnace and decreasing the volume and velocity of the gases

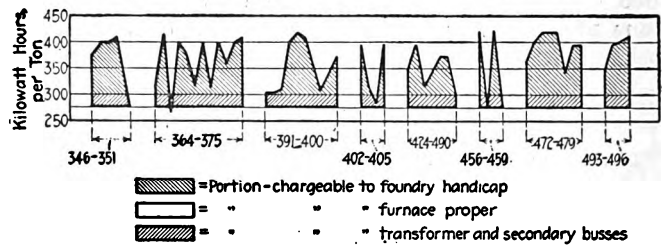

FIG. 5—ENERGY CONSUMPTION OF ELECTRIC FURNACE

Hearth capacity, 2000 lb.
Melting rate, 1700 lb. per hour.
Dirt skimmed from furnace, 107 lb. per ton.
No relining or patching during period of these tests.

tends to reduce volatilization loss. For each fuel there is a maximum limit to gas speed or velocity through the furnace, since each fuel in developing the required heat units to get the heat out at a given speed must develop a certain volume of gases which must pass out. Hence proper gas velocity is inseparably connected with products of combustion results from various fuels. The approximate volume of flue gases averages in coal, coke and oil furnaces from 3350 cu.ft. to 5800 cu.ft. per 100 lb. (2.1 cu.m. to 3.6 cu.m. per kg.) of metal melted. Hence it is easy to see how the flow of gas may bring about a very large volatile loss in the fuel-fired furnace. In the electric furnace the gas flow is very small, and consequently, though its atmosphere be saturated with metal vapors, so little gas leaves the furnace during the melt that loss is negligible.

Fourth Source of Loss in Melting.—Copper, zinc, tin and lead, the constituents of commercial brasses, are all very readily oxidizable at the temperatures to which they must be heated for melting and pouring. Oxidizing results in loss of metal and actually burns the metal to a dross. One can readily maintain a neutral or reducing atmosphere in the electric furnace, but it is certain that carbon monoxide must be so high and oxygen so low that one cannot, in ordinary fuel furnaces, hope to maintain a reducing atmosphere without sacri-

TABLE II—NON-FERROUS METALS MELTED IN ELECTRIC FURNACE

Metal	Condition of Metal Charged	State of Metal After Melting	Kw.-hr. per Ton to Melt	Metal Loss in Melting
Copper	Electrolytic cathode Pig Scrap—heavy Scrap—light Scrap—dirty Chips—oily Chips—clean	Pig at pitch without rabbling or poling Wire bar Foundry castings	300 to 500	No oxidation, a certain amount of copper oxide is reduced
Zinc	Electrolytic cathode Pig Punchings Chips Heavy scrap	Pig Foundry castings Billets for rolling Battery electrodes	90 to 120	Dross and oxidation under 2 per cent
Nickel	Shot Bar Scrap	Pig Foundry castings Billets for rolling	500 to 750	No oxidation loss
Aluminum	Pig Scrap Punchings Turnings	Pig Foundry castings Billets for rolling	400 to 750	Less than 1 per cent oxidation
Tin	Bar Pig Scrap	Bar Pig Wire	40 to 60	No oxidation
Lead	Pig Scrap Sheet	Billets for rolling Casting Pig	20 to 40	No oxidation

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ficing many heat units through burning carbon to CO instead of CO_2.

GAS ABSORPTION

Gas absorption is proportional to the temperature and the time metal is held in contact with gases. Incidental and intimately connected with oxidation of metal is the absorption of gases. In melting the constituents of an alloy a gas may enter into chemical union with some of its metals, forming oxides, or they may be occluded in the alloy. Absorption of gases is greater as the temperature increases, since, when the metals freeze, absorbed or dissolved gases are given up; if they are unable to pass through the metal before it freezes, sponginess and blow-holes in the alloy will be produced. All fuels used in the foundry at the present time contain sulphur in some degree. This sulphur is a very common cause of trouble. Melted brass absorbs sulphur greedily and gives it up upon cooling in the sand molds, thus causing porosity and blow-holes to be formed. One successful brass foundry asserts that many of the failures usually attributed to oxygen are really due to sulphur. In the most careful crucible melting in coke-fired furnaces the metal will absorb 0.002 to 0.005 per cent sulphur (see Fig. 4). Sulphur accumulates in a metal every time it is melted, which accounts for the dark skin of rerun castings as compared with first-melt metal. In fact, even though melted under a charcoal cover and CO blanket, copper needs a deoxidizer to free it completely from oxygen. These troubles should not occur in connection with electric melting, since the furnace chamber may be kept uncontaminated and free from oxygen and injurious gases.

TABLE III—NON-FERROUS ALLOYS MELTED IN ELECTRIC FURNACE

Metals	Condition of Metal Charged	State of Alloy After Melting	Kw.-hr. per Ton to Melt	Metal Loss in Melting
Red brass:				
Cu 80	Scrap—pig, electro-cathode	Foundry castings	250	0.25 to 0.7
Zn 10	Scrap—bar	Wire bar	to	Depends
Sn 6	Scrap—pig	Billets	400	upon manipulation
Pb 4				of furnace
Yellow brass:				
Cu 60	Scrap—pig, electrolytic cathode	Foundry castings	220	0.50 to 1.5
Zn 39.5	Scrap—pig	Wire bar	to	
Pb 00.5		Billets for rolling	350	

TABLE IV—NON-FERROUS ALLOYS MELTED IN ELECTRIC FURNACE

Alloy	Condition of Alloy Charged	State of Alloy After Melting	Kw.-hr. per Ton	Alloy Loss	Temperature, Deg. C.
Red brass	Yellow brass and copper or red brass and zinc, pig, scrap, sprues, turnings and chips	Foundry castings Wire bar Billets	225 to 300	0.15 to 0.50	1300
Yellow brass	Red brass and zinc or yellow brass and zinc, pig, scrap, sprues, turnings and chips	Foundry castings Wire bar Billets	200 to 275	0.40 to 1.00	1100
Copper	Scrap and billets	Foundry castings	500 to 750	No oxidation	1600
Nickel		Billets			
Aterite:					
Cu	Sprues, scrap	Foundry castings	500	2 per cent zn	
Ni	Virgin metal	Billets for drawing and rolling	to 750	1650 loss out of 32 per cent	
Zn					

TABLE V—AVERAGE COST OF MELTING BRASS WITH FUEL-FIRED OR ELECTRIC FURNACE

Furnace type	Pit	Pit	Tilting	Pit	Reverb.	Pit	Tilting	Crucible	Crucible	Tilting	
Furnace draft	Natural	Forced	Forced	Natural	Natural	Forced	Forced	Burner	Burner	Electric	
Furnace fuel	Coke	Coke	Coke	Coal	Coal	Oil	Oil	Natural gas	City gas	Electric	
Fuel cost price	9.75	9.75	9.75	8.00	8.00	0.098 gal.	0.098 gal.	0.30 M	0.60 M	0.015	kw.-hr.
COST PER TON MAKING RED BRASS. Pouring at 1300 deg C. (Zinc 10 per cent or less.)											
Fuel quantity	1400	700	600	1200	900	50 Gal.	60 Gal.	4800	7000	400 kw.-hr.-10 hr. 250 kw.-hr.-24 hr.	
Metal loss	70	30	30	70	124	30	44	40	40		15
Fuel cost	$6.82	$3.41	$2.92	$4.80	$3.60	$4.90	$5.88	$1.44	$4.20	$6.00	$3.75
Zinc value at 10c. lb	7.00	3.00	3.00	7.00	12.40	3.00	4.40	4.00	4.00	1.50	1.50
Cost reclaiming	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.15	0.15
Renewals and repairs	0.40	0.40	0.35	0.40	0.50	0.50	0.50	0.35	0.30	1.00	1.00
Cost preheating crucible	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.10	0.10
Furnace labor	2.25	2.25	2.25	2.25	1.50	2.25	1.50	2.25	2.25	1.00	1.00
Miscellaneous and labor and fuel	0.50	0.50	0.50	0.50	0.50	0.40	0.40	0.40	0.40	0.20	0.20
Cost charcoal	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.05	0.05
Air for blast	....	0.15	0.15	....	....	0.15	0.15	0.15	0.15	....	....
Crucible cost	5.00	5.50	5.50	5.00	....	8.00	....	8.00	8.00	....	....
Interest crucible stock	0.10	0.10	0.10	0.10	....	0.10	....	0.10	0.10	....	....
Lining pouring crucible	....	....	0.30	....	0.30	....	0.30	0.30	0.30	0.30	0.30
Electrodes and coke	....	....	....	....	....	....	....	....	....	0.60	0.60
Cost per ton—total	$23.09	$16.33	$16.09	$21.07	$19.82	$20.32	$13.85	$18.01	$20.72	$10.90	$8.65
COST PER TON MAKING YELLOW BRASS (Zinc 10 to 40 per cent)											
Fuel quantity	1000	600	400	700	400	40 gal.	45 gal.			350 kw.-hr. 10-hourday	220 kw-hr. 24-hourday
Metal loss	100	40	56	100	200	60	70			30	
Fuel cost	$4.88	$2.92	$1.95	$2.80	$1.60	$3.92	$4.41			$5.25	$3.30
Zinc value at 10c. lb	10.00	4.00	5.60	10.00	20.00	6.00	7.00			3.00	3.00
Cost reclaiming	0.50	0.50	0.50	0.50	0.50	0.50	0.50			0.15	0.15
Renewal and repairs	0.40	0.40	0.35	0.40	0.50	0.50	0.75			1.00	1.00
Cost preheating crucible	0.40	0.40	0.40	0.40	0.40	0.40	0.10			0.10	0.10
Furnace labor	2.25	2.25	2.25	2.25	1.50	2.25	1.50			1.00	1.00
Miscellaneous and labor and fuel	0.50	0.50	0.50	0.50	0.50	0.40	0.40			0.20	0.20
Cost charcoal	0.12	0.12	0.12	0.12	0.12	0.12	0.12			0.05	0.05
Air for blast	....	0.15	0.15	....	....	0.15	0.15			....	....
Crucible cost	4.50	5.00	5.00	4.50	....	4.50	....			....	....
Interest crucible stock	0.10	0.10	0.10	0.10	....	0.10	....			....	....
Lining pouring crucible	....	....	.30	....	0.30	....	0.30			0.30	0.30
Electrodes and coke	....	....	....	....	....	....	....			0.60	0.60
Cost per ton—total	$23.65	$16.34	$17.22	$21.57	$25.42	$18.84	$15.23			$11.65	$ 9.70

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Fifth Source of Melting Loss.—Loss of zinc is proportional to the temperature and the length of time metal is held at the high temperature. This statement means that if one charge is melted at the rate of 100 lb. (45 kg.) per hour, and a second charge at the rate of 200 lb. (90 kg.) per hour, then, all else being the same, the melting loss of the second charge will be less than that of the first charge. Electric methods of melting lend themselves to much higher melting rates than with fuel-fired furnaces, *viz.*: Melting rate, electric, 1500 lb. (680 kg.) per hour; fuel-fired, 1500 lb. in two and one-quarter hours; 600 lb. (270 kg.) electric, one-half hour; fuel-fired, 600 lb. (270 kg.) in three hours.

Metal loss in melting is ordinarily best judged from chemical analysis of metal charged. This test eliminates errors arising from furnace-wall absorption or the reverse, also from losses in pouring. Extensive tests show the inconsistency of the actual-recovery method of loss determination.

TABLE VI—AVERAGE MELTING RESULTS REALIZED IN THE AVERAGE FOUNDRY WITH FUEL-FIRED FURNACES

Type	Furnace Draft	Kind Fuel	Fuel Burned, per Ton	Metal Loss, per Cent	Kind Brass
			Lb.		
Pit	Natural	Coke	1400	3.5	Red
			1000	5	Yellow
Pit	Forced	Coke	700	1.5	Red
			600	2	Yellow
Tilting	Forced	Coke	600	1.5	Red
			400	2.8	Yellow
Pit	Natural	Coal	1200	3.5	Red
			700	5	Yellow
Reverberatory	Natural	Coal	900	6.2	Red
			400	10	Yellow
			Gal.		
Pit	Bumers Tangential	Oil	50	1.5	Red
			40	3	Yellow
Tilting	Open-flame Atomizing	Oil	60	2.2	Red
	Burners		45	3.5	Yellow
			Cu.Ft.		
Tilting Crucible	Burners Tangential	Natural gas	4800	2.75	Yellow
Tilting Crucible	Burners Tangential	City	7000	2.75	Yellow

* Low zinc, 10 per cent; high zinc, 10 per cent above.

A tabulation of physical tests of metal produced from an open-flame oil furnace and from an electric furnace melting the same brass follows:

	Electric Furnace	Oil Furnace
Tensile strength	27,900	24,969
Yield point	10,844	9,850
Elastic limit	7,300	7,000
Elongation in 2 in., per cent	19.4	16.9
Elongation in 8 in., per cent	17.2	14.9
Reduction of area, per cent	21.4	19.7

Likewise the physical properties of brass melted in an electric furnace appear to be better than those produced in a crucible furnace:

	Crucible Furnace	Electric Furnace
Tensile strength	30,250	30,820
Elastic limit	17,833	18,000
Elongation, per cent	16.14	19.37
Reduction of area, per cent	16.1	22

Performance of Electric Furnaces

Tables II, III and IV show performance on the average to be expected from the use of the electric furnace with the furnace charge in different physical forms. Table VI shows like results for fuel-fired furnaces.

The results given in Tables I to IV are average figures and will be influenced to meet any particular foundry by, (a) promptness of pouring; (b) temperature (since pyrometers are seldom used); (c) local conditions, such as physical condition of metal charged, its cleanliness, volume of air and products of combustion which pass through the furnace in natural-draft furnaces—this varies from day to day, depending on the weather; (d) design of furnace; (e) manipulation of furnace; (f) size of crucible; (g) percentages of composition; (h) length of working day; (i) whether observations are based on hot furnace and hot crucibles or whether first heat of the day is excluded; (j) pouring light castings requires hot metal, and pouring heavy ones metal at lower temperature; (k) whether results are from careful tests or whether they represent actual foundry or rolling mill practice and extend over a considerable period.

Cost of Melting Brass in Fuel-Fired and Electric Furnaces

Table V is a résumé of the statements contained in the paper relating to cost of melting brass per ton with the various typical fuel-fired furnaces and also with the electric brass-melting furnace. This table is an average table, and results for individual foundries may be readily found by substituting in the itemized costs those of the factory concerned; *i.e.*, 1.5 cents per kilowatt-hour has been used as electricity or power cost, but if the cost in the plant under consideration is 1 cent, then this figure should be substituted. In the same manner other values may be converted to actual ones for an actual local condition. It is believed that the values used in this table are fair and represent well-averaged conditions, and they may be considered directly without substituting for local conditions; in fact, in their direct form they permit a correct judgment of the general problem of electric versus fuel-fired furnaces.

Comparing the results if all the brass in the country were melted, (1) in fuel-fired furnaces, all types being employed equally, or (2) in electric furnaces, the saving from the employment of the latter would be as follows:

Alloy Melting	Length Working Day, Hours	Per Cent Savings Over Fuel-Fired, per Cent
Yellow brass	10	100
Red brass	10	80
Yellow brass	24	110
Red brass	24	700

These margins of savings are of such magnitude that it can no longer be doubted that the electric furnace is destined completely to dominate the brass-melting field.

DON'T let us forget the peril we have been in. It may arise again at a moment's notice. We must have a large and thoroughly trained standing army. We must have universal military training, both of a combatant military type and for the business end of the war. And we must arrange from this time forward that there be a close sympathetic liaison between the regular army officer and the so-called captains of industry. We must understand each other, respect and recognize our mutual dependence. We must obtain a better view of the regular army organization, and the regular army must learn something from the business man.—*Lieut.-Col. H. M. Byllesby.*

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

METER-TESTING PRACTICE OF MINNEAPOLIS COMPANY

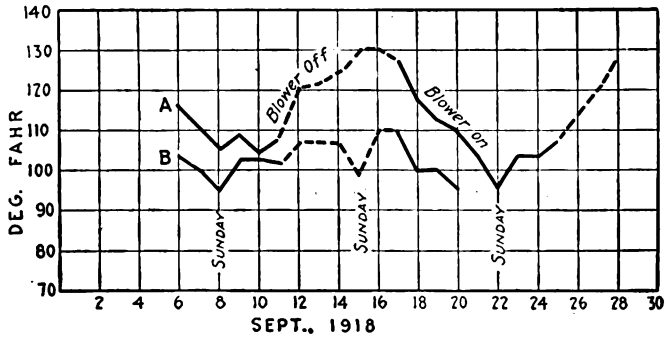
Testers Do Not Repair Meters, and Each Man Tests from Ten to Fourteen Single-Phase or Four or Five Polyphase Meters a Day

George M. Hewitt of the Minneapolis General Electric Company stated recently that those of his company's men who are engaged in testing are required to do nothing but that. When a meter is found out of order the tester does not repair it because the time required could be utilized to test one or two more meters. As a result the alternating-current meter tester averages from twelve to fourteen meters per day continually. In testing polyphase meters he averages four or five meters per day in size ranging from 5 amp. to 80 amp., including transformer types. Each man working on large direct-current meters in sizes from 100 amp. to 300 amp. usually tests from five to six per day and on meters ranging from 600 amp. to 1200 amp. will average from two to three complete tests per day.

BLOWERS INCREASE RATING OF UNDERGROUND CABLES

Forced-Air Circulation Is Shown to Have Reduced Manhole Temperature 15 Deg. Fahr. and Duct Temperatures Even More

Operators of underground distributing systems realize that operating temperature limits the rating of cables the same as it does the rating of other pieces of electrical apparatus. Temperature surveys are therefore being carried out on many underground cable



EFFECT OF BLOWER AND DECREASED SUNDAY LOAD ON CABLE TEMPERATURES

systems, and artificial means are sometimes used to reduce the ambient temperature.

The results which may be expected when a small blower operated by a 1-hp. motor is used to circulate air rapidly through an ordinary manhole is shown by the curves in the attached diagram. "A" shows the effect on the temperature recorded by a thermometer in the duct line 10 feet (3 m.) from the manhole. "B" shows the decrease in the temperature recorded near the roof of the manhole. The cooling effect on the cables due to the decrease in the load on Sunday is also well brought out.

EXTINGUISHING FIRES IN TURBO-GENERATORS

Armature Windings Saved by Shutting Off Air and Filling Generator Casings with High-Pressure Steam When Fire Occurs

The Duquesne Light Company of Pittsburgh, Pa., has made provision in every one of its turbo-generators for extinguishing fires by the use of steam at boiler pressure. This action was occasioned by a number of fires which started in the stator windings of the machines after heavy overloads, short circuits or line surges. Some of these fires necessitated the reinsulation of the entire armature windings, but since high-pressure steam has been made available fires have been extinguished before the insulation of the windings has become seriously damaged.

Before deciding on the use of steam as a fire extinguisher, carbon tetrachloride, carbon dioxide and water were also considered. The final choice, however, rested between steam and water. If water were used, it would have to be poured over the windings and it might not reach the point in the windings where the fire originated. Furthermore, the water would have to be removed after the fire was extinguished, and it would hardly be practicable to start up the machine again without at least an examination and test. These are among the considerations which led to the use of high-pressure steam.

The heat of the steam at boiler pressure has no deleterious effect on the insulation of the armature coils. The steam penetrates to every part of the winding where there could possibly be a fire and it leaves no unpleasant consequences. Steam used for extinguishing burning armature insulation has put out fires so quickly that it has been possible in emergency to put the machines back on the line after a fire without either shutting down the steam end or making an examination of the windings. This action was necessitated when a fire occurred during the system peak because the Duquesne Light Company carried a load in excess of its plant rating during the war.

It is essential that the steam be taken from a line which will always be alive when the turbine is running. The connection must be tapped into the top of the steam header and taken up to the control valves without making any trap in which water might collect. Two valves are used, one above the other, as an extra precaution to prevent leakage, but only the upper valve is inclosed in an iron case with a glass front. A ⅛-in. (3-mm.)

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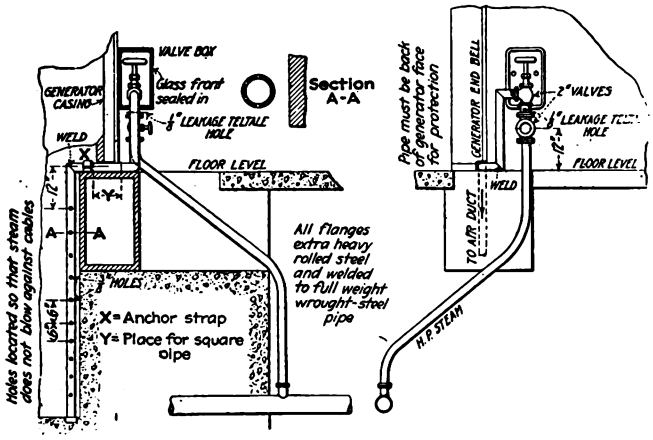
hole is drilled at the back of the pipe between the two valves so that any steam leakage through the first valve would escape and attract the attention of the operators. Sufficient steam is turned into the generator casing to



CONNECTIONS FOR STEAM FIRE EXTINGUISHER INSTALLED IN TURBO-GENERATOR

keep back any air which might otherwise leak past the closed dampers.

Enameled iron signs with instructions in white letters on a red background are placed above the fire extinguisher valves at each generator. The instructions in case of fire are as follows: (1) Have generator cut off the line immediately. (2) Cut off field excitation. (3) Close damper on air duct. (4) Break glass and open steam valves. (5) After two minutes shut off steam. If smoke continues to show, turn steam on again for two minutes and repeat this process until fire is completely extinguished. (6) Keep turbine running without load until satisfied that fire is extinguished and the generator is cooled. (7) Remove end bells and make thorough inspection.

ECONOMICAL BRASS MELTING IN ELECTRICAL FURNACES

Although Induction Furnaces Are Recognized as Inherently Efficient, Brass May Be Produced as Economically in Larger Units

An electric furnace in which the heat is supplied from carbon electrodes immersed in a bed of coke is described by E. F. Collins in a paper entitled "Melting of Non-ferrous Metals and Alloys," an abstract of which appears elsewhere in this issue. In dealing with the cost of melting brass in this furnace Mr. Collins compared its performance with that of the well-known induction type. He stated that, although the induction furnace is economical of electrical energy, the cost per ton of brass should be no less than the cost of production in the furnace described by him on account of the low attendance cost of the latter.

In the course of his discussion Mr. Collins said:

"Considering the induction furnace, this type is said to be exceptionally efficient thermally during melting. We shall see, however, that its over-all working efficiency for the week is not appreciably different from furnaces under consideration, and it is desired to call attention to the fact that the kilowatt-hours per ton consumed in melting may by no means indicate the highest over-all working efficiency. Suppose, for illustration, we concede that the induction type of furnace has the highest thermal efficiency in melting. A certain furnace of this type has a crucible capacity of 400 lb. (180 kg.) and no-load loss or radiation of 8 kw.-hr. per hour and melts a charge of red brass each hour. Suppose charge is poured at 1300 deg. C.; it is necessary to use hand ladles preheated in pouring the charge. The furnace must be kept hot twenty-four hours per day when the crucible has once been heated up. Let comparison be made between the effective working kilowatt-hour consumption per ton and that of a 2250-lb. (1020-kg.) per hour tilting-type furnace of the design described and melting 18,000 lb. (8160 kg.) of red brass per eight-hour day. It will be noted that this furnace may be charged by machine, whereas the crucible furnace must be carefully charged by hand. One man's labor will operate—*i.e.*, charge and melt this metal—say at $4.50 per day, or for $1 per ton labor. Pouring of charge will be by hand ladle preheated and should cast the same as pouring a like quantity from crucibles.

"It seems that since five to six 400-lb. (180-kg.) crucible furnaces must be employed to give the same metal output as one 2250-lb. (1020-kg.) tilting furnace, the labor of attendance for charging and melting should cost at least two and one-quarter times as much in the crucible furnace as in the tilting-hearth type, or $2.25 per ton. It follows from above that:

Metal melted per week in 400-lb. crucible induction furnace, eight-hour working day = 19,200 lb.

Kw.-hr. to melt 19,200 lb. at 200 kw.-hr. per ton = 1920 kw.-hr.

Kw.-hr. to keep furnace hot while not melting, 120 hours per week = 960.

Total kw.-hr. per week = 2880.

Kw.-hr. per ton = 2880 ÷ 9.6 = 300.

Power cost per ton at $0.01 = $3.00.

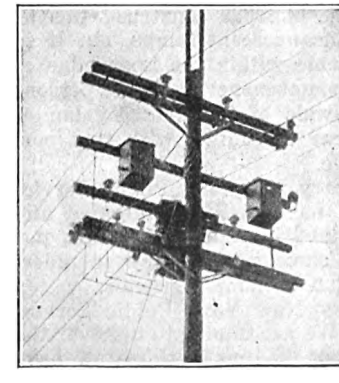
Excess labor cost of 400 lb. crucible furnace over 2250 lb. tilting hearth per ton = $1.25.

Total cost = $4.25.

"If the large tilting furnace melts with the not unexpected consumption of 425 kw.-hr. per ton, it will have equaled the performance of the induction crucible furnace, which, off-hand, seems much more efficient because it is said to melt for 200 kw.-hr. per ton. Large-capacity induction furnaces might change the above, but I do not know of any successful design for melting brass in capacity exceeding 600 lb. (270 kg.). In fact, these are limited to certain mixtures only. Leaded brass above 3 per cent, I believe, cannot be successfully handled owing to fluxing action on crucibles."

Standard 13,200-Volt Pole Service Connection

One of the utilities of the Central West taps its 13,200-volt lines to supply 115-230-volt secondary service to its small customers adjacent to its right-of-way. The illustrattion shows the top of one of the poles where such a connection has been made for a house. The secondaries are about 8 ft. (2.5 m.) below the primary line, and it will be noted that the transformer is protected by two expulsion fuses mounted above it. The back of the pole is always kept clear for the lineman.



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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

DAYLIGHT SAVING AND WAR RULES IN BOSTON

How These Affected the Edison Electric Illuminating Company of That City—Revenue Loss and Saving in Coal

The Edison Electric Illuminating Company of Boston estimates that owing to the daylight-saving law in the calendar year 1918 it saved 4420 long tons of coal, suffered a reduction in gross revenue of $350,000, generated 5,000,000 kw.-hr. less and sold 3,500,000 kw.-hr. less. Because the daylight-saving law was not in effect during November and December, 1918, the maximum demand of all customers upon the system—*i.e.*, the company's peak—was not affected. The aggregate of the maximum demands and the average of the demands of most customers was probably reduced, but to what extent it is impossible to estimate with any exactness. The company estimates that because of war regulations (lighting restrictions, "workless days," etc.) in effect during the period from Nov. 9, 1917, to Nov. 23, 1918, it saved 5450 long tons of coal, generated 6,200,000 kw.-hr. less, sold 4,700,000 kw.-hr. less, and suffered a reduction in revenue of $175,000.

FREE LAMP RENEWALS NOT PROHIBITED BY COMMISSIONS

Reports that Action Had Been Taken Regarding Incandescent Lamps Are Denied by New York, Maryland and New Jersey

Reports have been in circulation that various state public service commissions have prohibited the free renewal of incandescent lamps. These reports mentioned the commissions of New York, Maryland and New Jersey. In answer to inquiries from the ELECTRICAL WORLD the following denials were received from these companies:

A. N. Barber, secretary New Jersey Board of Public Utility Commissioners—There has been no law enacted in New Jersey which prohibits electric light companies making free renewals of incandescent lamps. The public utility act forbids a public utility making or giving "directly or indirectly any undue or unreasonable preference or advantage to any person." Possibly some one has construed this as preventing free renewals of incandescent lamps, but if so such a construction has not come within the knowledge of the Board of Public Utility Commissioners. If all persons are treated alike in the renewals of incandescent lamps, such renewals would not appear to conflict with that portion of the statute quoted above.

Benjamin T. Fendall, secretary Maryland Public Service Commission—This commission has never promulgated any rules prohibiting free renewal of incandescent lamps, nor has it any rule permitting the same, nor has it ever undertaken to pass upon the question of lamp renewals.

Francis X. Disney, secretary New York Public Service Commission, Second District—We are unable to discover the source of the current report that utilities in this state have been ordered to discontinue free renewals of incandescent lamps. We know of no such order.

James B. Walker, secretary New York Public Service Commission, First District—The Public Service Commission has issued no order prohibiting the renewal of incandescent lamps. The New York Edison Company and the United Electric Light & Power Company prior to July 1, 1918, had a provision in their schedule of rates as follows: "Lighting customers may obtain their lamps from the company in two ways: first, by direct purchase at prices listed below, or second, by signing a lamp-service agreement in which a charge of ½ cent a kilowatt-hour is made, the amount to be based upon the current consumption registered on the meter through which the lighting installation is supplied. This service includes the supply of 'mazda' lamps of 50 watts and larger size without added cost and of corresponding lamps of smaller size at a slight additional charge." This lamp service rider was canceled by the company on thirty days' notice to the commission, in accordance with the provisions of the Public Service Commission law in the matter of filing electrical rates, and became ineffective on July 1, 1918.

CHANGING FROM STEAM TO HYDROELECTRIC POWER

Problems Solved in Changing System of Approximately 2000 Kw., Steam-Operated, 60-Cycle, to Water Power, 50-Cycle

BY W. E. BODEN
Electrical Foreman Santa Barbara (Cal.) Gas & Electric Company

The electric distributing system of the Santa Barbara Gas & Electric Company in the past has been supplied with power from a 60-cycle, 2000-kw. steam plant situated on the ocean front at Santa Barbara. For several years the load on the Santa Barbara system has increased quite rapidly, and it became necessary either to go to considerable expense installing additional steam generating units or to arrange for delivery of power from a transmission system. The present-day high cost of oil was the principal consideration in the determination to connect up with a transmission system.

Contract was accordingly entered into between the Santa Barbara Gas & Electric Company and the Southern California Edison Company, whereby the latter agreed to build a 60,000-volt transmission line from its Saticoy substation to the Santa Barbara County limits, near Carpinteria, a distance of about 19 miles, and the Santa Barbara Gas & Electric Company to build a transmission line from this point to the Santa Barbara steam plant, 21½ miles, and there install the necessary transformers and other equipment to step down the power from 60,000 to 2400 volts.

After a careful study of the difficulties involved, it was decided to change over all consumers' installations so as to receive 50-cycle service rather than to install a frequency changer to convert the 50-cycle service from the Edison system to 60 cycles for delivery to the Santa Barbara system.

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In order to get an outline of the changes necessary to adopt the consumers' apparatus to 50-cycle service, a man was sent out with a list of all power consumers, routed by streets as listed on the power register. This man filled out a card giving the pulley sizes of all motors, including diameter, face, bore and keyways where belt drives were employed, or pitch, number of teeth, face, bore, keyways, as well as material, where gears were employed. In addition to this, all name-plate data of motors were carefully listed, with a description of driven apparatus with sizes of pulleys and general operating conditions. When this work had been completed a numbering machine was employed to give these cards a serial card number.

It was thought that pulleys could be changed from one location to another, but a study of the completed cards disclosed the interesting fact that only two pulleys out of more than 400 installations were of the proper dimensions to use without alterations, and inasmuch as a large proportion of these pulleys were thin cast-iron pulleys which could not be altered, it was deemed advisable to order paper pulleys to be installed for all motors.

The dimensions of the pulleys required were listed on the order, and the manufacturer was given the card number of each and instructed to attach a tag to each pulley bearing this card number. These pulleys were in the Santa Barbara warehouse before the change was started. All other parts were also shipped to Santa Barbara with card number attached. After the pulleys were obtained, the cards were further classified—*i. e.*, chain drives, gear drives, direct connections, motor-generator sets, pumps, organ blowers, etc.—in order that special consideration could be given to this class of apparatus.

As it was planned to change over one circuit at a time, the locations of consumers were listed by circuits, with the card number opposite each name in order to identify any material in the warehouse intended for this location. When the first circuit was changed the working force went out with all pulleys and changed them in index order; but this was found to cause considerable confusion and to create a great many imaginary troubles, and it was found to be much more practicable to change a circuit without notice to consumers except in cases where it was actually known that trouble would develop, and in all other cases to make the changes as complaints were received.

War Conditions Hampered the Work

We were hampered to some extent by the fact that the change was made while the nation was engaged in the war, and it was not possible to obtain certain materials for prompt delivery; but in these cases directly connected units could usually be operated temporarily by belt drive. This was particularly true of directly connected centrifugal pumps. These were all of the horizontal type, and they were temporarily belted until new pump bowls with impellers of proper diameter could be obtained. These bowls were mounted on the original pump base, using the same motor as before the change.

There were quite a number of both single-stage and multi-stage pipe-organ blowers, and these were fitted for 50-cycle speed in most cases by increasing the diameter of impellers to give the same peripheral velocity; but in some instances the small clearance between impellers and case would throttle the outlet and prevent an ample flow of air. In these instances a motor of higher speed was used and the diameter of impellers reduced, or in multi-stage fans one impeller would be removed.

The most expensive changes were on rotary oil burners for heating systems. These operate on the principle of centrifugal force and were geared to the motors. The speed reduction materially affected the proper combustion of fuel, and it was necessary to change all gears and gear cases before satisfactory results could be obtained.

As this system is on the edge of an extensive 50-cycle territory, where nearly all motors are furnished with good operating characteristics on 50 cycles, we had no difficulty with those above 1-hp. capacity; but small motors on washing machines and similar apparatus where motors are not standard but are designed cheaply for that special duty had to be replaced by standard 50-cycle motors.

There were quite a number of small single-phase motors of ¼ hp. and ½ hp. with which trouble was experienced, but these were usually found to be operating with considerably less than full load, and where a number were being supplied from one service an auto-transformer was employed to reduce the voltage in the same proportion as the frequency was lowered. This resulted in practically the same characteristics as were formerly found on 60-cycle service, and in many cases the results were improved. This same practice was applied to small dental motors and motors used on medical apparatus. These auto-transformers were individual units, and were furnished by the manufacturer's agents in Los Angeles, where both 50-cycle and 60-cycle systems are in use.

It was found that practically all motor-generator sets could be operated successfully on 50-cycle speed by connecting the shunt field in two parallel circuits instead of a single series as was done before the change, there being only three cases out of about thirty where it was necessary to rewind the field or armature coils.

Alternating-current elevators gave no trouble except that the magnet coils operating the contactors would slam considerably until the proper taps were used and the distance of travel was adjusted. This work was done by the manufacturers' representatives as this is a special field of operation. Aside from this, the change was made by the local force with little assistance from the outside. The whole change was made without interruptions in service except of momentary duration, and the system has been operating successfully for a period of about six months. The results fully justify the change to local 50-cycle service, which now allows any degree of expansion, with the entire generating capacity of the Southern California Edison Company's system as a reserve.

My recommendations to any company attempting such a change would be to select carefully the men to perform the work. Time must be spent, and spent freely if necessary, in order to make each apparatus work to the satisfaction of the owner, and it will be found that it is almost impossible to satisfy them all entirely. It is necessary to convince them that the company is not trying to "put something over." If compelled to exchange a motor, a good reason for so doing should be given, otherwise there will be two or three more in the same location to change. But the whole secret is, take care of the customer; attend to his wants no matter if his motor is rated at ⅛ hp. or 50 hp.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

General Characteristics of Electric Ship Propulsion Equipments.—E. F. W. ALEXANDERSON.—The design of the propulsion equipment is such that all momentary power requirements are met by corresponding adjustments of the generator field excitation. The amount of field excitation that can be applied continuously determines continuous performance at full speed, and the excitation that may be given momentarily determines the momentary overload and reversing performance. The

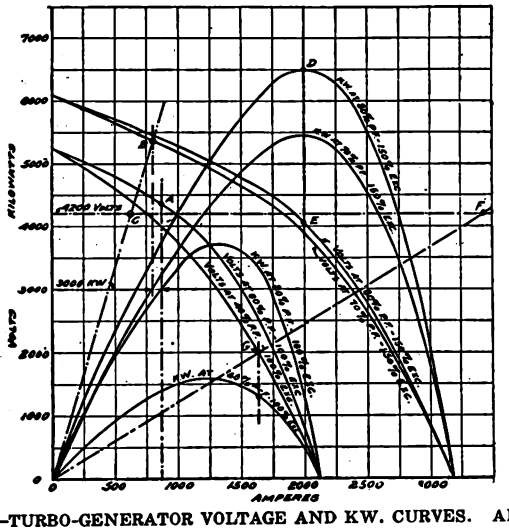

FIG. 1—TURBO-GENERATOR VOLTAGE AND KW. CURVES. AMPERES AND KW. HALF OF ACTUAL GENERATOR VALUES

dependence of the power equipment upon the excitation of the generator may be seen by reference to Fig. 1, which gives the kilowatt curves when the coils are connected for high voltage and operating at 35½ cycles. Point *B* shows the volts and amperes of the motors when drawing 3000 kw. per phase at 150 per cent generator excitation; while point *F* shows the volts and amperes drawn by the motor at 4200 volts and 20 per cent slip. In order to design a motor to meet the requirements for quick maneuvering and reversal of the propellers, it is necessary to have a motor which can not only develop a considerable driving torque to the propeller when it rotates in the reverse direction, but which also has a braking effect as high as full-load driving torque in order to stop the propeller before it can be reversed. The primary winding is such that the motor may be changed from a twenty-four-pole to a thirty-six-pole motor, but with this particular winding the advantage is gained that all the conductors in the windings are active with the same efficiency as in an ordinary induction motor with one-speed winding. The characteristics of one of these induction motors operating in constant potential at 4200 volts and at 35½ cycles are given in Fig. 2.—*General Electric Review,* April, 1919.

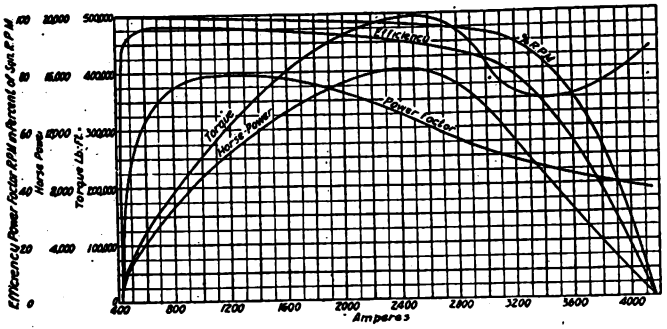

FIG. 2—CHARACTERISTICS OF INDUCTION MOTOR WITH DOUBLE SQUIRREL-CAGE WINDINGS

Theory of Asynchronous Machines with Elliptic Field.—W. GENKIN.—In dealing with the theory of Fynn the author establishes general equations for asynchronous machines and demonstrates that in all cases the problem should be reduced to the study of a single circuit replacing the combined circuits of the stator and the armature. An equivalent circuit is finally sought in the particular cases of a motor with revolving field, of a single-phase motor, of a phase connector and of an induction meter.—*Revue Générale de l'Electricité,* April 12, 1919.

High-Frequency Alternators.—MARIUS LATOUR.—An article reproduced from a communication to the French Society of Electricians. The different types of machines that are susceptible of use for the direcet generation of high-frequency currents intended to charge wireless-telegraphy antennas are described. The paper directs attention particularly to the French projects for machines which the author designates as "homopolar machines with partial utilization of the periphery" and "monopolar machines with variable reluctance."—*Revue Générale de l'Electricité,* April 12, 1919.

Generation, Transmission and Distribution

Effect of Air and Water on Materials Used in Engineering Work.—H. E. YERBURY.—The writer deals particularly with the effects of corrosion on steel, iron and non-ferrous alloys used in the construction of tanks, rotary pumps, condenser tubes, turbo-generators, economizers, turbines and other machinery found in and about the power house.—London *Electrician,* March 21, 1919.

Standardization of Cables in Germany.—New rules are published by the German standardizing committee relating to the construction and installation of electric cables. These are given in detail, but the contents are not of a nature permitting short abstraction.—*Technical Supplement Review of the Foreign Press,* April 1, 1919. (Abstracted from the *Elektrot. Zeits.,* Jan. 23, 1919.)

Failures of High-Tension Insulators.—E. PERRY.—The author gives a description of the insulators of the pin and suspension types. The special difficulties which have a bearing on the life and endurance of an insulator are outlined. The author thinks that porosity

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in the porcelain is the principal cause of failure. It is suggested that the interface of the joints should be glazed; that some non-porous and non-expanding substance should be employed for jointing purposes, and if Portland cement is used for this purpose, the exposed faces should be coated with some waterproof varnish. The face of the joint between the shells should be as small as possible and set horizontally with a recess above it so as to prevent water being forced against the cement face by wind pressure, as in the present designs.—*Science Abstracts, Section B*, February, 1919. (Abstracted from *New Zealand Journal of Science*, September, 1919.)

Short-Circuit Lighting Networks.—G. GORMANN.—The V. D. E. rules require that oil switches and cut-out releases be selected on the basis of the sustained short-circuit current at the place of utilization. The V. D. E. formulas for the determination of this current are applicable only to simple cases and are based on percentage voltage drop at a given load. Actually, the voltage drop itself is proportional to the load and dependent on network constants; hence it is better to base a formula on the network constants themselves, rather than on quantities which must be determined laboriously from these constants. The V. D. E. formulas often give too high values for short-circuit current, and a new formula is here given which makes clear the influence of every part of the network on the short-circuit current.—*Science Abstracts, Section B, February, 1919.* (Abstracted from *Elektrot. Zeits.*, Nov. 7, 1918.)

Powdered Fuel for Hammersmith.—Proposed installation with diagram of layout and photograph of the pulverizing house.—*Electrical Times*, March 13, 1919.

Turbines of the U.S.S. New Mexico.—E. O. HUNT.—Two duplicate Curtis turbines directly connected to two alternating-current generators supply power for the ship drive. These are practically of the same design as turbines built for land operation by the General Electric Company. A distinctive feature, however, of these marine-propulsion turbines is their ability to operate over a wide range of speeds, and a novel scheme of governing arrangements especially designed for this application is described in some detail.—*General Electric Review*, April, 1919.

Utilization of Peat for Power Generation.—JOHN B. C. KERSHAW.—A summary is presented of the most recent experience with the utilization of peat, the subject being discussed under the following headings: (1) Composition and constitution; (2) briquetting; (3) carbonizing; (4) classifying; (5) powdered peat; (6) conclusions. The author presents a table giving the specific requirements of boilers when fired by peat.—London *Engineer*, March 14, 1919.

Oscillations in Crank Shafts.—J. MAGG.—The author investigates the conditions arising if the revolutions per minute of an engine resonate with the natural period of oscillation of the torsional spring system constituted by the shaft and flywheel. A simple method is given by means of which the resonance may be predicted and avoided. Resonance occurring temporarily during acceleration may be of minor importance, but resonance at normal speed results in excessive vibration and unsteady running. A formula is derived for the period of the oscillating system, $T = [(32\pi l\Sigma(GD^2)/d^4G_g]$. The value of T calculated from this equation must not coincide with the period of revolution of the engine (or with one-half, one-third, etc., of this period). If resonance occurs, the value of $\Sigma(GD^2)$, as first chosen from the point of view of cyclic irregularity, must be increased sufficiently to destroy the resonance. The simplification introduced into the consideration of the problem consists in reducing the crank shaft to an equivalent plain cylinder. The diameter of the latter is chosen so as to coincide with as much as possible of the actual shaft, and the length is modified as required to compensate for reductions from actual to "equivalent" diameter.—*Science Abstracts, Section B*, February, 1919. (Abstracted from *Zeits. Vereines Deutsch.*, Oct. 26, 1918.)

Installations, Systems and Appliances

Utilizing the Time Characteristics of Alternating Current.—HENRY E. WARREN.—By the invention of a very small, simple and reliable self-starting synchronous motor, in conjunction with convenient means for regulating the average frequency of an alternating circuit, there has been developed a new field of usefulness for electric power. It is now feasible to drive all kinds of timing devices such as clocks, graphic-instrument movements, time recorders, etc., directly from the lighting circuits. Remarkable accuracy is obtained, and the amount of care is minimized by the elimination of winding and regulating.—*Proceedings A. I. E. E.*, May, 1919.

Unification of Pressures in Italy.—E. SOLERI.—The great number of different pressures used in the electric generating stations of Italy is a cause of much inconvenience, as the plants are unable to assist one another. The different values of pressures below 600 volts adopted in electric installations in Italy are 240 in number. All systems are comprised in this number—direct-current, single-phase and three-phase installations. The total power distributed amounts to 813,711 kw. A table and a diagram show the relative importance of the different systems. The author is in favor of the intervention of the state only for fixing the low pressures to be adopted, the high tensions to be employed being left to be decided by the companies themselves.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elettrotecnica*, Dec 5, 1918.)

Starting and Controlling Switchgear for Shipyard Machinery.—A. P. PYNE.—The unsatisfactory behavior of earlier types of switchgear mitigated against the more general adoption of electric motors. Improvements gradually introduced have now made it possible to obtain reliable switchgear of many types. Care is still required in the manipulation of automatic types, otherwise excessive repairs will result. High cost and lack of confidence have prevented the more general use of automatic gear, but improved design, standardization and manufacture in considerable quantities have largely eliminated both disadvantages.—London *Electrician*, April 11, 1919.

Modern Shipyard Cranes.—CLAUDE M. TOPLIS.—For the purpose of shipbuilding a number of alternative crane systems are available. From this point of view the mast and derrick system, the double cantilever crane running on a high gantry, the overhead-bridge traveling crane, the jib crane running on a high gantry and the tower crane system are compared in this article. The author then passes on to the consideration of the

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capacities of cranes and various essential features. He also discusses advantages and disadvantages of direct-current and alternating-current equipment.—London *Electrician*, April 11, 1919.

Searchlight Projector as Used in the Mercantile Marine.—R. C. HARRIS.—Searchlights used in the mercantile marine are distinct from those used in the navy and on land. The article deals with sizes in general use and with the manner in which they are designed, installed and used. Types of lamps, mirrors and lenses and also methods of remote control, both mechanical and electrical, are discussed as well as other details of searchlights.—London *Electrician*, April 11, 1919.

Use of Portable Machinery in Ship Construction.—G. F. MACKAY.—The author deals briefly with electric distribution for electrical portable plants and then passes on to describe a number of portable machines. These include the electric caravan, winches, sawing machines, electric drills and electric deck planers.—London *Electrician*, April 11, 1919.

Electric Welding Applied to Shipbuilding.—J. H. COLLIE.—After reference to the general systems of welding that are available, the author describes briefly the particular systems now mostly in use and then passes on to the question of testing electric welds. In conclusion, reference is made to recommendations by Lloyd's and the American Bureau of Shipping as to the applications of electric welding to ship construction.—London *Electrician*, April 11, 1919.

Magnetic Concentration of Pyrrhotite Ores.—J. P. BONARDI.—The author gives the results of experiments and tests made with a Wetherill-type magnetic separator with pyrrhotite ores. He states that classification is not necessary but that the ore should be stage-crushed to unlock the sulphides from the gangue. He states that a good quality of ore is economically obtained.—*Chemical and Metallurgical Engineering*, March 15, 1919.

Electrochemistry and Batteries

Electrolytic Silver and Gold Refining at Perth Amboy, N. J.—GEORGE G. GRISWOLD.—An illustrated description of refining silver bullion electrolytically by the Moebius process at the works of the American Smelting & Refining Company, at Perth Amboy, N. J. The Wohlwill plant for electrolytically refining the gold bullion and recovering from it platinum and palladium is also incidentally described.—Paper presented at the thirty-fifth meeting of American Electrochemical Society, April 3, 1919.

A Process for Electrolytically Refining Nickel.—GEORGE A. GUESS.—Impure nickel containing copper and iron is electrolytically refined, using it as an anode. Iron goes into solution and accumulates there, but copper, which also goes into solution, is precipitated therefrom continuously by keeping powdered calcium carbonate (limestone) suspended in the electrolyte. An unusual salt is thus formed from the copper in solution, completely precipitating out copper. The cathode is inclosed in a canvas bag to keep it free from mechanical impurities. Glue is used in the solution and the cathode nickel contains usually less than 0.001 per cent copper.—Paper presented at the thirty-fifth meeting of American Electrochemical Society, April 3, 1919.

Units, Measurements and Instruments

Electrical Measurement of Fluid Flow in Pipes.—JACOB M. SPITZGLASS.—Theory and development of a device embodying an ammeter and watt-hour meter and in which the electric current flowing is proportional to the quantity of fluid passing through the pipe. Diagram and sketch of electrical device and methods of determining velocity pressure are given. Also a diagram shows the relation between units of fluid flow and electric units.—*Mechanical Engineering* (journal A. S. M. E.), May, 1919.

Measurements of Small Alternating Voltages.—H. GEWEEKE.—The instrument that is described was designed to fill the need for measuring small alternating voltages with a negligible energy consumption. It consists of an electrometer with a range of 70 volts connected on the secondary side of a transformer with a ratio of 1:70, so that voltages up to 1 volt can be measured. The transformer has to be designed to work at very low saturation so that the losses may be as small as possible, and the magnetizing current is compensated by the use of a condenser. The main portion of the article is concerned with the details of the design of the transformer and the methods of testing it so as to determine the effect of change of voltage, frequency and temperature on its ratio of transformation. The instrument was found to be sufficiently accurate in its readings from 1 volt to 5 volts at frequencies of from 40 cyles to 60 cycles a second. The range can be increased or decreased by taking tappings from the secondary or primary windings. The instrument is manufactured by Siemens & Halske and by Hartmann & Braun.—*Technical Supplement*, April 1, 1919. (Abstracted from *Archiv. für Elektrotechnik*, Jan. 26, 1919.)

Miscellaneous

Molded Insulation.—W. H. KEMPTON.—The manufacture of hot molded materials and their characteristics, as well as the manufacture of cold molded materials, is discussed in order that the applications and collection of such materials may be made intelligently by the users. It is particularly urged that the engineer who has occasion to use molded insulation in his designs should visit the factory where molded insulations are made in order that he may not impose impossible or uneconomical conditions upon the manufacturer.—*Electric Journal*, March, 1919.

The Government and the Organization of Scientific Research.—FRANK HEATH.—The field of this work may be divided into three classes—(1) the encouragement of independent research workers, (2) the organization of research by industries, and (3) the organization of national resarch. Regarding the encouragement of research workers in colleges and universities, it is estimated that $150,000 will be usefully expended on this service during the next academic year. The relatively small size of most British firms and the shortage of well-trained research workers and even of routine workers in science have made it desirable for the government to encourage coöperation between firms in the industries. This coöperative research is supported by those receiving the benefits, but if further help is needed, an annual "grant in aid" to the association for a period of five years can be made. In addition to the research work carried on by the departments of state, the government is to act as a clearing house for information on the status of various phases of scientific and technical knowledge that may be accumulated as the result of work by other investigators.—London *Electrician*, March, 7, 1919.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

LAMME AND WEAVER HONORED BY THE A. I. E. E.

Edison Medal Presented to Benjamin G. Lamme—Unveiling of W. D. Weaver Memorial Tablet—Remarks of President-Elect Calvert Townley

The American Institute of Electrical Engineers held its annual business meeting on Friday evening of last week at the Engineering Societies Building, New York City. W. B. Jackson, vice-president of the Institute, who presided, said that the year just ended had been full of accomplishment but that the new one gave promise even greater. The report of the board of directors was distributed in the form of a pamphlet.

The new officers, as announced in the report of the tellers, are:

President—Calvert Townley, New York.

Vice-presidents—Charles E. Skinner, Pittsburgh; John B. Fisken, Spokane; N. A. Carle, Newark, N. J.; L. R. Jorgensen, San Francisco; Wills Maclachlan, Toronto; A. M. Schoen, Atlanta.

Managers—L. E. Imlay, Niagara Falls; L. F. Morehouse, New York; F. F. Fowle, Chicago.

Treasurer—George A. Hamilton, Elizabeth, N. J. (reëlected).

The above, together with the following hold-over officers, will constitute the board of directors for the next administrative year: C. A. Adams, Cambridge, Mass.; W. A. Del Mar, New York; G. Faccioli, Pittsfield, Mass.; W. A. Hall, Lynn, Mass.; E. H. Martindale, Cleveland; F. D. Newbury, Pittsburgh; E. W. Rice, Jr., Schenectady, N. Y.; Charles Robbins, Pittsburgh; Charles F. Ruffner, St. Louis; W. I. Slichter, New York; Wilfred Sykes, Pittsburgh. Ten states and Canada are represented in the above list. The number of valid ballots cast for president was 2269.

At the meeting of the board of directors held on the same date F. L. Hutchinson was reëlected secretary of the Institute for the coming administrative year.

Mr. Townley in a brief address said he considered it no time to make a speech, but that to decline to say a few words would be discourteous to the association which had honored him by making him president. The question of honor, however, was secondary, he said; an engineer was worthy of the name only in so far as he went ahead and did things. In the same way the Institute must be constantly on the watch to find new means for service if it is to be worthy of the name of a national institution.

The Weaver memorial tablet, erected in acknowledgment of the services of William D. Weaver to the Institute, was unveiled following an appreciation of Mr. Weaver's work by Dr. A. E. Kennelly. To Mr. Weaver, said Dr. Kennelly, was due much of the credit for the establishment of the great technical library now quartered in the Engineering Societies Building, and it was fitting that his portrait should form part of that library, for, declared Dr. Kennelly, "Where a man's heart is, there should his head be also."

Mr. Weaver's talent for ferreting out and appraising electrotechnical literature amounted almost to genius, said the speaker. Whereas most men able to judge one type of technical literature have no ability for appraising other types, Mr. Weaver was skilled in appreciating all. His work as editor of the ELECTRICAL

WEAVER MEMORIAL TABLET

WORLD, said Dr. Kennelly, established a high standard for electrotechnical literature. Mr. Weaver also had a remarkable talent for judging men. While most men are self-seekers, the speaker declared, Mr. Weaver is preëminently a seeker of others, and there are many men now leaders in the engineering world who owe their first success to him.

During the meeting the formal presentation of the Edison medal was made to Benjamin G. Lamme "for invention and development of electrical machinery."

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The medal is awarded annually, it was explained by Dr. Carl Hering, by the Edison medal committee "for meritorious achievements in electrical science, electrical engineering or the electric arts." The medal was founded in 1904 by associates of Thomas A. Edison, whose object was to commemorate the period in the rise of electrical engineering of which Edison is typical. The award is in the hands of the Institute, and the practice is to confer it yearly.

In discussing Mr. Lamme's work B. A. Behrend said that the choice of the medal committee was especially fitting since Mr. Lamme had just completed thirty years of service in the electrical field. His work served as a bridge connecting the days when the science of electricity was in its incipiency with the present, in which it has become firmly established. Mr. Lamme's versatile personality has impressed itself on the engineering profession and is part and parcel of its development. The untiring labors of Lamme were typical of the science which he helped to build up.

In many-sidedness of intellect as well as in name, and even in personal appearance, Mr. Lamme was likened to his predecessor in the electrical field, Benjamin Franklin.

In his address following the presentation of the medal, Mr. Lamme said it was difficult to express his appreciation in words. He took the award, coming as it did at this time, as acknowledging a change in the engineering profession which has been coincident with his own work. Thirty years ago, he said, there was the bitterest enmity between engineers of different organizations. Men in rival concerns were *ipso facto* personal enemies. This feeling of hostility has now given way to one of coöperation, and one's best friends are sometimes found in a rival organization. This change was brought about, said Mr. Lamme, by the work of such organizations as the American Institute of Electrical Engineers, which by fostering the get-together spirit among members of the profession has revolutionized engineering ethics.

When he went to work for the Westinghouse concern in 1889 Mr. Lamme said that the present methods of designing electrical machinery were unknown. It was just beginning to enter men's heads that electrical, like other types of machinery, could be calculated. Most of his work has been connected with the development of methods of design. He was called upon by the Westinghouse firm to undertake the calculation of a motor in 1890, and he has been designing motors and other machinery ever since.

He thought there was little in his work to appeal to the general public. His life differed from that of many of those who had received the medal in past years in that, whereas they were in many cases free lances, he was a member of an organization which developed along no one line but undertook whatever came along. The inventor is at an advantage compared with the engineer in that he can turn his hand to whatever he takes a fancy, and his work is consequently of a spectacular nature. The engineer, on the other hand, when he has undertaken a task must see it through to its completion. His work is consequently less appreciated than that of the inventor, since it is largely made up of necessary routine.

The achievements which Mr. Lamme considered his greatest were, he said, the development of the rotary converter and that of the single-phase system for railway motors. Difficulty after difficulty presented itself, and at times he felt his efforts were of no use. At one time he stood out almost alone in favoring the use of alternating current. The development of the single-reduction gear motor for railway work is another accomplishment in which he takes pride.

Mr. Lamme declared that the problems which the engineer had to solve in the past are insignificant compared with those which will confront him in the future. From the standpoint of achievement the past looms large, but the accomplishments of the present and future will seem even greater when viewed in proper perspective.

ANNUAL MEETING OF THE SOUTHWESTERN ASSOCIATION

Fifteenth Annual Convention at Galveston Covers Utility and Fuel Problems—Burr Martin of Dallas Elected President

A program which covered a number of subjects and interesting discussions characterized the "Victory convention," the fifteenth annual convention of the Southwestern Electrical and Gas Association, at the Hotel Galvez, Galveston, Tex., on May 12 to 14. Problems of the various classes of utilities received careful consideration in both general and section meetings.

A welcome to the delegates was extended by Mayor Kempner, who said that the city administration has been criticised for permitting an increase in light and power and street railway rates. "The increase was permitted," said Mr. Kempner, "because we were shown that the demands of labor for increased wages were justifiable on account of the increased cost of living expenses and an increase in the charge was needed to meet this additional cost of operation. We are convinced that we did the right thing, though we may suffer for it by going down in defeat at the polls."

Acting President Burr Martin said in the annual address of the president that the increased cost of labor and materials necessitated increases in the charges for service. The increase in charges should not be merely sufficient to cover the losses in revenue. Public utilities have the right to expect to prosper. Mr. Martin said that the companies should work to educate the public to realize that the increases have to be made if the efficiency of the utilities is to be maintained.

Mr. Martin also spoke of the difficult problem of fuel. During the war there was an increase in the cost and scarcity of fuel. New oil fields in Texas and Louisiana had provided for this need for many years in the past. The number of seagoing vessels, however, is increasing, and as these use oil for fuel there will be an increased drain on the supply. Natural-gas consumption is practically limited to domestic uses. Mr. Martin spoke of the lignite resources of Texas, which can be converted into good fuel, while in the process by-products of some value can be obtained.

Public confidence, said Mr. Martin, is the greatest asset public utilities can have. Without it managers fight a losing fight. They may go against public opinion a while, but they will suffer sooner or later. Before changes are made, or a new system is installed, Mr. Martin said that the utilities must take the viewpoint of the public and strengthen public opinion in their favor. He thinks that the attitude of managers of

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utilities has been too impersonal. The public has seen managers come and go, receiverships and bankruptcies, but yet the public utilities remain.

A. Hardgrave of Marshall, third vice-president, said that utilities have not taken the time to advise the people that their business is different from the ordinary business where the capital invested is turned over two or three times a year. "We must turn the spotlight on our own business," he said, "and we will not overcome some of our problems until we do."

Secretary H. S. Cooper of Dallas urged that efforts be made to increase the membership.

J. C. McKay, president Texas Lignite Operators' Association, made an address in which he said that readjustment to normal conditions has not been automatic as the orders providing for temporary rate increases by public utilities had indicated could be expected. The prices of fuel, materials and labor remain at an advanced rate.

Milton H. Wagner, United States Bureau of Standards, read a paper on "Standardization, Its Practical Application in the Public Utility Business," advocating the general adoption of the National Electrical Safety Code.

At the first light and power session S. R. Bertron, Jr., Houston Lighting & Power Company, presided. Discussing "The General Trend of Electric Light and Power Business in Texas," Mr. Bertron said that many valuable lessons had been learned by electrical and gas men during the war, and that the trouble with operators in the past was that they have not confided in the public and told enough facts regarding their condition. Other papers presented at this meeting were "The Problem of Extensions of Lines with the Medium and Small-Sized Light and Power Plant," by B. F. Cherry, Weatherford Water, Light & Ice Company, and "Power Supply to Oil Fields," by F. N. Lawton, Wichita Falls. Two questions from the round-table questionnaire were also discussed with much interest: "Is there any standard rule for the amount of deposit to be asked from a new customer, both light and power?" and "Do any of the preservative treatments of timber injure its tensile strength or do any of them tend to make a soft or brittle wood harder or tougher?"

On Wednesday three separate sections of the association were held. At the light and power session a paper was read by J. E. Meadors, American Public Service Company, on "The Effect of the Demand Rate on the Construction and Operation of the Power Plant." A number of questions from the questionnaire were discussed. H. O. Clarke, Houston, presided at this session. A. Hardgrave of Dallas was elected chairman of the power and light section for the ensuing year.

At the concluding session on May 14, E. P. Schoch, University of Texas, made an address on "Some Possibilities of Texas Lignite from the Chemical Standpoint." He said in part:

> There are twenty-nine billion tons of lignite in Texas, which is one-third of the amount in the entire nation. The largest supplies in the nation are in North and South Dakota and Montana.
>
> Approximately 15 gal. (56 l.) of fuel oil can be obtained from every ton of lignite, which will make the substance a valuable source of supply if it can be obtained on an economical scale. Another point of view to take in this matter is that the mines of lignite are so located that it will be necessary in most cases to haul it only about 100 miles to the place of consumption, while it usually requires a 400-mile haul to get fuel oil.
>
> Even in the face of the present oil prices I think it would be wise and timely to utilize lignite as a source of supply of oil. There are valuable by-products whose utilization in the process of retorting has been solved.
>
> A capital of $250,000 will be necessary to finance a trial plant to attempt the conversion of lignite. The United States government has promised $100,000 for this purpose. The University of Texas has set aside $20,000 for this plant, and approximately $50,000 is expected to be contributed by the lignite miners. I think this organization should be sufficiently interested in the project to appoint a committee to confer with the Lignite Association and others interested for the purpose of discussing whether this organization shall contribute.

Three prizes were awarded for the best-written answers to the question "What is the most urgent present need of the public utilities in Texas and how can it be best and most quickly fulfilled?" G. H. Cushman of San Antonio was adjudged to have written the best answer, W. B. Tuttle of San Antonio the second best answer, and J. K. Cheseboro of Galveston the third best answer. Mr. Cushman's answer was, in effect, a public service commission which would give stable rulings on rates and remove the question from home politics. Mr. Tuttle's answer was, in substance, a candid, fair presentation of the facts concerning the capital, operation and net revenue of the public utilities. Mr. Cheseboro spoke of the action of officials of Texas cities in regulating wiring.

Following are the officers for the new year: President, Burr Martin, Dallas; first vice-president, A. Hardgrave, Dallas; second vice-president, C. E. Calder, Dallas; third vice-president, Alba H. Warren, El Paso; secretary, H. S. Cooper; and treasurer, P. B. Walker, Dallas.

WESTERN SOCIETY MAY ENLARGE PRESENT SCOPE

Appoints Committee to Investigate the Possibilities of Becoming a Larger Body and of Being More Directly Useful to Members

The Western Society of Engineers, Chicago, in consideration of the problems now before the technical societies throughout the country, both national and local, has thought it a proper time to consider steps for enlarged activities. After informal conferences at which these matters were discussed, the board of directors has authorized the appointment of a committee to recommend plans for the enlargement of the society. This committee consists of E. T. Howson, chairman; F. K. Copeland, R. W. Hunt, C. F. W. Felt, W. A. Rogers and F. F. Fowle.

This committee has begun to study the situation thoroughly and develop plans for the society so as to enable it to render a larger service than at any time in the past. The society was organized in 1869 as the Civil Engineers' Club of the Northwest. In 1881 the name was changed to the Western Society of Engineers. Its members are drawn from all parts of the country, the greater portion of them living in the immediate vicinity of Chicago, and because of its location, its extensive library, lecture room and facilities it is the center of engineering society activities in Chicago. The society, being fifty years old, feels that it could well consider such changes in its constitution as will enable it more clearly to meet the present situation and fill in a larger measure than ever before the needs of Chicago and vicinity.

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Public Policy on the Pacific Coast

Report of Pacific Coast Section of the National Electric Light Association Directs Attention to Interconnection, Water-Power Wastes, Labor Rate and Other Issues—"Possibilities Are Boundless"

A remarkably helpful presentation of present conditions, read by John A. Britton, Pacific Gas & Electric Company, before the Pacific Coast Section of the National Electric Light Association at Coronado, Cal., on May 2, contains the views and conclusions of the public policy committee of the section on many problems confronting the industry.

IN THE helpfulness of patriotism during the war no industry more signally distinguished itself, said the report, than did the electrical industry. Without its help and the coöperation of every generating and distributing company the marvels accomplished by all the arms of the government would never have been realized.

On the Pacific Coast new impetus was given to shipbuilding, manufacture of aëroplane motors, and in the intensity of agricultural production. The extent to which electricity entered into the success of these war measures astounded the rest of the United States. Many dormant industries were awakened. California found itself possessed of minerals needed in the manufacture of munitions that had heretofore lain dormant, and not only to the nation but to the Pacific Coast States was added a wealth, not alone of money, but of knowledge.

The first main section of the report was devoted to interconnection. The committee commended the California Railroad Commission and the utilities for the particularly active and resourceful endeavors which they made to bring about the most economical utilization of the generating plants of all of the public utilities of the state, not only hydroelectric but steam as well. The companies acted under direction of the Railroad Commission as a unit. The report adds:

The help of the regulatory bodies in all the public land states is needed to impress Congress at its next session with the necessity for immediate action in unlocking the doors so long closed to water-power development.

It has been estimated that the net results of interconnection existing and planned will conserve power amounting to over 100,000,000 kw.-hr. per annum.

The diversity in the northern group was not so great as in the southern group. In the northern part of the state each of the companies operated at 60 cycles, and there was no particular difficulty experienced in operating the entire network as a unit. This was not true of the situation in southern California.

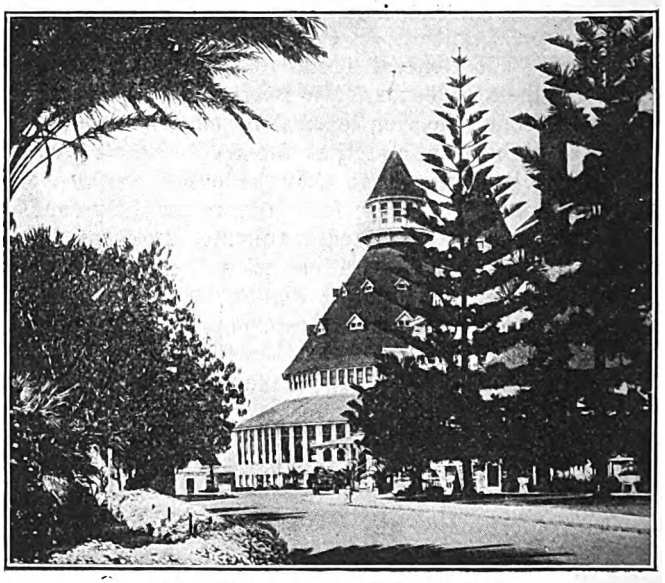
The emergency of the war brought about a tie-in with the California-Oregon Power Company, which practically put in service the longest transmission in the world. It is interesting to note in this connection that there remain but four small gaps to complete a continuous tie-in over 2000 miles in length, stretching from Harlowtown, Mont., through the Pacific Coast States and down to the border of Mexico. Thus is very nearly realized the dream of electrical engineers of the Pacific Coast that some day a busbar from Oregon to Mexico might be constructed from which would be fed each of the systems involved. The only limitation on such a project to-day lies in the question of the limited economical capacity voltage at which they may be operated.

Intensity of production in agriculture in the Pacific Coast States was discussed. The war demonstrated that more production is needed.

"Under the intensive electrification of lands it is easily demonstrable," the report declares, "that the Pacific Coast States alone, if they possessed the intensive cultivation of foreign countries, particularly that of southern Italy, could produce foodstuffs sufficient to feed the entire United States."

INDUSTRIAL UNREST

In speaking of unrest in industry the committee says that a vague feeling of industrial unrest confronts the country at this time, very largely augmented by fear. "Is not one of the first steps necessary to improve this situation for us all to pick up our courage and resume active expansion?" asked the committee. "Should our development work be held back because the cost of money, materials and labor is more now than under pre-war conditions?"



CORONADO HOTEL, CORONADO, CAL.

The committee discussed the question of whether the time has not come when the workers in our industries must have opportunity to participate in the increment of their own labor. "Participation is said to be the antidote to anarchy," said the committee.

To provide opportunity to employees to become stockholders has been found to be effective.

The principle of reward for efficiency in operation was also urged. "The utility," the report declares, "which through initiative, research or design, or through wise, skillful and diligent management, has reached a point of such efficiency that it is enabled to improve its service to its consumers, to operate at a lower cost and more advantageously to finance its requirements should not be crowded into a position where it will be stripped of all the benefits of its performance, but rather should receive a recognition which would tend to put a premium on careful, economical and efficient operation."

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During the past year the California Commission has made numerous adjustments in rates for service, in the majority of cases by the addition of surcharges. This form of added rate was adopted to compensate for specified increased costs, in order that adjustments might be made from time to time if costs were reduced or increased, and in order that the whole amount of the increase might be readily eliminated when the cost of operation returned to the normal pre-war basis.

LOOKING TO THE FUTURE

Looking ahead to future conditions, the report calls attention to the fact that since the help given by the commission to utilities conditions of operation have suffered little or no change, wages remain at war-time prices, taxes have increased, the cost of money has increased, and material and supplies of the character used by utilities have not changed very greatly. On this point the committee adds:

The hope is ventured that the commission may in readjustments of rates eliminate to a large extent the surcharge, which bears the impress of a war-time measure and therefore now that war has ceased ought to be eliminated, and make such adjustments of schedules as will compensate the public utilities to the same degree and help to maintain their increased efficiency.

It is the conclusion of the committee that to develop a feeling of security among investors not only must there be action by the commissions but as well the education of the masses. The report continues:

The public utilities are not sufficiently alive to the necessity for this education. They do not get to the vitals of their interests when they neglect by the means within their power the proper education of the people. While there has been a change for the better in respect to this in the past few years, the field is still comparatively untouched.

Advertising to a degree accomplishes it, but better still would be the personal contact by heads of public utilities with the public in explanation of their difficulties and problems; also the education of the employees of the utilities in such a way that they would be able to discuss with the consumers properly the trials and difficulties as well as the aims and ambitions of the utilities.

The committee believes that there should also be engendered among employees the feeling that the corporation is alive to their personal interests.

As a matter of policy to be adopted by all members the committee recommends reëmployment of all employees who were inducted into the service of the United States either by draft or by voluntary enlistment.

Possibilities electrically on the Pacific Coast are boundless, not only in the production of electricity but in its extended use. There is no part of the world where its use is more general or more diversified. The committee continues:

The average rate per kilowatt-hour at which energy is sold upon the Pacific Coast is less than that of any other section of the United States. This is partly due to hydroelectric developments and also to the greater diversity of use, and as soon as there is a relaxation by the government of its drastic rules governing possession of public lands, so soon will arrive a lower rate for the benefit of the communities which we serve.

The future of our industry on the Pacific Coast was never brighter. With the intensified education predominant here in the utilization of our commodity, and with a certainty of a proper return upon capital being given and with the lessons learned at this convention respecting contact with the public and the consumer as well, it is certain that the demand for electricity will continue and increase. Not the least of this demand will arise from the installation of house appliances, particularly the electric range. In reconstruction, labor must be fully considered.

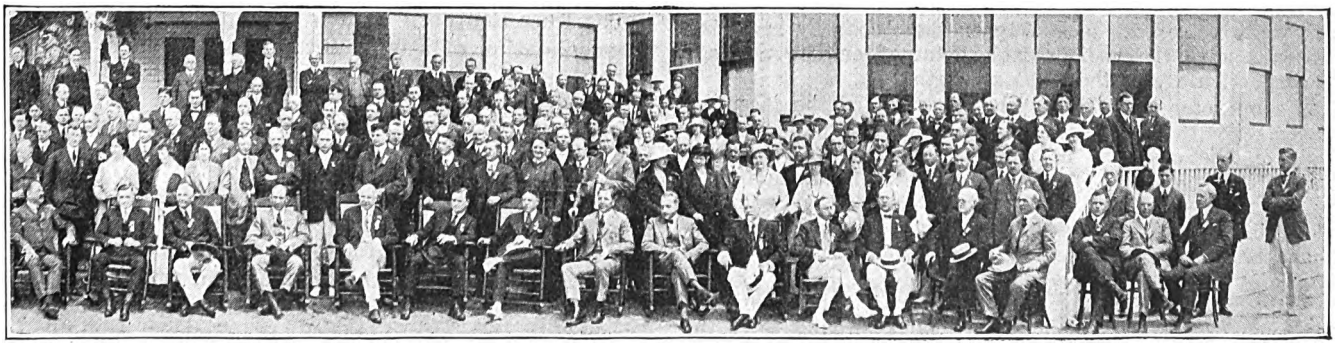
The committee strongly recommends to the companies a more careful consideration of the relation toward legislation. It does not mean by this that corporations should again enter politics, but it does mean that the corporation with millions of invested capital should see to it that in a fair and just way it shall be protected by such educational knowledge of the masses that representatives in legislative bodies will have due cognizance of its rights.

MUNICIPAL OWNERSHIP NOT DEAD

Municipal ownership is still rampant, the committee declares, under misguided and misinformed conditions. Much of the tendency that engenders municipal ownership can be arrested, in the judgment of the committee, by a policy of publicity that should be the same throughout the territory of the organization. The conclusion of the committee is:

Municipal ownership arises primarily from some misguided policy instituted by some public utility, in which an error of judgment on the part of the utility provokes the righteous indignation of right-thinking men, and the only relief apparent is in service to itself by the municipality; and once this seed is planted there are plenty of people who, without due knowledge, become rabid advocates of public ownership.

The underlying motives creating municipal ownership are twofold—first, dissatisfaction with the utilities' action, whether applied to the municipality or the public, and, second, the misleading statements of low costs of operation and large profits, which are contrasted with prices charged in other sections by privately owned utilities. Both of these fallacious arguments may be successfully met if the public utilities will move with one accord on the first motive, and to destroy the second motive secure legislation which will provide at least for some means to cause the municipally operated utility to keep its accounts by the same methods as those by which privately owned utilities are required to keep theirs. On the same basis of determined costs no privately owned utility need fear comparison with the publicly owned.



DELEGATES TO THE CONVENTION OF THE PACIFIC COAST SECTION OF THE N. E. L. A.

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RADIO EQUIPMENT ON THE NAVAL SEAPLANES

Details of the Apparatus on the Transatlantic Seaplanes Are Made Public by the Navy Department

Acting Secretary Roosevelt of the Navy Department has made public some details of the radio equipment on the NC type of seaplanes undertaking the transatlantic sea flight. His statement says in part:

The radio on the NC seaplanes involves two transmitters. One is a 0.5-kw. spark transmitter, the main element of which is a stream-line generator and accessory apparatus, which is driven by an air propeller and is mounted on the deck of the boat aft. This set weighs only 45 lb. (20 kg.), but is used for the regular telegraph communication between the seaplanes and stations up to a distance of 250 nautical miles (463 km.). Since this set is driven by a propeller, it can be used only while seaplanes are in flight. The antenna used for this set is a single trailing wire leading from the tail of the boat for a distance of 250 ft. (76 m.) down and to the rear. A stream-line lead weight holds the lower end of this wire down.

With this transmitter it is possible for the commanding officer to send messages from time to time regarding the progress of the flight, to be retransmitted by the nearest shore station to the Navy Department. Also communication can be held with destroyers or other craft and radio compass signals or other information requested.

The other transmitter is a combined telephone and telegraph transmitter, and operates on a small 12-volt storage battery. It is used on an antenna consisting of wires permanently stretched on the skid fins on the upper planes so that it may be used while the seaplane is in flight or on the water.

It is this set which is used for telephoning between the planes, arrangement being made so that either the radio operators or the commanding officers themselves may communicate directly by telephone while the planes are in flight. Such interplane telephoning may be carried on up to a distance of 20 miles (32 km.). While on the water this set may be used for telegraphing or telephoning a distance of about 30 miles (48 km.).

A special feature of the telephone sets is the anti-noise microphone, which is so constructed that the engine noises are not heard. This is accomplished by having the back of the microphone open. The exterior sound waves strike the back as hard as the face of the diaphragm, and therefore the effect is neutral. The voice waves strike only the face of the diaphragm, and even though the operator cannot hear his own voice, the radio sets receive enough effect to modulate the transmitted wave.

This single item has been the deciding factor in success or failure in long-distance transmission by telephone by airplanes. It is easy enough for short distances to get communication with an ordinary microphone, but for long ranges it is impossible without the anti-noise transmitter.

One of the most important of the radio installations on these seaplanes is the radio compass. This consists of a set of revolving coils mounted in the tail of the machine, on which are mounted many turns of enameled copper wire. The radio waves are picked up on these coils by revolving the coils until the radio signals obtained on two methods of connection are of the same strength.

The operator then knows the direction of the incoming waves. By then reading the position of a pointer on a scale on the coils the bearing of the transmitting radio station is determined. This bearing is then communicated by the radio operator to the navigating officer by means of the intercommunicating telephone, which consists of telephone receivers built into the helmets, and the same type of microphone used by the operator.

Using the same intercommunicating telephone system, the navigator can telephone to the pilots, giving them the proper direction in which to steer the plane. He may inquire of the engine room regarding the condition of the engines, or he may hold radio-telephone conversation with the navigating officer on one of the other planes.

In other words, the intercommunicating telephone makes possible constant communication between all members of the crews in spite of the terrific noise caused by the engine and the wind rush and in spite of the fact that they are in separate parts of the seaplane. In addition to this the radio telephone makes it possible for the commanding officer and navigators to talk directly with each other, although their seaplanes may be flying at a distance of 20 miles apart.

The radio compass signals may be received from a destroyer at a distance of 75 miles (120 km.) or from large land stations at a distance of 600 miles (965 km.).

The regular receiving apparatus on the seaplanes will permit of reception from land stations of high power at distances of several thousand miles, thereby permitting the seaplanes to copy weather reports or orders directly from the Navy Department at Washington.

The most striking fact regarding this radio equipment is that, completely installed, it weighs only 200 lb. (90 kg.).

CHANGE OF CONTROL IN IOWA PROPERTIES

David G. Fisher & Company of Davenport Purchase Majority Interest in Iowa Southern Utilities Company—Improvements and Expansion Planned

David G. Fisher & Company of Davenport, public utility engineers, have purchased control of the Iowa Southern Utilities Company, the stock and bonds of which total $2,500,000. This company furnishes electric power to thirty Iowa towns, 33 miles of interurban lines, principally coal carriers, the Centerville (Iowa) street-railway, gas, heating and electric light plants and 240 miles (386 km.) of high-tension transmission lines.

The Fisher interests, formerly owning a minority share of the stock, have purchased the holdings of Frank S. Payne and D. C. Bradley. Mr. Payne, who has been general manager, will remain with the company as director and general counsel. It is understood that the transaction involved a sum in the neighborhood of $450,000.

The formal transfer of control will be made May 15. J. C. Johnson, now secretary and treasurer of the Fisher company, will be the new general manager of the properties. Before becoming affiliated with the Fisher company he was superintendent of the Fisk Street station in Chicago. Ernst Jacobson, vice-president of the Fisher company, will have a prominent part in the active administration of the company, President David G. Fisher announced.

The Fisher company was organized in Davenport in 1909 and soon after that time began to purchase and operate public utility plants. The majority of the company's holdings are in Iowa. The gross business of the company last year was in the neighborhood of $450,000.

The Iowa Southern Utilities Company was formed by a consolidation of Payne, Bradley and Fisher interests in the fall of 1916. The companies represented in the consolidation were the Centerville Light & Traction Company, Centerville Electric Company, Centerville Gas Company, Leon Electric Company, Mount Ayr Light & Power Company, Lennox Electric Company, Clearfield Electric Company and Blockton Light & Power Company.

Besides supplying thirty towns the company furnishes light and power for thirty coal and gypsum mines. Plans are already laid for the rebuilding of the power plant at Centerville and for other improvements and expansion.

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DELRAY CENTRAL STATION SOON TO BE REVAMPED

Plans of Detroit Company for Bringing Total Generator Rating of One of Its Large Plants Up to 130,000 Hp.

Plans have been perfected by the Detroit (Mich.) Edison Company for the installation of a new 30,000-kw. unit in plant No. 2 at Delray. To receive it an extension will be made to the turbine room and a new switch house will be built. Work on the foundations has started already, and some time next winter it is thought that the unit will be ready for service. At present plant No. 1 at Delray can carry a maximum load of 44,000 kw. and in plant No. 2 the ultimate capacity is 62,000 kw., made up from four machines, three having a nominal rating of 14,000 kw. each, and the fourth one of 15,000 kw. By the addition of the new unit and with more economical loading of the older machine the Delray station will carry handily 130,000 kw.

It so happens that the Delray station has an exceptionally adequate installation of boilers, or will have when the new unit is installed, owing to its low water rate, so that instead of installing a sufficient number of boilers to carry the new unit it will be necessary to add only two 1300-hp. Stirling boilers of the same type as the 2365-hp. boilers that have long made this plant a leader in steam generation. This is explained by the fact that the new unit will carry 20,000 kw. on the same quantity of steam required by a 14,000-kw. machine. Then by adding sufficient boiler capacity to carry 10,000 kw., the load considered normal for one of the large boilers or the two new boilers, ample provision has been made for the installation of the 30,000-kw. unit.

Eventually it is the plan to remove two of the older machines, one 14,000-kw. and one 15,000-kw., to make room for another 30,000-kw. unit, and finally to substitute a third large unit for the two oldest machines remaining.

Delray revamped will be a refinement of the Detroit Company's Connors Creek station practice. The new General Electric unit, rated at 30,000 kw., will generate three-phase, 60-cycle, 12,200-volt energy, the steam conditions being 200 lb. pressure and 200 deg. of superheat and the speed 1800 r.p.m. The generator leads will be tied solidly to the low-tension terminals of a three-phase compensator-type 12,200/24,000-volt transformer. This will feed through single-conductor cables carried underground to the machine switches in the switch house which is being built at the north end of the Delray site. There will be no main switching done in the power house proper.

On the steam end the condenser auxiliaries will be driven by direct-current motors to insure a wide range of speed variation and convenience of operation. To effect a heat balance the plant will be provided with an auxiliary turbine exhausting into a heater condenser. To supply the motors the generator will be a direct-current machine. Ruggedness and simplicity of control are the reasons assigned for the choice of direct-current apparatus.

As the energy required by the auxiliaries is not at all times proportional to the load on the main generator, there will be times when the auxiliary power demands, if supplied entirely by the auxiliary turbine, would involve an excess of exhaust steam—more than enough to heat the condensate from the main unit. At other periods the conditions may be reversed. To meet this situation a synchronous motor-generator set will be installed. When the load on the main unit is light and the auxiliary apparatus requires more energy than the auxiliary turbine will supply, incidentally to heating the feed water, the deficiency will be made up from the main bus through the motor-generator set, and this source will be drawn on should the auxiliary turbine be out of commission. At times of heavy load, when in order to heat the feed water it will be necessary to generate more energy than the auxiliaries require, the surplus will be transformed to the main bus through this same motor-generator. This arrangement is unique and, because of its flexibility, should prove an advance over former practice.

There will be a rearrangement of steam piping in the station, and as at Connors Creek direct-current motors will drive the blower equipment. The ash aisles will be separated from the blower rooms and consequently be removed from the main ventilating circuit. More complete details will be available when the new unit is in operation.

ENGINEERS DISCUSS THEIR RELATIONS TO CIVIC LIFE

American Association of Engineers' Convention Crystallizes Thinking on Problems That Affect the Engineers as Individuals

Salary schedules, employment problems and opportunities, proper compensation and society interrelationships were the main features discussed at the annual convention of the American Association of Engineers, held May 12 and 13 in Chicago. Ninety delegates from thirteen of the association's chapters and three clubs were present, although the attendance was 186 at the largest session.

Changes were made in the constitution to establish a national practice committee, which is authorized to report on questions of ethical policy and conduct, and a grade of "candidate junior" in the various grades of membership was established. According to other changes in the constitution, chapters are to recommend grading of candidates, junior members may now vote but not hold office, the last past-president is a director, and the board is authorized to make mutual agreements with other societies.

The warmest discussion of the convention was over the proposal to fix the entrance fees at $5 or $10. By the present by-laws, which were retained, entrance fees automatically are increased $2 for each 500 members above 1000, the count to be made in December each year for the year. Apprehension that the fees would be so high as to keep out younger members gave way to the idea of the increased service that could be rendered by larger income.

Addresses and papers were presented by Fraser S. Keith, secretary of the Engineering Institute of Canada; H. G. D. Nutting on "Ways and Means of Obtaining Proper Compensation," F. H. Myers on employment activity, and others.

The election of officers resulted as follows: President, F. H. Newell; vice-presidents, W. W. DeBerard and F. A. Evans; new directors, W. W. K. Sparrow, P. E. Harroun, R. Burnham, F. D. Richards, A. A. Matthews and G. F. Collins. The next annual convention will be held in St. Louis.

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MISSISSIPPI SECTION RESUMES ITS MEETINGS

N. E. L. A. Section Starts Activities After Four Years of Quiet Due to the War—H. E. Brandli of Meridian Elected President

Owing to war conditions the Mississippi Section of the National Electric Light Association did not hold a meeting for four years until April 15 to 17, when the members convened at the Great Southern Hotel, Gulfport, Miss.

The meeting was an enthusiastic one and was well attended by representatives of central-station companies throughout the state, as well as by supply men and jobbers in the district. Discussions on all papers were entered into by those in attendance. One of the interesting social features of the program was the boat trip from Biloxi, Miss., around the bay.

Every effort is being made to liven up the spirit of the association, and it is hoped during the year to get every eligible company in Mississippi to join.

In the absence of W. T. Stewart, president of the Mississippi Coast Traction Company, Gulfport, Miss., Barney E. Eaton, attorney for the Gulf & Ship Island Railroad, an allied interest, gave the welcoming address.

Comprehensive Presidential Address

H. F. Wheeler said in his presidential address that the inactivity of the association during the last four years was due to various causes. While the war lasted there was little time for anything except duties to the government. Another cause, Mr. Wheeler felt, had been the connection with the National Electric Light Association.

"I should qualify this statement," he continued, "by saying that since the association of the Mississippi Electric Association with the National Electric Light Association the members have seemed to lose all interest. When a meeting of Class A members was called it was usually attended by three or sometimes four representatives, and usually the same ones attended each meeting. There has always been more or less discussion at each meeting as to whether or not it would be better to withdraw from the national association and start out on our own independent way again. I was formerly one of those who thought possibly it might be, but after seeing the activities of our parent organization during the war, as evidenced by the National Committee on Gas and Electric Service, the National Committee on Public Utility Conditions and the other work done by the national association, I feel that we should be doing wrong to withdraw. What I now feel is that each member should here and now make a resolve to give the Mississippi Section and the National Electric Light Association its whole-hearted cooperation, even to the sacrificing of some little time and money. The war is now over, and the time is opportune for making a new start."

Mr. Wheeler then took up the rate situation, saying that during the last year most of the companies had to ask for increased revenue. In many instances this was granted cheerfully by the communities, but in a few cases the public, influenced by a selfish motive, took advantage of the utilities' unfortunate condition and refused relief.

"In a number of instances," he added, "I feel that we have been cowardly and have been afraid to lay our cards on the table and ask for higher rates. Many companies have been forced into bankruptcy, and the public is now beginning to realize that when a utility does ask for higher rates there is possibly some necessity for it, and after this idea becomes more general it is my opinion that the tide will turn and that at least an impartial hearing will be granted."

After referring to the great growth of the central-station industry, Mr. Wheeler said that there is of course no question as to the future of the central-station plant. There are, however, three points under present conditions which must be given particular attention.

"First," he said, "every property must get and maintain rates which will permit a fair living profit. Too much emphasis cannot be laid on this point, for rates that are too low not only endanger the company making them but all of the plants within a considerable radius. I need not dwell on how when one of your rates is in question the board of inquiry immediately asks all of your neighbors their rates. It then picks out the lowest, not the average, rate and forces you to meet it.

"The second point lies in the fact that the central station is a large and continuous consumer of new capital. If this is not forthcoming, extensions cannot be made to meet the city's growth and a company stagnates, prospective customers become dissatisfied because service cannot be obtained, and public sentiment is eventually turned against the company. This point is also dependent upon the first, for new capital cannot be secured if the income is not sufficient to warrant investment.

"The third point is the tendency toward municipal ownership. I do not propose here to make arguments for or against it, but only wish to impress this fact, taken from statistics from the Bureau of Commerce report. In the five years between 1912 and 1917 there was a net increase of 565 commercial plants and 765 municipal plants. While it is true that more than this number of commercial plants were established, there have been many combinations which have brought down the actual number of new plants. Nevertheless, after making allowances for this fact, the figures are alarming."

In concluding, Mr. Wheeler spoke of the effect of the general level of prices on the industry.

Subjects Dealt with and New Officers

Among the subjects discussed were: "Public Utility Conditions in Mississippi," by L. O. Gordon, Jackson Light & Traction Company; "Public Relations," Frank J. Duffy, Southern Railway & Light Company, Natchez; "What Do Public Utilities of Mississippi Most Need?" discussion opened by R. B. Claggett, Delta Light & Traction Company, Greenville; "Rates," H. E. Brandli, Meridian Light & Railway Company; "Coal Situation," Monro B. Lanier, president Monro-Warrior Coal & Coke Company; "Possibilities of Crude Oil as Boiler Fuel," Charles M. Rogers, president Rogers-Higgins Manufacturing Company; "Care and Operation of Boiler Room," E. J. Lenz, Delta Light & Traction Company; "Securing New Business," E. B. Booth, Vicksburg Light & Traction Company.

H. E. Brandli, vice-president and general manager of the Meridian Light & Railway Company, was elected president of the Mississippi Section. E. S. Myers, manager of the Vicksburg Light & Traction Company, was elected secretary.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

S. A. E., Summer Meeting.—Plans are being completed for the summer meeting of the Society of Automotive Engineers to be held at Ottawa Beach, Mich., June 23 to 27.

Second Industrial Service Conference Held in Wisconsin.—The second annual industrial conference was conducted under the auspices of the Industrial Commission of Wisconsin in Milwaukee on April 28-30.

Engineers' Club of St. Louis.—This organization is conducting a campaign to assist in raising a fund for the reception and entertainment of the Twelfth Regiment Engineers upon their return to St. Louis, Mo.

A. I. and S. E. E., Annual Convention. — The thirteenth annual convention of the Association of Iron and Steel Electrical Engineers is to be held in the Hotel Statler, St. Louis, Mo., on Sept. 22-26. Exhibits are to be a new feature at the convention.

A. S. M. E., Buffalo Section.—E. S. Collins, engineer of the industrial heating department, General Electric Company, Schenectady, N. Y., recently delivered an illustrated lecture on "Industrial Applications of Electric Furnaces" before this section of the American Society of Mechanical Engineers.

New Electrical Association Formed in Milwaukee.—The Milwaukee Electrical League and the Milwaukee Jovian League have disbanded and a new organization, known as the Electrical Association of Milwaukee, has been formed. The first meeting, at which a new constitution was adopted and temporary officers were elected, was held not long ago. The objects of the new association are to promote social and commercial fellowship among its members, to further the interests of the electrical industry both locally and nationally, and to serve in the civic advancement of the community. It is also the purpose of the association to promote, if possible, the organization of a national body representative of the entire electrical industry and having objects corresponding to those of the local association. The membership is divided into six sections—contractors, dealers, jobbers, manufacturers, public utilities, and sales engineers. The association work will be carried on by a board of directors consisting of a president and six directors, one of which is chosen from each section of the membership. The meetings are to be held monthly. G. G. Post of the Milwaukee Electric Railway & Light Company is secretary of the new association.

Railway Electrification Urged by Ontario Hydroelectric Municipalities.—Three hundred representatives of the Ontario Hydroelectric municipalities held a meeting at Guelph, Ontario, on April 25 and decided to ask the Dominion government to turn over to the Hydroelectric Commission for electrification the branch lines of the Grand Trunk Railway and Canadian government railways. Also the meeting asked for immediate authority for the construction of hydroelectric railways already approved, involving an expenditure of $62,000,000.

Northwest Electric Light and Power Association.—The hydroelectric and technical committee of the Northwest Electric Light & Power Association found it desirable two years ago to hold monthly meetings for considering the National Safety Code. Other technical questions received consideration in a way that was found to be of great mutual advantage. The meetings were, in fact, too helpful to be discontinued and are still being held every month, usually with full attendance. Only topics of general interest are presented. The meetings are very informal, the purpose being to pool experience and information on technical problems for the benefit of all.

Iowa Section, N. E. L. A.—The tentative program for the meeting of the Iowa Section of the National Electric Light Association, to be held in Colfax, Iowa, June 18, 19 and 20, includes these addresses: Howard S. Phelps on "Transmission Lines and Telephone Interference," John E. Brindley on some economic question, F. D. Paine on "Testing Meters in Small Towns," J. B. Hill on "Principles of Rate Making in Small Towns," W. G. Raymond on some economic question, William Chamberlain on "Rate Litigation in Iowa," F. A. Warfield on "Rates as Affected by the Increased Cost of Production and the Attitude of Regulatory Bodies Thereto" and John A. Reed on "Municipal Ownership in Iowa."

American Institute of Electrical Engineers

Lynn Section.—"Submarine Detectors" was the subject of C. E. Eveleth, turbine engineering department, General Electric Company, Schenectady, N. Y., at the May 6 meeting of the section. Mr. Eveleth traced the stepe from early developments to the equipment of the Allied fleets with these devices and also recounted the tactics used on submarine chasers using the detectors.

Schenectady Section. — Two talks were given at the section's May 2 meeting. One, entitled "Pliotron Vaccum Tubes and Their Application to Radio Apparatus," was given by W. C. White, Research Laboratory, General Electric Company, and the other, on "Radio Apparatus for Aircraft and Ground Stations," was presented by E. M. Kinney, general engineering laboratory, General Electric Company.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Depreciation Requirement Repealed.—In a case affecting the Jacksonville Railway & Light Company the Illinois Public Utilities Commission repealed its orders requiring the utility to dispense with any allowance to meet depreciation on the electrical property during the year 1918 where it was shown that abnormal operating conditions during that year so depleted its revenues that they were entirely used in the payment of operating expenses, taxes and fixed charges.

Provision of Additional Facilities.—Although authorizing increased electric rates for the Cairo Electric & Traction Company, the Illinois Public Utilities Commission directed the company to provide additional facilities. The commission says: "The Public Utilities Commission law provides that all public utilities in the state shall furnish service of an adequate character. The respondent has realized for years past that it has not been in a position to furnish such service. The record shows that various interests in Cairo have equipped their plants for electric drive at considerable expense. In some cases consumers utilizing the company's services have been forced to install means for securing other power supply. Manufacturing interests which have proposed to locate in Cairo have been compelled to consider seriously the general character of power supply and have found that it has been of such a character as unfavorably to influence them. It appears that the respondent has been extremely dilatory in its failure to remedy these conditions which it has known to exist. The commission believes the time has come when the respondent should immediately initiate a procedure which will offer early and adequate relief. It appears that the respondent has in contemplation the purchase of equipment from the manufacturer which it is estimated will require seven months to deliver and an additional two months to erect. It is obvious that a delay of this character in relieving the situation in Cairo does not constitute an adequate solution of the present situation. There are other means by which the equipment may be secured and while it is possible that this equipment may not fit in so well with the equipment already installed in the station or may not be of the particular type which the respondent feels is best suited for its requirements, yet the time for the consideration of these matters has passed and the situation at present demands immediate action."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Ohio Supreme Court on Rate Schedules.—The Ohio Supreme Court on April 29 affirmed a decision of the lower courts in which the Ohio River Power Company was enjoined from putting into effect a new schedule of rates for private consumers at Steubenville which had been filed with the Public Utilities Commission. A lower rate had been accepted by the predecessor of the company in that city, and all the courts held for the municipality. On the other hand, the court held in favor of the company in a suit brought to enforce a contract for service with the Patterson Foundry & Machine Company. The contract was for two years, renewable for ten years, and the renewal option was exercised. The original contract was signed on June 30, 1911, the day a new law went into effect relating to filing schedules of rates with the commission. In June, 1917, the company refused to furnish energy under the private contract on the ground that the schedule of rates filed with the commission held. The courts sustained this contention.

Large Financing Plans of Baltimore Company.—President Herbert A. Wagner of the Consolidated Gas, Electric Light & Power Company of Baltimore has issued a circular regarding a general mortgage authorized by shareholders. The total amount of bonds that may be outstanding at any time is limited to $100,000,000. A first series issue of $5,000,000 was authorized, $3,500,000 of which is to be pledged to secure in part an issue of $5,000,000 three-and-one-half-year 7 per cent notes, which, together with the remaining $1,500,000 reserve, will provide for the conversion of the three-and-one-half-year 7 per cent notes. The proceeds of these $5,000,000 notes, together with additional cash to be furnished by the company, will provide $6,000,000, which will be used for the acquisition of equipment, buildings, etc., and for extending the capacity of electric power plants, etc. This financing will provide for the company's needs well into 1920. The first $3,500,000 of bonds are to be issued under the new mortgage, which will cover all the property now owned or hereafter acquired and will be a part of the $100,000,000 authorized. They will bear 6 per cent interest and will mature Feb. 1, 1949. The bonds will be redeemable on sixty days' notice during the first five years at 110, during the next five years at 107½, during the next fifteen years at 105, and durin the last five years at the rate of 102.

Electric Trucks in Metropolitan District.—A. Jackson Marshall, secretary Electric Vehicle Section, National Electric Light Association, declares that on Jan. 1, 1919, there were approximately 33,000 automotive street trucks in the New York metropolitan district. Of these, there were 3288 electric trucks. In other words, about 10 per cent of all automotive street truck equipment in New York City was of the electric type. These electric street truck figures do not include several hundred electric industrial trucks and tractors in use.

Power Survey in Mexico.—A newspaper dispatch from the city of Mexico says that applications for renewal of concessions for installation of hydroelectric plants and development of the water-power resources of the country have been received recently by the Department of Commerce and Industry. Original concessions granted Americans and other foreigners by the late President Diaz were canceled by the Carranza government for alleged nonfulfillment of contract. The government is planning to make a complete survey of available sites for hydroelectric plants and to estimate the amount of energy which may be generated.

Business Training for Engineers.—The Commissioner of Education of the Bureau of Education, Department of the Interior, has issued a call on behalf of the conference committee on commercial engineering recently appointed by him for a public conference on business training for engineers and engineering training for students of business. This conference, national in scope and in character fully representative of all interests, will be held at the New Willard Hotel, in Washington, Monday and Tuesday, June 23 and 24. All educational institutions, commercial organizations, manufacturing associations and educational and engineering societies are cordially invited to cooperate and to designate one or more representatives to attend the conference. Prominent engineers, educators and business men will be invited to discuss the following major topics: Business training for the engineer, engineering training for commercial enterprises, significance of the war experience for engineering education, and training of the engineer for overseas engineering projects. Glen Levin Swiggett, specialist in commercial education, chairman of the conference committee on commercial engineering, has written an invitation to commercial organizations, manufacturing associations and educational and engineering societies to send delegates. At the meeting of the conference committee on commercial engineering in Washington on March 31 the Amercian Institute of Electrical Engineers was represented by E. W. Rice, Jr., president General Electric Company, his alternate being Francis C. Pratt, who is assistant to the president of the General Electric Company.

New York Franchise Tax Held Valid.—In a unanimous decision the Appellate Department of the Supreme Court, Third District, on April 8 held that corporations in New York State subject to the franchise tax of 3 per cent, based upon "the entire net income," are not entitled to deduct the amount of tax paid to the federal government on account of excess profits before computing the amount payable to the state. With respect to the state statute, the court said: "This is not an income tax; it is a franchise tax. It is a tax for the privilege of doing business in a corporate form in the State of New York, and the only relation of the federal act to the statute of New York is the basis for the computation of the state tax. The state franchise tax thus assessed bears equally upon every like corporation within New York. It does not constitute a double franchise tax, though the national government makes use of the same foundation in levying an income tax." The original ruling of the State Tax Commission, that no deduction of federal taxes would be allowed in computing the 3 per cent franchise tax, is thus sustained.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Warranty of Plants and Systems.—Where the seller guarantees cooking or lighting "plants or systems . . . against defects in materials and workmanship, and warrants same to be in good working order," and in subsequent provision of contract agrees to furnish lighting or cooking fixtures shown in a catalog at 50 per cent of list price, not expressly warranting such fixtures, the warranty of "plants and systems" does not cover such fixtures, the fixtures being covered by a separate and distinct part of the contract, according to the Supreme Court of Wisconsin (171 N.W. 662).

Damages for Injury by Accident While on Vacation.—In a case where an engineer during his vacation, but while in pay of and subject to employer's call, at the request of its superintendent went to inspect a pumping station, to increase his efficiency as an employee, and was injured in an automobile accident on his journey or his way homeward, his widow is entitled to damages for his death as an "injury by accident in the course of his employment" and while "actually engaged in the furtherance of the business or affairs of the employer," within the provisions of the workem's compensation act, according to the Supreme Court of Pennsylvania (106 A. 85).

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Men of the Industry

Changes in Personnel and Position—Biographical Notes

H. J. Musgrove, until recently in the Signal Corps of the army, has resumed his former duties of local superintendent of the Central Illinois Public Utilities Company at Marion, Ill.

W. B. Wallis, vice-president of the firm of W. E. Moore & Company, consulting steel engineers, Pittsburgh, Pa., sailed on the Mauretania, May 13, for Europe on an extensive trip undertaken to investigate electric furnace operation in the industrial centers of Europe. Mr. Wallis is a graduate of Pennsylvania State College and has been a member of the firm of W. E. Moore & Company for several years. Previous to that he was engaged in development work for various engineering and public utility companies.

Frank F. Fowle and **James R. Cravath** have formed a consulting engineering partnership under the firm name

F. F. FOWLE

of Fowle & Cravath, with offices at 1201 Monadnock Block, Chicago. Frank F. Fowle, who until recently served as one of the receivers of the Central Union Telephone Company, was formerly a consulting engineer. James R. Cravath is a well-known consulting electrical and illuminating engineer of Chicago. Both are men who have made national reputations in their work and are especially well known in Chicago and the Middle West. The services of the firm will be devoted to investigations, research, design, supervision, management, appraisals and rate cases in the several fields with which the partners have heretofore been identified.

Mr. Fowle was graduated from the Massachusetts Institute of Technology, Boston, in 1899, in the electrical engineering course, and then served nine years with the American Telephone & Telegraph Company in various engineering capacities, finally serving as manager of the Chicago territory of the long-lines system. From 1908 to 1912 Mr. Fowle was engaged in consulting engineering practice, headquarters in Chicago. In 1912 he went to New York and jointly with Dr. A. S. McAllister was in charge of the editorial department of the ELECTRICAL WORLD. In 1913 Mr. Fowle became editor-in-chief of the "Standard Handbook for Electrical Engineers" and entered engineering practice again in New York. Early in 1914 he was appointed one of the receivers of the Central Union Telephone Company, serving until recently discharged by the court. Mr. Fowle was elected a manager of the American Institute of Electrical Engineers on May 1. He has also recently been reëlected manager of the Chicago Section, Illuminating Engineering Society, and is a member of the development committee of the Western Society of Engineers.

Mr. Cravath was graduated in 1892 from Grinnell College, Grinnell, Iowa. From 1892 until 1907 he was the electrical editor of the *Street Railway Review* of Chicago. In 1900 he became Western editor at Chicago for the ELECTRICAL WORLD and other McGraw publications, remaining on the editorial staff until 1910, when he began to give his time to consulting engineering and executive work, in which he has been engaged ever since. He was for four years president of the Lawrenceville (Ill.) Light & Water Company and for two years secretary, treasurer and managing director of the People's Water & Light Company of Harrisburg, Ill. For the last five years, since its organization, he has been president and treasurer of the Tri-City Artificial Ice Company of Rock Island, Ill. For two years he had general charge of the Menominee Range Power Company, serving the Iron River mining district of Michigan. In a consulting capacity Mr. Cravath has served many companies and municipalities in connection with street-lighting plans, alterations, contracts, public utility rates and appraisals and power-plant economies. He is perhaps best known through his prominence in the illuminating engineering field. He is one of the authors of "Principles of Interior Illumination" and of "Practical Illumination" and the author of "Street Lighting for Small Towns and Cities." He has held numerous offices in technical societies in the electrical and illuminating field, was first secretary of the Chicago Section of the Illuminating Engineering Society, and is at present chairman of the electrical section of the Western Society of Engineers.

L. M. Helmreich, heretofore assistant engineer to the Public Utilities Commission of Missouri, has been appointed engineer of the newly organized Arkansas Corporation Commission to take charge of the general supervision of the utilities operating in that state. He will establish headquarters at Little Rock. Mr. Helmreich was formerly head of the Ranken Mechanical School of St. Louis. He was graduated from the University of Missouri with the degrees of mechanical engineer and electrical engineer.

Henry C. Meyer, Jr,, a well-known consulting engineer, has joined with Bassett Jones and William E. S. Strong in incorporating the firm of Meyer, Strong & Jones, Inc., which succeeds to the engineering practice of Henry C. Meyer, Jr. Messrs. Meyer and Jones have been engaged in consulting work in New York City since 1903 and have been responsible for the mechanical, electrical and power equipments of many buildings and industrial plants. During the war they acted as consulting engineers for steam and electrical equipment for naval projects and were also engaged on steam work for three United States air nitrate plants and the Raritan Arsenal and on shipyard work for the Emergency Fleet Corporation.

J. R. CRAVATH

Obituary

Henry M. Norton, president of the Norton Electrical Company, Manchester, Conn., died of pneumonia on April 30. Mr. Norton was associated with his brother in the manufacturing of electrical instruments. He was forty-three years old.

Col. Richard H. Abbott, president of the Abbott Light & Power Company, Petersburg, Ill., died May 3 in a Springfield (Ill.) hospital, where he was recently taken to undergo an operation for appendicitis. Mr. Abbott was secretary of the Illinois Electric Light Association. He was a lieutenant-colonel in the Quartermaster's Corps of the State Adjutant General's staff and a major on the staff of Governor Lowden of Illinois. Colonel Abbott saw service in the Spanish-American War. He was forty-nine years old.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FACTORS THAT FIGURE IN INCREASED JOBBING COSTS

Higher Wages Play a Part in Jobbers' Costs and Indicate that Greatest Advance Is Given to Store Salesmen

Figures collected from about sixteen jobbing houses show clearly the trend of costs in wholesale electrical establishments. During the period over which the data were taken the operating expenses increased about 7.5 per cent, and the total volume of business based on money values dropped off about 3.5 per cent. The data showed very distinctly that wage increases had been granted to all classes of employees. The following table gives a summary of the averages calculated from the detailed data:

Classes of Employees	Present Salary or Expenses per Month in Dollars	Increases in Per Cent.
Stenographers (salary)	91	15
Typists (salary)	70	15
Country salesmen (salary)	200	11
Country salesmen (expenses)	165	11
City salesmen (salary)	170	12
City salesmen (expenses)	45	19
Store salesmen (salary)	105	24

There appeared to be no opinion that the present wages were unduly high nor was there an expressed sentiment toward reduction by any jobber. The general feeling was that prices of living which made the increases necessary are still present, and that in justice to employees increases should remain at least for the present.

Income taxes last year for jobbers amounted, generally, so far as has been stated, to 2 per cent of the sales and will, it is thought by jobbers, be more this year. Some companies are considering this tax as an added cost of doing business and are adding to the selling price of all goods a fixed percentage which is calculated to cover the tax for this year.

IMPROVED DISTRIBUTION OF INCANDESCENT LAMPS

More Lamps Sold in Greater New York Since Central Stations Discontinued "Free" Renewals than Were Previously Sold and Renewed

It has been shown in New York City that under proper conditions more lamps can be sold by the central stations, jobbers, contractor-dealers and manufacturers working together than the central stations are able to dispose of under their renewal or combined sale and renewal policies.

The success of the unrestricted sale of lamps was found to be contingent upon the territory being adequately covered by retail merchants, such as electrical contractor-dealers, hardware stores and other retailers, who combine the qualities of merchants with sufficient knowledge of the lamp business to give customers the right service. When the New York Central stations took the price of lamps out of their rate schedule and advised their customers that lamps would have to be purchased separately in future there was not a sufficient number of this class of dealer in the field, and as a result the number of lamps delivered into the district by the manufacturers began to drop off. Grocery stores, drug stores and other retailers signed lamp contracts and put lamps on their shelves for their regular salesmen to sell. These untrained lamp merchants did not improve distribution; in fact, it is claimed that they made matters worse. They so often sold lamps of incorrect size or voltage that their customers became disgusted and did not buy lamps until it was absolutely necessary.

A committee of all branches of the electrical industry interested in the sale of lamps in New York City was organized to grapple with the problem after the lamp business had been allowed to drift for about six months. A canvass was first made of all the lamp agents in the district, and about one-half were crossed off the manufacturers' list either because they were not actively engaged in the sale of lamps or because they had gone out of business. Steps were then taken to place lamp contracts with agents who could give the public proper service and who were established in parts of the city not adequately served. Some of the retailers who gave their lamp customers good service were nevertheless not conversant with the most modern selling methods. These people were taken in hand by the manufacturers, who taught them how to dispose of lamps to the best advantage.

The coördinated efforts of the committee have changed the number of lamps disposed of in the district from minus to plus quantity compared with a year ago when the free-renewal policy of the central station was in effect. Although the central stations are only selling from 25 to 40 per cent of the lamps they formerly delivered to their customers, the total number of lamps now being supplied to the district is probably 50 per cent greater than it was last year. The manufacturers' receipts from a large number of comparatively small contracts at a list price 10 per cent in excess of last year's figures show 100 per cent increase over a similar period in 1918.

TRANSFORMER RAW MATERIALS COSTS DOUBLE THOSE OF 1914

Review of Increases with Respect to Selling Price Seems to Indicate that No Further Price Recessions Are Scheduled

The approximate percentages of increase in the prices of materials entering into the manufacture of transformers in 1919 over the prices of the same material for 1914 are set forth in the following table:

Material	Approximate Percentage of Increase
Sheet-iron laminations	100
Copper wire	150
Copper sheets	100
Cases and covers	125
Cotton tape	300
Insulating compounds	60
Hardware (iron)	160
Hardware (copper)	120
Hardware (brass)	200
Hardware (porcelain)	60
Lumber for crating	80

It is apparent from this table that the cost of the principal raw materials involved in the manufacture of transformers will average over 100 per cent above the cost of the same materials in 1914. The effective increase in the price of transformers which has taken place during that time amounts to something like 40 per cent. It appears, therefore, that the ability to market transformers at an

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increase of only 40 per cent as against 100 per cent increase in the cost of material must have been due to some striking increase in efficiency. In most cases it was due to the application of principles of greater efficiency in the factory and to the application of methods involving a lower percentage of overhead in handling the business. It may be expected that some of the materials listed in the table will go down to some extent in the future, but in the majority of cases the labor is not being reduced in price; moreover, the load factor on transformer orders has fallen off considerably. In view of all these circumstances and after having discussed the matter with some manufacturers of transformers, it does not appear probable that there can be a much further reduction of transformer prices during the year 1919.

METAL MARKET SITUATION

Nearly All Metals Advance in Price—Copper at 16.75 Cents—Demand Better

The expected improvement in the metal market has set in. There is hardly a base metal the price of which has not increased in the last week. The whole tone of the market is one of greater stability.

The improvement in copper is most decided. Two weeks ago, when the upward movement set in, copper was 15.37½ cents a pound, while to-day it has advanced to 16.75 cents. Much was purchased last week for both foreign and domestic use. Foreign sales for May are expected to double those for April. There is considerable room for improvement, however. Wire base has advanced in the neighborhood of a cent, and London spot has increased £3. The price of 18 cents domestic is looked for in June, according to some authorities. The copper market to-day has been termed the most favorable since consumption fell off after last November. It is expected the early extension of foreign credits will cause renewed foreign buying.

Much interest has been shown lately for tin for delivery as soon as possible. London quotations on spot tin have increased nearly £10 the last week. American manufacturers are apparently preparing for a lifting of the embargo which will permit the importation of that metal to the States.

Lead has advanced in the New York market to 5.25 cents. The advance came as a surprise to buyers who were not especially well stocked. The demand has increased. Antimony increased seven-eighths of a cent, but the demand is rather light.

The scrap market in coppers, brass, lead and zinc has followed the upward trend of the new metal market. Scrap dealers are reported buying new metal on speculation. They are very optimistic in their expectations for the future.

NEW YORK METAL MARKET PRICES

	May 13	May 20
Copper:	£ s d	£ s d
London, standard spot	76 5 0	79 5 0
	Cents per Pound	Cents per Poun
Prime Lake	16.00 to 16.25	17 00
Electrolytic	16.00	16.75
Casting	15 37½	16.00
Wire base	17.25 to 18.00	18.00 to 18.50
Lead, trust price	5.00	5.25
Antimony	7.12½	8.00
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.40	6.65
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	32.00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.50 to 14.00	13.75 to 14.25
Brass, heavy	7.50 to 8.00	7.75 to 8.25
Brass, light	6.50 to 7.00	7.00 to 7.25
Lead, heavy	4.25 to 4.37½	4.37½ to 4.50
Zinc, old scrap	4.00 to 4.25	4.50 to 4.75

THE WEEK
IN TRADE

GENERAL business conditions indicate a gradual returning to a more stable basis. Retailers are enjoying continued activity, but jobbers' prosperity is somewhat spotty. Jobbers in different sections of the country have or have not satisfactory activity according to the industries which prevail in those sections.

Reports of building activities are becoming more favorable each week. No spectacular booms have started, but a healthy amount of construction is under way. Most of this, however, is of the residential type, due to housing conditions in and near the cities.

Stocks of nearly all materials are in good shape, both factory and local. Vacuum cleaners and flexible armored conductors prove the greatest exception to this rule. Deliveries to jobbers are improving, and prices in general are holding firm. Collections of all classes appear to show continued improvement.

NEW YORK

The general tone of business in this section shows improvement. This seems to be more true of manufacturers than of jobbers. Opinion among the latter is somewhat unsettled. Reports of satisfactory buying come from some jobbers, while from others the reports are not quite so good. Not all are of the opinion that the month of May is showing up as well as the month of April, so the conclusion may be drawn that buying is spasmodic and localized in spots.

Armored conductor and fittings, the materials principally used in wiring old houses and new ones, are having a heavy run, while rigid conduit and fittings for commercial and apartment buildings are still rather slow. Fans are moving better. Rubber-covered wire is picking up in manufacturers' sales.

There is a much better tone in the building market. For commercial buildings the borough of Queens gives the greatest promise in number of large projects already under way or about to start. Remodeling of used plants also figures in that section. Throughout several suburban districts near New York City come reports of improvement in house building. This is quite noticeable in driving through the country.

FLEXIBLE ARMORED CONDUCTOR.—Large demands from all sections are piling up on manufacturers to the extent that the orders cannot be filled promptly. Jobbers' stocks are low, and they apparently were unprepared for the rush which is now on. Fittings and boxes for this conduit are not moving so fast as might be expected. They are in better supply than the conduit.

RIGID CONDUIT.—Jobbers are finding spotty markets. One prominent jobber reports a satisfactory market, while others report little movement. Prices are steady at present, but an upward tendency has been predicted in one case. Heavy buying is expected in the early fall.

OUTLET BOXES.—A somewhat better demand is found, although nothing of a startling nature.

LIGHTING FIXTURES.—Lighting fixtures, sockets, cutouts, switches, etc., for outdoor use, the product of one manufacturer, are reported down 5 per cent early in May.

LAMPS.—Sales are holding up well for this season. Stocks of 100-watt tungsten lamps have been reported in better shape. Stocks in general are in a good condition and deliveries are satisfactory.

MARINE GENERATING SETS.—The Emergency Fleet Corporation received bids in Philadelphia, on May 17, for 125 and 175 15-kw. direct-current engine-driven marine

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sets. The government's decision to carry out its marine work is encouraging to the trade.

SCHEDULE MATERIAL.—No special movement has been found in this line, although small amounts have gone with the purchasing of conductors.

RUBBER-COVERED WIRE.—Nine manufacturers are quoting on a 20-cent base, one on 19 cents, one on 18 cents, one on 24 cents and one on cost. The tendency seems to be to stiffen in price rather than recede.

CHICAGO

General conditions surrounding the outlook for more construction appear better, but the general labor situation has not improved. Brick prices have been shaded. The City Council is again active on the problem of electrifying the Illinois Central terminal and suburban railroad, but it is difficult to tell whether anything material will come out of this or not. The steel mills in the Chicago district are working only from 25 per cent to 40 per cent full time.

The Willys-Overland strike has not been settled yet; a milk drivers' strike in Chicago, based on a demand for $4 per week increase in wages, has been settled. There have been other minor disturbances.

Building activities are about one-half what they should be at this time of the year, the total permits for the week running $1,215,600. Buildings projected total $3,825,000.

FARM-LIGHTING PLANTS.—It has been stated that the Electric Auto Lite Company, which is affiliated with the Willys-Overland Company, Toledo, will soon be ready to market a farm-lighting plant.

COPPER WIRE.—Bare and weatherproof copper wire were somewhat stronger this week, the bare advancing about ½ cent. Rubber-covered remained the same.

CONDUIT.—There has been no change in conduit prices.

FLASHLIGHTS.—The manufacturers have changed the list price on flashlights about 20 per cent.

INSULATORS.—There has been some price cutting in standard porcelain, but there has been no change in high-tension insulators, except for a slight advance in guy strain insulators.

METERS.—The business in meters is picking up. Revamping of old buildings, replacing of gas lighting and work of this sort, particularly in Chicago, is active. Some manufacturers' associations in the Middle West are being formed for the purpose of building workmen's houses, and this has also increased the demand for meters. The 5-amp. type is the most active.

ELECTRIC RANGES.—One manufacturer asserts that he has sold more ranges so far this year than he ever has in the first six months of any proceding year.

SYNCHRONOUS MOTORS.—The practice of using synchronous motors on ice machines continues to grow, one large installation of this character tested in Chicago recently having proved very satisfactory.

VACUUM CLEANERS.—The Hoover Suction Sweeper Company reports the sale of $100,000 worth of cleaners to the Denver Gas & Electric Company and $182,000 worth to the Sanger Department Store of Dallas, Tex. Both of these concerns it is expected will reorder before the end of the year.

MOTORS.—Inquiries and business are both picking up in the Chicago territory, the greater part of the demand being for sizes of less than 100 hp.

ELECTRIC FIRELESS COOKERS.—Manufacturers producing electric fireless cookers retailing at around $35 are making a strenuous effort to make central stations and dealers see the long profit in handling this class of goods. Considerable success is attending their effort.

SMALL THREE-PHASE MOTORS.—Reduced prices were placed in effect on April 19 on Emerson 1-hp. and 2-hp., three-phase motors. The price reduction amounted to 10 per cent in the case of 1-hp., 110-volt and 220-volt, 60-cycle, three-phase motors and 20 per cent on the 2-hp., 110-volt and 220-volt, 60-cycle, three-phase motors.

BOSTON

Business is somewhat quieter this week among jobbers, although trade in specialties holds up well. Automobile supplies are moving fast. Prices are firm, with slight upward tendencies in some products. Fractional-horsepower motors are a little easier, and an advance in wire is expected shortly. Stocks are in fair shape to meet present demands, but would probably soon be heavily depleted if buying should set in on a big scale. Collections are somewhat improved over last week. Deliveries are very satisfactory with the exception of a few prominent makes of vacuum cleaners, which are low in local stocks. Armored flexible conduit is also short. Contractors are occupied chiefly with renovation jobs. Building work is handicapped by labor demands. Consulting engineers are active on report and "proposition" work, and here and there some central-station construction work is being handled. The electric railway market is dull, but the Boston elevated is spending about $1,000,000 on track construction and betterment and has comprehensive plans for a total improvement program of about $20,000,000 in the next five years.

Bids were to be opened Monday by the New England Power Company at Worcester, Mass., covering the cost of installing 12,000 kva. in waterwheel generating units, transformers and electrical equipment for the enlargement of the company's 20,000-kw. hydroelectric plant at Vernon, Vt.

WIRE.—Armored flexible cable is scarcer, and the demand is increasing. Early advances in the price of bare weatherproof and slow-burning wire are forecast. The shortage in non-metallic flexible conduit is relieved.

ELECTRIC RANGES.—The demand is increasing rapidly, and it is practically impossible now to accumulate factory stocks.

FANS.—Fan movement showed some increase in response to warmer weather a week or so ago, but soon dropped back to a quiet market. The indications are that local stocks will soon be exhausted if protracted hot weather hits New England.

SEWING MACHINES.—Trade reflects keen competition and a fair demand. The volume of trade fell off with the diminution of Red Cross and related war work, and a full recovery has not been attained. A recent advance in Western Electric No. 1 outfits of $1.05 is noted at wholesale, and this led to a retail increase of about $5 in some units, the stores feeling that their percentage of profit should be increased in view of present economic conditions.

FLATIRONS.—A steady demand is noted, but some factory stocks are now reported to be established.

VACUUM CLEANERS.—The demand is very heavy, and increased manufacturing facilities appear necessary to restore satisfactory deliveries in two prominent makes.

LAMPS.—Stocks are in excellent condition. The demand holds up better than might have been expected at this season. Miniature and sign lamps are greatly improved in deliveries, and in most cases exceedingly prompt shipments can be made.

INDUSTRIAL ELECTRIC TRUCKS.—Inquiries have begun to increase again, and a better feeling dominates the local market. Prices are steady and deliveries on a satisfactory basis. It looks as though sales would shortly show much improvement.

STORAGE BATTERIES.—The automobile trade is brisk. Local stocks are better than for a long while, and one prominent dealer states that he is now ahead in his stock for the first time in three years. The demand for industrial batteries is a bit dull at the moment, although there is a better outlook in the truck field.

MOTORS.—Sales are not up to the mark of last year, but in some cases orders compare favorably with pre-war volumes. Fractional-horsepower motors are easier in price, perhaps 5 per cent lower than a fortnight ago. The second-hand motor market does not appear to be making much disturbance in prices. Stocks are on the whole pretty well prepared for future demand, barring occasional gaps in the listings. By and large, the market is somewhat dull, but the feeling is strong that better times are not far away.

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ATLANTA

The week's most significant features are not the clear evidences of further business recovery, steadily widening its area, but rather those political events which foreshadow a lessening of uncertainties that have been influential in retarding a full measure of economic development. Residence and apartment construction is gaining. This with the erection of manufacturing plants in the Southeast makes for increased demand on dealers and contractors. Requirements for schedule material appear to be increasing as evidenced by a more active movement this week. The American Cotton Export Financing Corporation has been formed this week, capitalized at $100,000,000. This company will export cotton, handle foreign securities and erect cotton warehouses throughout the South.

POLES.—The market is holding up well and jobbers report a satisfactory trade. Drop shipments direct from Western stocks to consumers are prompt. Prices are steady.

RANGES.—Very little activity is noted in this line; in fact, trade in these has been dormant for the past two months. Factory shipments are good.

CABLE.—The buying undercurrent is strong and business is becoming more active. Industrial demand has developed beyond expectations. A 20-cent base prevails for weatherproof and rubber-covered. Inquiries are out for three-conductor lead-covered for 19,000 volts. Shipments are improving.

INSULATORS.—Glass insulators are quoted a shade off the market, with an increased call and good shipments. An improvement is noted in porcelain, but prices are somewhat unsettled.

FLASHLIGHTS.—While the volume of business is fairly satisfactory, a decrease in sales is noted over the previous week. Stocks are ample and incoming shipments are tending to swell normal stocks. Retail prices on certain items are off 10 cents this week.

FANS.—A shortage of 32-volt fans for farm-lighting outfits is noted. As jobbers and dealers are absorbing the 5 per cent tax, no change in price has been made to the final user. Shipments to outlying points on stock orders are moving more rapidly.

LAMP CORD.—The coming fan season has stimulated this line and manufacturers report increased movements. Local stocks have been built up well. An 18-cent base covers the market.

OUTLET BOXES.—These are going slow and a moderate demand only is evident. Prices are remarkably firm. Jobbers are pretty well stocked up and Eastern shipments are coming in promptly.

ARMORED CABLE.—Prices have sagged and regained their former position in a short time. With the exception of a shortage in a few sizes, deliveries are good. Jobbers expect the market to widen as apartment-house construction advances. The volume of transactions shows a slight increase.

SEATTLE—PORTLAND

Persistent reports that the completion of present contracts for steel ships in Seattle and Tacoma yards early in the fall will terminate shipbuilding on the present large scale is seriously affecting all lines of industry, including electrical business. The hope is held out that canceled contracts will be reawarded for a larger type of vessels, although nothing definite can be ascertained. In spite of present conditions, jobbers are optimistic, believing that renewed activity awaits only assurances that shipbuilding is to be continued. Sales of consequence during the past week have been very light. Government buying is almost at a standstill. Domestic appliances sales are moving fairly well. The tentative lifting of the ban on foreign ship contracts may mean that the Foundation Company of Tacoma and Portland will be able to bring back the order for 174 steel ships which it holds from the French government. The contract will approximate $200,000,000.

Northwest lumbermen declare that the lumber industry is about to come into its own with the resumption of peace and the restoration of normal conditions of business. The tendency toward the electrification of lumber plants and flour mills has resulted in an unusual number of motor inquiries, indicating a renewed interest. In some cases good-sized orders have been placed. With a few exceptions stocks are in excellent shape. There has also been some slight demand for small motors for new grain elevators in eastern Washington. The wire demand is continually decreasing, particularly for the type used in shipyards. Recently rural central stations absorbed a considerable amount for extensions and maintenance, particularly the latter. The volume of residence construction under way in this section is also demanding a good supply of wire. Stocks are good.

Storage batteries, owing to an increasing automobile demand, jobbers report, show a fairly brisk trade. This year's sales volume to date has exceeded all expectations. Stocks are in fair shape and prices show no change. Ornamental lighting inquiries from rural communities are becoming more numerous, and it is believed a satisfactory volume of sales will result. Several good-sized lighting projects which have been held up during the war period will be undertaken in small towns in this vicinity during the summer. Stocks of insulators are good, but the demand is considerably lighter than at any time during the past two years. Prices remain firm. The conduit demand from shipyards, while of hand-to-mouth variety, presents a satisfactory total.

SAN FRANCISCO

Business is still exceedingly good, running in most cases over last year's business in volume. This is somewhat surprising and unexpected. The building boom has still failed to materialize, although there are unmistakable indications that the disinclination of builders to buy at the present market prices is being broken down. Crops are steadily ripening and promise to be of the bumper variety. Credits and collections are fair and stocks and shipments good. Altogether it is a period of optimism.

LAMPS.—Business is showing signs of the usual midyear cut-down, and this fact and also the fact that the lamp factory is running at its pre-war strength in quantity and quality have brought back orders down to a minimum.

SCHEDULE MATERIAL.—This class of material is moving steadily though slowly and thus far remains fairly constant in price. The bulk of the present sales work is being directed toward architects and engineers because the jobs have not yet reached the stage of actual preparedness for dealers and contractors.

MARINE AND SCHEDULE MATERIAL.—This class of material has dropped in demand and will decrease more. To the Eastern factory styles must be added numerous local makes which combine to glut the market.

HEATING MATERIAL.—Practically all standard household flatirons are now listed at $6.50 each, several makes recently falling into line with the market. In general, it may be said that, in spite of the efforts of intensive solicitation, the heating business is poorer this year than in previous years.

MEASURING INSTRUMENTS.—Prices on some makes are slightly better, but deliveries are wonderfully improved, owing to the factories' release from government contracts. The former six months' time for a shipment has now been cut to less than a quarter.

CONDUIT AND FITTINGS.—The market is quiet. Stocks are good and prices fairly steady.

SEWING MACHINES.—Eastern stocks of various manufacturers are being supplied, and the sewing-machine field is rapidly becoming as highly competitive as the washing-machine field. Prices have recently advanced to the consumer, the standard three-quarters-head vibrating model now retailing for around $47 each, but prices to dealers have remained steady, the extra margin allowing them to make exchanges, etc.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25-50	35.00
2	25-50	45.00
2½	25-50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25 to $78.75	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¾	.06	1¼	.33
¾	.09	1½	.40
⅞	.12	1¾	.47
1	.15	2	.55
1	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00	$18.00	$16.00
¼-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$60.00	$30.00	$26.00-26.50
¼-in.—	65.00	32.00-32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.90 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft.	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00—$36.00
Coil to 1000 ft.	21.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$33 00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20 00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20% 35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $22 40
1/5 to std. pkg.	12.00 to 15 35
Standard package, 2200. List per 1000,	$21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00
Standard package, 2200. List per 1000,	$20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg.	10.50–11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27 20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4 50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to 10%
Std. pkg.	8% to 23%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.39–$0.41
No. 18, full spools	.35– .37

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.53 to $0.90
No. 18, full spools	.47 to .64

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10 50–$10 60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35 00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$17.50–$20.00	$9 50–$15.00	$9.50–$13 00
12	17.50– 21.63	17.55– 21.63	17.55– 18.54
10	24.05– 28.91	24.05– 28.91	21.16– 24.78
8	33.35– 39.34	33.35– 33.72	29.35– 33.72
6	52.95– 61.74	46.60– 52.92	46.60– 52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$24.00–$29.25
25 to 50 lb	24.00– 25.25
50 to 100 lb	23.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$23.75 to $35.75
25 to 50 lb	23.75 to 34 75
50 to 100 lb	23.75 to 37.35

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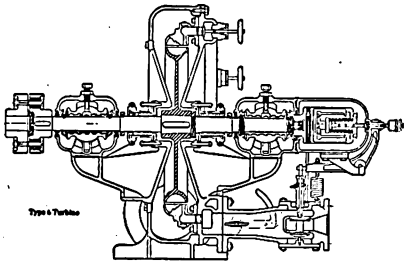
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Steam Turbines

For direct connection to blowers, fans, electric generators and centrifugal pumps, type 6 steam turbines are now being offered by the B. F. Sturtevant Company of Hyde Park, Boston.



CAN BE DIRECTLY CONNECTED TO GENERATORS, PUMPS, ETC.

They are said to retain the fundamental features of previous types made by this concern and in addition embody numerous refinements in detail construction.

In operation, steam enters an annular steam chamber in the turbine's casing through a balanced throttle valve, and from this chamber it passes through nozzles to the bucket wheel or rotor. The steam is said to leave the nozzles at a high velocity, since they expand it to a pressure equal to the exhaust pressure in the turbine casing. At this high velocity the steam then impinges against the semicircular rotor buckets, imparting full impulse to the rotor, and leaves the bucket in a reverse direction. As it leaves the rotor the steam enters the semicircular reversing buckets, which are cast in one piece with the nozzles, thus again reversing the direction of the steam and driving it back into the rotor. The steam enters and leaves the rotor in a circular motion several times before its kinetic energy is absorbed and its velocity dropped to that of the rotor. When this occurs it passes out into the exhaust.

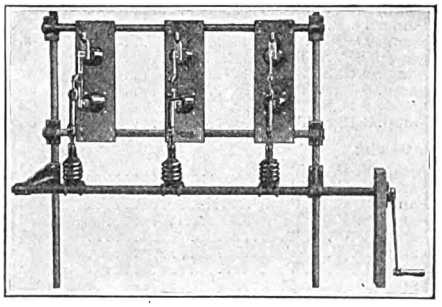
These turbines are constructed with standard rotors of 12, 18, 24, 30 and 36-in. (30, 45, 60, 76 and 90-cm.) diameter.

Three-Pole Remote-Control Disconnecting Switches

For use where "disconnects" must be operated quickly and safely or in congested locations, the Delta-Star Electric Company, 2433 Fulton Street, Chicago, has developed a three-pole interlocked remote-control disconnecting switch. It is intended for mounting on walls or pipes in compartments or in open work. When mounted in compartments the operating shaft extends through the wall, a face plate covering the opening.

When the operating handle is in the open or closed position it rests against position stops which are cast on the face plate. As this handle can be removed the necessity of a lock is eliminated. Minimum effort is required for operating the switch because of the lever arrangement. Double insulation is secured between the live parts and the ground as the connecting levers consist of porcelain insulators connected with impregnated wood sections.

Auxiliary indicator switches can easily be attached to the operating shaft, thereby permitting the use of position pilot lamps on the switchboard or at any other point. By altering the length of the wooden rods the mounting height above the floor can be varied to suit local conditions. The over-all dimension from rear of base to the most extended point of the switch is 21 in. (53 cm.) with the switch blades in open position. The use of narrow aisle space is thus permitted.



LEVER ARRANGEMENT MINIMIZES EFFORT NECESSARY TO OPERATE SWITCH

Screwdrivers for Use on High Voltages

With handles formed of insulation said to resist current as high as 5000 volts, "Hyvoltage" screwdrivers are being made by the Strong Machinery & Supply Company of 21 Walker Street, New York City, in three styles. In the regular electrician's type the insulation extends nearly three-quarters of the blade's length to prevent the fingers from touching the metal; in the switchboard type for line work the insulation is extended to within ½ in. (1.3 cm.) of the end, in which the blade is narrowed to ⅜ in. (0.9 cm.) in order to prevent short-circuiting of the lines when working between them. The third style is the garage type for auto work.

These tools are said to be waterproof, infusible and to have a low coefficient of expansion. Grooves are cut deeply in the handles to insure a firm grip, and the blades are embedded to the center of the handle to give greater strength.

Electrically Heated Suits for Aviators

For enabling aviators to withstand extreme cold occurring at high altitudes and on lower flights during cold weather, electrically heated clothing has been developed by the Simplex Electric Heating Company of Cambridge, Mass.

The energy required to heat these suits is 80 watts, disposed as follows: Helmet, 20 watts; each glove, 16 watts; each moccasin, 14 watts. The energy is supplied at 12 volts, either from a storage battery or from a small fan-driven generator of stream-line shape mounted on the airplane, the fan being rotated by the passage of the plane through the air. The heating elements are flat loops of resistance wire spaced about seven per inch and about $\frac{9}{32}$ in. (7 mm.) wide per row. They are machine-sewed on a cotton cloth base, the cotton thread being carried along the top and bottom of each row of loops parallel to the horizontal axis of the row. Flexibility results from this mounting, and the base can be stretched or crumpled at will without danger of breaking the wire. Each heating element is composed of

ENERGY SUPPLIED FROM STORAGE BATTERY OR AIR-DRIVEN GENERATOR

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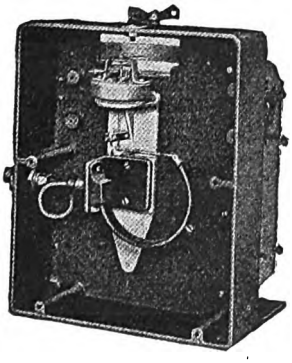
two bare wires in contact with one another throughout a considerable part of every loop, so that if a break occurs in any one wire, the effect is merely to force the small amount of energy concerned through a conducting path of smaller cross-section between the break and the nearer points of contact. One unit is provided for the helmet, and this with four units required for gloves and moccasins is wired in multiple. There are three circuits per suit, and the warming of hands, head and feet is controlled at a Hart & Hegeman push-button switch mounted near the pocket on the right side of the trousers. The supply of energy is provided through a plug and rubber-covered cable leading from the control switch to the source of electricity.

The suits are lined with "Nuback," a non-inflammable artificial wool, and with "Kapok," a cork-like material which facilitates floating in water. Outside waterproofing is also provided, and the gloves are silk-lined on each side of the heating element. The heating elements are arranged to warm the back of the head, the facial parts around the ears, across the forehead and across the mouth, along the side and under part of the sole of the foot and along the fingers and thumbs. A small opening is left in the side of the helmet for a telephone receiver.

Graphic-Pressure and Vacuum Recorder

The graphic-pressure and vacuum-recording instruments which are being made by the Esterline Company of Indianapolis, Ind., resemble the "type MS" ammeters and voltmeters made by this company. In this instrument, however, a pressure-measuring instrument is used as a meter element. These recorders can be furnished in various ranges up to 2000 lb. per square inch (140 kg. per sq. cm.). A feature in their construction is the pen tube. Removing this for cleaning, for inserting a new pen or for changing the pressure on the recording chart is accomplished by simply lifting the pen from its stirrups without any necessity of opening

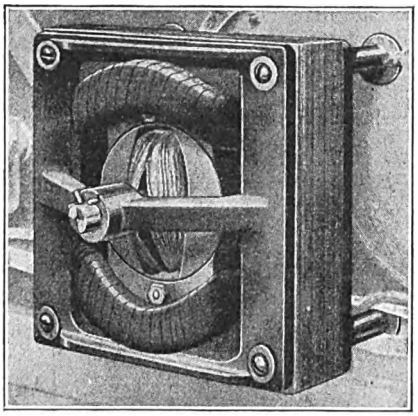


REAR VIEW OF RECORDER WITH COVER REMOVED

the compartment containing the meter element. The meter element is placed in the rear compartment of the instrument case, and the pen tube projects through into the front compartment, which contains the clock and the chart-feeding mechanism. The maker also calls attention to the non-spillable ink well used in this instrument. Only the front cover need be opened to replenish the supply of ink since filling tubes project through the compartment wall, making unnecessary the opening of the meter compartment.

Induction Regulators

Particularly designed for maintaining definite values of current or voltage during tests or comparisons of alternating-current electrical instruments, induction regulators are being marketed by the States Company of 72 Francis Avenue, Hartford, Conn. In calibrating indicating instruments they are said to be very convenient for holding constant indications at the points of the scale to be compared. They may be put to other uses not only in the electrical testing laboratory but in any application where it is desired to con-



AUXILIARY AUTO-TRANSFORMER CAN BE USED TO INCREASE VOLTAGE RANGE

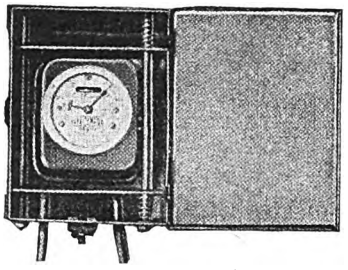
trol voltage or current and the amount of power involved is small.

A laminated steel core having a stationary part and a movable part, resembling very closely the structure of a direct-current motor, comprises the regulator. On the stationary part is a primary winding which may be connected to a source of constant voltage. On the movable member is a secondary winding in which a voltage is generated, in value varying from zero to a maximum, depending upon the position of the movable part. A small hand wheel serves to turn the movable part of the core and to enable the operator to adjust the current or voltage as desired.

These regulators have a 100 volt-ampere capacity. The primaries are wound for 110 volts and 220 volts, 25, 40 or 60 cycles. The maximum secondary voltages are 11 and 110 and the maximum secondary amperages 1 and 10. The regulators may be wound for other voltages and current if desired. Two styles of these regulators are obtainable, "type J" with legs for switchboard mounting and "type J-2" contained in a case for portable use.

Battery-Charging Regulator for Industrial Trucks

To withstand the rough service usually given industrial trucks the Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, Ohio, is prepared to supply the "Dreadnaught



SPRINGS ELIMINATE VIBRATION AND BOX PROTECTS METER FROM INJURY

chargometer," an instrument for automatically regulating the charging of storage batteries. It consists of a standard "chargometer," described in the ELECTRICAL WORLD of July 20, 1918, mounted upon springs and inclosed within a heavy steel box. This assembly may be mounted in any convenient location on all types and makes of industrial vehicles, since the spring suspension eliminates all danger of injury due to excessive vibrations and the steel cabinet protects the meter against mechanical damage.

Motor-Driven Flashers for Electric Sign

Simplified construction and reduction in the cost of installation have been aimed at in designing the "Travel-Flash" flashers recently placed on the market by the Alpha-Omega Electric Manufacturing Company, 241 Lafayette Street, New York City, for use with "talking" signs—that is, signs in which the letters of the words appear on the right of the sign and travel across to the left-hand side where they disappear.

Only a minimum number of lamps are required when these flashers are used. The bulbs are placed at uniform distances on the sign, forming a universal lamp-letter field, consisting of horizontal rows of about 100 lamps. According to the size of the letters, there may be seven, nine or eleven of these rows. The bulbs in such signs are more intensely used than those in "talking" signs controlled by the customary flashers; for instance, in some styles of letters, the maker says, about 40 per cent of the bulbs are lighted by each word-flash.

In a lamp bank having 900 lamps there are 900 brushes, the average letter being formed by about twenty-one lamps. During the lapse of time necessary for ten letters to travel across the lamp bank or the face of the sign the number of make-and-break contacts is 210 multiplied by 100, or 21,000. The flashers, it is stated, make about 504,000 contacts a minute, and at five

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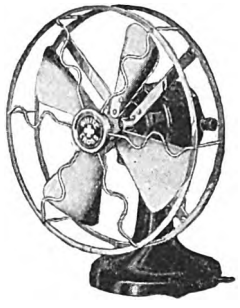
hours a day the monthly total is more than 4,500,000,000 make-and-break contacts. This intensive performance of the flashers necessitates durable construction for satisfactory operation. According to the maker, this is obtained by a special method for taking care of the countless sparks produced by the multitude of making and breaking contacts.

A Combination Direct and Alternating-Current Fan

By adjusting a lever in the base of the 9-in. (23-cm.) desk and bracket fan which the Lindstrom, Smith Com-

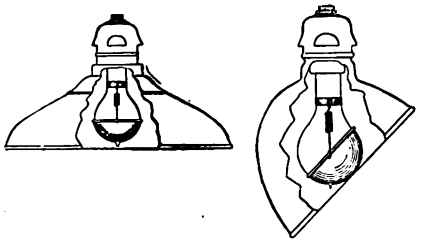


TWO SEPARATE FIELD WINDINGS

pany, 1100 South Wabash Avenue, Chicago, will release to the trade early next month, it is possible to change the fan from a direct-current circuit and operate it on an alternating-current circuit or vice versa. This is because the fields have two separate field windings. Another special feature pointed out by the maker is a regulating switch which permits operating the fan at three different speeds. The fan, which is of the desk and wall type, can be obtained for voltages ranging from 12 to 220 volts, any cycle. It weighs 10 lb. (4.5 kg.) and is finished in black enamel and brass.

Porcelain - Enameled - Steel Glare Shields for Reflectors

Shields which serve as screens and protect the eye from the direct rays of lamps and prevent glare from reflectors which do not give requisite eye protection have recently been brought



LEFT — SHIELD ON LAMP, STANDARD REFLECTOR; RIGHT — SHIELD IN ANGLE REFLECTOR

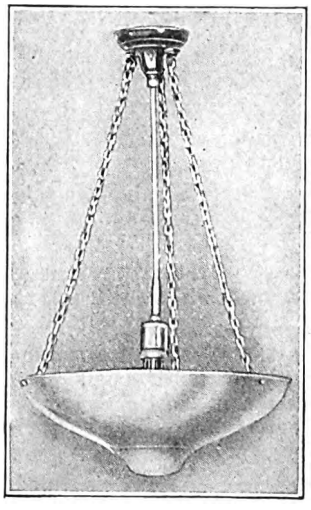
out by the Wheeler Reflector Company, 156 Pearl Street, Boston. They are made of porcelain-enameled steel and are held in position by coiled brass spring holders to cause them to fit snugly on the bulb of gas-filled lamps.

These shields may be attached to gas-filled lamps in any standard reflector. For use with standard angle reflectors an angle glare shield to fit gas-filled lamps is also procurable. This latter style is particularly adapted for use in protective lighting around industrial plants, in foundries, in tennis courts and in other places where angle reflectors are employed.

Shields may be had to fit 100-watt and 150-watt medium-base lamps, 200-watt medium-base lamps and 400-watt and 500-watt lamps with mogal bases.

Indirect-Lighting Fixtures for Gas-Filled Lamps

Indirect-lighting fixtures for gas-filled lamps have lately been placed on the market by the Wheeler Reflector Company, 156 Pearl Street, Boston, which consist of a chain-supported porcelain-enameled-steel dome-shaped reflector so positioned that when inverted below the lamp it gives a wide distribution of light against a white or slightly tinted ceiling and a soft diffusion by redirection over the area beneath it. The socket and lamp are suspended from a silk drop cord connected with the outlet, which is concealed in the ceiling canopy. The re-



REFLECTOR IS OF PORCELAIN ENAMELED STEEL

flector is finished in white both inside and outside. These fixtures are made in three sizes—with medium-base socket for 100-watt and 150-watt lamps, with medium-base socket for 200-watt lamps, and with a mogul socket for 300, 400 and 500-watt sizes. The diameters of these fixtures are respectively 15, 18 and 20 in. (38, 46 and 51 cm.).

Portable Utility Motor

An electric motor mounted on a portable stand and especially suited for driving small power machines in farms and country homes is being marketed by the Robbins & Myers Company, Springfield, Ohio. The outfit has a ½-hp. motor furnished for operation on 32-volt lighting-plant circuits and for 110-volt, 60-cycle alternating-current circuits. A spiral-type back gear reduces the motor speed of 1150 r.p.m. to a speed of 285 r.p.m. at the pulley. The gears are fully inclosed and grease-packed.

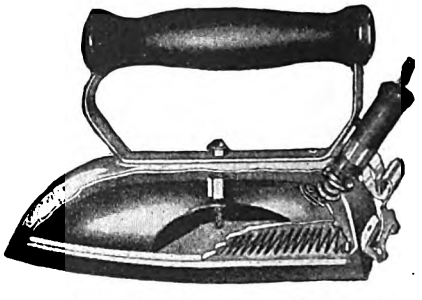
A three-step pulley is supplied, having groove pulleys 4 in. (10 cm.) and 3 5/16 in. (8 cm.) in diameter to take 5/16-in. (8-mm.) round belts and a crown pulley of 2½-in. (6-cm.) diameter and 2-in. (5-cm.) face for flat belts.

The motor is mounted on an iron tripod base with rubber caps on the four feet and a handle on the motor top for carrying. A brass rod with a clamp for attachment to the driven machine is provided to maintain the proper belt tension. This rod is telescopic to take care of length adjustment, and the clamp can be turned at any angle.

Iron with Embedded Heating Wire

The heating wire or resistor of the Victory electric iron now being manufactured under the Wiegand patents by the Pittsburgh Electric Specialties Company, 396 Broadway, New York City, is completely incased in an insulating material which is said to be practically indestructible and to have a high heat conductivity. The wire is embedded under great hydraulic pressure, so that the base of the iron, the embedding material and the resistor form a compact solid mass which is then baked at high temperature, producing an extremely solid element that protects the resistor wire from destructive atmospheric influences.

Because of this construction all portions of the heating wire are in contact with a good heat conductor. Therefore the heat is conducted away from the wire into the base of the iron as fast as it is generated so that the temperature of the wire is maintained below the oxidation point. As the resistor is fixed rigidly in position, short or open circuits are prevented between the turns of the wire or other parts. The heating wire or resistor is said to be arranged for the most efficient heat dis-



RESISTOR HERMETICALLY SEALED IN INSULATING MATERIAL

tribution at the ironing surfaces. Only three minutes are required for the iron to reach proper temperature, this heat being retained for a long time.

The contact pin used to connect the

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iron is removable, and the handle is roomy and comfortable. A tilt-up stand is provided so that the iron can be stood on end when not in use. Three voltages can be used with these irons, one type being made for 105-114 volts, another for 115-125 volts and the third for 32 volts.

Washer with Worm and Gear Drive

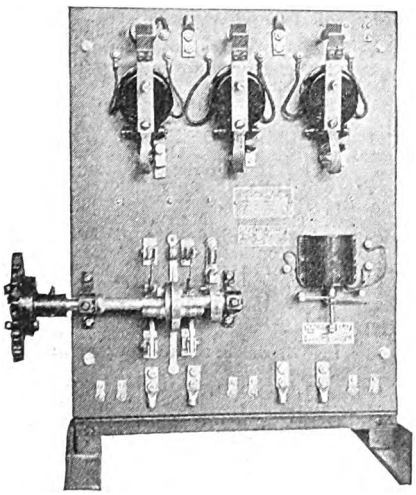
The electrically operated cylinder washing machine known as model 12 which the Automatic Electric Washer Company of Newton, Iowa, has just placed on the market utilizes a compact and quiet operating worm and gear drive. The carbonized steel worm runs with cast-bronze gear, bronze bushings and ball thrust bearings. A friction clutch between the motor and worm serves as a protective measure for the motor, which is operated by means of a toggle switch.

The cylinder of this washer rotates continuously in one direction, the drive being positive, simple and direct. The cylinder is constructed of wood and the tub is of galvanized iron. The machine is equipped with a ball-bearing swinging wringer which has 12-in. (30-cm.) rolls and locks in five different positions. The machine is equipped with a folding side bench for carrying extra tubs or a basket.

The "Nelson Automatic" model 14, also recently developed by this company, has the same washing and wringing mechanism as model 12, differing only in its transmission, which is a combination of flat belt and inclosed gears.

Semi-Magnet Controller for Elevator Installation

To be used on semi-magnet elevator installations a controller has recently been brought out by the Automatic Switch Company, 4 White Street, New

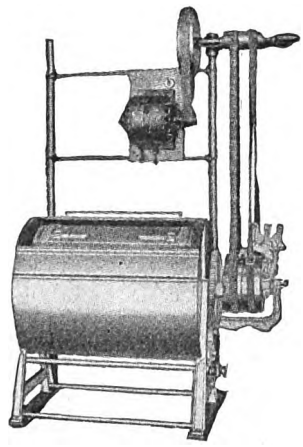


PREVENTS MOTOR FROM STARTING WHEN CURRENT RETURNS AFTER FAILING

York City. It includes, in addition to the controller proper, a type DV-30 reversing switch and a no-volt relay, the purpose of which is to prevent the starting of the motor when current returns after it has failed while the controller is in the "on" position. This controller can be used on motors up to and including 50 hp., the number of steps in the resistance varying from one to four according to the size of the motor.

Laundry Washer with Driving Mechanism

In order to save space and time in installing its Simplex laundry washing machine the American Ironing Machine Company, 168 North Michigan Avenue, Chicago, is equipping some of its machines with a self-contained countershaft and motor. As can be seen from the accompanying illustration, these are both supported on an iron framework, thereby saving the space which would be taken up by mounting the motor on the floor. Another advantage



PREVENTS MISALIGNMENT OF MOTOR

accruing from this arrangement is that the location of the washer may be easily changed without the bother of remounting the motor or altering the lengths of the belt. It eliminates possibility of misalignment of motor and pulley wheel and thus insures good operation.

Indoor Illuminating Sign with Changeable Front

A pencil or a match is the only tool necessary to form the legend on the face of the "Raco" sign manufactured

PLUGS ARE PUSHED OUT TO FORM SIGN

by Paul A. Raymond, 42 Coal and Iron Exchange, Buffalo, N. Y., for use in stores, banks, theaters and other places. It consists of a box serving as a reflector for the lamp bulb it contains and a card which fits into the open side of the box. This card contains many rows of small circular plugs previously cut out and then replaced in the holes. By pushing out these plugs a sign can be made showing words, characters, punctuation marks, figures, underlining, ornamental borders, etc. These can be made in different sizes since the entire card is filled with replaced perforations. By the use of ground and clear glass and colored-paper backings varied effects may be obtained.

These signs may be obtained in either flashing or steady-burning styles and are supplied with either single or double face. Cards have word fields of either 4 in. (10 cm.) by 13½ in. (34 cm.) or 4 in. (10 cm.) by 21 in. (53 cm.).

A 25-watt or 40-watt tubular tungsten lamp is used, and the reflecting surfaces are arranged for greatest efficiency. The exterior of the sign is finished in flat black, but special styles with other colored finishes and nickeled, brushed or polished brass metal frames as well as wood frames can be procured if they are desired.

Notes on Recent Appliances

Tapping Machine

Bench-type motor-driven tapping machines are being manufactured by the Bicknell-Thomas Company of Greenfield, Mass.

Portable Electric Drill

A ½-in. (1.3-cm.) portable electric drill with pistol grip and trigger is being marketed by the Black & Decker Manufacturing Company, 105-115 South Calvert Street, Baltimore, Md.

Coffee and Water Urn

Combination coffee and hot-water urns with capacities of 3 gal. to 10 gal. (11 l. to 37 l.) have been placed on the market by the Duparquet, Huot & Moneuse Company, 108 West Twenty-second Street, New York City.

Guy-Wire Pole Clamp

Clamps for attaching from one to six guy wires to poles are being sold by the Threadless Pipe Fitting Company of Newark, N. J.

Portable Electric Sewing Machine

The Standard Sewing Machine Company, Cleveland, Ohio, is selling a portable rotary-movement sewing machine equipped with a Hamilton-Beach electric motor.

Combination Valve Grinder and Drill

Combination portable electrically operated drills and valve grinders are a recent development of the Petterson Engineering & Manufacturing Company, Worcester, Mass.

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Trade Notes

Westinghouse Changes

The following changes in the executive sales personnel of the Westinghouse Electric & Manufacturing Company are announced:

E. A. THORNWELL, manager of the railway and power division, Atlanta office, returned from government service, has resumed his former duties.

C. E. SMITH, of the engineering department, who spent several years in the Pittsburgh office and later was connected with the Robbins & Myers Company of Pittsburgh, has resumed work with the export department of the Westinghouse company.

A. D. STEPHANUS, after eight years in the export department, East Pittsburgh, Pa., has been transferred to the Westinghouse Norsk Elektrisk Aktieselskap, Christiania, Norway.

BIG SHIPMENT OF SEAMLESS TUBING IN APRIL.—The Wheeler Condenser & Engineering Company, Carteret, N. J., in the month of April manufactured and shipped 879,900 lb. of seamless drawn-brass and copper condenser tubes.

CINCINNATI COMPANY TO BE DISSOLVED.—The board of directors of the Incandescent Light & Stove Company, Cincinnati, Ohio, have called a meeting of the stockholders of that firm for May 27 for the purpose of ratifying a resolution for the dissolution of the company.

BARCELONA TO HAVE ELECTRICAL EXHIBITION.—Plans are being made for an international electrical and allied industrial exhibition at Barcelona, Spain, in 1921. The exhibition, according to the London *Electrical Review*, will be divided into thirteen sections, covering the whole field of constructive electricity. Before the war Germany supplied the greater part of the Spanish electrical imports.

"TRADING WITH THE FAR EAST," a companion volume to "Trading with Latin America," is a new title in the foreign trade series issued by the Irving National Bank, New York City. In acquainting the manufacturer or exporter with outstanding factors in trade beyond the Pacific, it provides an interpretation for commercial purposes of conditions in what promises to be one of our most exceptional markets for years to come.

GENERATING SETS TO BE SOLD.—The director of sales of the Surplus Property Division, War Department, will soon sell a number of generating sets bought originally for use in France but not shipped. The list is as follows: One Skinner-Westinghouse set, 12 in. by 12 in., left-hand, automatic, center-crank, high-speed, direct-connected to a 50 kw., three-wire, 125-150 volt Westinghouse direct-current generator, complete with field rheostat; two Erie-Ball sets, 10 in. by 10 in. (right and left) automatic 300-r.p.m. engines, direct-connected to 50-kw. General Electric direct-current, three-wire, 125-150-volt generators, complete with field rheostats and balancing coils. Bids for the sale of the above material will be opened May 28. Information can be obtained upon application to the office of director of storage, Munitions Building, Washington, D. C., or to the zone offices in the following cities: Boston, New York, Philadelphia, Newport News, Atlanta, Chicago, St. Louis, New Orleans, Omaha, El Paso and San Francisco.

HOOVER SWEEPER PLANS TO ENLARGE.—With plans under way to extend its trade into foreign countries and in order to erect a proposed new plant at Hamilton, Ontario, directors of the Hoover Suction Sweeper Company of North Canton, Ohio, have decided to increase the capital of the corporation from $1,000,000 to $2,000,000, their attorney, C. G. Herbruck, has announced. Preparations are being made by the Hoover company to build homes for its workmen which it will sell at cost. Thirty-five acres have been purchased in North Canton for this purpose. The homes will be built by a separate corporation, Mr. Herbruck said. In order to establish relations with British colonies and to obtain concessions for the introduction of Hoover sweepers into English possessions, Mr. Hoover will leave next week for England to confer with government officials. He also will visit France for the same purpose. The company recently took over the W. H. Hoover Company. The North Canton plant employs more than 700 persons and is working three eight-hour shifts. The population of North Canton is only 1300, and for this reason it has become necessary for the company to build new homes there.

THE EDISON STORAGE BATTERY COMPANY, Orange, N. J., announces that reduced prices for "A," "B" and "G" type Edison storage batteries made public March 1, 1919, are guaranteed until January 1, 1920.

THE CHELTEN ELECTRIC COMPANY, Philadelphia, announces the appointment of B. J. Aplin, 30 Church Street, New York City, as New York factory representative. Mr. Aplin was formerly with the New York Edison Company for a number of years.

THE R. B. COREY COMPANY, INC., announces the election of Charles L. Eidlitz as president of the company, succeeding the late R. B. Corey. Mr. Eidlitz, who is also president of the Metropolitan Electric Manufacturing Company of Brooklyn, N.

CHARLES L. EIDLITZ

Y., is well known in the electrical industry. The R. B. Corey Company is now carrying in its New York City warehouse complete stocks of conduits manufactured by the American Circular Loom Company, boxes and fittings manufactured by the Pratt Chuck Company, wires and cables manufactured by the Collyer Insulated Wire Company and expansive-screw anchors and bolts manufactured by the Ackerman-Johnson Company, in quantities sufficient, it is claimed, to meet any demand.

MAX LOWENTHAL announces that he has disposed of his interest in the Panama Lamp & Commercial Company and resigned as manager of its appliance department and will, beginning May 1, conduct an organization under the name of the Globe Commercial Company, with offices at 618 Mission Street, San Francisco. The new firm will represent the following factories and products: Tideman Electric Manufacturing Company, manufacturer of "Menominee" electrical products; "Pittsburgh" electric specialties; Russell "Hold Heat" appliances; "America" vacuum cleaners; "Haag" washing machines; "Domestic" electric steam washers; "Ostrander" sockets, shades, etc.; Standard "National" line of switches; "Empire" bell and toy transformers; "Wells" motor starting switches; "Globe" and "Waage" electric irons; "Red Top" toasters and iron plugs; automobile specialties, spotlights, timers, etc. Above representation does not include "Haag," "Domestic," "Ostrander" and "Standard" lines for California, Utah and Nevada.

THE VAN DORN & DUTTON COMPANY, Cleveland, Ohio, manufacturer of gears, has opened branch offices at New York and Chicago. At both cities it is the company's purpose to specialize in gears and pinions for electrical work. Harry F. Keegan, formerly with the Chicago surface lines, will manage the Chicago branch, with offices at 1241 First National Bank Building. His brother, John Keegan, will manage the New York end, with offices at Room 317, 30 Church Street.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, announces the removal of its Pittsburgh office to larger quarters at 707-709 Ferguson Building, still in charge of Don D. Gill.

THE FRANK B. COOK COMPANY, Chicago, has obtained a license from A. F. Daum to manufacture refillable fuses under Daum patents. Negotiations are under way with other firms for a similar license.

L. V. ESTES, INC., industrial engineer and accountant, for a number of years in the McCormick Building, has removed its offices to the Century Building, 202 South State Street, Chicago, occupying the entire fifteenth floor.

THE GENERAL DEVICES & FITTINGS COMPANY has moved its offices from the Mid-City Bank Building to 441 South Desplaines Avenue, Chicago, thus consolidating its warehouse, manufacturing establishment and offices under one roof.

THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago, announces the appointment of N. B. Stewart as district representative in charge of its St. Louis territory. Offices have been opened at 708 Merchants-Laclede Building, St. Louis.

A. P. ROYCE, formerly a lieutenant in the 108th Field Signal Battalion, U. S. A., has been appointed manager of the Detroit office of the Burke Electric Company. Before entering the army Mr. Royce was assistant sales manager of the Burke Company's office at Erie, Pa.

C. J. SKITTRALL, Dulwich Hill, Sydney, New South Wales, Australia, at present sales manager with Compton & Company, expects to engage in business as an electrical engineer and desires to represent American producers of motors, generators, transformers, cables, switchgear, fans, heating and cooking apparatus. Mr. Skittrall is experienced technically and practically in installation and managerial work.

THE PORTABLE ELECTRIC TOOL ASSOCIATION held its annual meeting in Cincinnati on April 24-25. In the discussions that ensued it was brought out that American manufacturers of portable electric tools would have to coöperate more closely to obtain a fair share of foreign business. Many requests for agency representations were reported, as were visits of European machinery importers with a view to making selling arrangements. That the outlook is good was the consensus of opinion.

F. W. ANDERSON, for six years in the Boston office of the Holtzer-Cabot Electric Company, will take up his new duties in New York about June 15 as sales engineer for this company. He will coöperate with Douglas Cairns in giving better and more extended service on motors under one horse power for labor-saving devices. Mr. Anderson was connected with the Westinghouse Electric & Manufacturing Company as a sales engineer on motors of the industrial type, joining the Holtzer-Cabot Company at Boston about 1913.

FIRST LIEUT. JOHN W. REED, of the Signal Corps, Engineering Research Division, Radio Development Section, Washington, will take up his new duties in June with the Holtzer-Cabot Electric Company, Roxbury, Boston. Mr. Reed will act as sales engineer and devote all his time to the specific application of fractional horsepower motors to various labor-saving devices. Mr. Reed has been with the Cutler-Hammer Manufacturing Company and with the Diehl Manufacturing Company of Elizabeth, N. J., where he broadened his experience in motors under 1 hp. in rating.

J. P. ALEXANDER, until recently resident agent for the General Electric Company at Trenton, N. J., has been transferred to the power and mining department of the office of the company in New York City. For five years previous to Sept. 1, 1910, when he joined the engineering staff of the General Electric Company at Pittsfield, Mass., Mr. Alexander was purchasing agent for the Wheeling (W. Va.) Traction Company. In 1912 he was transferred from the Pittsfield office of the General Electric Company to New York, and later was stationed in Trenton, where he established the office of resident agent in 1914. Mr. Alexander has been closely identified with the engineering development of the pottery industries of that section.

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THE FORD MICA COMPANY, INC., has moved its factory and offices to 14 Christopher Street, New York City.

THE TERRY STEAM TURBINE COMPANY, Hartford, Conn., announces the appointment of R. L. Thomsen as sales manager.

THE STANDARD ELECTRIC TOOL COMPANY of Cincinnati, Ohio, is reported to have completed the removal of its machinery to the new plant at York Street and Western Avenue.

THE WHITE LILY MANUFACTURING COMPANY, of which Sam T. White is president, has announced that it will spend $150,000 in erecting an addition to its washing machine factory at Davenport, Ia.

THE MARLIN-ROCKWELL CORPORATION, manufacturer of automobile accessories, is concentrating its plant at New Haven, Conn., and is also going to manufacture incandescent lamps, it is reported.

THE APPLIANCE MANUFACTURING & DISTRIBUTING COMPANY of Logansport, Ind., it is reported, is planning to remove to Peru, Ind., following an agreement made with the Peru Chamber of Commerce.

JOSEPH MYERSON, dealer in steam, electrical and power transmission machinery, announces that he has moved to large and more centrally located quarters at 411-413 Atlantic Avenue and 74 Purchase Street, Boston.

ALFRED N. PREMO, formerly with the New Engineering Company, Waterbury, Conn., has been appointed assistant manager of the Hartford (Conn.) Electrical Supply Company, one of the largest jobbers in the Hartford district.

M. G. CARHART and GEORGE B. CROSS, formerly with the Industrial Electrial Furnace Company, are now associated in the sale of the Detroit Electric Furnace Company's equipment, carrying the firm name of Carhart & Cross, 1401 Monadnock Block, Chicago.

H. B. BUSH of the Bush Electric Tool & Manufacturing Works, Redlands, Cal., writes that he is shipping his entire equipment to Cleveland, Ohio, where he is forming a new company to be known as the Bush Electric Manufacturing Company. A rapidly growing volume of sales made it necessary to have large factory space in the East. The company's temporary address is 6616 Morgan Avenue, Cleveland, Ohio.

THE VAN DORN & DUTTON COMPANY, Cleveland, Ohio, manufacturer of gears, has opened branch offices at New York and Chicago. At both cities it is the company's purpose to specialize in gears and pinions for electrical work. Harry F. Keegan, formerly with the Chicago Surface Lines, will manage the Chicago branch with offices at 1241 First National Bank Building. His brother, John Keegan, will manage in New York, with offices at Room 317, 30 Church Street. The latter comes from the Interborough Rapid Transit Company, New York.

MEYER, STRONG & JONES, INC., have succeeded to the engineering practice of Henry C. Meyer, Jr., and Bassett Jones, associated, and of William E. S. Strong. Mr. Strong was connected for many years with the American Radiator Company as chief engineer, and represented the Bankers' Trust Company, the Guaranty Trust Company and J. P. Morgan & Company in the construction of the buildings they now occupy. He was also connected with the export department of J. P. Morgan & Company and during the past year has been engaged in war work with MacArthur Bros. & Company, in connection with the United States Bag Loading Plant No. 2 at Woodbury, N. J. Mr. Meyer and Mr. Jones have been engaged in consulting work in New York City since 1903 and have been responsible for the mechanical, electrical and power equipments of many buildings and industrial plants, including the United States Military Academy at West Point, the Chelsea Piers in New York City, the Bloomfield Works of the General Electric Company, the Equitable, Bankers' Trust, Guaranty Trust and Morgan Buildings, and the naval operating base at Hampton Roads. Messrs. C. A. King, H. E. Meeker, H. F. Richardson and J. J. Ruckes, who have been associated with Messrs. Meyer and Jones for a number of years, will be in responsible charge of the work in the new organization. The new firm will act as consulting engineers for steam and electrical work, power plants, etc., and will have offices at 101 Park Avenue, New York.

Trade Publications

TABLE STOVE.—A folder about its electric table stove has been prepared by the Standard Stamping Company, Huntington, West Va.

PORTABLE CONVEYOR.—The Portable Machinery Company of Passaic, N. J., is circulating an illustrated folder that tells about the Scoop portable conveyor and its uses.

GRINDERS.—The Stow portable electric grinder and tool-post grinder are illustrated and cataloged in a leaflet prepared by the Stow Manufacturing Company of Binghamton, N. Y.

SOLDERLESS TERMINALS.—An illustrated folder about Meliorate solderless terminals is being distributed by the Standard Scientific Company, 70 Fifth Avenue, New York City.

INDUCTION REGULATORS.—Induction regulators, types J and J-2, are the subject of circular No. 31, which the States Company of 72 Francis Avenue, Hartford, Conn., has issued.

TACHOMETER.—The Van Sicklen-Elgin chronometric precision tachometer is completely explained in bulletin No. 81 from the Central Scientific Company, 460 East Ohio Street, Chicago.

LIGHTING FIXTURES.—"Eleco" adjustable lighting fixtures (Raymo patent) are the subject of a folder which the Elliott-Lewis Electrical Company of 1017 Race Street, Philadelphia, is distributing.

LIGHTING FIXTURES.—The Wheeler Reflector Company of 156 Pearl Street, Boston, tells about its new "1300" line of fixtures for lighting railroad properties with multiple "mazda C" lamps in schedule FB.

MINE-LAMP CHARGER.—The Edison electric safety mine-lamp charging equipment manufactured by the Mine Safety Appliances Company, 539 Fourth Avenue, Pittsburgh, Pa., is described in a leaflet of recent issuance.

MINE-LAMP HEADPIECE RACK.—The Mine Safety Appliances Company, Chamber of Commerce Building, Pittsburgh, Pa., has issued a leaflet telling about its Edison electric safety mine-lamp headpiece rack equipment.

SAFETY MINE LAMP.—The Edison electric safety mine lamp is the subject of bulletin 300 issued by the Edison Storage Battery Company, Orange, N. J., and the Mine Safety Appliances Company, 539 Fourth Avenue, Pittsburgh, Pa.

WASHING MACHINES.—"Seven Million Dollars Untouched" is the title of an interesting booklet issued by the Blue Bird Appliance Company, St. Louis, in which the possibilities of electric appliance sales are discussed for the electrical dealer.

STREET-LIGHTING FIXTURES.—Series Mazda street-lighting fixtures with porcelain receptacle heads and hooded or unhooded reflectors are described and illustrated in bulletin F of the Wheeler Reflector Company, 156 Pearl Street, Boston.

LIGHTING FIXTURES. — Industrial lighting and production are discussed in a booklet issued by the Henkel & Best Company, 122 South Michigan Avenue, Chicago, to describe its heavy-duty reflectors, "Factrylites" and shade-holder reflectors.

ICELESS REFRIGERATOR.—The "Frigidaire," a self-contained, automatically operated iceless refrigerator, is described and illustrated in an advertising folder got out by the Frigidaire Corporation of Detroit, Mich., and 1760 Broadway, New York City.

WASHING MACHINE.—"The Blue Bird Book" is the title of an exceptionally handsome booklet of twenty-one pages printed in colors and giving the features and advantages of the washing machine made by the Blue Bird Appliance Company, St. Louis, Mo.

ALTERNATING-CURRENT INSTRUMENTS.—The Pyroelectric Instrument Company, 636 State Street, Trenton, N. J., has issued circular No. 161 on alternating-current instruments and accessories, describing and listing the following pieces of apparatus: Northrup alternating-current galvanometer, a static swinging coil electro dynamometer, Compton quadrant electrometer, dry-cell potential sets, quartz fibers, variable standards of self and mutual inductance, standards of self-inductance, lamp and scale reflection indicator and telescope and scale.

ENTRANCE SWITCH.—The Trumbull Electric Manufacturing Company of Plainville, Conn., catalogs its new externally operated entrance switch No. 5741 in circular No. 43.

ELECTRIC RANGES.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., announces a new range part catalog covering type 3-19-B automatic electric ranges.

PULLEYS.—Pulleys, hangers, pillow blocks, arbor presses, reducing gears and revolving display tables are cataloged in a booklet issued by Winfield H. Smith, 10 Lock Street, Buffalo, N. Y.

FLOOR MACHINE.—The "Utility" floor machine for scrubbing, waxing, polishing and refinishing floors is told of in a circular which the Kent Vacuum Cleaner Company, Rome, N. Y., has recently printed and distributed.

PYROMETER.—The Northrup continuously deflecting pyrovolter, a pyrometer containing circuits for checking its indicators, is described in circular No. 15, which has been printed by the Pyroelectric Instrument Company, 636 East State Street, Trenton, N. J.

New Incorporations

THE RED SPOT BATTERY COMPANY of Nashville, Tenn., has been chartered with a capital stock of $5,000 by F. W. Gilbert, T. E. Gilbert, R. S. Pide, H. A. Robertson and DeWitt Chappell.

THE LAKE ERIE LIGHT & POWER COMPANY of Geneva-on-the Lake, Ohio, has been incorporated with a capital stock of $10,000 by G. H. Swan, J. Y. Hall, L. C. Spencer, Sidney Ramsey and H. B. Gregory.

THE WESTFIELD (N. J.) STORAGE & BATTERY COMPANY has been incorporated with a capital stock of $5,000 by Leo N. Berse of Plainfield, David Berse of Plainfield and Martin H. Cohen of New York City.

THE AMERICAN ELECTRIC FUSION COMPANY of Warren, Ohio, has been incorporated by A. R. Ackerman, Thomas F. Turner, Wendell Herbruck, H. W. Webber and G. Kellogg. The company is capitalized at $25,999.

THE CONTRA-POLE ELECTRIC COMPANY of Brooklyn, N. Y., has been incorporated by S. Mandell, S. T. Siegel and M. Greenberg. The company is capitalized at $100,000 and proposes to manufacture electrical apparatus.

THE GORDON ELECTRIC MANUFACTURING COMPANY of Waterbury, Conn., has been incorporated by Ira A. Seltzer, A. J. Smith and N. A. Neill. The company is capitalized at $75,000 and proposes to manufacture electrical devices of various kinds.

THE ROBERT PHILLIPS COMPANY of New York, N. Y., has been incorporated with a capital stock of $125,000 to manufacture electric and gas fixtures. The incorporators are H. E. Cook, J. and Robert Phillips, 101 Park Avenue, New York City.

THE ARTCRAFT CLOCK COMPANY of New York, N. Y., has been incorporated by Aaron Frankenburg, Max Teicher and H. Eliot Reid, 137 Joralemon Street, Brooklyn. The company is capitalized at $10,000 and proposes to manufacture clocks, electrical novelties, etc.

THE BEECH BOTTOM POWER CORPORATION of Wheeling, W. Va., has been incorporated by Allen E. Moore, George F. Jebbett and Alfred F. McCabe. The company is capitalized at $400,000 and proposes to construct and operate an electric power plant.

THE CUBA (N. Y.) ELECTRIC COMPANY has been incorporated with a capital stock of $50,000 to generate and distribute electricity for lamps, heaters and motors. The incorporators are Robert H. Bartlett, Harry E. Keller and George M. Bartholomew of Cuba.

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New England States

MANCHESTER, N. H.—Plans are under consideration by the Amoskeag Company, it is reported, for installing turbine wheels at the head of the lower canal and at the old paper mill of the P. C. Cheney Company on the west side of the Merrimac River, a short distance below Amoskeag Falls. Nothing definite has been decided upon.

AMSDEN, VT.—The Amsden Lime Company is reported to be contemplating equipping its lime quarries for electrical operation. Amsden has not a post office.

BROOKLINE, MASS.—The installation of an ornamental lighting system on Harvard Street, from Stearns Road to Babcock Street, and on Beacon Street, from Winchester Street to St. Paul Street, is under consideration by the Board of Selectmen.

HAMDEN, CONN.—The Yale Tire & Rubber Company, recently organized, is planning to erect a factory and power house on Dixwell Avenue in Hamden. J. E. Hubinger, 827 Main Street, New Haven, is president of the company.

PAWTUCKET, R. I.—Plans are under consideration by the Chamber of Commerce to secure a better lighting system for the center of the city.

Middle Atlantic States

BELMONT, N. Y.—Bonds to the amount of $10,000 have been voted to establish a municipal electric light plant in Belmont.

BROOKLYN, N. Y.—Plans have been filed by the Robins Dry Dock & Repair Company, 29 Beard Street, for alterations and improvements to its engine plants on Beard Street, near Otsego Street.

BUFFALO, N. Y.—Preliminary plans are being prepared by the Board of Supervisors of Erie County for the erection of a new penitentiary building to be located at Wende. The plans provide for a power house, refrigerating plant, dormitories, laundry and other structures. The cost of the project is estimated at about $1,000,000. Alonzo G. Hinckley, 29 City Hall, is clerk.

CENTRAL ISLIP, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until June 4 for construction of additional quarters for acute cases, including heating, sanitary and electric work, at the Central Islip Hospital, to cost about $150,000. L. P. Pilcher, Capitol, Albany, is state architect.

NIAGARA FALLS, N. Y.—Contract has been awarded by the Niagara Falls Power Company to the Read-Coddington Company, Portage Road, Niagara Falls, for the construction of an addition to its plant. The building will be about 65 ft. by 238 ft. and will cost about $160,000.

OSSINING, N. Y.—Bids will be received by Charles F. Rattigan, superintendent of state prisons, Room 618, Hall of Records Building, Centre and Chambers Streets, New York City, until June 17 for construction of mess hall and kitchen building (No. 4); detention building (No. 5); outside cell building (No. 7); clinic building (No. 8), including heating, sanitary and electric work; also for pump house and reservoir and two new 400-hp. water-tube boilers. Drawings and specifications may be consulted at the office of the warden of the above institution; at Room 618, Hall of Records, New York City, and at the Department of Architecture, Capitol, Albany. L. F. Pilcher is state architect.

ROME, N. Y.—Arrangements have been completed by the Rome Gas, Electric Light & Power Company for the purchase of property, consisting of about 11 acres of land, near Rome, to be used as a site for the erection of a new electric and gas plant. The company has been granted permission by the Public Service Commission to issue $245,164 in bonds for the construction of the proposed plant.

SYRACUSE, N. Y.—The Ward Brothers Company has purchased a site on Taylor, Burt, South, State and Grape Streets, on which it proposes to erect a baking plant, to cost about $250,000. E. J. Moore is local manager.

HOBOKEN, N. J.—Plans are being considered by the Navy Department, Washington, D. C., for the installation of an electric power plant to furnish electrical service for the operation of mechanical equipment and lighting, etc., of the three piers taken over by the United States government, heretofore owned by the Hamburg-American Line. Electricity has formerly been furnished by a private company. The cost of the proposed improvements is estimated at $2,500,000.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

JOHNSTON, PA.—Plans have been prepared by the board of directors of the Memorial Hospital for the construction of a two-story boiler plant and laundry at the nstitution. The building will be about 45 't. by 70 ft. and will cost with equipment about $50,000.

KINGSTON, PA.—Plans have been completed by the Kingston Coal Company for the installation of a quintuple electrically operated pumping unit, having a capacity of 3,000,000 gal. per day from a depth of 700 ft. Power will be furnished by a 500-hp. turbine. Contract has been awarded for machinery.

PITTSBURGH, PA.—The Duquesne Light Company is contemplating the erection of a condenser building and switching plant at Woodville, to cost about $10,000.

PITTSBURGH, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 16 for furniture, lighting fixtures, etc., for the United States post office and court house at Pittsburgh, Pa. For details see Searchlight Section.

WAYNESBORO, PA.—Preliminary work has been started by the Waynesboro Electric Company for the erection of a high-tension transmission system from the present terminus at Blue Ridge Summit to Greenstone via the Monterey and Charmain districts, a distance of 2 miles. The proposed line will furnish energy for stone-crushing operations and other industrial plants.

BALTIMORE, MD.—Bids will be received at the office of the city registrar, City Hall, Baltimore, Md., until June 11 for furnishing and erecting one 25-kw. and one 15-kw. turbo-generator set and switchboard for the Mount Royal pumping station. Specifications may be obtained at the office of Walter Lee, water engineer, City Hall, after May 23. A deposit of $5 will be required for each set of specifications.

SPENCER, W. VA.—The installation of a municipal electric light plant is under consideration by the City Council.

WELCH, W. VA.—The Welch Armature Company, it is reported, is contemplating the construction of a new plant. The company recently increased its caiptal stock from $5,000 to $25,000.

WHEELING, W. VA.—Bids will be received until May 31, by S. G. Smith, receiver of the Benwood-McMechen Consolidated Water Company, for two motor-driven centrifugal pumps. Specifications, etc., may be obtained upon application to Leo Hudson, engineer, 8001 House Building, Pittsburgh, Pa.

CHARLOTTESVILLE, VA.—The plant of the Briggs Electrical Company was recently destroyed by fire, causing a loss of about $12,000.

WASHINGTON, D. C.—The Public Utilities Commission has authorized the Potomac Electric Power Company to issue $1,750,000 for extensions and general improvement work.

North Central States

DETROIT, MICH.—The Stecker Electric & Machine Company is contemplating the construction of a new factory building.

KINDE, MICH.—The Council has awarded a contract to the Electric Supply Company, 107 South Water Street, Saginaw, for the installation of an electric lighting system in Kinde, at $10,000.

SAGINAW, MICH.—The Saginaw Malleable Company is planning to double the output of its plant. One addition is under construction and two more units will be built, at a cost of about $275,000. The company is a subsidiary of the General Motors Company.

BELLEVUE, OHIO.—Bids will be received at the office of the director of public service, Bellevue, until June 5 for construction of reservoir, low service pumping station and furnishing and installing two gas-engine-driven centrifugal pumping units, each having a capacity of 5000 gal. per minute. William G. Clark, Spitzer Building, Toledo, is consulting engineer.

HAMILTON, OHIO.—Work, it is understood, will soon begin on the construction of the power plant in connection with the tractor plant of Henry Ford & Son at Hamilton.

OBERLIN, OHIO.—An election will be held May 27 to submit to the voters the proposal to issue $50,000 to establish a municipal electric light and power plant in Oberlin.

PIQUA, OHIO.—Plans, it is reported, are being prepared by the J. J. Wernette Engineering Company for a 1000-hp. power plant for the Orr Felt & Blanket Company in Piqua.

PIQUA, OHIO.—The J. J. Wernette Engineering Company, it is understood, is preparing plans for an addition to the power house of the French Oil Machinery Company in Piqua.

PORT CLINTON, OHIO—The City Council has awarded the Port Clinton Electric Light & Power Company a contract to supply electricity to maintain the new lighting units to be installed in the lake front section.

PAINTSVILLE, KY.—The Wells-Elkhorn Coal Company, recently incorporated, is planning to install three power plants and to equip three mines with motor-driven machinery. The company would like to receive proposals from manufacturers and dealers in equipment and machinery for electrical and steam plants and mining machinery. Further information may be obtained from C. O. Messenger, general manager, Paintsville.

PIERCETON, IND.—The Pierceton Light & Water Company has petitioned the Public Service Commission for permission to issue $35,000 in capital stock, the proceeds to be used for to make improvements, etc.

CHICAGO, ILL.—The question of equipping the Illinois Central Railroad lines within the city liimts for electrical operation is under consideration by the City Council. Plans for carrying out the project will be submitted to the Council by the railroad and city engineers.

DECATUR, ILL.—The Decatur Railway & Light Company has purchased a site on Wood Street, on which it will erect new barns and city shops.

DELAVAN, ILL.—The Royal Light & Power Company is contemplating the erection of an electric transmission line from Delavan to San José.

QUINCY, ILL.—The Quincy Railway Company has entered into a contract with the Mississippi River Power Company to supply energy for its system.

GREEN BAY, WIS.—The Green Bay Drydock Company is being organized by local business men headed by Carl Hartmann. The company will be capitalized at $500,000 and proposes to construct a new floating drydock, 630 ft. long. It will be built in four sections and will be equipped with electrically operated machinery.

PORT WASHINGTON, WIS.—The Council is considering an issue of $30,000 in bonds for extensions to the municipal electric light and power plant, including the installation of an additional steam generating equipment.

DULUTH, MINN.—The Great Northern Power Company is installing a 15,000-hp. generating unit at its plant, increasing the total output to 75,000 hp.

RED WING, MINN.—Bonds to the amount of $350,000 have been voted for the construction of a municipal electric light plant.

STACYVILLE, IOWA.—J. A. Weber, it is reported, is contemplating the construction of a dam and power plant in Stacyville. The Power Engineering Company, Corn Exchange Building, Minneapolis, is engineer.

WAPELLO, IOWA.—Bids will be received by the Muscatine-Louisa Drainage District No. 13, at the office of the county auditor of Louisa County, Wapello, until June 10, for a steam-driven pumping plant, containing one 36-in. and one 24-in. suction centrifugal pump, and for building to house the plant. The Elliott & Harman Engineering Company of Peoria, Ill., has charge of the engineering work.

ST. LOUIS, MO.—Plans are being prepared by the Manufacturers' Railway, 2925 South Broadway, St. Louis, for changing its switching system from steam to electricity. The work consists of the installation of poles, trolleys, transformers and the erection of 24 miles of transmission line.

EMERSON, NEB.—An election will be held on May 28 to submit to the voters the proposal to issue $20,000 in bonds for the installation of a municipal electric light plant.

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PLYMOUTH, NEB.—Arrangements are being made by local business men for the erection of an electric transmission line from Plymouth to Beatrice to secure electricity for the town, which has been without electrical service for a number of years. Harry Gerhardt of Plymouth is interested in the project.

WEST POINT, NEB.—Plans are under consideration for the construction of a hydroelectric plant on the Elkhorn River, 3 miles from West Point, to supply electricity here.

CLAYTON, KAN.—Bonds to the amount of $10,000 have been voted for the erection of an electric transmission line from Clayton to Norcatur to supply electricity here.

TOPEKA, KAN.—Contracts, it is reported, will be awarded by the State House committee on May 27 for improvements to the State House light and heating plant. Further information may be obtained of the secretary of the building committee.

Southern States

BENSON, N. C.—Contract has been awarded by the city of Benson to Tucker & Laxton of Charlotte for the construction of an electric light plant. The plans call for the development of 200 hp., to cost about $40,000. Gilbert C. White of Durham is engineer.

HICKORY, N. C.—The Hickory Electric Company is planning to erect an exchange building in Hickory. A. A. Shufford, Jr., is manager.

NASHVILLE, N. C.—Bids will be received until June 2 by the Board of Commissioners of Nash County for construction and improvement, lighting and heating of the Nash County courthouse. J. B. Boddie is clerk of board.

CORNELIA, GA.—The Wofford Shoals Light & Power Company is considering enlarging its plant and extending its transmission lines to nearby towns.

FORT GAINES, GA.—The Georgia-Alabama Power Company, it is reported, has purchased property, including several acres of land on Pataula Creek, and contemplates a hydroelectric development involving an expenditure of about $200,000. Electricity generated at the proposed plant will be transmitted to Fort Gaines, Ga., Eufaula, Fla., and probably other cities. Dermott Shemwell of Lexington, N. C., is president.

SARASOTA, FLA.—Bids will be received by the city of Sarasota at the office of the city clerk until June 9 for furnishing and installing three internal combustion engines, fuel oil as motive power, two of 150 hp. and one of 100 hp., directly connected to generators and exciters. Air to be furnished in accordance with underwriters' specifications; two compressors, complete circulating system, switchboard, two three-stage rotary pumps, with 25 ft. suction and against a 350 ft. head, to have a capacity of 500 gal. per minute each. Motors 75 hp., 220 volts, three-phase, 60 cycle, slip ring type, all on one C. I. base. Wilbur A. Ginn is engineer in charge.

KINGSPORT, TENN.—The Holston River Power Company, recently organized, contemplates the construction of dams on Holston River in Sullivan County, above Kingsport, and on Watauga River in Washington County. Dam sites have been secured 3 to 10 miles from Kingsport, and 10 to 20 miles from Johnson City and Bristol. The plans provide for a development of 100,000 hp. Electricity generated at the proposed plant will be transmitted to Kingsport, Johnson City, Bristol and other nearby cities in Tennessee and Virginia. The cost of the project is estimated at $5,000,000. James B. Cox of Johnson City is president, and F. M. Butler of Orbisonia, Pa., is engineer.

MEMPHIS, TENN.—Bids will be received at the office of the district engineer, Mississippi River, Memphis, Tenn., until June 20 for furnishing three water-tube boilers for U. S. dredge Pappa. Further information may be obtained on application to district engineer, P. O. Box 1017, Memphis.

SNEEDVILLE, TENN.—Plans are under consideration for the construction of a hydroelectric plant on Clinch River at the Auger in Hancock County, to develop about 4000 hp. Electricity generated at the plant will be used to operate a proposed electric railway. The transmission system will extend from Morristown to Moorsburg, Treadway, Sneedville and Kyle Ford. The cost is estimated at $1,500,000. John N. Adams, chemical engineer, Charleston, Tenn., is interested in the project.

BELZONI, MISS.—Either a 150-hp. boiler or a 75 to 100-hp. crude-oil engine will be installed in the municipal electric light plant within the next 60 days. J. J. Sisloff is superintendent.

TAHLEQUA, OKLA.—Estimates of the cost of a dam on the Illinois River to supply power for the proposed municipal electric light plant will be submitted to the Council in the near future. It is estimated that 1000 hp. could be developed. Investigations are being made by Prof. Gladstone of the Arkansas University.

CAMP TRAVIS, TEX.—Bids will be received at the office of the constructing quartermaster, Mexican Border Project, Camp Travis, until June 2, for construction of approximately 997 adobe and brick buildings, water and sewer lines, wiring, etc., at approximately 30 posts and camps along the Mexican border in Texas, New Mexico and Arizona. Plans, specifications, etc., may be obtained upon deposit of $50.

BRIDGEPORT, TEX.—Steps, it is reported, have been taken by Harry Hardy to organize a company to construct and operate an electric light plant and ice factory in Bridgeport.

GONZALES, TEX.—The Gonzales Water Power Company is contemplating installing additional machinery at its hydroelectric power plant, to cost about $80,000.

GROVETON, TEX.—The property of the Groveton Light & Ice Company has been purchased by Hayne Nelms and associates. New machinery, it is understood, will be installed.

STEPHENVILLE, TEX.—The Texas Power & Light Company of Dallas has purchased the local electric light and transmission system at Stephenville. The company plans to extend its transmission system from Brownwood plant to Stephenville. Improvements, including the installation of additional machinery, will be made.

Pacific and Mountain States

SEATTLE, WASH.—Work has started on the construction of the first two pontoons of an 18,000-ton drydock at the shipyard of the Ames Shipbuilding & Drydock Company. Six pontoons will be built, each having a lifting capacity of 3000 tons each. Electrically driven pumping equipment will be installed. T. A. D. Jones is general manager.

SEATTLE, WASH.—The Western Coke & Collieries Company has engaged Herbert C. Moss of the Standard Electric Company of Seattle as consulting engineer in connection with developing large coal areas near Snoqualmie. The company contemplates the installation of an electric locomotive and hauling system, an aero tramway, compressor fans and other coal-mine equipment.

SEATTLE, WASH.—The City Council has appropriated $20,000 for the further drilling operations at George Creek in connection with investigations of the Skagit power project.

WENATCHEE, WASH.—The Okanogan Valley Power Company will soon begin work on construction of a dam and power plant on the Similkameen River, a short distance below its present power house. The new plant will have a generating capacity of 5000 hp.

KLAMATH FALLS, ORE.—The plant of the Big Lakes Box Company has been closed for repairs and improvements. An addition will be erected and electrically operated machinery installed. A sawdust and shavings burner system, to cost $10,000, will be installed.

MARSHFIELD, ORE.—The Mountain States Power Company is planning to rebuild the Dutch ovens under the power plant boilers at Smith Mill. A. L. Martin is manager.

CALEXICO, CAL.—An election will be held May 27 to vote on the proposal to issue $160,000 for a municipal electric plant and $165,000 for a municipal gas plant.

COVINA, CAL.—The board of directors of the Covina Citrus Association has authorized an expenditure of $140,000 for the erection of a new precooling plant and packing works. Considerable electrical and mechanical equipment, including fans and blowers, industrial motors, refrigerating and ice-making apparatus, conveying and hoisting machinery and other appliances, will be installed. W. W. Bennett is manager.

FRESNO, CAL.—Arrangements, it is understood, are being made by Umbsen, Kerner & Elsert of San Francisco, for the construction of a large reservoir and dam on Chowchilla River, near Fresno, to be used for irrigation purposes. The cost of the project is estimated at about $300,000. O. L. Markley is local representative of the company.

FRESNO, CAL.—Plans are being prepared by the San Joaquin Light & Power Company for the erection of a new substation and shops at a location on the west side of the Southern Pacific tracks, extending from Divisadero to Belmont Street. The present substation at Fresno and N Streets will be abandoned.

LOS ANGELES, CAL.—Bids, it is reported, are being asked by the Keystone Iron Works, Merchant National Bank Building, Los Angeles, for the construction of its new plant on Santa Fé Avenue, consisting of foundry, office building and a warehouse and service. The foundry will be equipped with furnaces and three electrically operated cranes.

LOS ANGELES, CAL.—An agreement has been reached between the City Council and the Southern California Edison Company whereby the latter has agreed to sell its electric distributing system to the city for $11,000,000. The proposed purchase contract will be submitted to the voters at the general election to be held on June 3. Under the terms of the contract it is provided that the company shall have the option to purchase, at rates fixed by the Railroad Commission, all surplus power generated by the city for a period of fifteen years.

OAKDALE, CAL.—The Sierra & San Francisco Power Company is considering plans for the construction of new reservoirs, which will more than double its storage capacity, part of which will be used for irrigation purposes. H. F. Jackson, 58 Sutter Street, San Francisco, is general manager.

PORTERSVILLE, CAL.—Plans are under consideration by the City Council for the establishment of a municipal electric light plant.

MACKAY, IDAHO.—The Public Utilities Commission has granted the Mackay Light & Power Company a certificate of convenience and necessity to furnish electricity for the entire Lost River Valley. The company will extend its service to the towns of Arco, Moore, Leslie and other places in the valley. The cost is estimated at about $50,000.

PHOENIX, ARIZ.—A company is being organized by the Phoenix Wholesale Meat & Produce Company, Fifteenth Avenue and River Street, and the Tribolet Packing Company of Bisbee, for the purpose of erecting a packing plant in Phoenix, to include a refrigerating and ice-manufacturing plant.

RED LODGE, MONT.—The Northwestern Improvement Company is contemplating the installation of a generating unit and condenser at its power plant, increasing the output by about 300 hp.

Canada

NANAIMO, ONT.—The Nanaimo Electric Light, Power & Heating Company has applied to the Minister of Lands for permission to divert, store and distribute water from the Millstone River. William Lewis is secretary.

WALKERVILLE, ONT.—General contract for the construction of the new plant for the General Motors Corporation, 88 East Congress Street, Detroit, Mich., at Walkerville, has been awarded to W. E. Wood & Company of Canada, 103 Sandwich Street, Windsor, Ont. The cost of the plant is estimated at $6,000,000.

MONTREAL, QUE.—Arrangements are being made for equipping the railway system of the Montreal harbor for electrical operation.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until May 31 for boiler tubes, copper wire, steel rope, cable clips, bronze springs, gasoline tractor and trailers, battery cells, oilers, etc. Blanks and information relating to this circular (1278) may be obtained at the above office, and at the office of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

CAVITE, P. I.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until May 26 for furnishing and installing equipment for power plant at the local naval station. The cost is estimated at $90,000. Specification 3871.

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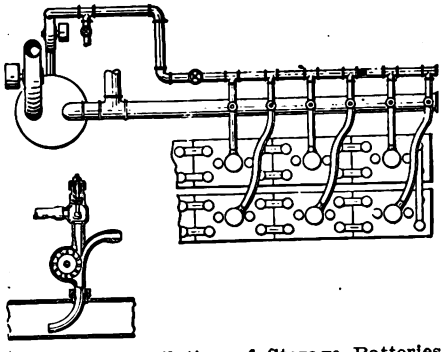
(Issued May 6, 1919)

1,293,100. AUTOMOBILE; Merion J. Huggins, New York, N. Y. App. filed March 27, 1916. Electric speed-controlling mechanism.

1,293,314. STARTING AND LIGHTING SYSTEM FOR AUTOMOBILES; William L. Bliss, Niagara Falls, N. Y. App. filed May 13, 1914. Generator effective at low speeds.



1,302,648—Ventilation of Storage Batteries

1,293,573. MOUNTING FOR ELECTRIC GENERATORS; Ira T. Swartz, Indianapolis, Ind. App. filed Oct. 22, 1917. Self-centering.

1,293,646. POWER-TRANSMISSION MECHANISM; Cyrus B. Kurtz, Lakewood, Ohio. App. filed May 22, 1915. Two electric units in combination with differential mechanism between the engine and the driven shaft.

1,302,603. SECONDARY CLOCK; Alfred L. Sohm, Chicago, Ill. App. filed May 21, 1917. Step-by-step mechanism.

1,302,604. SECONDARY-CLOCK SYSTEM; Alfred L. Sohm, Chicago, Ill. App. filed May 21, 1917. Proof against double or false impulses.

1,302,605. SECONDARY CLOCK; Alfred L. Sohm, Chicago, Ill. App. filed May 21, 1917.

1,302,616. AUTOMATIC TABULATING MACHINE; Robert N. Williams, London, Eng. App. filed May, 1915. Adding mechanism is operated by perforated cards.

1,302,618. WARNING SIGNAL; John M. Witmer, Lancaster, Pa. App. filed June 11, 1917. Also indicates direction of vehicle.

1,302,622. CONTACT MEMBER FOR VIBRATING CURRENT-CONTROLLING REGULATORS; Vincent G. Apple and Jesse G. King, Dayton, Ohio. App. filed April 23, 1917. Maintains its contact uniformly.

1,302,648. VENTILATION OF STORAGE BATTERIES; Louis H. Flanders, Jenkintown, Pa. App. filed May 10, 1917. Keeps them properly cooled.

1,302,674. CLAMPING DEVICE; Hubert F. Krantz, Brooklyn, N. Y. App. filed Feb. 24, 1913. Suitable for various types of terminal members of switches.

1,302,715. SIGNALING INSTRUMENT; Lloyd B. Salt, Dedham, Mass. App. filed Dec. 24, 1917. By means of light flashes or sound waves.

1,302,736. SAFETY SWITCH; Ira C. Vincent and Barzillai Vincent, Brilliant, Ohio. App. filed Jan. 5, 1916. Disconnecting for arc lamps.

1,302,767. TELEPHONE-EXCHANGE SYSTEM; Henry P. Clausen, Mount Vernon, N. Y. App. filed Dec. 17, 1918. Night-alarm service system.

1,302,787. SOCKET FOR INCANDESCENT ELECTRIC LAMP HOLDERS; Alexandre Gourju, Lyons, France. App. filed Oct. 23, 1918. All the metal parts comprised in it can be cut without any loss.

1,302,788. ELECTRIC FURNACE; Henry Arnold Greaves and Harry Etchells, Sheffield, Eng. App. filed Feb. 12, 1919. Three-phase balanced load obtained with two upper and one lower electrode.

1,302,795. MANUFACTURE OF CARBONS FOR ELECTRIC ARC LAMPS; Walter Heape, London, Eng. App. filed March 26, 1919. Salt of calcium is used.

1,302,796. INSULATOR; Thomas J. Heard, Wilson, Kan. App. filed May 15, 1918. Means for easily attaching wire.

1,302,808. TELEPHONE-EXCHANGE SYSTEM; Charles W. Keckler, Newark, N. J. App. filed Nov. 5, 1917. Periodically interrupted signaling current is impressed upon the called line.

1,302,809. TELEPHONE-EXCHANGE SYSTEM; Charles W. Keckler, Newark, N. J. App. filed May 11, 1918. Expedites handling of connections.

Record of Electrical Patents

Notes on United States Patents

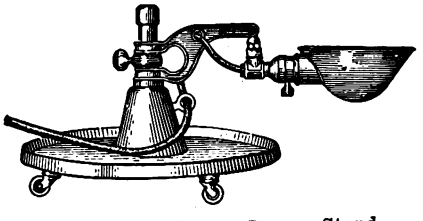
1,302,811. ELECTRICAL CONDUIT INSTALLATION; Homer G. Knoderer, Edgeworth, Pa. App. filed Oct. 3, 1917. Connects two parallel molding conduits in planes at right angles to each other.

1,302,817. ELECTRIC CONTROLLING MEANS; Harry W. Leonard, Bronxville, N. Y. App. filed Oct. 12, 1915. Utilizes vibratory contacts for controlling a winding.

1,302,824. ELECTROLYTIC CELL; Clarence W. Marsh, Greenwich, Conn. App. filed July 14, 1917. Vertical-type cell.

1,302,847. ELECTROMAGNETIC CIRCUIT INTERRUPTER; Harlie O. Putt, Elkhart, Ind. App. filed Dec. 28, 1917. Automatically "times" itself to the peak of the primary current wave regardless of the direction of rotation or speed of magneto.

1,302,851. AUTOMATICALLY RECLOSING CIRCUIT-BREAKER MECHANISM; Estelle C. Raney, Columbus, Ohio. App. filed Oct. 12, 1915. Automatically adapts itself to operate properly.



1,303,061—Portable Lamp Stand

1,302,855. ENGINE GOVERNOR; William Robbins and Harry F. Bryan, Chicago, Ill. App. filed March 12, 1917. Prevents driver from exceeding a predetermined rate.

1,302,871. DISPOSITION OF INFLAMMABLE GASES; Alfred Spice, Jersey City, N. J. App. filed Nov. 10, 1917. Gas burned regardless of the volume.

1,302,887. COMMUNICATION-RECEIVING APPARATUS; Maxmilian Weil, N. Y. App. filed Oct. 19, 1916. Effects complete seal between the receiver and the acoustic passage.

1,302,895. NEGATIVE ELECTRODE FOR SEARCHLIGHTS, PROJECTORS AND THE LIKE; Carl Buchwald, Berlin, Germany. App. filed April 1, 1912. Hard and soft carbon cores embedded in refractory electrode.

1,302,916. ELECTROMAGNETIC CURRENT LIMITER; Trygve Gudem, Christiania, Norway. App. filed March 27, 1918. Takes up and equalizes current shock.

1,302,945. ROTARY RECTIFIER OF ALTERNATING CURRENTS; Constantine D. Macropoulos, New York, N. Y. App. filed Sept. 23, 1918. Comprises a series of insulated disks in electrical connection with insulated collector rings.

1,302,946. ROASTING APPARATUS; William J. Malcolmson, Cicero, Ill. App. filed Aug. 3, 1917. For continuously roasting granular carbon.

1,302,959. PRODUCTION OF ELECTRODES; William K. Page, Chicago, Ill. App. filed Jan. 10, 1916. Insoluble in the electrolyte.

1,302,968. SWITCH FOR ELECTRIC FIRING DEVICES; John N. Powers, Washington, D. C. App. filed June 7, 1916. Instantaneous.

1,303,001. TELEPHONE-EXCHANGE SYSTEM; Ray S. Wilbur, Jersey City, N. J. App. filed June 11, 1917. For controlling the application of signaling current.

1,303,006. ELECTRICAL FIXTURE; Willard J. Allphin, Portland, Ore. App. filed Oct. 5, 1917. Pair of conductors may be tapped or connected to pair of circuit wires.

1,303,007. ELECTRIC BRAZING SWITCH; Peter F. Alzmann, Brooklyn, N. Y. App. filed Sept. 24, 1917. For soldering.

1,303,032. FIREARM; Wheeler D. Cortner, Osawatomie, Kan. App. filed Jan. 22, 1919. Electrical hammer-operating means.

1,303,036. TELEGRAPH SYSTEM; George C. Cummings, East Orange, N. J. App. filed Oct. 23, 1918. Repeater service.

1,303,047. SYNCHRONIZING MEANS FOR MOTION-PICTURE PROJECTORS AND SOUND-REPRODUCING MECHANISMS; Charles W. Ebeling, New York, N. Y. App. filed Sept. 14, 1914. Sound-reproducing mechanism will automatically control motion pictures.

1,303,056. MACHINE-SWITCHING TELEPHONE SYSTEM; Alfred E. Hague, New York, N. Y. App. filed Oct. 30, 1917. Prevents false setting or actuation of selective switches through the accidental transmission of a single impulse.

1,303,061. PORTABLE LAMP STAND; William D. Herwig, Jr., Chicago, Ill. App. filed July 6, 1918. Easily moved and adjusted.

1,303,068. POCKET-LAMP GENERATOR; Oskar Junghans, Schramberg, Germany. App. filed Oct. 10, 1916. Magnet is combined with plates to constitute the casing.

1,303,084. CROSS-BAR LINE SWITCH; Frank A. Lundquist, New York, N. Y. App. filed Nov. 27, 1916. Interconnection between incoming and outgoing lines.

1,303,086. ELECTRIC CIRCUIT CLOSER FOR AUTOMOBILES; Sidney B. Lust, Washington, D. C. App. filed Oct. 9, 1918. Electric horns on automobiles are caused to sound when brakes are applied.

1,303,096. ELECTRIC LIGHT SOCKET; Helmuth Melaun, Indianapolis, Ind. App. filed Oct. 30, 1918. Base is provided with a pair of oppositely extending pins.

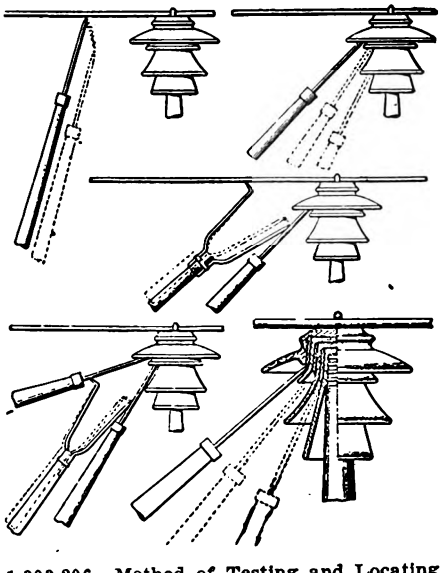
1,303,146. ELECTRICAL MEASURING INSTRUMENT; Harold G. Applegarth and Harold B. Taylor, Wilkinsburg, Pa. App. filed Sept. 10, 1915. For measuring the total volt-amperes traversing one or more electric circuits.

1,303,161. ELECTRIC SWITCH; John F. Cavanagh, Meriden, Conn. App. filed March 30, 1918. Simple tumbler switch.

1,303,162. SPARK COIL; John F. Cavanagh, Meriden, Conn. App. filed Aug. 15, 1918.

1,303,183. PHONOGRAPH TRANSMITTER; Henry C. Egerton, Passaic, N. J. App. filed March 13, 1916. Highly efficient magneto-inductive current generating system.

1,303,184. METHOD OF AND APPARATUS FOR CONTROLLING ELECTRICAL ENERGY; Cornelius D. Ehret, Philadelphia, Pa. App. filed Dec. 29, 1917. By thermionic or electronic action occurring in connection with an audion, pliotron, vapor electric apparatus and the like.



1,303,206—Method of Testing and Locating Defective Multiple-Part Pin-Type Insulators

1,303,188. PUSH-BUTTON ATTACHMENT FOR STEERING POSTS; Eugene D. Ferrell Wayzata, Minn. App. filed Jan. 22, 1917.

1,303,206. METHOD OF TESTING AND LOCATING DEFECTIVE MULTIPLE-PART PIN-TYPE INSULATORS; Tomlinson F. Johnson, Jr., Atlanta, Ga. App. filed Oct. 31, 1918. Can be used without interruption of service.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 — New York, Saturday, May 31, 1919 — *Number* 22

European Industry Needs a Helping Hand

FRANK A. VANDERLIP, a master mind in American finance, has brought to this country straight from Europe a heart-rending story of industry in an appalling state of disorganization. To all American industries the conditions bear a definite significance. Opportunities for the electrical industry are not wanting. Already there have been proposed by a prominent French concern two very definite and practical ways to assist in building up the industrial activities of France to the mutual advantage of both French and American manufacturers. One way is to establish agencies in Europe that will not only represent American mechanical and electrical manufacturers but handle the necessary credit, a problem of great importance, for credit is the greatest need of European buyers. Another way is to organize companies for renting American industrial equipment. Manufacturers of hydroelectric equipment certainly should lose no time in getting acquainted with the conditions in Italy and France. Coal is scarce in both countries, but water power is abundant in the mountain sections. By harnessing these powers we confer a lasting benefit on both countries and conserve the coal supply of the world. Power for their industries both need and must have, but it is short-sighted to ship coal, of which there is not an overabundance, when water power is available. We are just beginning to appreciate that lesson in the United States, and it has been partly learned by both France and Italy during the war. The scheme of developing the water powers of the Pyrenees and the Alps tried in the emergency of war should be carried through to fruition. American electrical engineers and manufacturers can aid in this work, and during the present crisis that aid becomes an obligation.

One reason for public displeasure over government telephone service is fundamental. You take what is given by an inexorable, impersonal system; if you do not like it, there is no real recourse. In private company operation, one can appeal over the head of the offending employee to his superior; you find a personality somewhere; but even if you fail there the all-powerful state regulating commission will function.

Hydro-Alternators Rated at 32,500 Kva. for Niagara

IT IS not so many years since the building of a 1000-kva. alternator, or one megawatt machine, was justly hailed as an epoch-making achievement. It is now announced that three alternators, each of 32,500 kva., or 32.5 megavolt-amperes, are under construction for helping to harness Niagara Falls. An interesting outline of the engineering features of one of these alternators is presented this week by W. J. Foster. Each field pole, with its winding, will weigh 3 metric tons. The cooling air is to be taken from the dynamo room, passed through the machine, and driven into a large ventilating casing, whence it can either be discharged out of doors or returned to the building. The machine is required to have the highest efficiency yet attained in hydro-alternators, yet one of the principal engineering problems of design has been to remove waste heat.

We hope that when these three machines are put into service a careful test may be made of their electrical and mechanical behavior, and that the results of the tests may be communicated to the American Institute of Electrical Engineers in such a manner as to eliminate any tendency to commercial rivalry.

The more "year-round" electrical products we can develop the better for the industry. Domestic appliances are rapidly being removed from the seasonal class by far-sighted merchandisers. While there seems little chance of establishing a horizontal or upward straight-line output in sales department work throughout the year, cultivation of the field and taking advantage of economic conditions will accomplish much.

Are They Prepared to Strike?

WE NOTE with regret that a large body of technical experts in the employ of various government bureaus have felt it necessary to unionize in order to protect their interests. It is a sorry fact that scientific men in the service of the government are ill paid. During the war they have had no relief and more hard work than ever, which has been creditably accomplished. Several instances have been cited in which investigations, for instance in the Bureau of Standards, have saved the government from being done out of very large sums by investigations which probably any well-trained engineer could have made but which would not have been committed to the proper technical care had the bureau not been at hand. We feel especially for the bureau, since it has done a large amount of admirable electrical work in spite of being continually robbed of some of its best men, hired away from it by large private institutions who are glad to pay more than the government is disposed to appropriate. Doubtless, too, the bureau will suffer more than some of the other departments from the coming of peace, inasmuch as war conditions compelled its activities to be spread over a range which will be perhaps neither feasible nor desirable at other times. Nevertheless, it is a shame that such inadequate salaries should be paid to thoroughly competent investigators. We do not feel that we are in the least exaggerating their importance in advocating

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for the active heads of technical bureaus at least the salary of a humble congressman, and it assuredly is bad policy to pay assistants so inadequately that they are forced in self-defense to welcome other positions. In this country, of course, an institution like the Bureau of Standards cannot in the nature of things be accorded the wide authority that can be given for instance to the British National Physical Laboratory, for the states are jealous of their local prerogatives and most of them are equipped with state universities amply competent to deal with most of the problems which otherwise might be turned over to a national institution. Even so, it certainly is a scandal that men of the known competence of some of the heads of the national technological departments should be so poorly paid, and that many of their subordinates, charged with large responsibilities, should be struggling to get along with barely the salary of an assistant professor in some country institution. Living conditions in Washington, where these faithful men have to work, are notorious, and unless something is done to relieve the situation there will be, not a strike probably, but a gradual exodus of talent which will seriously handicap the efficiency of all the departments concerned.

It is easy to exaggerate the influence of overhead charges to a point which blocks needed development of industry. Fixed costs, so called, diminish per unit of output as production grows, and it is often within the power of efficient management to overcome the effect of a fairly high overhead by reducing unit operating expenses. Let there be no hesitation to put funds at work where economical mass production appears feasible.

Progress in Prime Movers

AS USUAL, the report of the committee on prime movers of the National Electric Light Association, which was abstracted in last week's issue, contains much valuable material. To a certain extent the war has checked the normal course of developments in some lines and actually hastened it in others. That part of the report which deals with the prime movers themselves refers particularly to size of units, a subject which has frequently been discussed heretofore. That the rating of the big generating sets in large stations has steadily increased is a matter of common knowledge. The main question is, what is the maximum size of unit that can be employed to advantage? This, of course, depends on the whole capacity of the station concerned. We recently described a 70,000-kw. composite unit, the largest yet recorded, but a single-shaft set of 45,000 kw. rating is already in service, and the end perhaps is not yet. For very large ratings the composite unit, coupled together electrically only, is very likely the coming form, combining as it does large output at very high efficiency with a considerable amount of intrinsic reserve in case of accident. The tables prepared by the committee show that in many cases a single generating set may comprise 25 per cent or more of the total generating capacity, and the question of reliability therefore looms large. It is the judgment of the committee that the records of the big machines already in service indicate that the policy of intrusting at least a quarter of the load to one unit is not an unwise one. The difficulties in these large sizes appear from the records to be almost entirely mechanical. While there have been a number of accidents, the outlook seems to be for a decided reduction of difficulties as experience is gained with the larger sizes accompanied by a degree of security equal to that found with machines of lesser output.

The great opportunity for improvement in the operation of turbo-generator plants seems at present to lie back of the turbine itself, which is progressing faster than its supply equipment. There is a strong tendency toward higher boiler ratings in recent plants, and with this comes the necessity to which we have often referred of getting back to improvements in furnace and stoker design as the last resort in economy. Essentially the steam plant up to the turbine is the place where the maximum improvement from the dollars-and-cents standpoint can be made. The turbine itself is a wonderfully efficient machine within the temperature limits for which it is designed. Between it and the coal pile there are ample opportunities for gain. Very great boiler ratings can be obtained by low ratios of heating surface to grate surface, and beyond this there must be facilities for efficiently burning, through a suitable adjustment of furnace capacity, grate capacity and draft, the requisite amount of fuel to maintain a high average efficiency over a rather wide range of steam demand. The quality of the fuel is another vital factor, and a suitable water supply is equally necessary to the best performance of the boilers. Generally, therefore, the best boiler ratings and performance are obtained by plants equipped with surface condensers where the minimum trouble with bad water is found.

Aside from the furnaces and boilers as such, the greatest gain in economy comes in increasing the temperature range in the prime mover proper and hence raising its thermodynamic efficiency. Herein are concerned the two allied questions of boiler pressure and superheating. The superheater design has not been considered as fully in this country as it should have been, practice having been confined in the past to degrees of superheating so modest as not to be of profound significance in economy. The final phase of the matter is the resulting steam temperature at the turbine. The proper relation of boiler pressure to superheat, the two factors determining the final quantity, does not seem to have been very thoroughly studied, and more information on it is highly desirable. Practice is certainly heading upward, and we believe the time is coming when the average boiler pressures in use to-day will be looked back upon much as we now turn the historical eye on the square-stayed boilers and atmospheric pressures of two generations ago.

The committee reports that, in spite of minor difficulties, each of these installations is regarded as operating satisfactorily. No troubles have developed in the boilers or turbines, although a few have appeared in flange joints, valves and similar places. The present limit on ultimate temperature seems to be set by the physical properties of commercial steels when pushed to and maintained at high temperatures. On the other hand, the fact that the troubles just referred to have not been with the boilers but with the accessories, in which other matters than tensile strength controlled the situation, would indicate that final temperatures around 700 deg. Fahr. are entirely manageable without going to extraordinary boiler design. In what proportions this temperature should be associated with the boiler and with the superheater remains still to be practically determined as a matter of economics. The future of the

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efficient production of electrical energy from steam units lies in the increase of thermodynamic utilization due to wide temperature range and in the improvement of furnace design and practice so as to utilize effectively fuel of minimum cost. We have published of late not a few items regarding the successful employment of low-grade fuels, and this, although necessarily confused with problems of transportation, still remains the most promising channel for economic gains. The ultimate desideratum in a steam plant is the lowest feasible cost of fuel and upkeep per pound of steam at the highest practicable temperature.

Thoroughness in cost accounting runs into money fast where reliable data are sought for comparative purposes. Superficial records of construction and operating expense, however, are of little value, and it is better to "go the limit" on a few jobs at stated intervals than to rely upon fragmentary information on all jobs handled as the base of advancing practice. Accuracy has always "come high," but it is worth paying for in dealing with engineering units.

Standardizing Industrial Equipment

THOSE of our readers who have an interest in the intricacies of electrically equipped industrial plants will appreciate the article in this issue by E. E. George dealing with the gains which are to be made, and which in his own special experience have been made, by properly standardizing electrical methods and the supplies required for their application. The plant under consideration is a large producer of machine tools, and the first step taken was completely to rehabilitate the electrical layout. To this end the old generating plant was laid aside and power in the form of 4400-volt, three-phase energy was purchased. The necessities of the case require both three-phase and direct-current motors, and so, while the larger motors were operated upon the power directly received, a 300-kw. synchronous motor directly coupled to a 115-volt direct-current generator found active employment. This particular voltage was chosen on account of its ready applicability to modern lamps and to the charging of batteries for trucks and tractors. Moreover, in connection with the generator a storage battery was floated on the lines, operating a wide variety of accessory apparatus, including emergency lights for the factory.

A great deal of pains was taken toward the thorough standardization of wiring, switchboards and motor equipment, so as to reduce to a minimum the varieties of material to be purchased and kept in stock. One of the great savings in this particular was in reducing to comparative uniformity the sizes and type of wires and conduit to be used. In the original plant seventeen sizes of conductor were included, some of them in several varieties. When the work of rehabilitation was done only ten sizes were utilized, each of these in but a single standard type, which greatly decreased the stock of wire necessary to be carried. Conduit sizes and wiring material were also standardized, to the great simplification of the entire work. In a similar fashion all the switches were brought down to the minimum number of types really necessary, and the wiring layout throughout was reduced as nearly to uniformity as careful selection made practicable. Throughout the requirements of safety were borne in mind, so that the final installation more than complies with the latest code requirements.

Overhead Lines and Inductive Interference

AT THE convention of the National Electric Light Association in Atlantic City an important report was read from the committee on overhead lines and inductive interference. This subject is of great technical and industrial significance. It relates to the relative rights, privileges and spheres of influence of the electric lighting and power companies on the one hand and of the telephone companies on the other.

Both the power companies and the telephone companies are naturally and rightfully extending their conducting networks over the country. They tend, therefore, to interfere more and more each succeeding year. Because the interference is distinctly one-sided, public sympathy is most likely to be found on the side of the telephone as against the turbo-alternator. It must be remembered, however, that both the power house and the telephone exchange are public service institutions and, as such, both have a right to fair consideration. The interference between them is largely a matter of public inconvenience. If the public demand for electric light and power distribution were so great as to overshadow every other consideration, then interference with telephonic traffic might be regarded as an unfortunate incident. On the other hand, if the public demand for telephonic communication transcended that upon every other electrical utility, then any interference with the telephonic service might be regarded as a serious offense against the rights of the community. As a matter of fact, it may be accepted that the public desires to retain both the electric lighting and the telephonic utilities without giving great preponderance to either. Consequently it becomes necessary to take such steps as may be economically possible to reduce interference to a minimum.

To the committee's report is appended a more technical article, by John B. Taylor, on the questions involved in interference. This article shows how important it is that there shall be active coöperation between the power and telephone companies, and particularly between their engineers, to work together in the public interest, and for their joint benefit, so as to avoid interference. Such friendly coöperation is far more likely to be advantageous to both parties than a spirit of hostility and litigation.

One plan which is likely to commend itself to both parties is to require from their own engineers some knowledge of the other side's technique. It will probably pay the power companies to engage electrical engineers who know something about telephone engineering, and it will likewise be advantageous for the telephone companies to employ electrical engineers who have some acquaintance with power transmission. This interchange of technical understanding is particularly desirable in the line construction and maintenance departments. By cultivating such mutual understanding throughout the interference difficulty can be minimized without great expense, whereas if both sides go to law the ultimate results may be both expensive and unsatisfactory.

Advocates of mass production should support research and development work with enthusiasm. This is no paradox, for progress stimulates demand, lowers unit costs or substitutes service of greater worth, and in the long run yields higher profits than can result from excessive duplication. It takes sound judgment to determine when to change gears, as it were.

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Cost Comparison of Transformer Types

Rational Method of Proportioning Dimensions of Single-Phase Transformers to Obtain Minimum Cost for Material—Comparison Between Five Types of Single-Phase Transformer Designed from Same Specifications

BY B. C. DENNISON
Department Electrical Engineering, Carnegie Institute of Technology

A RATIONAL method of transformer design applied to single-phase shell-type transformers was presented in an article by the author published in the ELECTRICAL WORLD, Nov. 3, 1917. In the present article the same method of design is developed for core-type and multiple-magnetic-circuit transformers. A comparison is then made between preliminary designs of five types of transformers of the same rating, all designed to the same specifications and for essentially the same flux and current densities.

SYMBOLS EMPLOYED

The following symbols are employed:

A_i = gross area of iron core.
A_o = gross area of coils in opening.
c = height of opening (see Fig. 1).
a = width of opening.
h = gross depth of core section.
b = width of single core.
k_i = space (stacking) factor of iron.
k_c = space factor of copper.
V_i = net volume of iron.
V_c = net volume of copper.
w_i = loss per cubic inch of iron core.
w_c = loss per cubic inch of copper.
C_i = cost per cubic inch of core, including labor.
C_c = cost per cubic inch of copper, including insulation and labor.
$P = A_i \times A_o$.
E = high-tension kilovolts.
T = high-tension turns in series.
B = flux density in core (kilo-lines per square inch.).
ϕ = total flux in core, in megalines.
s = current density in copper (kilo-amperes per square inch).
I = high-tension current at rated kva.

Design Precedure Outlined.—

1. In the previous article it was shown that the preliminary design of a transformer may be made with ease and rapidity. Starting with the fundamental design equation

$$P = A_o A_i = \frac{KVA \times 10^5}{2.22 f s B K_c K_i}$$

and employing the ratio factors

x = height of opening divided by width of opening.
y = depth of core divided by width of core.
z = gross area of core divided by gross area of opening.

2. The ratio factors may be chosen to give the minimum cost for materials, x and y being simple functions of z and $k_c C_c / k_i C_i$, while z is given by the equally simple expression $z = (\alpha + \beta q)$; $k_c C_c / k_i C_i$, α and β being constants.

3. Having chosen the dimensions for minimum cost, the proper proportion between the iron and copper losses may be realized by adjusting the values of flux and current density, keeping the product $B \times s = P'$, unchanged. Thus,

$$B = \sqrt{F} \times \sqrt[4]{\frac{npV_c}{mV_i}}$$

as developed in previous article.

Calculations for the shell-type transformer with rectangular core, uniform flux density and shell types with non-uniform flux density were set forth in the previous article. Other types are now taken up.

*Core-Type Transformers with Rectangular Cores and Uniform Flux Density.—*An expression for the volume of iron and copper is first derived and then the proportions to give minimum cost of material are determined.

By reference to Fig. 1 it may be seen that the iron volume

$$V_i = 2bhk_i(a + 2b + c)$$

or, allowing for the corners,

$$V_i = 2bhk_i(a + 1.66b + c) = 2k_i A_i(a + 1.66b + c) \quad (1)$$

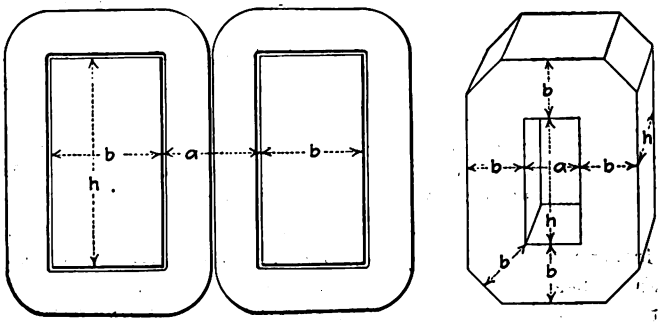

FIG. 1—CORE-TYPE TRANSFORMER WITH EQUAL CORE AND YOKE AREAS

Volume of Copper.—

$$V_c = 2A_o k_c(h + b + \tfrac{\pi}{4} a) \quad (2)$$

Since $A_i A_o = P$, $A_i/A_o = z$, $ac = A_o$, and $c/a = x$, $hb = A_i$, and $h/b = y$,

Then $a = (P/zx^2)^{\frac{1}{4}}$, $c = (Px^2/z)^{\frac{1}{4}}$, $h = (Pzy^2)^{\frac{1}{4}}$, and $b = (Pz/y^2)^{\frac{1}{4}}$ (3)

From equation (1) and equations (3),

$$V_i = 2k_i \sqrt{Pz}\left[\sqrt[4]{\frac{P}{zx^2}} + 1.66\sqrt[4]{\frac{Pz}{y^2}} + \sqrt[4]{\frac{Px^2}{z}}\right] \quad (4)$$

Likewise from equation (2) and equations (3),

$$V_c = 2k_c\sqrt{\frac{P}{z}}\left[\sqrt{Pzy^2} + \sqrt[4]{\frac{Pz}{y^2}} + \frac{\pi}{4}\sqrt[4]{\frac{P}{zx^2}}\right] \quad (5)$$

Substituting from equation (4) and equation (5) in the expression for total cost of material, namely, in

$V_i C_i + V_c C_c$ = cost (to be a minimum),

and taking partial derivatives with respect to each of the ratio variables, equating each time to zero, the following expressions are obtained:

$$x = 1 + \pi R/4z \quad (6)$$

$$y = 1 + 1.66z/R \quad (7)$$

and

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$$\frac{1+x}{\sqrt{x}}+5\sqrt{\frac{z}{y}}-R\left(\frac{1+y}{\sqrt{yz}}+\frac{3\pi}{4\sqrt{xz}}\right)=0 \qquad (8)$$

Where $R=\frac{k_c\,C_c}{k_i\,C_i}$.

Solution for values of z satisfying equation (8) was made as for shell-type transformers in the previous article, and the results, when plotted against R (see Fig. 2), show that

$$z=0.2+0.54R \qquad (9)$$

Examples of Core-Type Transformer Design.—Given: 15-kva., 60-cycle, 2200-volt transformer. Assume $B=65$, $s=0.8$, $C_c=\$0.115$, $C_i=\$0.0286$.

Various examples were worked out, starting with the theoretical ratios as obtained above, then changing these ratios to determine whether minimum cost actually corresponded with the theoretical values and to what extent the cost increased with departure from these values. The results obtained are tabulated below, and costs are plotted in Fig. 3.

Losses and Efficiency.—So far as the determination of the dimensions is concerned, it may be considered that only the product, Bs, has been fixed in the transformers designed. Their proper values, in order that iron loss shall bear a desired relation to copper loss, are determined as follows:

Let the desired ratio of losses, $\frac{W_i}{W_c}$, be $p=0.6$. Then for the transformer employing the ideal relations x, y, and z, *i.e.*, for the first design,

$Bs=P'=65\times 0.8=52$, $V_i=800$, $V_c=248$

From equation $B=\sqrt{P}\sqrt{npV_c/mV_i}$ (10)*

$$B'=\sqrt{52}\sqrt{\frac{0.82\times 0.6\times 248\times 10^4}{0.58\times 800}}=51.2$$

Then $s'=52/51.2=1.015$.

These values of B and s are permissible.

Iron Loss.—The loss per pound at 51 kl. per sq. in. = 0.54 watt. Then iron loss $=800\times 0.54\times 0.28=121$ watts.

Copper Loss.—The copper loss $=0.82\times(1.015)^2\times 248=208$ watts. Per cent loss at full non-inductive load:

Per cent loss $=(208+121)10^2/(15000+329)=2.14$

Efficiency $=100-2.14=97.86$ per cent.

Core-Type Transformers with Rectangular Cores of Unequal Areas (Non-uniform Density).—Following the method employed for the uniform-density core type the design for minimum cost of non-uniform density transformers is carried out.

Volume of Iron.—In the core shown in Fig. 4, in which the yoke areas are 1.3 times the core areas, allowing for the corners,

$$V_i=2A_ik_i(1.3a+1.82b+c)\ldots \qquad (11)$$

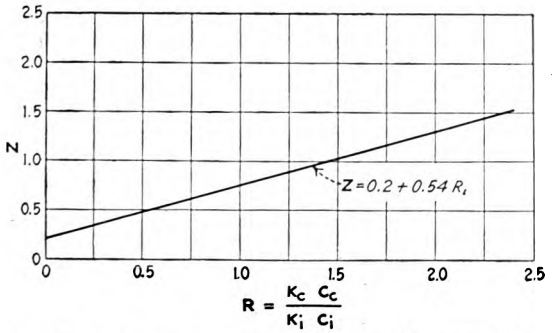
Volume of Copper.—

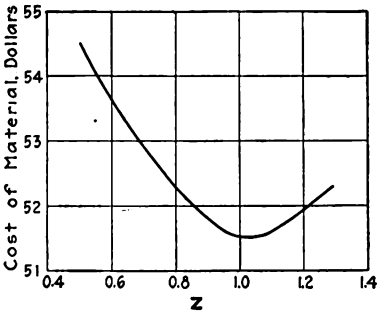
$$V_c=2A_ok_c\ (h+b+\pi a/4) \qquad (12)$$

Cost of material, expressed in x, y, z and P, becomes

$$D=2k_iC_i\sqrt{Pz}[1.3\sqrt[4]{P/zx^2}+1.8\sqrt[4]{Pz/y^2}+\sqrt[4]{Px^2/z}]$$
$$+2k_cC_c\sqrt{P/z}(\sqrt[4]{Pzy^2}+\sqrt[4]{Pz/y^2}+\pi/4\sqrt[4]{P/zx^2}) \qquad (13)$$

This is to be a minimum.





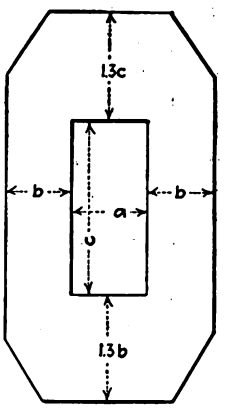


FIG. 2—VARIATION OF RATIO Z WITH R CORE-TYPE TRANSFORMER WITH UNIFORM FLUX; FIG. 3—DEPENDENCE OF COST OF IRON AND COPPER ON Z; FIG. 4—PROPORTIONS IN CORE-TYPE TRANSFORMER WITH NON-UNIFORM FLUX

Equating the partial derivatives to zero and simplifying, the following expressions result:

$$x=1.3+\pi R/4z \qquad (14)$$

$$y=1+1.82z/R \qquad (15)$$

and

$$f'(x,y,z)=\frac{(1.3+x)}{\sqrt{x}}+5.46\sqrt{z/y}-$$
$$R\left(\frac{1+y}{\sqrt{yz}}+\frac{3\pi}{4\sqrt{xz}}\right)=0 \qquad (16)$$

Equation (16) was solved in the same manner as were similar expressions in the earlier examples, and the value of z, when plotted as a function of R, gave the expression

$$z=0.57R \qquad (17)$$

In a redesign of the core-type transformer but for unequal core of sections a reduction in cost of material of 6 per cent is obtained over the core-type with uniform density, without sacrifice in efficiency.

TABLE I—EFFECT OF CHANGING Z, TOTAL COST

In these examples the greatest increase over the minimum cost is 5½ per cent

Design No.	x	y	z	A_o	A_i	a	b	c	h	V_i	V_c	Costs of Coils	Costs of Iron	Costs of Total
1	2.25	2.0	1.0	26.2	26.2	3.4	3.6	7.7	7.2	800	248	$23	$28.5	$51.5
2	2.25	2.0	0.5	37.2	18.6	4.1	3.0	9.2	6.1	612	320	36.8	17.5	54.3
3	2.25	2.0	0.75	30.3	22.8	3.7	3.4	8.3	6.7	740	276	31.7	21.2	52.9
4	2.25	2.0	1.25	23.5	29.4	3.2	3.8	7.3	7.7	893	231	26.6	25.5	52.1

*For derivation of this equation see previous article by author. m = core loss constant and n = specific resistance of copper.

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In this design the following values were obtained:

$x = 2.7$, $y = 2$, $z = 0.9$
$V_i = 775$ cu.in.
$V_o = 227$ cu.in.
Cost of iron = \$22.10
Cost of coils = \$26.10
Total cost = \$48.20
Copper loss = 119 watts
Iron loss = 189 watts

This iron loss is too high, while the copper loss is correspondingly low.

To obtain the densities which will give a proper relation between the losses it is convenient to speak of the equivalent flux density—*i.e.*, that which would give the same iron loss as now exists provided it obtained throughout the entire core. In the example being considered, in 347 cu.in. of the core the flux density = B,

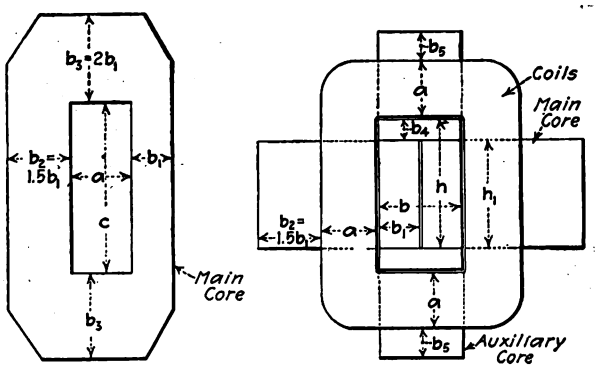

FIG. 5—MULTIPLE-MAGNETIC-CORE TRANSFORMER

while for 428 cu.in. the density = $B/1.3$. This equivalent density may be solved for as follows:

$$347 \times B^2 + 428 \times (B/1.3)^2 = 775 \times B^2_{eq},$$

$$\text{Or } B_{eq} = 0.88B$$

$$\text{Thus } B_{eq} = 0.88 \times 75 = 66 \text{ kl.}$$

From equation (28) of the first article for the correct relation, p, of iron loss to copper loss $P' = B_{eq}s = 66 \times 0.8 = 52.7$. If $p = 0.6$,

Then

$$B'_{eq} = \sqrt{52.7}\sqrt[4]{\frac{0.82 \times 0.6 \times 227 \times 10^4}{0.58 \times 775}} = 51.2\,kl.$$

The new current density should be

$$s = P'/B'_{eq} = 1.03 \text{ kiloamp. per sq.in.}$$

New iron loss = $775 \times 0.28 \times 0.55 = 119$ watts.
New copper loss = $0.82 \times (1.03)^2 \times 227 = 198$ watts.

$$\text{Per cent loss} = \frac{(119 + 198)10^2}{15{,}000 + 119 + 198} = 2.06.$$

Efficiency = 97.94 per cent.

Multiple-Magnetic-Core Transformers.—Fig. 5 illustrates the multiple-magnetic-core transformers now used so extensively for distributing service. With the relative core widths shown in the sketch the volume of iron (ignoring corners) is expressed as follows:

(a) Main core:

$$V'_i = 2k_ih_1[(b_1 + b_2)(c + 2b_2) + 2b_2a]$$

But $b_1 = b/2$, $b_2 = 1.5b_1 = 0.75b$, $b_3 = 2b_1 = b$,

$$h_1 = (h - b/2)$$

Therefore

$$V'_i = 2k_i\,(1.25bch + 2.5b^2h + 2abh - 0.625b^2c - 1.25b^2 - ab^2) \quad (18)$$

(b) Auxiliary core:

$$V''_i = 2k_ih_2[(b_4 + b_5)(c + 2b_5) + 2b_5a]$$

But

$$b_4 = 0.5b_1 = 0.25b,\ b_5 = 0.75b_1 = 0.375b,\ b_6 = b_1 = 0.5b,$$
$$h_2 = 2b_1 = b.$$

Therefore

$$V''_i = 2k_i(0.625b^2c + 0.625b^2 + ab^2) \quad (19)$$

Total volume, from equations (18) and (19):

$$V_i = 2k_ibh(1.25c + 2.5b + 2a - 0.625b^2/h) = 2k_iA_i(2a + 2.5b + 1.25c - 0.625b^2/h) \quad (20)$$

Or, allowing for corners removed,

$$V_i = 2k_iA_i(2a + 2.4b + 1.25c - 0.67b^2/h) \quad (21)$$

When written in terms of the unknown relations x, y and z, and of the product P, (21) becomes,

$$V_i = 2k_i\sqrt{Pz}[(1.25(Px^2/z)^{\frac{1}{4}} + 2.4\sqrt[4]{Pz/y^2} + 2\sqrt[4]{P/zx^2} - 0.67/y \times \sqrt[4]{Pz/y^2})] \quad (22)$$

Volume of Copper.—(See Fig. 5).

$$V_o = 2A_ok_o(h + b + \pi a/2),$$

total cost, or $D = V_iC_i + V_oC_o$, is to be a minimum.

Writing total cost of materials in terms of x, y, z and P, and simplifying by dividing by $P(P)$

$$\text{Cost} = 2k_iC_i\sqrt{z}\left[1.25\sqrt[4]{\frac{x^2}{z}} + 2.4\sqrt[4]{\frac{z}{y^2}} + 2\sqrt[4]{\frac{1}{zx^2}} - \frac{0.67}{y}\sqrt[4]{\frac{z}{y^2}} + 2k_cC_c\sqrt{\frac{1}{z}}\left[\sqrt[4]{zy^2} + \sqrt[4]{\frac{z}{y^2}} + \frac{\pi}{2}\sqrt[4]{\frac{1}{zx^2}}\right]\right] \quad (23)$$

Taking partial derivatives, equating to zero and simplifying, it is found that

$$x = 1.6\left(1 + \frac{\pi k_cC_c}{4k_iC_i} \times \frac{1}{z}\right) = 1.6\left(1 + \frac{\pi R}{4Z}\right) \quad (24)$$

$$y = (0.5 + 1.2z/R) + \sqrt{(0.5 + 1.2z/R)^2 - 2 \times z/R} \quad (25)$$

$$f'(x, y, z) = z\left(\frac{7.2y - 2.0}{y^{\frac{1}{2}}}\right) + \sqrt{z}\left(\frac{1.25x + 2}{\sqrt{x}}\right) - R\left(\frac{1 + y}{\sqrt{y}} + \frac{3\pi 1}{2\sqrt{x \,.\, z}}\right) = 0 \quad (26)$$

The solution of equation (26) is somewhat more involved than that of the similar equations in former examples, but the solution yields a very simple expression for the unknown z, namely

$$z = 0.1 + 0.49R \quad (27)$$

Examples of Design.—The method just derived will be applied to the design of a 100-kva., 60-cycle, 2200/220-volt multiple-magnetic-circuit distributing transformer.

Assumptions:

$B = 90$ kl. per sq.in., $s = 1.3$, $C_c = \$0.175$, $C_i = \$0.035$, $k_i = 0.85$, $k_c = 0.35$.

Then $R = (0.175 \times 0.35)/(0.035 \times 0.85) = 2.05$.

From equations (27), (24) and (25)

$z = 1 + 0.49 \times 2.05 = 1.1$,
$x = 1.6(1 + 0.785 \times 2.05/1.1) = 3.94$, say, 4.0,
$y = (0.5 + 1.2 \times 1.1/2.05) + \sqrt{(0.5 + 1.2 \times 1.1/2.05)^2 - 2 \times 1.1/2.05} = 1.67$.

From the specifications and values assumed,

$$P = A_iA_o = \frac{100 \times 10^5}{2.22 \times 60 \times 1.3 \times 90 \times 0.35 \times 0.85} = 2175$$

Then

$A_o = \sqrt{2175/1.1} = 44.3$ sq.in., $A_i = 2175/44.3 = 49$ sq.in.

$a = \sqrt{44.3/4} = 3.32$ in., $c = 44.3/3.32 = 13$ in.

$b = \sqrt{49/1.67} = 5.44$ in., $h = 51.2/5.44 = 9.1$ in.

From equation (21)

$V_i = 2 \times 0.85 \times 49\,[1.25 \times 13 + 2.4 \times 5.44 + 2 \times 3.3 - 0.67(5.44/9.1)^2] = 2840$ cu.in.

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Iron Loss.—It may be shown that in the core of the proportions chosen (see Fig. 5), having densities of B, $\frac{2}{3}B$ and $\frac{1}{2}B$, the iron loss equals that resulting if an equivalent density of the value $\frac{2}{3}B$ were common to all parts of the core; *i.e.*, for $B_{max} = 90$, $B_{eq} = 60$ kl. per sq.in. Therefore, looking up the iron loss at 60 kl., or 0.74 watts per lb., the iron loss becomes,

$$W_i = 0.74 \times 2840 \times 0.28 = 590 \text{ watts.}$$

Volume of Copper.—

$V_c = 2 \times 0.35 \times 44.3(9.1 + 5.44 + 1.57 \times 33) =$ 610 cu.in.

Cost of cores $D_i = 2840 \times 0.035 =$ \$99.5.

Cost of coils, $D_c = 610 \times$ \$0.175 = \$106.5.

Copper loss, $W_c = 610 \times 0.82 \times (1.3)^2 = 845$ watts.

Total cost = \$206; total loss = 1435 watts.

TABLE II—COMPARATIVE DESIGNS OF SEVERAL TYPES OF TRANSFORMERS

Specifications: 75-kva., 60-cycle, 2200/220-volt, single-phase, distributing

	Shell, Uniform Flux	Shell, Non-Uniform Flux	Core, Uniform Flux	Core, Non-Uniform Flux	Multiple-Magnetic-Circuit
B_{max}	60	90	60	70	90
s	1.3	1.3	1.3	1.3	1.3
k_c	0.35	0.35	0.32	0.32	0.35
k_i	0.85	0.85	0.85	0.85	0.85
R	1.65	1.65	1.5	1.5	1.65
P	2425	1620	2650	2260	1620
s	2.7	1.2	1.0	0.85	0.9
x	2.0	3.3	2.2	2.7	4.0
y	2.4	2.8	2.0	2.0	1.7
A_o	30	36.9	51.5	51.5	42.4
A_i	81	44.0	51.5	44	38.2
a	3.87	3.32	4.84	4.35	3.3
c	7.75	11.1	10.6	11.75	12.8
b	2.87	2.0	5.1	4.68	4.75
h	14	11.1	10.1	9.2	8.05
V_i	2250	2130	2085	1940	2085
W_i (watts)	470	440	433	408	432
D_i (dollars)	78.8	74.5	73.2	67.8	72.9
V_c	595	588	625	570	534
W_c (watts)	815	810	865	788	740
D_c (dollars)	83.3	82.2	87.5	80	74.8
Total loss	1285	1250	1300	1196	1172
Total cost	162.1	156.7	160.7	148	147.5
Efficiency	98.31	98.37	98.30	98.45	98.47

Per cent loss = $1435 \times 10^2/101{,}400 = 1.4$ per cent.

Efficiency = 98.6 per cent.

Example 2.—A certain transformer of the multiple-magnetic-core type which was examined was found to have the following proportions:

$$x = 2.44, \quad y = 1.37, \quad z = 0.66.$$

Designing the transformer of the above specifications to these proportions gives the following:

$A_o = \sqrt{2175/0.66} = 57.3$ sq.in., $A_i = 2175/57.3 =$ 38 sq. in.

$a = \sqrt{57.3/2.44} = 4.85$ in., $c = 57.3/4.85 = 11.85$ in.

$b = \sqrt{38/1.37} = 5.25$ in., $h = 38/5.25 = 7.25$ in.

$$V_i = 1.7 \times 38(1.25 \times 11.85 + 2.4 \times 5.25 + 2 \times 4.85 - 0.67\left[\frac{(5.25)^2}{7.25}\right] = 2140 \text{ cu.in.}$$

Cost of cores, $D_i = 2140 \times$ \$0.035 = \$75.

Iron loss, $W_i = 2140 \times 0.74 \times 0.28 = 443$ watts.

$V_c = 0.7 \times 57.3(7.25 + 5.25 + 1.57 \times 4.85) = 805$ cu.in.

Copper loss, $W_c = 0.82 \times (1.3)^2 \times 805 = 1115$ watts.

Cost of coils = $805 \times$ \$0.175 = \$141.

Total cost = \$216. (This exceeds that of the theoretical design by some 5 per cent.)

Total loss, $W_i + W_c = 1558$ watts.

Per cent loss = $1558 \times 100/101{,}560 = 1.53$ per cent.

Efficiency = 98.47 per cent.

It would be easy to adjust B and s so that the proper relations existed between iron and copper losses.

Comparison of Types of Transformers.—It may be of interest to compare the five types for which the method of minimum cost has been derived, by designing to the same specifications a transformer of each type. In Table II the corresponding figures are brought together and a comparison made.

All five transformers are designed for the same effective flux density—*i.e.*, for 60 kilo-lines per sq.in.—and for a current density of 1300 amp. per sq.in.

Consider the following items:

1. Volume of Iron.—The shell type with uniform fluxes has the maximum volume of iron—*i.e.*, 2250 cu.in.; the core-type with non-uniform flux has the least, or 1940 cu.in., while the multiple-magnetic-circuit and the core-type with uniform fluxes both have 2085 cu.in.

2. Volume of Copper.—The core type with uniform flux has the greatest copper volume—namely, 625 cu.in. —while the MMC (multiple-magnetic-circuit) has the least, at 534 cu.in.

3. Cost of Material.—The plain shell type has the highest cost, at 162.1; the plain core and the shell type with non-uniform flux follow with \$160.7 and \$156.7 respectively, while the core type with non-uniform flux and the MMC type seem to cost nearly the same, or \$148, which is approximately 8 per cent less than the plain shell-type.

4. Efficiency.—Efficiency at full load is highest for the MMC type, and lowest for the plain core type, the range being slight, however, from 98.47 to 98.30.

CONCLUSIONS

I. For any type of transformer the design for dimensions which will yield a given rating at the minimum cost for material is easily and quickly worked out, basing the design upon three ratio quantities, namely, z, the ratio of core section to coil section; x, the ratio of height of opening to width of opening, and y, the ratio of core depth to core width.

II. These ratios may be calculated by simple expressions involving $R = K_cC_c/K_iC_i$, or the ratio of space factors, copper and iron, times the ratio of costs per cubic inch, copper and iron. These figures should be in the possession of any one in commercial design.

III. The assumptions of flux and current densities permissible, together with the ratio factors, permit the quick determination of all dimensions and the calculation of weights, costs and efficiencies.

IV. Should the iron and copper losses not bear the desired ratio, this may be changed without modifying the dimensions of the transformer or affecting its cost, assuming that reasonable densities were assumed and no unusual ratio of losses is desired.

V. In an example used to compare the five usual types of single-phase distributing transformer highest efficiency and lowest cost point to the choice of the multi-magnetic-circuit transformer, with the core-type having unequal core and yoke areas as the second choice.

VI. It would seem that the method here outlined might profitably be extended to apply to polyphase transformers.

The writer is aware that the items considered in the choice of type for a given service and in the determination of the dimensions for a transformer of given type and specifications leave many practical considerations untouched, but he hopes by the presentation of this paper to bring about a more complete and frank discussion of these items.

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Features of Mammoth Waterwheel Generator

Method of Construction Employed in One of the 32,500-Kva. Generators Which Are Being Built for the Niagara Falls Power Company—Conservation in Design and Highest Possible Efficiency Characterize This Unit

SELDOM has the problem of design of an important machine been put up to the designer with fewer restrictions or less interference on the part of the purchaser than in the case of the new Niagara Falls generators which are to be rated at 32,500 kva., 25 cycles and 12,000 volts. About all the customer specified was the highest efficiency consistent with other desirable and extremely important characteristics such as reliability. He insisted upon a generator which, in combination with its waterwheel, should give the highest efficiency that has yet been obtained in a hydraulic unit. No restrictions as to the kinds of material or weights of parts were placed upon the designer. The only restrictions were those involved in the problem itself, such as good mechanical construction in all of the parts and sufficient reactance to protect against the strains and stresses that are pretty sure to occur in the operation of large electric systems because of accidents of one kind or another, such as the breaking down of insulation, trouble on the distribution lines or mistakes in switching.

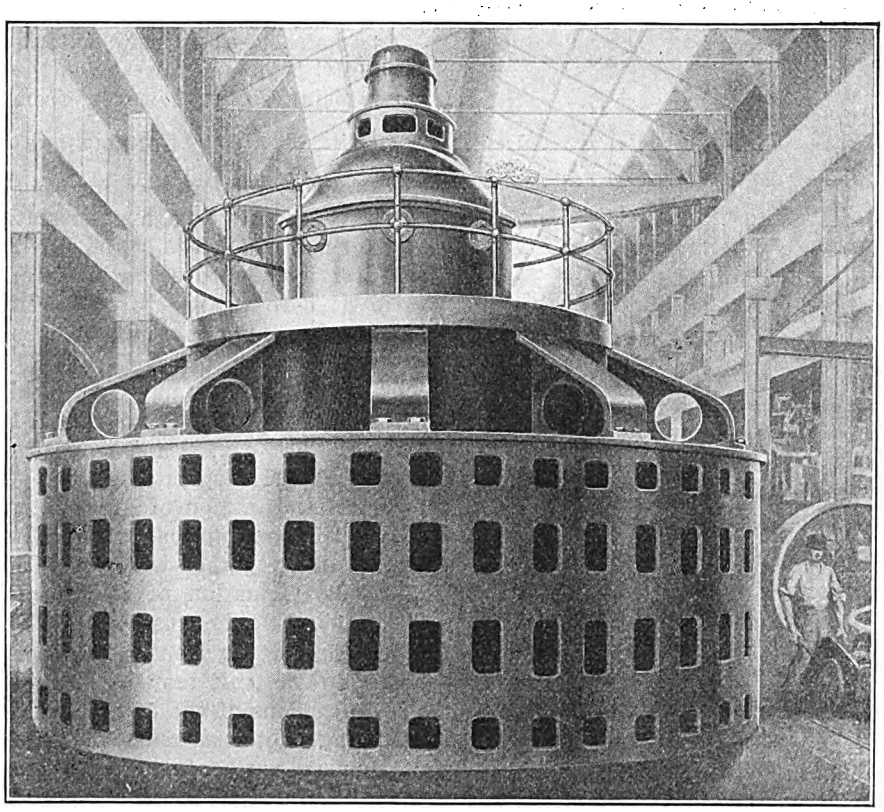

FIG. 1—ASSEMBLY OF NIAGARA FALLS GENERATOR RATED AT 32,500 KVA., 25 CYCLES AND 12,000 VOLTS

Three such units have been ordered—one from the General Electric Company, one from the Westinghouse Electric & Manufacturing Company and one from the Allis-Chalmers Manufacturing Company. The latter will make both the waterwheel and the corresponding generator, while the waterwheels for the other two generators will be made by the I. P. Morris department of the William Cramp & Sons Ship & Engine Building Company. Some of the features of the General Electric unit, as brought out by W. J. Foster of the alternating-current engineering department, will be recounted in this issue. Features of the other units will be described later.

Conservatism has characterized practically every feature of the design. The mechanical stresses allowed in the various parts, such as bearings, spider and rotor, are in many cases no higher than is sometimes allowed when using cast iron, whereas the best steel is being used. Because of the high efficiency that has been striven for relatively small losses will occur as the insulation will not be required to withstand abnormal temperatures. The guarantee to the customer is a 100-deg. C. machine at the rated output—32,500 kva. This is 5 deg. more conservative than the standard of the American Institute of Electrical Engineers for Class "A" or low-temperature insulation, whereas the insulation that has been used in the armature for both turn and external insulation is Class "B." This insulation, according to the A. I. E. E. standards, is suitable for 125 deg. The reactance of the generator is approximately 20 per cent, which permits the stator winding to be supported mechanically with unusually large factors of safety against the stresses produced by instantaneous short circuits. It is planned to determine the generator efficiency by using the input method, operating the generator as a synchronous motor and measuring the energy input by wattmeters. At the same time, certain losses like friction and windage and core losses will undoubtedly be determined by other methods, such as retardation, to check the accuracy of the input readings. The load losses will undoubtedly be checked by the calorimeter method; that is, by a determination of the temperature rise of the cooling air under various conditions of load, in which the excess of the heat losses as calculated in the cooling air over the combined segregated losses will be taken as the true load losses. A most careful determination will be made of the over-all efficiency of the unit as a whole, by measuring the water used and obtaining input from it, and taking the output from the switchboard instruments,.

One of the considerations arising in the early stages of the design was the selection of a diameter that would make possible a simple and mechanically strong rotor. It was quite evident that a rotor with a solid rim would

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be better than one involving joints. Hence the diameter selected was determined by the possibilities of the shipment of the rotor. As shown in Fig. 2, the rotor spider consists of six wheels, each wheel a single casting of steel. The hubs are rabbeted into one another and are of such length that the rims lack a little of meeting one another, thus allowing space for the flow of air. The wheels were all cast from the same pattern except the

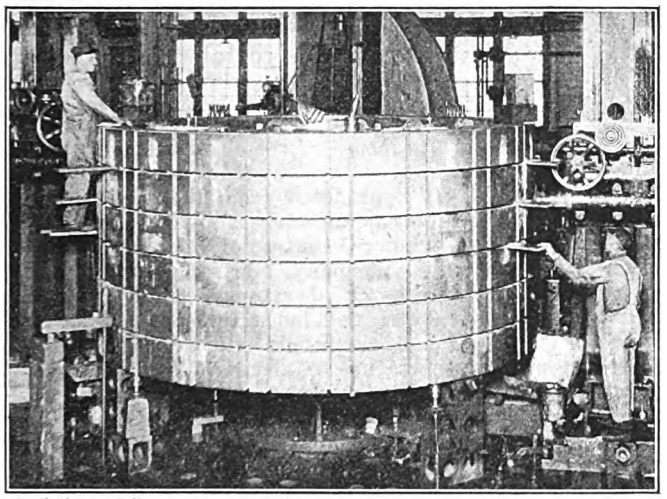

FIG. 2—CONSTRUCTION VIEW OF ROTOR SPIDER—SIX STEEL CASTINGS

one at the bottom, which had some stock added on the inside to furnish a surface for the brakes to act against. Two dovetails of the "T" type were machined for the attachment of each pole piece.

The construction of the field poles proper involved no particular difficulty, as it was not necessary to depart from standard construction. However, each pole piece is probably of greater weight than any heretofore built, the weight complete, without field winding, being 5000 lb. (2267 kg.). Copper strips wound on edge are used for the field coil in the usual manner, but they are larger than any yet wound for a commercial machine—so large, in fact, that they could not be formed upon the regular helix winding machines. The weight of the copper in each field coil is 1600 lb. (725 kg.).

The shaft extends a few inches below the stator frame and terminates in a solid flange machined to serve as a half coupling for attachment to shaft of the waterwheel. This flange is as close to the generator rotor spider as space for removal of the coupling bolts will allow. The upper end of the shaft is machined for a thrust collar which takes the entire weight of rotating parts and for a guide bearing which will be immediately below the thrust bearing. Only one other guide bearing will be provided, and that will be on the waterwheel. The shaft projects above the thrust bearing a sufficient distance to permit the lifting bale to be used to take the weight entirely off the thrust bearing; after this is done blocks may be inserted at twelve points around the circumference of the structure which carries the brakes. As soon as the thrust bearing is relieved of the weight of the rotor it may be dismantled, the bearings spider removed and the rotor lifted out.

Considerable thought was given to the appearance of the top of the unit. The bearings bracket, which serves as the supporting deck for the thrust bearing, is of cast steel in halves, with eight arms. The upper guide bearing is carried within this spider. The thrust bearing rests immediately on top of the spider, at which level is placed a circular platform and guard rail, access to which is obtained by a walk from the top of the operating gallery. Immediately above the thrust bearing are the collector rings, protected by a cage on which rests a dome that extends over the top of the revolving shaft, thus thoroughly protecting operators from any chance of injury.

The stator spider is in four parts, divided vertically. It is possible to assemble the laminations at the shops of the manufacturer building the core in halves or to ship the stator spider without the laminations and build up the core in the power house. There are advantages in building the core at the shops of the manufacturer, due to the facilities that exist there, which enable the work to be done in much shorter time. On the other hand, when the core is built at its destination the advantage is gained of obtaining a continuous rim and consequently one that does not have joints which sometimes make it difficult to arrange clamps capable of exerting sufficient pressure to prevent looseness and vibrations of laminations from developing. The slots are very deep, being of practically the same dimensions as those of the largest steam-turbine generators. The stator winding is of the common "barrel" type, assembled with two coil sides in a slot. Both the turn and external insulation consist of mica tape, and they are applied with the molding and compounding processes that have proved best for the largest turbo-generator coils.

The projecting ends of the winding at both top and bottom rest back against two solid steel rings that are carried by brackets attached to the heads of the stator. As shown in Fig. 4, these supporting rings are heavily insulated to form a seat for the coils. The individual coils are laced to the supporting bands by strong linen cord specially treated. The individual coils also have spacing blocks laced to their sides at short intervals, of

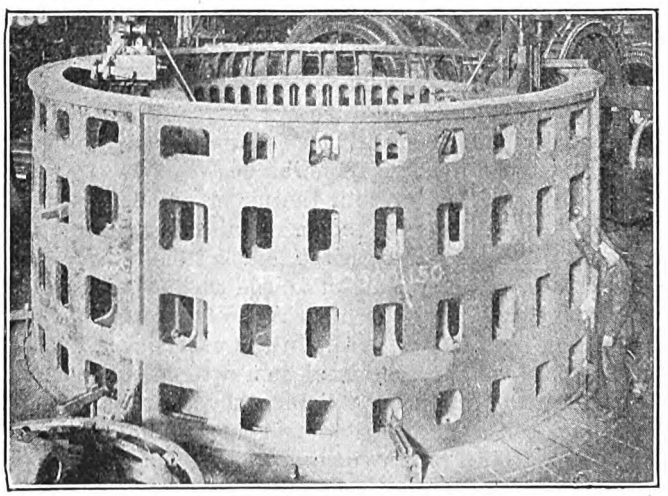

FIG. 3—TWO MACHINE TOOLS WORKING ON STATOR FRAME SIMULTANEOUSLY; RELATIVE SIZE INDICATED BY WORKMAN

such thickness as to make the completed winding perfectly ring-bound. This method of support has many advantages over the use of clamps placed on the inside of the winding that require bolts to pass through the winding, or the use of continuous metallic rings on the inside that may be expanded out so as to obtain sufficient clamping effect to keep themselves in place. A certain amount of flexibility to secure highly insulated

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windings is of extreme importance. Such a method of securing end windings insures against the bruises and breaks in the insulation that are liable to occur where clamps are used that are harsh and unyielding when compared with the insulating material itself.

A great deal of thought was given by the engineers of the Niagara Falls Power Company to the general question of ventilation of the power house. In conferences with the designers of the generators a scheme was evolved by which the generators are designed to take in air at both the top and the bottom directly from the dynamo room and emit the air through the ventilation holes in the stator spider into a casing provided by the operating company. This casing is not circular in its external dimension but approximates the surface of a cylinder half way around the machine. This will be continued almost tangentially to the side of the operating gallery, which will run so as nearly to touch the side of the several generators.

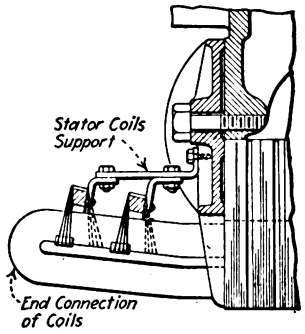

FIG. 4—METHOD OF BRACING PROJECTING END TURNS OF STATOR

In the outlet compartment underneath the operating gallery opposite each generator it is the intention to install a motor-driven fan to assist the circulation of the air—something which may prove necessary in the hottest weather. The air at the top of the machine will enter in a radial direction through screens underneath the operating platform that surrounds the thrust bearing. At the bottom the air will enter the machine from a pit underneath the generator into which two openings, in the form of stairways 90 deg. apart, connect with the dynamo room. From the warm-air compartments under the operating gallery the air may be passed out of doors or back into the dynamo room, as desired.

Fans are attached to both the upper and lower rims of the rotor at the outer edge. Housings to serve as baffles are provided at both top and bottom. They are of such design as to minimize eddies and effectively prevent the return of the air. Although fans are employed, they will simply assist in the ventilation, as the greater part of the air circulation will be caused by the rotor itself, the poles of which have unusual radial depth and consequently give large blower effect. The fan action of the rotor will be highly efficient because of the provision that has been made for the passage of a large quantity of air through the rotor rim.

Running Equipment Above Its Rated Capacity

One engineer in the East considers that the most important thing he has learned from his experience during the war is that generating equipment can be safely run over its full rated capacity when required. It is of course too early to say whether the plants suffered any extra depreciation on account of the heavy loads which were carried, but it would seem that they have not.

STATEMENT OF THE AIMS OF NEW ST. LOUIS BOARD

Organization Which Will Stand for Advancement of Electrical Industry in That City Announces Its Policy and Practice

The St. Louis Electrical Board of Trade is the name of an organization which is being formed to replace the local chapters of the Jovian Order as an instrument of local coöperation within the industry. The constitution and by-laws of this organization contain the statement of policy and practice which follows:

1. To create a spirit of mutual respect, esteem and cooperation between all branches of the electrical industry of St. Louis, with the view of systematizing and improving electrical practices as approached from the viewpoint of either the manufacturer, manufacturers' agent, wholesaler, retailer, consulting engineer, contractor, electric railway, electric light and power company, telegraph and telphone company, railroad or research laboratory, not only in the industrial and general electric field but in the home; such work to include the education of the people as to the benefits to be derived from the general use of electrical equipment, appliances and devices, from complete electrical wiring installations, from use of high-quality material and workmanship, from transaction of business only with competent and responsible people, and from placing business on the basis of advice rendered, ability to serve, quality and quanity of material installed, grade of workmanship and satisfaction to be derived from an electrical installation, machine or appliance.

2. To work for complete plans and definite specifications for all electrical installations and for expert supervision over all work to insure compliance with original plans and to secure a high grade of workmanship.

3. To secure full recognition of the desirability of healthy and prosperous public utilities, foster and promote the welfare, success and prosperity of such interests, encourage extension of public utilities as rapidly as the growing needs of the community require, and aid the utilities to secure a proper revenue, believing that the best interests of the community and the industry will be served thereby.

4. To keep closely in touch with all public matters pertaining to electrical problems, that all other business organizations and municipal, state and federal authorities may know that our organization is responsible and capable of handling intelligently subjects pertaining to electrical matters.

5. To assist in coördinating and systematizing "community advertising" among the various branches of the electrical industry, arranging for the necessary paticipation by the various branches of the industry both in the general scheme and the details which go with or follow after the main plan.

6. To take up problems having to do with desired readjustment of freight classifications for all electrical goods handled in the St. Louis market.

7. To interest itself in encouraging export shipments via all routes, including the river through New Orleans, and in accumulating the necessary information in regard to standards in use in South America and other foreign countries.

8. To maintain an information bureau as to any material and labor supply and demand which is of local interest.

9. To interest itself in the question of temporary or permanent exhibitions for the benefit of the electrical industry.

10. To provide weekly luncheon meetings for coöperative and educational purposes.

11. To interest itself in the matter of holding evening meetings when desirable for the purpose of discussing strictly trade subjects, both educational and coöperative.

12. To provide and equip proper headquarters and office force to serve the organization.

It is recommended that the aid of municipal, state and federal authorities be invited and that a manual of recommended practice be provided.

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Electric Service in World's Largest Hotel—II

Provisions Were Necessary for Care of 2200 Rooms and Baths and for Feeding 6500 People—Complete Electric Laundry Installation Is of Special Interest, and Illumination of Bedrooms Is Unusually Good

THE problems involved in the selection of electrical energy supply, together with the general scheme of switchboards and distribution, for the Hotel Pennsylvania, New York, were discussed in the issue of May 10. In the present issue the signal and communication layout, which required making 10,000 connections, the large electrically operated laundry, elevator arrangements and ventilation are described. The illumination of bedrooms, commonly inadequate in even the best hotels, is unusually complete in this hotel.

Each of the bedrooms is provided with a center ceiling light controlled by a push-button switch near the door. These fixtures are of the semi-indirect type consisting of simple but attractive etched-glass bowls. Each fixture is equipped with a rather novel means for removing the bowl for the purpose of lamp renewals and cleaning. In addition to the ceiling fixture in each room there is a desk lamp supplied from a plug. Two other fixtures attached to the bureau are supplied from a second plug through a duplex cord, and a third plug is provided for supplying energy to a small fixture attached to the bed for reading purposes. In the bathroom a simple fixture is provided over the mirror above the wash basin. This is controlled by a pull switch in some cases, and in the larger bathrooms by a push-button switch near the door. In each of the bedroom closets a lamp is provided over the door, controlled by a pull-chain socket.

The service portions of the house are generally lighted by lamps with porcelain-enamel steel reflectors close to the ceiling, the object being to obtain fixtures requiring a minimum amount of cleaning. Metal reflectors are used to accomplish that purpose and also to avoid breakage. The lighting equipment in other portions of the hotel is shown in the accompanying illustrations.

All of the lighting panelboards in the hotel, of which there are about 240, are of the safety type. Each panel has two doors, one within the other. The inner door covers the switches for the various circuits, and every part that can be reached when this door is open is electrically "dead" so that it is impossible to get a shock when operating the switches. The fuses are under the second door, which is kept locked and can be opened only by an authorized electrician.

Signaling and Communication Systems.—In the design of the signaling system the object sought was to keep the installation as simple as possible, reducing the initial expenditure to a minimum and at the same time giving the guests every convenience which they expect in a modern hotel. As an instance of the simplification of design no push-button calls are provided from the bedrooms as the telephone is used entirely for transmitting the guests' desires and requirements. If the guest wants a page, a maid or valet, he uses the telephone and through the main switchboard a proper connection is made. If he wishes to order a meal, a telephone connection is made to a special order board, with separate operators, in the telephone room. These operators receive the order and make suggestions if the guests so desire, the order being sent by telautograph to the kitchen, floor clerk and floor-service pantry.

On each bedroom floor is a clerk who has pneumatic-tube connection with a tube station at the back of the main office and telautograph connection with the main room clerk, valet, porter, laundry, etc. On each bedroom floor is also a service pantry, in charge of a waiter

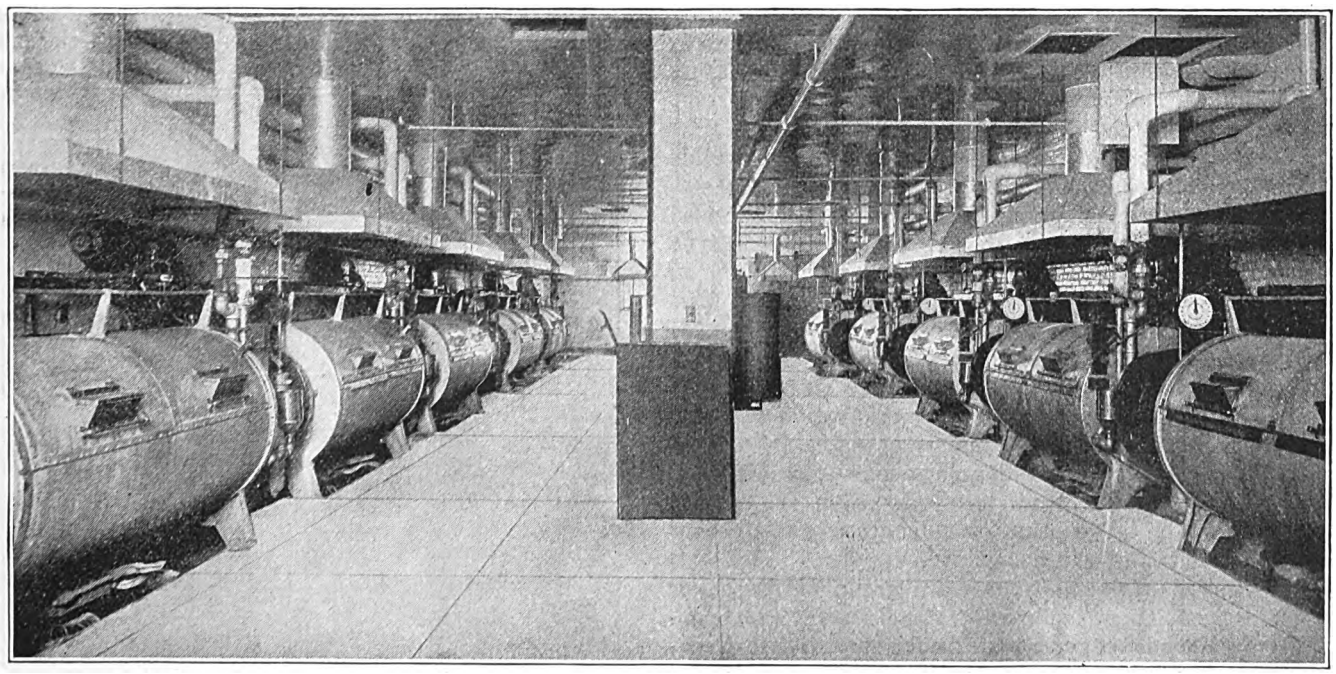

FIG. 1—VIEW OF LARGEST ELECTRIC LAUNDRY IN THE WORLD

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and bus boys. These pantries are connected with the main kitchen pantry by a bank of six electrically operated dumbwaiters. Telautographs and a separate pneumatic-tube service are also part of the equipment of the service pantries. This pneumatic-tube service extends to the main kitchen on the basement floor. From the main office at the ground floor a system of pneumatic tubes connects with a number of stations throughout the hotel, including the bar, grill, roof, restaurant, etc.

Of the twenty-three positions on the main telephone switchboard, nine incoming positions are used for receiving messages from outside of the hotel. Two official positions are used for connections to the administration officers of the hotel, and twelve house positions are used for the guests' service, including the outgoing messages. The telautograph system is used for transmitting messages of all kinds left by visitors and for breakfast orders, etc., and therefore constitutes an important factor in the hotel.

The watchman's detector system is of the portable type; in addition there is a separate watchman's station on each floor connecting with an outside supervised service. The fire-alarm system is of the interior type connecting with the engine room. A single station on each floor connects directly through the National District Telegraph Company with fire headquarters.

An electric clock system is provided, including a clock in each elevator corridor, in the public rooms on the main floors and in some of the administration and service departments. This system is operated in connection with an electric time-stamp system, the time stamps being placed on the floor clerks' desks, in the service pantries, at the bell captain's headquarters and in other service portions of the house.

Elevator Equipment.—The main group of passenger elevators consists of two rows of six elevators each opening onto the passenger-elevator corridor. These elevators run from the basement to the roof floor. By putting all of the elevators in one group it was decided that better service to the guests would be provided because less confusion would result in finding the elevators. One set of six elevators may be run as local cars and the other set express. Two other elevators are installed at one corner of the building and serve to carry passengers from the tunnel connecting with the Pennsylvania Railroad station and the subway to the main floor. At one side of the building near the ballroom entrance are two other elevators for carrying passengers from the main floor to the ballroom floor.

For the service requirements of the hotel a bank of eight elevators is provided. These elevators run from the sub-basement to the roof and are arranged to be operated in three groups so far as signaling is concerned, thereby permitting a certain amount of flexibility in assigning the elevators to different purposes. For example, one pair of elevators may be used for waiters exclusively, another pair for baggage, laundry, and so forth. Three additional elevators in the rear of the building serve to carry supplies from the driveway to the lower floors and also to provide service between the sub-basement and the banquet-room kitchen, which is on the first mezzanine floor.

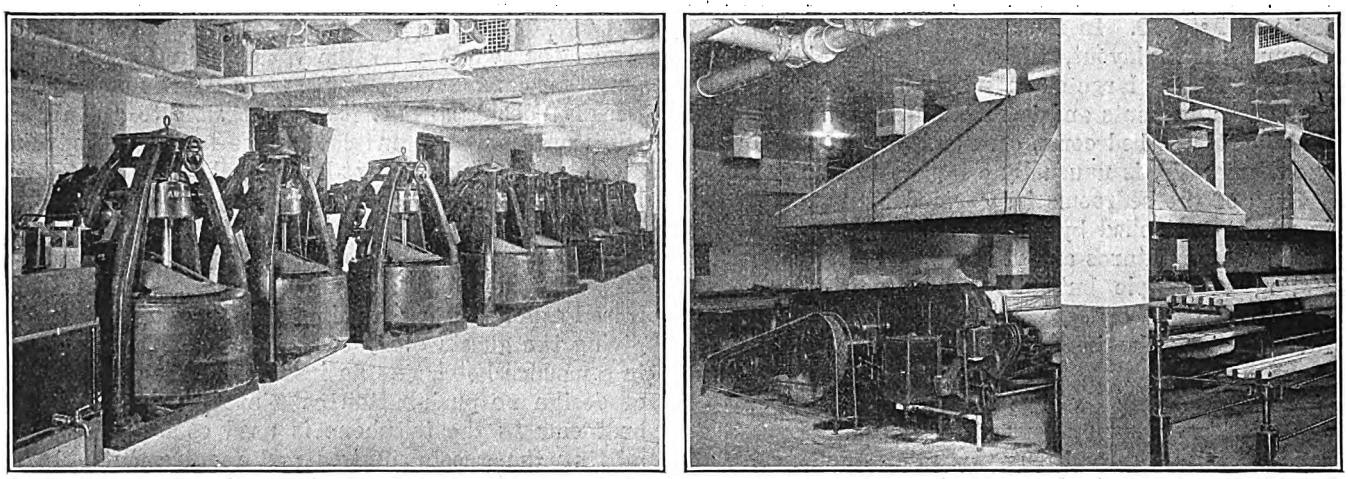

FIG. 2—DRYING AND IRONING MACHINES HAVE INDIVIDUAL MOTOR DRIVE

All of the passenger and service elevators, with the exception of one large service elevator, are of the one-to-one gearless-traction type running at 600 ft. (180 m.) per minute. The large service elevator, which is approximately 9 ft. wide by 7 ft. deep (3 m. by 2 m.), is of the worm-gear traction type running at 450 ft. (150 m.) per minute.

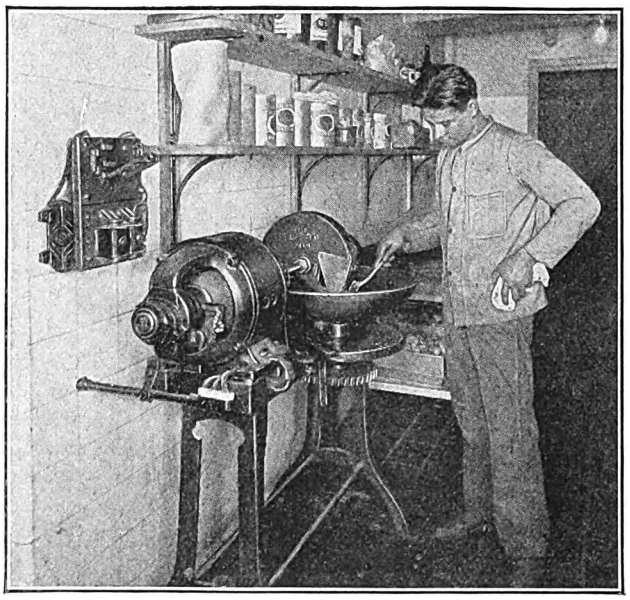

FIG. 3—THE KITCHEN ALSO HAS THE NECESSARY MOTOR EQUIPMENT

The signal system for the passenger elevators consists of up-and-down flashlight annunciators in each car

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with push-buttons and up-and-down signal lanterns at the various landings. Dial indicators as well as tell-tale annunciators are placed on the ground floor for furnishing to the elevator starter the necessary information as to the location of cars and the car signals. On all passenger elevators a simple safety device is used to prevent the possibility of the car moving until both the hatchway door and the car gate are securely closed.

waiters to the various floors in accordance with demands or signals received from the various floors. These signals are indicated on an annunciator in the basement kitchen. The dumbwaiters run at a speed of 500 ft. (150 m.) per minute and are capable of carrying a load of 100 lb. (45 kg.).

Laundry Equipment.—It can be readily understood that this gigantic hotel, with 2200 rooms and baths and

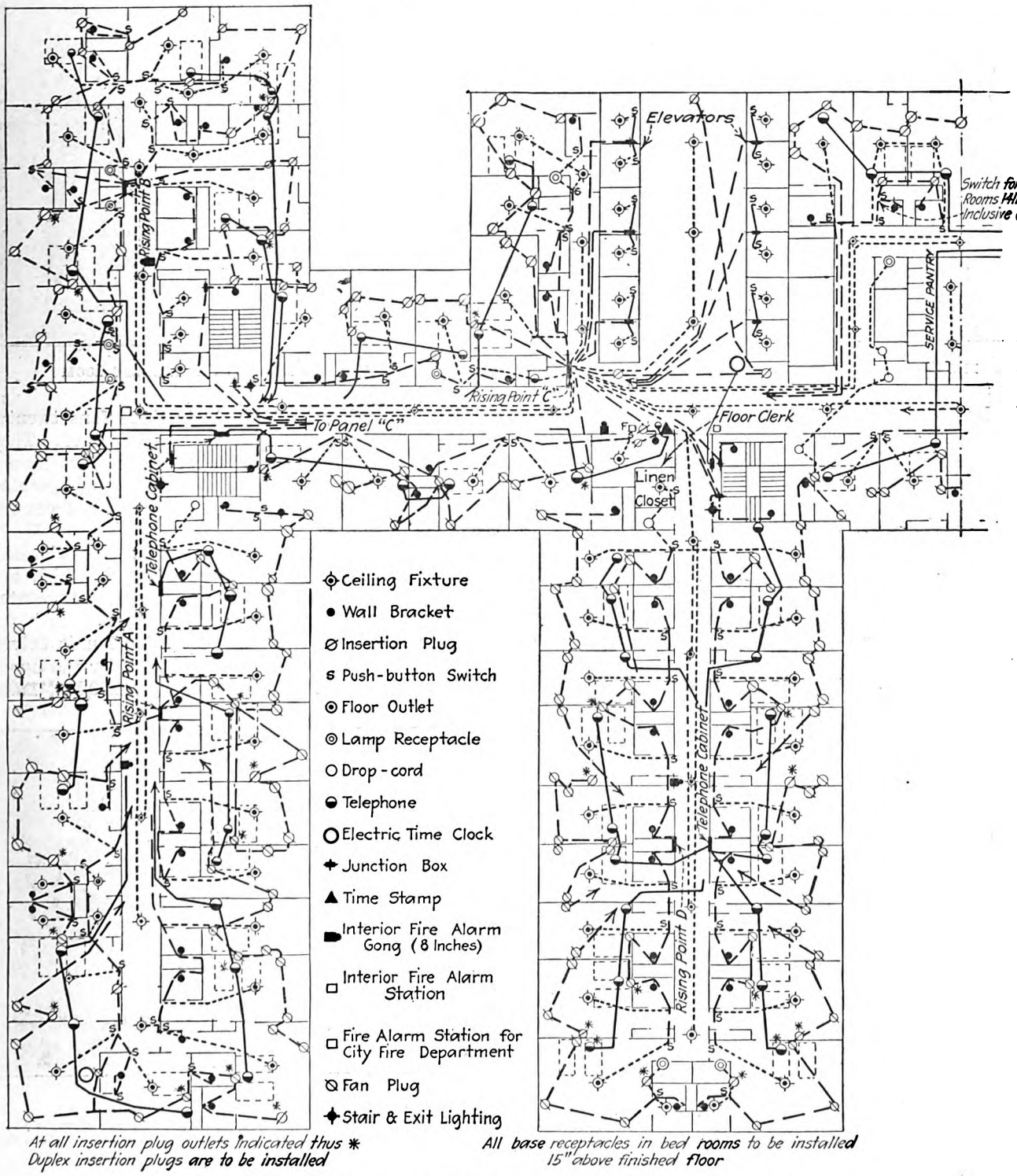

FIG. 4—DETAILS OF WIRING ON PORTION OF A GUEST-ROOM FLOOR

The six dumbwaiters previously mentioned for furnishing service between the kitchen and the various floor pantries are operated on the single-point control plan. That is, an operator in the basement kitchen controls the movement of the cars and dispatches the dumb-

facilities for feeding 6500 people, will have quantities of towels and bed and table linen to launder which will be measured in tons rather than pounds. To handle this enormous quantity the most modern and up-to-date laundry equipment has been installed, making the largest

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electrically driven laundry in the world. The equipment includes ten 42-in. by 72-in. (100-cm. by 180-cm.) cascade metallic washers, which are driven by direct-connected reversing motors. Twelve 40-in. (100-cm.) overdriven centrifugal extractors dry the work, with the exception of bath towels, which are handled in three

Ventilating-Fan and Pump Motors.—The system of artificial ventilation used in the Hotel Pennsylvania is very complete. Pure filtered, washed and tempered air is blown into and the foul air is exhausted from practically all the concourse and service rooms in the lower floors and basements. All of the 2200 bathrooms are

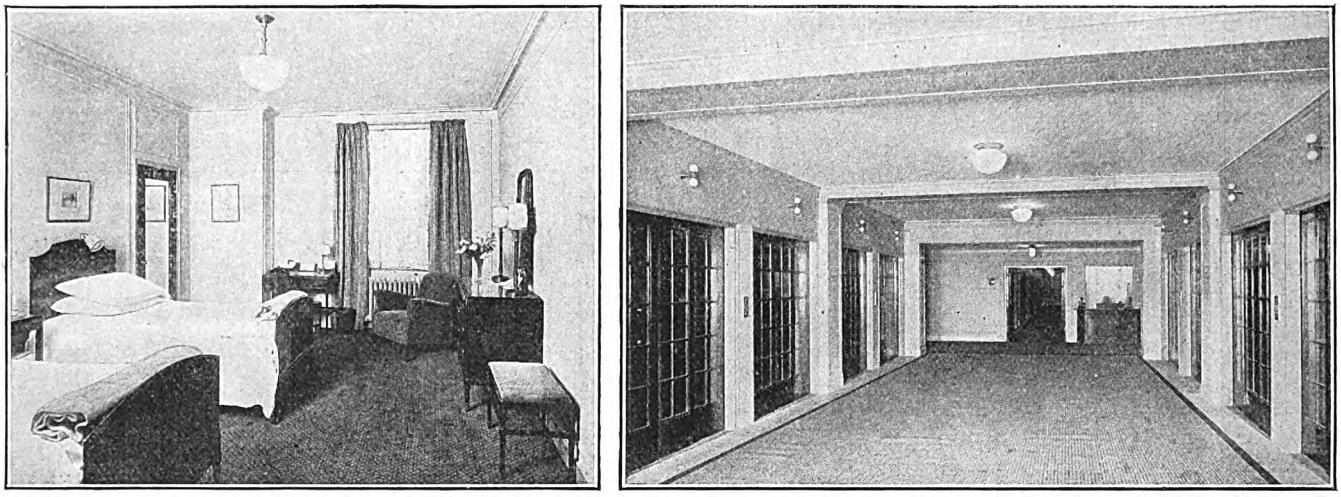

FIG. 5—GUEST-ROOM AND CORRIDOR LIGHTING; NOTE THE DRESSER, DESK AND BED LAMPS IN THE GUEST ROOM

40-in. by 94-in. (100-cm. by 240-cm.) steam-heated drying tumblers. Ironing is performed with five 120-in. cm.) flat-work ironers. A curtain drier and finisher and complete laundry equipment for handling guests'

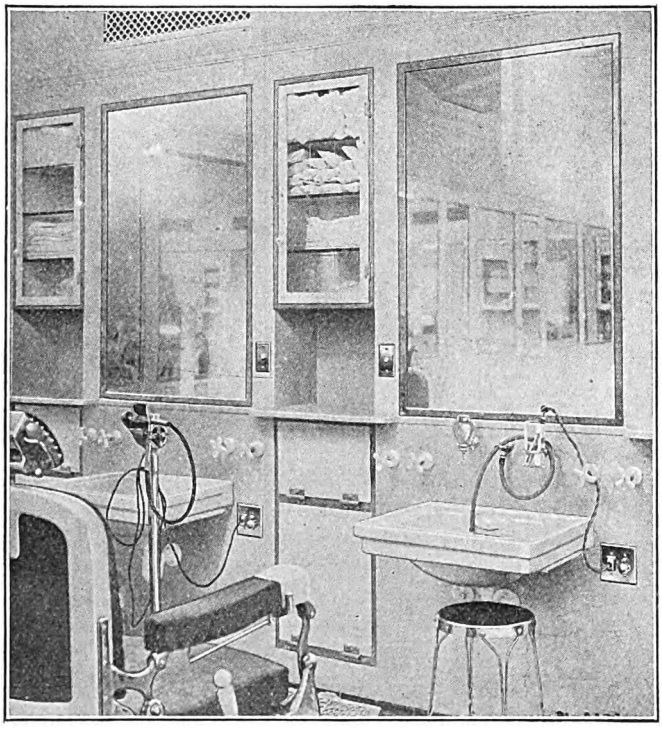

FIG. 6—BARBER-SHOP FACILITIES

Each chair of the barber shop has as part of its equipment an outlet for an electric hot-water sterilizer. The outlet is installed at the right of the water basin and is equipped with an indicating lamp which is lighted when the current is flowing through the heating coil. This outlet can also be employed for attaching massaging and similar appliances. A push-button for calling a bootblack or asking for electric appliances is available at each chair.

wearing apparel are also installed. Each machine is driven by its own motor, and panelboard control is used extensively. Although located in the sub-basement, this laundry is very comfortable as a working place because of the effective ventilating system provided.

ventilated by exhaust. To operate these fans twenty-seven motors, totaling nearly 700 hp., are used. They are run at low speeds (around 300 r.p.m.) to secure quiet operation. Each is quipped with a hand-operated field speed controller and has a speed range of from one to one and a half or two.

Two water tanks are provided, one on the eleventh floor and the other on the twenty-second, which are ordinarily supplied by means of steam pumps in winter and electric pumps in summer. The electric pump for the lower tank is a two-stage centrifugal unit driven by a 60 hp., 1600 r.p.m. motor, and that for the upper tank has four stages and is driven by a 100-hp., 1200-

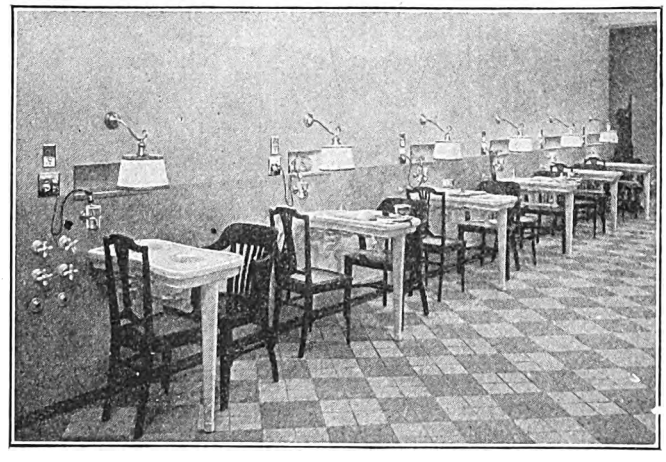

FIG. 7—MANICURING IS ALSO PROVIDED FOR

The men's manicuring parlor, adjoining the barber shop, is likewise equipped with a heater for sterilizing and a push-button for signaling purposes.

r.p.m. motor. Both are equipped with automatic float controllers.

Motor-driven pumps are also used for circulating refrigerated brine to 150 cold-boxes located throughout the hotel, for supplying each guest room with ice water, for circulating the brine in the freezing tank, and for emptying the sump at the lowest level of the hotel.

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Two vacuum pumps, each operated by a 20-hp., 1750-r.p.m. motor, connect with 489 vacuum-cleaner outlets through the hotel. Each pump can operate thirty cleaners at once, producing the same vacuum whether one or all are in use. Motors are also used for operating the dish conveyors, potato peelers, meat choppers, cake mixers, ice cutters and other kitchen machines.

Electrical Construction Work.—Aside from the magnitude of the work of installing the electrical equipment, there were very few difficult problems presented in the electrical construction work, because the much-to-be-desired and seldom-realized elbow room for electrical work was here obtained. Hence the placing of about 635,000 ft. (195,000 m.) of conduit, 150 tons of wire and 30,000 outlets proceeded without a hitch. The equipment for the bell and telautograph systems was installed in such a way that with more than 10,000 original connections to be made the systems operated perfectly from the start and no reconnections were made. The greatest problem was to get the material to the job under war-time conditions.

PROPER SELECTION OF ARC-WELDING EQUIPMENT

Little Difference Found in Quality of Welds Made Under Various Processes—Results Depend Chiefly on Skill of the Operators

BY R. H. FENKHAUSEN
Electrical Engineer, San Francisco, Cal.

The selection of arc-welding equipment is influenced more by considerations of first cost and local conditions than by any question of the quality of the work performed. Experience shows conclusively that successful welding lies 75 per cent in the skill of the operator and only 15 per cent in the apparatus used. A properly trained welder can do excellent work with a water-barrel resistance connected to a 220-volt or 550-volt direct-current shop power circuit, whereas the finest type of constant-energy arc-welding equipment in the market will not even give fair results in the hands of a man who has not had proper training. This statement should not be construed as a recommendation for the use of water barrels or other forms of resistance to reduce the voltage of 220-volt or 550-volt direct-current power circuits for welding purposes. It is intended, rather, to drive home the very important fact that the welder and not the equipment is the most important factor in the welding process.

Welding equipment may be broadly divided into three classes—constant potential, direct current; constant energy, direct current, and alternating current. There should be little if any difference in the quality of work done, under proper conditions, by these several types. In selecting the equipment choice will be influenced primarily by first cost and by local conditions, such as the number of arcs used in the plant, the type of current available and the density of welding operations within a given area.

Constant-Potential Direct-Current System.—The constant-potential direct-current system is the oldest and simplest arc-welding system known. The apparatus required is limited to a resistance sufficient to absorb the difference between the line voltage and the necessary 21 volts across the arc. The source of power should preferably be a direct-current generator wound for 60 volts to 75 volts. Any higher voltage results not only in decreased efficiency but also in greater liability of burning the metal. Even at 60 volts the resistance losses are almost two-thirds of the total current energy consumption, but where the cost of energy is at all reasonable the low efficiency is more than offset by the increased reliability and low maintenance cost of the apparatus. The use of a voltage less than 60 is not advisable, as experience has shown that at least 60 volts is necessary to strike an arc properly, especially in overhead work.

This system is suitable for use where a comparatively large number of welders are employed within a restricted district and where the transmission at 70 volts will not lead to a prohibitive copper cost. A large central generator can be used at the load center of the system or several smaller generators can be installed at various points. The use of a large number of small generating sets is not recommended, however, as this offsets the low maintenance cost which is one of the principal advantages of the constant-potential system.

Constant-Energy Direct-Current System.—The constant-energy direct-current system employs small one-man motor-generator or balancer sets which can be mounted on small portable trucks and easily drawn from place to place as required. The motor-generators are suitable for operation on alternating-current power circuits of any voltage, phase or frequency, and the balancers are used upon 110-volt direct-current circuits or between the grounded neutral and the positive wire of the 110-volt and 220-volt Edison three-wire system.

The field for the constant-energy system is where the number of arcs required will be relatively small in number, scattered over a comparatively large area, or where considerable moving from place to place is required. The efficiency of this system is very high. In fact, it is the most efficient welding system available at the present writing. The equipment, however, is more or less complicated, subject to high maintenance costs and to more or less labor expense in moving from place to place when necessary. It should not be used where a large number of welders are confined to a very small space.

Alternating-Current System.—The alternating-current system employs special transformers usually having a high leakage reactance. Many types of this equipment which have been placed on the market differ only in minor characteristics of energy control. The efficiency of the alternating-current system is fair but its power factor is very poor. As regards its operation it will be found that with an expert welder and under very favorable conditions the work done with alternating current can be made to equal that done with direct current. It is a fact, however, that the average welder used to direct current will experience great difficulty in welding with alternating current.

In conclusion, it may be stated that the constant-potential 70-volt direct-current system is the best system for use where welding operations are to be carried on on a large scale, as in a shipyard, where a large number of arcs per ship would be employed. The constant-energy direct-current system should be used under all other conditions, except on special jobs where the lack of direct-current facilities renders the use of alternating current advisable. In the selection of welding equipment it should be remembered that low maintenance goes with low efficiency, and high maintenance costs may be expected with high-efficiency apparatus.

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A League to Enforce Industrial Peace

We Cannot Return to the Pre-War Harassing Hostility Between Employers and Employed, and the Labor Problem Must Be Solved in a Comprehensive Way to Assure Continuity of Production

BY L. K. COMSTOCK
L. K. Comstock & Company

Mr. Comstock deals here with the entire problem of readjustment of relations with labor. The labor problem touches all industries. Mr. Comstock's discussion is of particular interest to the electrical industry because of his close connection with and understanding of the conditions under which it operates.

THE whole world, and in particular the industrial world, is undergoing readjustment and reconstruction. The process began before the close of the war, but has been greatly accelerated since, partly because men's minds have been pried open by the facts and jolts of the war and are therefore more receptive to new ideas than formerly, and partly because the fear of Bolshevism, a thing but imperfectly understood in America, is driving men to take preventive measures against ills they know not of. Men of the industrial world are striving toward the realization of ideals formerly considered unattainable and hence impracticable. Men who are called practical worship the god of things as they are and do not sense the great fact that the world marches on irresistibly, changing the practical man of to-day into the back number of to-morrow and the idealist of to-day into the practical man of to-morrow.

He who senses the movement, the inexorable movement of the human world, and lives a life of eternal adjustment and readjustment, is the man who is constantly realizing ideals and hence may be called the practical idealist. The world moves, and men either move with it or are left behind. The tremendous event of the war will not leave the world as it found it. Social and economic institutions, deep-rooted and ancient though they be, must undergo change if they block the path of the highest attainable level of social justice and the widest extension of opportunity, welfare and industrial contentment.

REFORMS ARE DEMANDED BY THE TIMES

The spirit of a new day justly demands reforms, and those who obstruct and stubbornly resist them will be the derelicts left behind. The world moves on in endless cycles, because man by nature is an adventurer and none who does not adventure is likely to stumble on the facts in the realms of science, of law, of medicine, of industry and of politics. The stay-at-homes are the conservatives, who like things as they are, who abhor change, in a world of kaleidoscopic aspect.

The history of the world is the story of adventure, over lands and seas, real continents of land and real seas of water, but more often seas of scientific doubt and continents of intellectual challenge. War stirs the intellect and the heart to their very depths, and readjustment is the result of these stirrings. Readjustment causes adventure, and the sharpened edge of adventure quickens the mind to sense the inequalities, injustice, inappropriateness and inadequacies of things as they are, and it reaches out toward change when once the necessity of change becomes obvious to the quickened mind.

A change of attitude toward labor, whether organized or unorganized, is foreshadowed by the events of the past four years. The industrial world in small units and in large units, but all disconnected, disjointed and without unity of thought or action, has been struggling with the problem of labor. The struggle, though successful in isolated cases—like the Steel Corporation and the Colorado Fuel & Iron Company—has been generally carried on without clear thought of the future and without any clear idea of coöperation with labor, but rather with the idea of maintaining the existing status, rectifying here and there minor abuses and differences of opinion, conceding as little as possible, and as infrequently as possible, anything in the way of wages.

PROBLEM HAS NOT BEEN WHOLLY GRASPED

There does not seem to have been a comprehension of the breadth and stature of the general problem, or any broadly concerted action looking toward a general solution. Most employers and employees seem to have naturally drifted into opposing camps, whose daily existence consists of forays, patrol raids, skirmishes, and now and then pitched battles, without ever an approach to a general engagement. The captains of the employers of labor can scarcely be said to have realized that in the last analysis their interests are hard to differentiate from the interests of labor, and the same is true of the leaders of labor—they have seldom appreciated that those whom they led were generally better off if their struggles could be carried on without undue cessation of work and its consequent penalties.

The problem of labor can and must be solved in a comprehensive way. The industrial world cannot go on indefinitely with the great problem of labor unsolved, baffling the feeble attempts of unorganized thinking, continually shifting ground, with employers sporadically and in isolated places conceding bit by bit what labor, perhaps rightfully, often unjustly, demands. This is the great task confronting American business to-day. There can be no handwriting on the wall clearer than that which reads: "We cannot return to the pre-war competitive methods, business sabotage, down-pulling and harassing hostility between employers and employed, between organized industry and the government."

May it not be possible that the development of the control of industry shall in its general outlines follow the development of political control? The common people of England before the time of Simon de Montfort had no voice in the government. The king, nobility and the church were the sole repositories of political power. But when De Montfort, a patriot in advance of his age, calling the common people about him, overthrew Henry III (in 1265) he established what has since been known

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as the House of Commons. The development of the political power of the Commons down to the present time is a story of intense interest, known to all the world.

In the development of government in industry may it not be said that we are now in a transition period somewhat resembling that of government within the state in the reign of Edward I? Here and there far-seeing employers—De Montforts of industry, after a fashion of speaking—are summoning to their councils representatives of labor and the community, as well as of capital and management.

In the struggle for a wider freedom, mankind will not rest until in industry, as in the state, autocratic government, whatever its form, is superseded by a form of government representative of all the parties in interest and ultimately by a system the corner stone of which is responsible self-government.

There is a growing consciousness permeating all strata of society that the war was fought, somehow or other, for the sake of democracy. Democracy free, democracy intelligent, democracy conscientious, is only coöperation, and real coöperation between capital and labor means a juster recognition of the part played by labor in the development of the modern world.

THE FOUR FACTORS OF MODERN INDUSTRIALISM

The modern industrial world consists of four parts —labor, capital, management and community. By the joint coöperation of all four industry is carried on and wealth produced. The reward of labor's contribution is wages; interest is the reward of capital's contribution; salary the reward of management and direction, and the community receives its reward in increase of quantity, or improvement in quality, in exchange for its large purchasing power.

These four parts are so intimately related that it would seem to be utter folly to abandon them to function in opposition. A well-ordered industrial society will accord a certain place and assign definite functions to each of the four chief members, and there must be lodged somewhere the requisite authority to execute these assignments of function.

Failure of labor to continue the processes of production, because of disinclination on the part of capital to meet a demand, would be a case in point; or the failure on the part of capital to meet a just demand on the part of labor for an advance in wages or an amelioration in working conditions would be another case in point. Any failure on the part of management properly to represent capital to labor or labor to capital, or interference in any way with close coöperation between capital and labor, would also be a case in point. The failure on the part of labor and capital to meet the just requirements of the community by decreasing definite production requirement, whether by studied inefficiency or cessation of work, would be a case in point.

Government regulation as a principle has been accepted. Government regulation has been applied to banking, railroading, telephone and telegraph, public utilities and trade relations.

In these days when men's minds have been attuned to leagues, leagues to enforce peace, leagues of nations, why not give some thought to a league to enforce in dustrial peace?

As a foundation upon which to build let us formulate a legislative program concerning private industry which shall rest upon the following propositions, on the legal principle of conserving the public (and industrial) welfare:

I. CLEAR RECOGNITION OF THE MORAL AND LEGAL RIGHT OF MEN TO ORGANIZE

This is paralleled by the first paragraph of a declaration of principles submitted by the War Labor Conference Board, signed by all members of the War Labor Board and indorsed by presidential proclamation April 8, 1918, reading as follows:

"The right of workers to organize in trade unions and to bargain collectively through chosen representatives is recognized and affirmed. This right shall not be denied, abridged or interfered with by the employers in any manner whatsoever."

II. THE ESTABLISHMENT OF TRIBUNALS, UNDER THE LAW, WHOSE MEMBERSHIP SHALL BE REPRESENTATIVE OF EMPLOYERS, EMPLOYEES AND THE PUBLIC

In its fundamental characteristics, this proposition is similar to the following paragraph taken from an agreement signed on Jan. 19, 1917, by the Secretary of War and Samuel Gompers, president of the American Federation of Labor, and reads as follows:

"For the adjustment and control of wages, hours and conditions of labor, in the construction of cantonments, there shall be created an adjustment commission of three persons, appointed by the Secretary of War, one to represent the army, one the public and one labor."

The fundamental idea underlying the various agreements entered into between the government and labor unions, or agencies performing government work and labor unions, is prevention of cessation of production and insurance of maximum production—two things which are quite as necessary under post-war conditions as during war, in order to meet successfully world competition. The war, however, created a set of conditions which made imperative these obvious remedies.

III. THE ESTABLISHMENT OF MACHINERY TO COLLECT DATA FOR THE USE OF SUCH TRIBUNALS IN DETERMINING FAIR AND REASONABLE WAGES AND FAIR AND REASONABLE WORKING CONDITIONS

This proposition is similar in character to the Bureau of Labor Statistics, whose function is to acquire and diffuse useful information on subjects connected with labor's relations with capital, hours of work, wages and earnings, and prices of food and commodities.

IV. THE CLEAR RECOGNITION OF THE JUSTICE AND NECESSITY FOR EFFICIENCY AND DISCIPLINE IN ALL INDUSTRIAL UNITS

This proposition finds its counterpart in the following paragraph quoted from the declaration of principles submitted by the War Labor Conference Board above quoted:

"The maximum production of all war industries should be maintained and methods of work and operation on the part of employers or workers which operate to delay or limit production, or which have a tendency to arbitrarily increase the cost thereof, should be discouraged."

V. EVERY WORKER TO BE GUARANTEED THE OPPORTUNITY TO SECURE REDRESS FROM ARBITRARY OR OPPRESSIVE EXERCISE OF HIS EMPLOYER'S FUNCTIONS

No defense is needed of this proposition, since all will agree that redress from arbitrary or oppressive laws and customs is an ancient right, inherent in the genius and institutions of the Anglo-Saxon race.

VI. EVERY EMPLOYER TO BE GUARANTEED THE OPPORTUNITY TO SECURE REDRESS FROM ARBITRARY OR OPPRESSIVE EXERCISE OF POWER BY LABOR

What is true of Proposition V is also true of Proposition VI.

VII. PUBLIC REGISTRATION OF ALL COLLECTIVE AGREEMENTS

With respect to this proposition, it may be said that such registration with a legally constituted department of the

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government will have a deterrent effect on the making of improper and unlawful agreements between employer and employ

VIII. A NATIONAL COUNCIL, WITHOUT WHOSE SANCTION THERE WILL BE NO CONCERTED CESSATION OF WORK OR CLOSING DOWN OF PLANTS, TO WHICH ANY INTERESTED PARTY MAY APPLY FOR RELIEF, AS IT MAY IN PUBLIC SERVICE MATTERS TO THE INTERSTATE COMMERCE COMMISSION OR THE PUBLIC SERVICE COMMISSIONS OR IN TRADE MATTERS TO THE FEDERAL TRADE COMMISSIO

This is a development of the idea involved in the War Labor Policies Board. During the war the President appointed the Secretary of Labor to act as War Labor Administrator, and the Secretary of Labor, Mr. Wilson, exercised this power in large measure through Felix Frankfurter, chairman of the War Labor Policies Board. In actual fact, the Secretary of Labor not only acted in his normal capacity as Secretary of Labor, but also exercised extraordinary prerogatives as Director of Emergency Policies. Here again the war was responsible for the creation of a perfectly obvious remedial agency, although it lacked the breadth and scope intended for a national council.

IX. SUCH NATIONAL COUNCIL TO BE CONSTITUTED OF MEMBERS ELECTED FROM GROUPS OF EMPLOYERS AND GROUPS OF WORKERS AND REPRESENTATIVES OF THE PUBL

This requires the national council to be made up of members drawn from employers, employees and the public. There can be little question about the propriety of both employers and employees sitting on such a council. There may be some question in regard to the membership being made representative of the public also. The public, however, in the opinion of most students of the industrial situation, is quite as much concerned in the matter of continuous production as either employer or employee, and ought to be represented wherever the relations of employer and employee are under consideration. To show that this policy has already received governmental sanction it is only necessary to mention the composition of the national War Labor Board, which consists of William Howard Taft, Frederick Judson, Frank P. Walsh and William Harmon Black, who were intended to be and are representative of the public, and in addition nine men representing employers and ten men representing workers. One of the latter died, leaving but nine on the board.

X. CLEAR RECOGNITION OF THE FUNCTION ON THE PART OF THE NATIONAL COUNCIL TO DETERMINE THE DEFINITION OF A REASONABLE WAGE AND REASONABLE WORKING CONDITIONS

This is only a forward step and development of the declaration of principles laid down for the guidance of the National War Labor Board. This board cannot properly function without determining the definition of a "reasonable wage and reasonable working conditions." It can settle neither wage disputes nor controversial matters in connection with working conditions without being able to determine and define reasonable conditions.

XI. CLEAR ACCEPTANCE OF THE PROPOSITION THAT, ADEQUATE MACHINERY BEING ESTABLISHED FOR THE REDRESS OF ALL JUST GRIEVANCES, THE RIGHT TO COERCE BY STRIKE OR LOCKOUT IN ALL SERVICE AFFECTING PUBLIC HEALTH, SAFETY, CONVENIENCE OR ECONOMY SHALL BE MADE AS OBSOLETE AS THE DUEL OR AS ILLEGAL AS LYNCHING OR MURDER

The above proposition is clearly foreshadowed by all the acts of the government during the war pertaining to the elimination of labor disputes.

XII. ACCEPTANCE OF THE PRINCIPLE OF DELEGATION OF ORDINARY POWERS BY THE NATIONAL COUNCIL TO LOCAL BODIES, DULY AUTHORIZED AND CONSTITUTED, FOR THE PURPOSE OF DEALING WITH LOCAL, AS DISTINGUISHED FROM NATIONAL, QUESTIONS, IN THE INTEREST OF SPEED, ECONOMY AND EFFICIENCY

Delegation of powers in well-defined districts would seem desirable where no national question is involved. A local council under this plan could be composed of those whose understanding of local questions and conditions would contribute to speed, accuracy and justice in decisions, and would afford a reasonable measure of local self-government. Acting under the control of the national council, the decisions of a local council would follow the general lines laid down by the national council, and thereby a unity in industrial policy would result.

The foregoing twelve propositions, representing nothing new or radical, if duly and properly enacted into law, would create a simplified piece of machinery for regulating industrial affairs, whereas during the war the machinery was complex, lacking unity of action and in many cases the power to enforce decisions. Many of the governmental departments during the war adopted their own labor policies, which placed the government as a whole in the untenable position of enunciating conflicting views and decisions with reference to labor disputes, and a number of these disputes finally reached the President for decision. Machinery should be set up which would render it unnecessary for a labor dispute ever to reach the President; but such disputes should be decided by tribunals composed of experts, who, when necessary, may call upon properly constituted departments for facts and data pertaining to the case before them.

It is doubtless necessary to meet the objection that such a plan argues too much eighteenth-century governmental interference with the industrial world—too much governmental interference with too little governmental efficiency. That this objection has force must be admitted; but, on the other hand, it must be argued that governmental interference is the price we pay for liberty—that self-imposed restraint free men call liberty. To decry governmental ownership, regulation or control because of the too obvious inefficiencies of our present legislative and administrative systems is merely begging the question and will not meet the situation.

We must amend, change or brush away those parts of our present eighteenth-century governmental system which stand in the way of a modern twentieth-century solution of our industrial problems if we are to succeed in world industrial competition; and if success shall attend our efforts, we shall have to stop business buccaneering, fleecing the public and resistance to the legitimate demands of labor for generally better standards of living. Meeting these situations from day to day as we see them is evolution; continued resistance to them will bring revolution.

This plan differs from the industrial council plan reported by the Whitley committee to the British government in the following important respects:

(a) This memorandum contemplates enactment of a plan into law *in toto*, at once, whereas the Whitley plan contemplates voluntary individual trade and labor organizations acting jointly in recommending to Parliament from time to time such legislation as seems desirable. To quote from the Whitley report:

"According to most recent advices, the English Ministry of Labor has already been successful in setting up national councils in fifteen industries, including pottery, building, rubber, gold and silver trades, matches, silk, furniture, chemical trade, baking, vehicle building, china, clay, hosiery, paint and varnish, and leather goods; and organization is under way in at least half a dozen more. In other words, the documents here brought together relate to a going and active movement, one whose extension and development is assured."

(b) The public does not appear to be directly represented in any of the trade councils under the Whitley plan, whereas under this plan the public is represented equally with employer and employed.

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(c) The plan here exhibited would undoubtedly work most effectively if all employers were organized by trades or occupations and all employees similarly organized, but the plan should work quite regardless of the degree of organization accomplished. The Whitley plan, on the other hand, seems to depend for its effective workability on complete organization. In this connection the following paragraph, quoted from the Whitley report, is instructive:

"It may be desirable to state here our considered opinion that an essential condition of securing a permanent improvement in the relations between employer and employed is that there should be adequate organization on the part of both employers and workpeople. The proposals outlined for joint coöperation throughout the several industries depend for their ultimate success upon there being such organization on both sides, and such organization is necessary also to provide means whereby the arrangements and agreements made for the industry may be effectively carried out."

This memorandum is not intended to do more than suggest in merest outline a plan to simplify and unify the relations that exist between employer, employee and the public.

This, or some other plan having for its object the legalizing of relations between employer and employed, the stabilizing of conditions and the consequent assurance of continuity of the processes of production, ought to make an instant appeal to the employer who is a business man. It ought to appeal with even greater force to large corporations, the cessation of whose production is even more serious, on account of the quantity involved and the great inconvenience, injustice and general detriment to the public.

Such a plan ought to appeal to the public because by its terms the public is a part of the council and can make a direct appeal to the council whenever its interests are in jeopardy.

The plan ought to appeal to organized labor because labor's status becomes legalized, and therefore definite, and a body of precedent and common law of labor could in time be built up which would establish the relations of employer, employee and the community on foundations of principle, justice, morality and fair dealing which not even the most enthusiastic protagonist of either side of the great question would have the hardihood to claim exists at the present time.

Nothing in the plan contemplates the abolition of existing organizations of either employees or employers, but the plan taken as a whole offers the industrial world a court of last resort; therefore labor delegates, business agents, trade boards, boards of governors and executive committees of employers' associations may continue to function and enjoy all the prerogatives, duties and emoluments to which they have heretofore justly been entitled.

Industrial Maintenance and Rehabilitation Methods

Great Saving Effected by Standardization of Methods and Materials—Arguments for the Use of 115 Volts Direct Current Supply Instead of 230 Volts—Functions of Storage Battery in Industrial Plants Are Clearly Stated

BY E. E. GEORGE
Electrical Engineer, Chicago, Ill.

DURING the last three years the Lodge & Shipley Machine Tool Company of Cincinnati, Ohio, has made a particular effort to standardize its electrical and mechanical maintenance methods and its mill supplies. While the chief object has been to reduce the length and the number of shutdowns of productive equipment, some detailed results were:

(1) A virtual rehabilitation of the electrical system, causing it to do more than comply with the latest code requirements.

(2) A reduction of the number of extra parts and operating supplies to about 30 per cent of the number formerly necessary.

(3) An increase in the size of purchase orders for maintenance material, which permitted standard package discounts, with an average saving of 20 per cent.

(4) The accumulation of a number of spare units available for quickly replacing inoperative equipment.

(5) A reduction in the time required for training helpers to become proficient in maintenance work.

(6) A 50 per cent reduction in the labor of keeping a perpetual inventory of plant equipment.

(7) The introduction of prints and records of all wiring and piping layouts.

(8) Ordering of all material and the scheduling of all machining operations for a maintenance or construction job beforehand, with as great a degree of accuracy as on new production work.

(9) The development of several new devices and fittings, built in the company's own shops or added by electrical manufacturers to their lines.

CHOICE OF DIRECT-CURRENT VOLTAGE

The first steps toward the standardization of electrical equipment were to purchase outside power and to install a new switchboard. A 300-kw. synchronous motor, supplied with 4400-volt, three-phase, 60-cycle current from the Union Gas & Electric Company's primary lines, directly connected to a 115-volt direct-current generator, was substituted for steam-driven generators.

While there was no question regarding the desirability of 440-volt, three-phase, 60-cycle induction motors for all constant-speed line shafts and individual motor-drive machines requiring less than 100 hp. each (4400-volt synchronous motors being chosen for any future installation of air-compressing or other equipment of 100 hp. or larger), there was a wide disagreement regarding the voltage for the direct-current equipment. The representatives of the electrical manufacturing companies insisted that 230 volts was the standard for direct-current industrial motors and with difficulty were induced to bid on a 115-volt direct-current generator.

The following arguments for 115-volt direct-current distribution in place of 230-volt were advanced by the purchaser's engineer:

(1) That 230-volt motors are standard only because manufacturers have insisted on discouraging the design, manufacture and sale of 115-volt equipment.

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(2) That the two-wire and three-wire, 230-volt systems were developed for city distribution before the long, heavily loaded direct-current networks were superseded by alternating-current distribution with regulated feeders, and that such conditions do not apply in modern plants.

(3) That any three-wire system involves an unnecessary complication of wiring and of switchboard construction.

(4) That wherever alternating-current power is available direct current is used only for variable-speed motors, battery charging or electromagnet equipment, and that in modern industrial plants this load is a small proportion of the total (owing to the development of quick-change gearing for machine tools, which the writer considers superior to the variable-speed motor drive). High-voltage alternating-current power may be carried to a central point, converted into 115 volts direct current by a motor-generator set and distributed to the

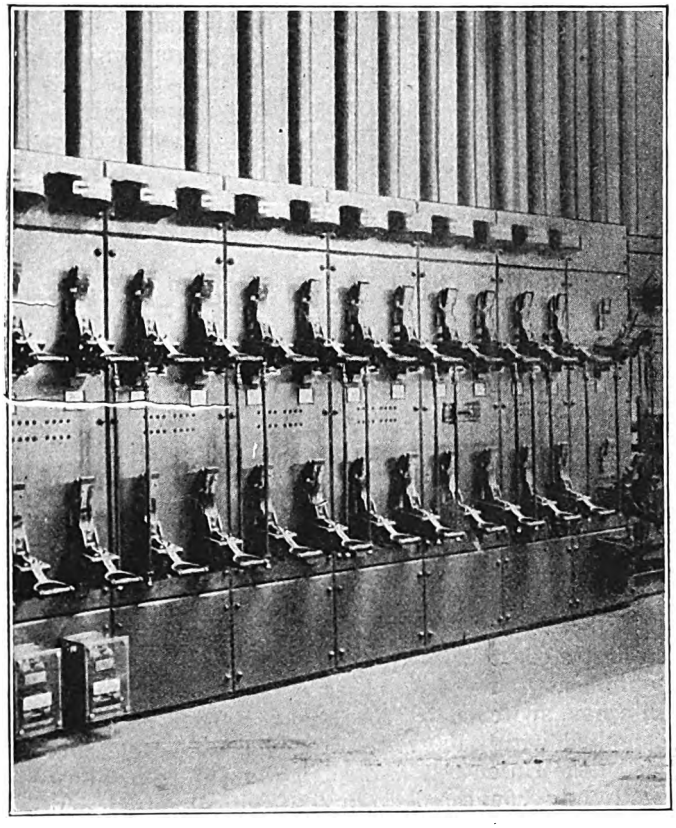

FIG. 1—CIRCUIT BREAKERS USED INSTEAD OF KNIFE SWITCHES

cranes, storage batteries, lifting magnets, arc welders, reversing planers, etc., with a copper expenditure for direct current which is very small compared with the cost of copper for alternating-current power or with the cost of direct-current variable-speed motors, controllers, storage batteries, lifting magnets, etc.

(5) That 115 volts is preferable to 230 volts for tungsten lamps.

(6) That 115 volts is far cheaper than 230 volts for truck and tractor battery charging.

(7) That 115 volts is the actual and rightful standard for storage batteries for power, light or control service, and that no modern alternating-current or direct-current switchboard is complete without such a battery (of 80 amp.-hr. or larger capacity) for operating trip coils, relays, remote-controlled circuit breakers, pilot lights and emergency lights. Such a battery is also generally useful around an industrial plant for operating time clocks, solenoid valves and whistles, annunciator systems, fire alarms, autocall systems, telephone equipment, etc.

For these reasons 115 volts was chosen for the direct-current service.

DIRECT-CURRENT SWITCHBOARD IS SUBSTANTIAL

On the new direct-current board circuit breakers were used exclusively, there being no knife switches or fuses whatever. On the back of this board of very substantial construction, the busbar arrangement was both novel and simple.

The breakers were of the Cutter I T E "Directite" type with the positive poles directly above the negative poles, instead of side by side. The bottom studs of each pole were of the horizontal laminated type and were made 9 in. (22.9 cm.) long. Allowing 2 in. (5 cm.) for slate, 2 in. (5 cm.) for the angle framework and 3 in. (7.6 cm.) for intermeshing with the busbars, there was 2 in. (5 cm.) for clearance between the busbars and the framework.

No busbar supports were necessary, the bars being clamped between the laminated breaker studs with busbar clamps. The total-load breaker and all feeder breakers were mounted on the board with the centers of the laminated lower studs exactly in line horizontally, so that the busbars were straight ¼-in. by 3-in. (6.3-mm. by 7.6-cm.) bars running the full length of the board. The upper studs of both poles were laminated vertically, and all ammeter shunts were milled to fit these laminations. Connections between the shunts and outgoing lines were made with the Electrical Engineers' Equipment Company's tongued cable terminals, provided with busbar-type clamps. In order to avoid the unsymmetrical appearance of various-sized cables from No. 0 to 1,000,000 circ. mil, running up from the top of the board to the ceiling, lengths of 4-in. (10-cm.) conduit, mounted with their axes vertical and spaced 12 in. (30 cm.) apart horizontally, were run from the top of the board to the bottom member of the roof truss, being fastened at each end with U-bolts. The lower ends of the conduit were hidden by the top of the board, as they came down below the top-tie channel at the back of the board. Ordinary malleable bushings were screwed on the lower ends. The upper ends were practically hidden by the roof truss and were finished with bushings for open wiring, with LB condulets for conduit work, or were extended on through the roof and capped with FE condulets for lines running over the roofs or on poles to other buildings.

GENERATOR CABLES IN 8-IN. CONDUIT

The generator cables were brought to the board through steel conduit under the floor. This installation is of interest because of the size of the conduit. Ten 1,000,000-circ.mil lead-covered, rubber-insulated stranded cables were run through 40 ft. (12 m.) of 8-in. (20-cm.) conduit. Because of the limitations of space it was not practicable to use five 4-in. (10-cm.) conduits, and the 8-in. (20-cm.) installation was approved by the Underwriters, although standard electrical fittings were not used. The necessary fittings, however, were obtained from sprinkler equipment. The ends were finished by screwing on standard cast-iron companion flanges and bolting to these flanges circular disks of ⅜-in. (9.4-mm.) Bakelite-Micarta, through which ten holes just large enough to clear the cable were drilled. These end

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plates kept rats and mice out of the conduit and held the cables symmetrically for fanning out to their terminal blocks. The ten cables, guided carefully, were pulled in with a 12-ton crane, and there was no serious abrasion of the lead sheaths. One-inch pipe rollers were placed about 2 ft. (61 cm.) apart under ten cables before they entered the conduit, and this materially reduced the power required.

The conduit installation for the 4400-volt service to the synchronous motor was unusual in that lead-covered cable was not used. Four Okonite No. 0 type RD 70 double-braid 7000-volt rubber-covered stranded cables were run through 3-in. (7.6-cm.) steel conduit about 80 ft. (24 m.) from the pole line to the oil fuses. G. & W. disconnecting potheads were used on both ends of the conduit. In addition to the service company's expulsion fuses on the pole lines, Schweitzer & Conrad carbon tetrachloride fuses were placed between the inside pothead and the disconnecting switches. These oil fuses have proved particularly valuable in protecting the equipment from excessive mechanical and electrical strains, because of their low-time element, while the G. E. induction relays controlling the oil circuit breakers have been relied upon for protection from damage by heating.

The disconnecting switches were double-throw, with one set of contacts connected to power and one set connected together and to ground, so that there was no damage from static, lightning, leakage or generated voltage while working on the oil circuit breakers or on the motor, as the motor leads were shorted and grounded.

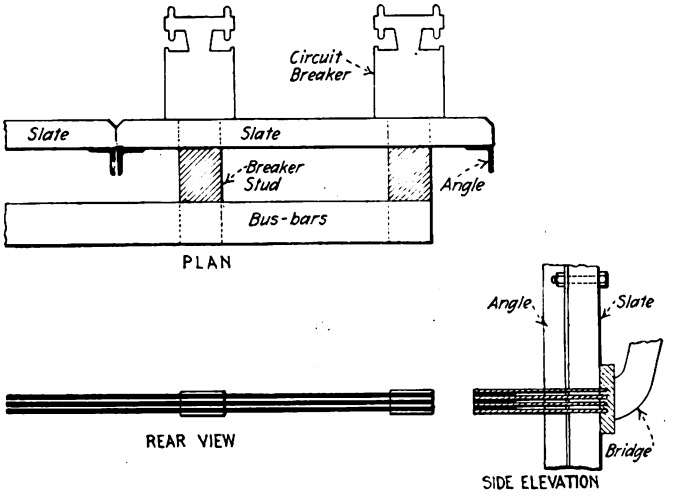

FIG. 2—BUSBARS CLAMPED DIRECTLY TO LAMINATED BREAKER STUDS

SIZE OF WIRE, CONDUIT AND SWITCHES FOR 115-VOLT LOADS

B. & S. or American Wire Gage	Rated Motor Horsepower: 1½	2	2½	3½	5½	7½	10½	15	27	50	82
	Number of Light Circuits: 1	1	2	3	4	6	7	10	19	34	56
14	50	....	....	....	....	....	....	....	....	....	....
12	80	60	....	....	....	....	....	....	....	....	....
10	125	95	60	....	....	....	....	....	....	....	....
8	200	150	100	70	....	....	....	....	....	....	....
6	320	240	160	120	80	....	....	....	....	....	....
4	500	375	250	180	125	90	....	....	....	....	....
2	800	600	400	300	200	150	110	....	....	....	....
0	1,300	960	640	480	320	240	160	125	....	....	....
0,000	2,600	1,900	1,300	960	640	480	320	250	150	....	....
500,000	6,000	4,500	3,000	2,200	1,500	1,100	750	600	350	200	....
1,000,000	12,000	9,000	6,000	4,400	3,000	2,200	1,500	1,200	700	400	250
Knife-Switch Rating	30	30	30	60	60	100	100	200	400	400	600
Cartridge-Fuse Rating	15	20	25	35	50	70	90	125	225	400	....
Circuit-Breaker Rating	20	20	30	45	60	80	100	150	300	500	700
Highest Breaker Setting	19	26	32	45	65	90	115	160	290	520	840

Size of Loom One Wire	Size of Conduit One Wire	Size of Conduit Two Wires	Size of Conduit Three Wires	Size of Conduit Four Wires
½	½	½	½	½
½	½	½	½	½
½	½	½	¾	¾
½	½	¾	1	1
½	½	1	1	1¼
½	½	1¼	1¼	1½
½	¾	1¼	1½	1½
¾	1	1½	2	2½
1	1	2	2	2½
1½	1½	2½	3	3
1½	2	3½	4	4
2	2½	4	4½	4½

DIRECTIONS FOR 115-VOLT DIRECT-CURRENT WIRING TABLE

The figures in the body of the table show distances in feet from end to end of two-wire lines. These distances are figured for a 3-volt drop. For intermediate loads or distances use the next larger figures given. Lighting circuits are figured with 12 amp. or 1320 watts each.

STORAGE BATTERY FOR CONTROL AND PILOT SERVICE

One of the most valuable features of the electrical installation was a 115-volt, 80-amp.-hr. storage battery, which was allowed to float on the generator most of the time. This battery operated the oil-circuit-breaker trips, solenoid-operated field rheostats, whistles, time-clock system, autocall, fire alarm, solenoid-operated circuit breakers, annunciator system and emergency lights. Failure of voltage on the lighting feeder for the switchboard and generator room caused a solenoid-operated emergency breaker to trip in and furnish battery energy to several 200-watt lamp and plug sockets in the switchboard room and in the electrician's workroom. The emergency breaker gave light and power for all repairs, regardless of what trouble occurred. To prevent the battery from carrying any of the light or motor load on the generator buses the charging breaker was tripped out by the tripping out of the oil circuit breakers by manual or relay operation, the tripping out of the total load direct-current breaker by manual or shunt trip operation, reversal of current or overload on the charging breaker or overload on the master breaker. About one time in three the busbar load would be high enough to drag the storage-battery voltage down so low that the shunt trip on the charging breaker could not operate. At other times the interval between the opening of the generator circuit and the clearing of the battery was practically zero. The tripping was made certain by adding a low-voltage trip to the charging breaker, so that its overload setting could be kept high. All load from the battery, except the emergency load, was fed through a breaker called the master breaker, which never opened except on short circuit and which was depended on for the protection of all control and pilot circuits. The field switches of the motor and generator

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fields of the motor-generator set were double-throw and were thus connected to the generator armature or the master breaker. This assured correct polarity in starting up after generator trouble.

Clearing Grounds by Dead Short

Ground detectors were not used, as it was believed that a constant potential to ground placed a strain on all insulation, reversing in the case of armature coils, and made breakdowns more frequent. By manipulation of the voltmeter plugs the voltage from either line to ground could be read as often as desired. Grounds were cleared by burning them off, a special interlocked double-pole breaker being provided for this. Either side of the line could be dead-grounded. The explosion-like action attending the sudden institution of a power arc instantly cleared many grounds that ordinarily would have gradually carbonized the insulation until they could not have been cleared. As most of the open wiring was on the ceilings and often had to be worked "hot" by men standing on the steel framework of the roof trusses, it was a great convenience to have the lines normally clear of grounds.

Standardization of Wire and Conduit

One of the greatest savings in reducing maintenance stock and in promoting convenience for the electrical department was made by standardizing the sizes and types of wire and conduit to be used. Formerly Nos. 16, 14, 12, 10, 8, 6, 5, 4, 3, 2, 1, 0, 00, 000, 0000, 500,000-circ. mil. and 1,000,000-circ.mil. wire was kept in stock in weatherproof, slow-burning, single-braid, rubber-covered and double-braid rubber-covered insulations, and some sizes in solid, stranded and rope-laid. Nos. 12, 10 and 8 solid and Nos. 6, 4, 2, 0, 0000, 500,000-circ. mil. and 1,000,000-circ. mil. stranded were standardized in double-braid, rubber-covered, and other sizes and types were discontinued. This materially reduced the stock of wire and of Dossert connectors. Reinforced type P lamp cord was substituted for the common cord telephone bridle wire for annunciator, office and fixture wire, and rope-laid cable was bought only on special order. Duplex was discontinued.

A special wiring table was made up, with motor ratings and light circuits plotted against wire sizes, so that distances in feet appeared in the body of the table. This table was figured for a 3-volt drop with a 118-volt supply. Opposite the wire sizes was shown the size of loom to use for one wire and the size of conduit to use for one, two, three or four wires. Below the motor or lamp load was shown the size of cut-out, switch and circuit breaker to use and the maximum fuse rating or breaker setting allowed. The table of conduit sizes was very carefully worked out and gave considerable leeway on short runs, but the saving in time paid for the extra cost of large conduit. Condulets were next standardized, and out of approximately 5500 kinds listed in the catalogs about 300 were found necessary for the work. One hundred and eighty of these were then kept in stock.

Solderless Connectors Are Economical

For all taps and splices on cable larger than No. 8, Dossert connectors were used. In fact, tapping and splicing stranded wire has almost become a lost art in the maintenance department of this company. At first Dosserts were only used for temporary test wark, emergency rush work, connections in RS condulet junction boxes and other crowded quarters, and for switchboard work where artistic appearance was essential. In a few months, however, the Dosserts proved so essential in saving time and copper that they were standardized for all splices and taps, and for all lugs with the exception of soldered stamped terminal lugs and tongued clamp terminals for busbar work. After adopting Dossert fittings the electrical department was able to help out in cases of shut-down by making temporary installations that previously would have taken so long as to have been impracticable. A device whereby a helper is enabled to make a perfect splice in "million cable" in five minutes is certainly an improvement over old methods. In fact, in one case where a large number of feeders had to be changed over in thirty minutes men were borrowed from the labor and the millwright departments to help the electricians, and they make good connections with very little supervision.

In a later issue of the ELECTRICAL WORLD other improvements in this plant will be discussed.

ILLUMINATION STANDARDS USED IN SOUTH AFRICA

Representative Figures Showing Good Practice in Illumination Indicate that South African Standards Are Equal to Those in America

For purposes of comparison with American practice, as indicated by the lighting code of the Illuminating Engineering Society, a table of standard illumination values in South Africa follows. These values were given by H. A. Tinson, in a paper entitled "Illumination and Some of Its Fundamental Considerations," recently read before the South African Institute of Electrical Engineers:

	Foot-Candles
Auditorium, church	1.5–3
Public hall, drill hall	2–4
School, classroom or library	3–6
Shops, show window	10–50
Large shops, ground floors on first-class streets	7–10
Clothing, haberdashery, millinery, jewelry	4–7
Drugs, grocery, meat, bakery, stationery, florist, furniture, etc	3–5
Office, private and general	4–8
Drawing office	8–12
Industrial, for rough manufacturing occupations, *i. e.*, rough assembling, rough forging, rough woodworking, ice making, potteries, tanneries, etc	2–4
For medium manufacturing occupations, *i. e.*, rough machinery, rough bench work or automatic machine work, meat packing, paper making, laundries, bakeries, etc	3–5
For fine manufacturing operations, such as fine assembling, leather working, fine woodworking, fine lathe work, tobacco manufacturing, fine sheet-metal working, light-colored textiles, etc	4–8
For extra fine work, *i. e.*, watch and jewelry making, engraving, typesetting, shoemkaing, enameling, manufacturing dark-colored textiles, etc	7 up
Building exterior (surface) lighting	3–15
Street lighting, yards and open areas	0.02–2

MUNICIPAL ownership with all its shortcomings will come unless public utility corporations are permitted to charge for their wares enough to return their operating expenses and taxes and so much for profit as will insure their ability to attract new capital to the enterprise as needed for improvement and extensions of service.—*Walton Clark.*

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

THREE-PHASE UNBALANCED LOADS SHOULD BE LIMITED

Unequal Line Current in Three-Phase Generators Has Demagnetizing Effect on Field and May Result in Burnt-Out Field Windings

Whenever the currents in the three phases of a generator are not equal the armature reaction or demagnetization of the field pulsates with a frequency equal to twice the frequency of the machine. This pulsation of flux induces an alternating current in the field iron and heats the magnetic structure. The extent of this heating depends on the amount of unbalance between the phases. If the out-of-balance current becomes too great, the heat may be sufficient to damage the insulation of the field winding. The General Electric Company has made the following recommendations on this subject for the benefit of operators using different types of machines:

Waterwheel generators should not be operated with a difference in current between maximum and minimum phase of more than 66 per cent of the rated full-load current. This figure should not exceed 30 per cent for turbo-generators with forged field pieces, and the difference should not exceed 15 per cent for turbo-generators with laminated poles. The maximum out-of-balance current for turbo-generators having solid rotors should not exceed 15 per cent if the end rings which hold the rotor windings in position are not insulated. However, it is the general practice to insulate these end rings in most of the modern turbo-generators. The Electric Bond & Share Company printed this advice in one of its engineering letters.

OUTPUT PER KILOWATT-HOUR GIVEN FOR ENAMELING OVENS

Tests on Different Types Indicate that Continuous Conveyor Type Is from Two and a Half to Four Times as Efficient as Others

The increasing use of electrically heated enameling ovens, etc., has resulted in a demand for ovens of better construction and with better insulation than was in general use with the cheaper gas fuel. Some of the ovens which have been developed for electric operation have been tested by the Westinghouse Electric & Manufacturing Company with the following results:

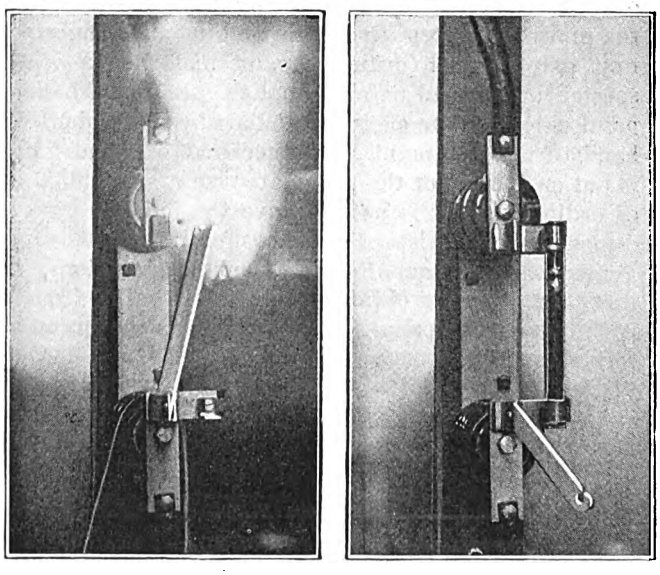
Type of Oven	Method of Handling Material	Output in Lb. of Work per Kw.-hr.
Kiln type	By hand	6 to 8
Kiln type	By truck	10 to 12
Conveyor type	By semi-continuous conveyor	10 to 12
Conveyor type	By continuous conveyor	25 to 30

In all types the oven insulation is placed between an inner and outer metal lining; through metal connections from the interior to the exterior of the oven should be reduced to a minimum. Tests indicate that 1 sq.in. (6.45 sq.cm.) of metal extending from the interior to the exterior surface of the oven will conduct as much heat to the atmosphere as about 7 sq.ft. (6503 sq.cm.) of the high-grade insulation. It has also been found desirable to insulate the floor of the ovens in view of the desirability of obtaining uniform temperature throughout.

PROTECTING DISCONNECTING SWITCHES WITH FUSES

Tests Under Various Loads and Conditions Show that Danger of Operating "Disconnects" Can Be Practically Eliminated

An investigation was recently made by the testing department of a certain central station to determine whether a disconnecting switch could be made safe when pulled under load by shunting it with a fuse of proper design and carrying capacity. Eighteen trials



OPENING A DISCONNECTING SWITCH WITHOUT (LEFT) AND WITH (RIGHT) SHUNT FUSE
Note small arc in fuse near top of inclosing tube

were made under various conditions of load to test the effectiveness of this method of protection. The tests proved successful except in one case where the "disconnect" was pulled deliberately at a very low speed to give the fuse a chance to blow before the switch blade and clips became separated by any appreciable distance. This gave the arc a chance to establish itself across the switch after the fuse had blown. Tests were made with "disconects" both with and without the safety fuse to show the difference in performance of the switch under these two conditions at various loads and voltages. Some of the tests without the fuse were made at 60 amp. at 9000

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volts. The arc which formed between the blades under these conditions could not be interrupted by opening the switch to the full distance. The switch was, therefore, closed to stop the arc. The left-hand illustration shows the arc formed between the blade and clips without a shunt fuse. The other picture, taken when a fuse is used, shows the small arc which then occurred in the fuse near the top of the inclosing tube.

It was concluded from the tests that by the use of a fuse of proper design and rating it is possible to shunt a disconnecting switch so that the switch can be pulled under load without any arc forming at the contact. It was found, however, that even with the disconnecting switch properly fused it should be pulled quickly, because if it is deliberately pulled at a very low speed, there is an opportunity for the arc to jump across a small gap after the fuse has blown. In such a case the conditions similar to those on a non-fused switch would be repeated.

CONDENSATION PREVENTED BY TREATING WATER PIPE

Layers of Ordinary Paint, Cork Cement Paint and Granulated Cork Used to Stop Condensation on Cold-Water Pipes

The Pennsylvania Water Company has practically eliminated condensation on cold-water pipes by the use of paint and a layer of ground or pulverized cork. Only on very damp days is there a slight condensation since the pipes have been given this treatment. The pipe is first painted with ordinary paint and then a coat of special cork cement paint is applied. Before the cement paint dries a layer of dry granulated cork is applied by hand to the wet paint. Another coat of cement paint is put on the top of the granulated cork, and a final coat of ordinary paint is used to give the finished pipe any desired color. Alex. Bauhan, superintendent of the Pennsylvania Water Power Company's stations, says that the company obtains the cement paint from the I. P. Morris Company, Philadelphia, and the granulated cork from the Armstrong Pipe Company at Lancaster, Pa., or from the United Cork Company, Lyndhurst, N. J.

SYNCHRONOUS MOTORS IN THE WORKING OF BRASS

Power Requirements of Rolling Mills in the Brass Industry, Where Trend Is Toward the Use of Synchronous Motors

In the issue of April 28 appeared under this heading a table giving data on synchronous motors in brass rolling mills. The heading of one column was erroneously given "R.p.m. of Rolls" instead of "Surface Speed of Rolls in Ft. per Min." The corrected table is herewith reproduced in full:

Operation	Roll Size	Surface Speed of Rolls, Ft. per Min.	Hp. per Stand
Breaking down cast bars..	20 in. to 24 in. by 36 in. (50.8 cm. to 60.9 cm. by 91.4 cm.).....	75 to 100	300 to 750
Running down.....	18 in. to 20 in. by 36 in. (45.7 cm. to 50.8 cm. by 91.4 cm.).....	125 to 250	200 to 400
Finishing.....	10 in. to 20 in. by 36 in. (25.4 cm. to 50.8 cm. by 91.4 cm.).....	150 to 250	75 to 200

These data were brought out by W. R. Clark of the Bridgeport (Conn.) Brass Company in a recent paper which he read before the Association of Iron and Steel Electrical Engineers.

IMPROVEMENT EFFECTED IN OFFICE ILLUMINATION

Change to Indirect Lighting and Retinting Ceiling Reduces Energy Consumption and Gives More Satisfactory Illumination

BY JOHN A. HOEVELER

Serious complaints regarding the lighting of the building were made by employees of the general office of the Industrial Commission in the State Capitol at Wisconsin. Investigation showed that the lighting equipment consisted of two domes made up of six panels of opal glass, suspended in the inverted position so as to make semi-indirect fixtures, and eight three-light wall brackets. The illumination from this equipment was inadequate in intensity even at the most favorably placed desk. There was objectionable glare from the bright wall brackets, and deep, sharply defined and unavoidable shadows caused much eye strain.

An installation of luminous-bowl indirect fixtures was substituted for the semi-indirect domes, and the brackets were disconnected. This eliminated glare and objectionable shadows and gave adequate intensity on all desks. However, the light buff ceiling absorbed so much light that the consumption of energy was unnecessarily high. The center panel of the ceiling was then painted a flat white, with the result that the energy consumption was reduced 25 per cent with practically no reduction in the illumination at the desks.

The table gives the results of the illumination test with the old and the new system. It will be noted that with the new system and the light buff ceiling 240 watts less energy was used. At the same time the illumination at the work was increased from 3.8 foot-candles to 12.5 foot-candles for the best lighted desk and from 1.1 foot-candles to 6 foot-candles for the most poorly lighted desk. Painting the ceiling white permitted another reduction in connected load of 500 watts with an intensity of 11.6 foot-candles at the best lighted desk and 5.2 foot-candles at the most poorly lighted desk.

ADVANTAGE OF INDIRECT LIGHTING AND WHITE CEILING

Type of Installation	Ceiling	Walls	Watts	Illumination on Desks in Foot-Candles Max.	Min.	Ave.
Two semi-indirect units (old dome fixtures inverted) and eight wall brackets.....	Light buff	Light buff	2240	3.8	1.1	*
Two luminous-bowl indirect units equipped with mirrored reflectors; no wall brackets...	Light buff	Light buff	2000	12.5	6	9.1†
Two luminous-bowl indirect units equipped with mirrored reflectors; no wall brackets..	Center panel painted white	Light buff	1500	11.6	5.2	8.9†

* Not enough tests made to give a true average value.
† These values are not the average of maximum and minimum readings, but the average of a sufficient number of tests at enough stations to give a true average value for the room.

A satisfactory intensity of illumination at the work for offices is 6 foot-candles. Hence it will be seen that all desks now get adequate light and yet the connected load required to give service is 740 watts less than was installed with the old unsatisfactory system.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

MAKING PROPER RATES FOR ELECTRIC WELDING

Present Practice in Some Cases Seems to Result in Equitable Charges, but in Other Instances Changes in Methods Are Necessary

BY C. I. CRIPPEN*

It seems proper at the present time to look into the central-station revenues from electric welding. Direct-current arc welding where the welding current is supplied through the usual motor-generator sets does not offer the disadvantages of the other classes of welding, although the load factor and power factor are lower than central stations would like. The load, however, is sustained for an appreciable length of time, all conditions being quite stable during the load interval, or in other words until the arc breaks. Alternating-current arc welding in its common application will probably have about the same general characteristics as the direct-current process except that the power factor and the load factor will be slightly lower. As more data are available this load can be more closely analyzed. In brief, it would seem that present practices as to demand and energy measurements carefully applied and translated into dollars through existing rate schedules which take account of power factor conditions will yield a very reasonable return on investment and energy costs. Study should be given this situation as experience grows, particularly with reference to alternating-current arc welding.

Resistance-Welding Rates Need Special Examination

Resistance welding, including both spot and butt welding, appears to require special attention to determine whether or not the return calculated in the ordinary fashion is commensurate with the service rendered and does not discriminate in favor of the small spot-welding installation

The normal rating of the usual spot-welding equipment ranges from 5 kw. to 75 kw. per welder, with ratings of about 30 kw. predominating. The usual operation of such a welder calls for the very frequent instantaneous closing and opening of the circuit, and from a large number of observations it has been noted that the load interval ranges close to a half second for a typical welding operation. Occasionally a welder is observed on work requiring a load time of as high as three seconds, but such cases are exceptional and nearly every installation is included in the former class. The cycle of welding operation varies greatly according to the work being handled and ranges from as low as thirty to as high as 1000 welds per hour, while the average installation probably makes 400 welds per hour, or about seven per minute throughout the working day, this being based on the assumption that there is sufficient work at hand to keep the welder busy.

Metering equipment is called upon to measure, therefore, a load of 30 kva. to 40 kva. for half a second or less possibly seven or eight times per minute for the average installation. Theoretically present-day meters should measure such a load in a satisfactory manner, but from experience it would seem that this does not actually work out in practice. A casual observation of the theoretical performance of the integrating watt-hour meter reveals the fact that its ability to measure such a load is based on the assumption that even though the meter disk lags behind the load to a certain extent during the acceleration period, yet this lag in acceleration is counterbalanced by the same lag in deceleration, with the result that the meter should record the actual load over the given time. It seems to work out, however, that the load interval is so short and the peak so abrupt that it virtually amounts to a short-circuited condition for the period of load on the welder. Perhaps metermen will question this statement, yet from close observation covering several years and by independent observations it is reasonably safe to say that the energy registered on a small installation of such welders probably does not amount to more than 25 per cent to 35 per cent of the current used.

Load Curve of a Group of Welders

For a group of welders it would seem that the load curve should straighten out materially and that the energy consumption as registered should correspond very closely to the actual use. In one specific instance in which observations have been made, consisting of ten welders with the welders in regular operation, tests taken on a single-phase meter on the welder circuit indicated an average requirement of but 12.5 kw. during a ten-minute test, compared with a total rating of 250 kw. for the welders. These welders were making fifteen welds per minute on each machine, and even though the operation of the welders would have been such that the load was constant and calculating only one-half second per weld, the meter should have indicated an average requirement of not less than 45 kw., or almost four times that actually shown. As a check against the above data a test is cited where a group of welders rated at 400 kw. were operated from a single-phase generator of 150 kva. rating, and with these welders in regular operation the generator lacked sufficient capacity to hold up the voltage, making it necessary to reduce the number of welders. From general observation it would seem that the rating of a generator or transformer and line to supply spot welders should be approximately one-half of the capacity to be supplied.

From this it appears that in the small installation the energy as registered is probably less than that actually used, while usual methods of demand measurement also fall short. It would, therefore, seem logical that some

*From a paper read before the commercial men of the Ohio Electric Light Association

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special means should be provided to determine that the company's revenue does correspond with the service rendered. It has also been brought out that the single-phase generator capacity required for a group of welders must be equal to at least one-half of the total welder capacity, and in case a consumer were putting in a generating equipment of his own to supply this service for a group of say five to ten welders, it would be necessary for him to provide generator capacity in which the kilovolt-ampere rating would be approximately one-half of the welder rating in kilowatts.

THE PROBLEM OF METERING

The problem presented in providing a proper and sufficient metering arrangement is one requiring detailed study and is beyond the scope of this article, so that a means should be provided for producing the required revenue by the use of the metering equipment now at hand. In an installation where the welding load forms a considerable proportion of the total, or where we have an installation of welders only, the above observations hold true; but where the proportion of welder load to the total load becomes small it is readily seen that the power required for welders, the peaks and low power factor is absorbed in the total, so that the deficiencies in measurement do not apply in so acute a fashion with this combination as in the former. One other point is perhaps necessary in order to make the situation clear, since it has been suggested by some central-station operators that the transformer capacity is the proper measure of the maximum demand. It is only necessary to reflect for a moment in order to understand that the modern transformer has a very considerable overload capacity, and if the overload is not sustained for a sufficient length of time to develop excessive heat, the transformer will handle high peaks without injury. Applying this to spot-welding practice, it is possible to make use of the overload capacity by having a group of service transformers handle peaks ranging to 200 per cent or 250 per cent of their rating. It is in the distribution lines, however, that the effect of the welders is measured, for the short acute peaks pull down the voltage, and if these same distribution lines are used for lighting purposes the regulation is extremely poor unless the lines are of ample size to accommodate the total load, including the high peaks of the welders. Therefore the measure of capacity allotted to the welding load is the line proper rather than the measured demand or the transformer capacity.

As was suggested, the single-phase generator capacity required to serve a group of welders would probably equal one-half of the total welder rating. On this assumption it would be proper to bill the maximum demand at one-half of the connected welder load. This, however, might seem a little severe on the consumer, and, bearing in mind that he has welders out of service very frequently, it is suggested that in the case of a single welder the maximum demand be taken at the full rated capacity of the welder, that in the case of perhaps two or three welders the demand be taken at 60 per cent of the total rated welder capacity, and that in installations running from four to seven welders a factor of 50 per cent be employed and that for larger installations the factor be 33⅓ per cent. These values are rather favorable to the consumer, since it is well established that his own capacity to save time if furnished from a private plant would be considerably higher. For the installations where the welder load is but a small part of the total load it would seem advisable to have demand tests taken frequently if demand meters are not used, since the welder load may have an appreciable bearing on the total demand. In these installations, however, it is probable that the effect will not be greatly noticeable, and furthermore in many of such installations the consumer provides his own transformer equipment and is responsible for the regulation of lighting service used from his main transformers so that the problem is about equally divided between company and consumers.

CHECKS MADE IN FAC SIMILE CAUSE MISUNDERSTANDING

Utility Customer Stockholders Confuse Them with Regular Dividend Payments, and Some Manage to Cash Them at Local Banks

As a part of its publicity campaign in connection with utility stock sales to its customers, a central station recently sent out fac-simile checks to prospective stock buyers. These checks were clearly intended for advertising purposes only, and while they were properly filled out and indorsed each was carefully rubber-stamped "Copy" and advertising matter was printed on the back of the check and on the lower part of the sheet to which it was attached. The printed text was

> Could you use a check like this every three months?
>
> Our shareholders get them and will continue to get them as long as they hold their stock.
>
> You become a shareholder and you too can depend on it that the mailman will bring your check on March 1st, June 1st, September 1st and December 1st each year as regularly as the months roll round.
>
> (Your money is safely and profitably invested when it buys Preferred Stock.)

NOTWITHSTANDING THIS EXPLANATION, SOME THOUGHT THE CHECKS REAL

especially clear in its meaning. It invited the recipient of the fac-simile check to become a shareholder of the company, pointing out that by so doing he could be sure of the receipt four times a year of a real check similar to the one represented. That any mistake could be made concerning the nature of this advertising circular never probably entered the heads of the company's officials when they thought of the plan.

However, in spite of all these precautions, some of the people who got the checks thought that they were receiving dividends on stock already purchased. They therefore detached the white printed section of the sheet from the green check and presented the fac-simile checks at their banks. Not all of the local banks were familiar with the central-station company's activities, and the result was that some of the fac-simile checks were actually cashed, causing no little confusion of a mingled amusing and serious character. In the end the whole affair was satisfactorily settled, but the company has decided not to use any more "near checks" as publicity matter, thereby inviting an unexpected draft on its bank funds.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Core Defects in Electric Apparatus.—M. VIDMAR.—Insufficient attention is often paid to the construction of the magnetic cores of electrical apparatus. Eddy-current losses are often increased by electric contact being formed between the edges of the laminations of which the core is built up. These losses can be greatly decreased by care in the design and construction. The paper that is often placed between the laminations is an impediment to the flow of heat in a direction from lamination to lamination through the core, and it is often desirable to dispense with this paper insulation. Bolts and rivets through the core should be avoided where possible. In some cases they remove the most effective portion of the magnetic circuits and in others they complete electric short circuits in which heavy currents flow. Such bolts and rivets should be well insulated from the core. The transfer of heat through the magnetic pocket is considered. Small potential differences between the ends of a prismatic element of iron may cause very great heating. For instance, a potential difference of 0.2 volt may suffice to raise the temperature of the iron 1000 deg. C. The presence of a small iron filing between the laminations may cause excessive current densities to be produced.—*Technical Supplement Review of Foreign Press*, April, 1919. (Abstracted from *Electrot. u. Maschinen.*, Jan. 5, 1919.)

Standardization of Transformers in Germany.—The German standardizing committee has issued rules to cover the construction of transformers with aluminum windings. These are classified in two groups—the first for normal transformers and the second for special transformers for agricultural purposes. For each group the capacities, voltages, percentage short-circuit voltages, temperature rise, overload capacity and various details of construction are laid down. An explanatory memorandum on the standardizing rules is given by Dr. Stern.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstract.)

The Half-Synchronous Working of the Induction Motor with Single-Phase Rotor.—G. VALLAURI.—It was recently observed that a synchronous polyphase motor when started as an asynchronous one by short-circuiting the direct-current circuit sometimes approximately reaches the half-synchronous speed but cannot surpass it. In this condition the motor develops altogether a positive torque. The author remarks that the same phenomenon was already observed by Gorges about twenty years ago in starting a polyphase induction motor the rotor of which had been rendered single-phase by lifting one of the brushes from its slip ring. The theory of the phenomenon was also given by Arnold in his "Induction Motors." But as this phenomenon is not well known, the author has made a series of experiments to throw more light upon it. The rotor current generates an alternating magnetic field which can be considered as the resultant of two fields rotating at different speeds, the one synchronous with the field generated by the current of the main, rotating at $n_1 = f/p$ rev. per sec., the other rotating, always with respect to the stator, at $2n - n_1$ rev. per sec., where n represents the revolutions per second of the rotor. This latter field induces in the stator windings an emf. of frequency $f' = (2n - n_1)p$, which in its turn generates a current of which the intensity and the phase will depend on the impedance of the external circuit and, in particular, on the number, power, etc., of the apparatus inserted in the circuit. As a first approximation the motor running at about half-synchronous speed can therefore be considered as formed by two motors in cascade, in the first of which the stator is the inductor, while in the second one the inductor is constituted by the motor. The approximately half-synchronous speed disturbs the phase line, as the load is not equally distributed over the three phases, but is in turn more or less derived from each phase. In particular, if the speed is rigorously half-synchronous, the three phases are differently loaded, but no cyclic phase interchange of the load takes place. Hysteresis phenomena give to a motor a certain stability at half-synchronous speed. In conclusion, the working of a three-phase motor with a single-phase rotor at half-synchronous speed can be made use of without very serious inconvenience. A large number of curves and diagrams illustrate the article.—*Science Abstracts, Section B*, March, 1919. (Abstracted from *Elettrotecnica*, Jan. 15, 1919.)

Generation, Transmission and Distribution

Switchboards, Their Design, Installation and Maintenance.—J. H. SANDIFORD.—The functions of a switchboard are discussed and the design of switchboards is considered. —*Electricity*, April 4, 1919.

Lubricants for the Power Plant.—REGINALD TRAUTSCHOLD.—Essential properties of a lubricant, the specific gravity, acidity tests, evaporation test, test for animal oils, quality test, suitable oil lubricants, engine oils, cylinder oils and various other kinds of oils are discussed in this article.—*Power Plant Engineering*, April 15, 1919.

Hydroelectric Development at Vernes.—Description of this development, together with cross-sections and views of the hydraulic turbine-driven generating units, are given. Plant data are also listed.—*Power*, April 15, 1919.

Use of Oblique Axes in the Solution of Transmission Line Problems.—V. KARAPETOFF.—It is shown that the oblique axes may be so chosen that the equations of projections of vector triangles are much simplified. The voltage regulation of the line is then computed, taking into account the line capacity concentrated at the two ends of the line. Explicit instructions are appended at the end for the procedure in a given case. The number of articles which appear year after year on transmission-line computations are an indication that there

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is ample room for improvement and simplification of the methods in use. This paper deals with a common case when the generator voltage and the load kva. are given and the power factor of the load is also known. It is required to compute the voltage regulation of the line, assuming the line capacity to be concentrated at the ends. The difficulty lies in the fact that the load current is not known, so that the line impedance drops cannot be computed directly.—*Sibley Journal of Engineering*, April, 1919.

Interconnection in Switzerland.—Abstract of an article by E. Kohler in *Technik und Industrie* regarding the proposed high-tension line from Geneva to Lake Constance tying in the more important electrical power houses of Switzerland. The extensive water-power projects established and under way in that country make it important to insure the best utilization of the energy produced by the central stations. A syndicate has been formed with this object in view, and a plan has been adopted to construct a line 133 km. in length, with aluminum conductors, six cables, to operate at 30,000 kva. The price is estimated at 8,500,000 francs, and it is hoped to finish the work of construction in two years. Not only will energy be equitably apportioned between the central stations, but it will be sold in bulk. Railroad electrification is another important object of the projected interconnection.—*Revue Générale de l'Electricité*, April 12, 1919.

Three-Phase to Two-Phase Transformation with Single-Phase Transformers.—E. G. REED.—Calculations are made showing the current and voltage relations for two-phase-three-phase transformation, and diagrams are developed from which regulation data are obtained.—*Electric Journal*, March, 1919.

Traction

Electric Traction and Hydraulic Power in Italy.—This article, by an anonymous author, is the continuation of two others upon the subject, the rolling stock of electric railways. The principles upon which the comparison of the different systems must be founded are developed at length and demonstrated by the aid of practical data. The comparison includes steam, three-phase, single-phase and direct-current high-tension systems. Comparative tables of data and of results of operation are given. The conclusions of the author are favorable to the high-tension direct-current system.—*Science Abstracts, Section B*, March, 1919. (Abstracted from *Elettrotecnica*, Feb. 5, 1919.)

Installations, Systems and Appliances

Alternating-Current Plunger-Type Relays.—VICTOR H. TODD.—Photographs of instruments and curves showing the time characteristics, diagrams of relay and transformer connections and of resetting devices are shown in this article.—*Power*, April 29, 1919.

Electric Welding: Its Theory, Practice, Application and Economics.—H. S. MARQUARD.—The various properties of metals which have an important bearing on difficulties experienced in welding are dealt with. These include melting points, specific heat, oxidation, expansion and contraction. A brief classification is then given of the electric welding processes now in use.—London *Electrician*, March 28, 1919.

Combustion and Flue Gas Analysis.—JOSEPH W. HAYS.—The author tells why some excess of air is necessary and why an unnecessary excess of air is very wasteful. He discusses how flue-gas analysis detects excess air and why the use of a pyrometer saves the fuel. A list of instruments that can be used is given along with the best requirements for their use and installation.—*Technical Paper No. 219*, Bureau of Mines.

Electric Welding and Welding Appliances.—The first of a series dealing with the development of electric welding. The article is devoted mainly to the historical aspect of the subject and to a discussion of fundamental processes of electric welding.—London *Engineer*, Feb. 14, 1919.

Main-Control Equipment of the New Mexico.—C. T. HENTSCHEL.—One of the outstanding features of the battleship New Mexico is the unique control of its propulsion machinery. The keynote of the control system is flexibility. This property, coupled with the ability of either or both generating units to drive all four propeller motors, produces a propulsion equipment of great reliability. In this article may be found in detail the construction and interrelationship of the units of the control apparatus.—*General Electric Review*, April, 1919.

Improved Contact Design and Material.—H. VON FLEISCHBEIN.—Causes of trouble in delicate contacts are discussed and means are suggested for their elimination. Further developments in tungsten contacts represent a considerable improvement and make tungsten a complete substitute for platinum in this service. There are innumerable applications in which it is of great importance that weak-current contacts should give good and reliable service. The advantages of platinum as a contact material are freedom from oxidation, relative hardness and high melting point. Tungsten is unaffected by steam and acids at ordinary temperatures and can be worked only at glowing heat. Tests were made with contacts interrupting from 0.5 amp. to 10 amp. up to twenty times a second. Owing to the variable current, sparking could not be eliminated completely by parallel capacity and resistance. At first a pencil of tungsten 3 mm. in diameter was used as stationary contact, working against platinum contact on a steel spring. After six months the tungsten showed no sign of wear, but the steel showed colors indicative of severe heating. More successful results were obtained by increasing the cooling facilities and by making the second contact of tungsten (a disk 3 mm. in diameter by 0.5 mm. thick, welded on to a small iron cylinder). Vigorous arcing, due to three times normal current, resulted in no damage even after prolonged trial. Subsequently tungsten disks were welded successfully to brass, steel and German silver by spot-welding in an inert atmosphere. An ordinary arc-lamp transformer can be modified to provide suitable welding current at 5 volts to 10 volts. Owing to the high resistance of tungsten, the contact pieces should not be longer than necessary. Tungsten can be used satisfactorily for even the smallest and finest contacts, and should not be regarded as merely a "substitute."—*Science Abstracts, Section B*, February, 1919. (Abstracted from *Elektrot. Zeits.*, Nov. 7, 1919.)

Flow of Water Through 1½-in. Pipe and Valves.—FREDERICK W. GREVE, JR.—Loss of head through globe valves and straight pipes and the relation of the diameter of the pipe to the loss of head and discharge are plotted in a curve. A description of methods used and photographs of apparatus are given.—*Bulletin No. 1*, Engineering Equipment Station, Purdue University, July, 1918.

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Electric Motor Vehicles.—F. AYTON.—The construction, care and upkeep of electric motor vehicles are discussed, together with diagrams of power circuits and diagrammatic illustrations of the windings of the type of electric motor used on electric vehicles.—*Electric Vehicle*, December, 1918.

Electrophysics and Magnetism

On the Fundamental Law of Electrical Action.—MEGH NAD SAHA.—In this paper an attempt has been made to determine the law of attraction between two moving electrons by the aid of the new electrodynamics as modified by the principle of relativity.—*Philosophical Magazine and Journal of Science*, April, 1919.

Electrochemistry and Batteries

Electroplating on Iron from Copper-Sulphate Solution.—OLIVER P. WATTS.—A discussion on getting good electroplatings of copper upon iron by preliminary dipping of the iron in solutions of various metals which lie electrochemically between iron and copper. Nickel can be deposited upon aluminum by using a ferric-chloride dipping solution.—Paper presented before the thirty-fifth meeting of the American Electrochemical Society, April 3, 1919.

Remarkable Pitting of Electroplating.—OLIVER P. WATTS.—When making some lead platings heavy pitting suddenly and irregularly appeared. After considerable study of the cause it was finally found to be due to the air dissolving in the electrolyte while it was resting over-night and cooling, the air being then expelled as minute air bubbles on the work when the bath was heated by the passage of the current. The microscopic bubbles clinging to the work, which had been left immersed in the bath, started the pitting.—Paper presented before the thirty-fifth meeting of the American Electrochemical Society, New York City, April 3, 1919.

Units, Measurements and Instruments

Centrifugal Tachometers of the Rotating Pendulum Type.—W. WILKES.—The author presents a critical investigation of the characteristics of centrifugal tachometers of the rotating pendulum type. The static properties of the pendulum as well as the scale division are considered. The fundamental requirement is that each position of the pointer shall correspond to a single definite speed. This essential being obtained, the question of range and scale division may be considered. Usually it is desired to obtain an even scale, but sometimes a particularly open scale is desired in the neighborhood of the normal speed. Only an approximately even scale can be obtained, however, with a centrifugal tachometer, and the range is limited so far as concerns a good scale. Moreover, the zero is "suppressed," the readings commencing at a certain speed. The stability of the pendulum determines the single significance of a given deflection. The article investigates the scale pitch and measuring range, together with the static properties of various tachometers. Influences of temperature and friction are not considered. The types of tachometer considered are: (1) With torsion spring (Morell cross-pendulum type); (2) with weight loading (Morell); (3) with tension spring perpendicular to spindle (precision tachograph; (4) with epicyclic drive (Morell); (5) with spring and weight loading. In each case the mechanism and general principle of the tachometer are explained. The characteristics of the several tachometers differ materially one from another. Several of the types fail to comply with the condition of a single definite deflection for each speed beyond a certain range. The limitations of each type are discussed in the original. The Morell tachometer with epicyclic drive, concerning which nothing has hitherto been published, is treated very fully.—*Science Abstracts, Section B*, February, 1919. (Abstracted from *Zeits. Vereines Deutsch. Ing.*, Nov. 16 and 23, 1918.)

Telegraphy, Telephony and Signaling

Radiation from Antennas of Various Shapes.—W. BURSTYN.—The radiation characteristics are calculated for a number of types of antenna for all directions in space, and the ratio of the maximum to the mean radiation is determined. It is shown that an antenna of U-shape radiates with virtual equality in all directions under certain conditions, and that an antenna of spiral shape emits a rotating field.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstracted from *Jahrbuch der Drahtlosen Telegraphie*, January, 1919.)

The Loop as a Wireless Receiver.—W. BURSTYN.—The calculations show that the receiving power of a closed loop is approximately proportional to the third power of its linear dimensions and decreases with increasing wave length at a more rapid rate than in the case of an open receiver.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstracted from *Jahrbuch der Drahtlosen Telegraphie*, January, 1919.)

Post-War German Wireless Activity.—The telegraphy research department has resumed its work in research in wireless telegraphy since the end of the war. At a meeting held in December, 1918, the agenda included the preparation of lists of names of persons who had been occupied on scientific and technical work in wireless telegraphy during the war, the determination of the state of their various investigations, the collection and publication of reports and patents originated during the war, the continuation of the work begun and methods of using available apparatus. The department was requested to take charge of documents and apparatus to prevent the loss of scientific information that had been obtained. The *Jahrbuch der Drahtlosen Telegraphie* was requested to publish a list of secret patents and important foreign patents with short explanatory notices.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstracted from *Jahrbuch der Drahtlosen Telegraphie*, January, 1919.)

Miscellaneous

Eighth Annual Report by the Director of the Bureau of Mines.—The general work of the fuels and mechanical equipment division under O. P. Hood, chief mechanical engineer, is discussed. Investigations completed, special problems of war work, mechanical equipment of mines and the study of Illinois coals are also included. The electrical equipment of mines, of which H. H. Clark was in charge, made tests on permissible apparatus in mines. Electrical furnaces for melting brass were tested and the preparation of alloy steels and electric smelting of manganese ore were discussed. A small handbook on the use of fuel oil was completed during the year and will be soon published in coöperation with the United States Fuel Administration. This was prepared by J. M. Wadsworth, consulting engineer of the Fuel Administration.—Bureau of Mines report, year ended June 30, 1918.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

WATER-POWER LEGISLATION ALREADY UP IN CONGRESS

Three Bills Introduced in Senate, and House of Representatives Creates Another Special Water-Power Committee

Water-power legislation in three different forms has been introduced in the Senate at the present extraordinary session of Congress, and the House of Representatives has passed a rule providing for the creation of another special water-power committee similar to that which worked a bill through the House at the last session of Congress, although the proposed legislation failed in the Senate as the old Congress ended, owing to the filibuster on President Wilson's foreign policies.

Representative Gillette, the new Speaker of the House, has been charged with the duty of naming the new special water-power committee. The committee will be made up of members of the committee on interstate and foreign commerce, the committee on public lands and the committee on agriculture, and will consist of the chairmen of those committees and their ranking members.

Representative Campbell of Kansas took a leading part in having the House pass the rule providing for the new committee. The rule is as follows:

"Resolved, that the Speaker of the House be and he is hereby authorized and directed to appoint a special committee of eighteen, to whom all bills and resolutions heretofore or hereafter introduced during the Sixty-sixth Congress pertaining to the development or utilization of water power shall be referred, notwithstanding any general rule of the House to the contrary."

The three forms in which legislation has been proposed in the Senate are as follows: A bill (Senate No. 152) by Senator Jones of Washington to create a Federal Power Commission and to define its duties and powers, to provide for the improvement of navigation, for the development of water power, and for the use of the lands of the United States in relation thereto, which was referred to the committee on commerce; a bill (Senate No. 220) by Senator Walsh of Montana, to amend the act to regulate the construction of dams across navigable waters approved June 21, 1906, also the act approved June 23, 1910, and to provide for the improvement and development of waterways for the uses of interstate and foreign commerce, which was referred to the committee on interstate commerce; a bill (Senate No. 651), by Senator Shields of Tennessee, to provide for the construction of dams across the navigable waterways of the United States, for their improvement and development, and to provide for the lease and use of public lands and the development or utilization of water power in the streams running through or adjacent to them.

Speaker Gillette announced the personnel of the new water-power committee as follows: Representatives Esch of Wisconsin, Hamilton of Michigan, Winslow of Massachusetts, Sinnott of Oregon, Smith of Idaho, Elston of California, Haugen of Iowa, McLaughlin of Michigan, Anderson of Minnesota, Sims of Tennessee, Doremus of Michigan, Barclay of Kentucky, Ferris of Oklahoma, Taylor of Colorado, Baker of California, Lever of South Carolina, Lee of Georgia and Candler of Mississippi.

SUMMER SECTION MEETINGS OF ASSOCIATED MANUFACTURERS

Tentative List of Meetings to Be Held at New London, Conn., from June 16 to 18—Program Includes General Association Meeting

A tentative schedule for the section meetings of the Associated Manufacturers of Electrical Supplies to be held at the Hotel Griswold, Eastern Point, Conn., on June 16 to 18, has been issued by Charles E. Dustin, the general secretary. The hours of the different meetings have not been fixed. With the exception of the meetings arranged for Monday, this will be considered at the general meeting on the evening of June 16 and arrangements made to meet the convenience of the members.

As an interesting program has been arranged for the Monday evening meeting, Mr. Dustin expresses the hope that all members will arrive early on that day. It is also suggested that the secretary of each section send notice to the members of his section, calling attention to the meetings and urging attendance, and also that reservations be made through Mr. Dustin's office. Ladies will be welcomed and special arrangements will be made for them.

The schedule of meetings follows:

Monday, June 16

Outlet-Box Section.
Industrial and Street-Lighting Fixture Section.
Signaling Apparatus Section.
Air-Circuit-Breaker Section.
International Trade Committee.
General association meeting in the evening for all members.

Tuesday, June 17

Heating-Appliance Section.
Electrical Porcelain Section.
Molded or Formed Insulation Section.
Rigid-Conduit Section.
Non-Metallic Conduit Section.
Armored Conductor and Metallic Flexible-Conduit Section.
Lamp Receptacle and Socket Section.
Attachment-Plug Section.
Snap-Switch Section.

Wednesday, June 18

Fuse Section.
Knife-Switch Section.
Panelboard and Switchboard Section.
Line-Material Section.
Wire and Cable Section.

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ELECTRIC POWER CLUB IS TO ENLARGE ITS WORK

Membership Divided Into Eleven Working Sections and Provisions Made for Recognizing Departure from Adopted Practice

At the annual meeting of the Electric Power Club on Thursday, Friday and Saturday of last week at Hot Springs, Va., important changes in the form of organization and in the methods of doing work were acted on. The membership will hereafter be divided into working sections and greater initiative and responsibility will devolve on each working section. The sections recommended by the board of governors and adopted by the club are at present as follows: Transformer, industrial control, power switchboard and oil circuit breaker, mining and industrial locomotive, motor and generator (not including turbo-driven apparatus), turbo-driven apparatus, storage battery, electric welding, electric furnace, portable electric tool and electric measuring (not integrating) instrument.

The existing standards of the club were also divided into two classes, namely, adopted standards and recommended practice, and it is contemplated that this departure will finally solve the 50 deg. motor question by specifically authorizing the 50 deg. general-purpose motor and the 50 deg. direct-current generator, as a departure from the adopted standards of the Power Club.

Reports were presented by committees on vertical and back-gear motors, underwriters, power switchboard and oil circuit breakers, large polyphase alternating-current motors, direct-current generators, industrial control, cost accounting, labor and transformers.

The same standard ratings as have been adopted by the club for horizontal motors are recommended for vertical alternating-current and direct-current motors ranging from 2 hp. to 200 hp. The maximum speeds for direct-current and alternating-current 60-cycle back-gear motors are 1100 r.p.m. for the sizes ranging from 2 hp. to 15 hp., 900 r.p.m. for the 20-hp. to 25-hp. sizes, and in the case of 25-cycle motors the maximum speed for motors ranging from 2 hp. to 25 hp. in rating is 750 r.p.m. All of the back-gear motors have standard gear ratios of five to one and conform to the code standards as to voltage and phase.

The Underwriters' committee does not believe it desirable for the Bureau of Standards to issue a combined safety and national electrical fire code at the present time and is opposed to a combined fire and safety code for several reasons. Rules were adopted for 50 deg. rated direct-current generators in addition to the rules now enforced for 40 deg. rated direct-current generators. The committee on cost accounting discussed the direct and indirect results of uniform accounting methods in the electrical manufacturing industry.

ETHICS IN BUSINESS

In his presidential address Clarence L. Collens, 2d, dwelt on the industrial consciousness which the war has served to develop and on the definite responsibility and moral obligations existing between manufacturer and manufacturer and between the manufacturer and the industry. Barbarous price wars, destructive and wasteful competition, patent litigation and secret contracts, as well as all forms of commercial and industrial robberies directed against fellow manufacturers, are being thrown aside, so that progress and advancement may be made along the lines of equity, fair play and full recognition of the rights of others.

Mr. Collens pointed out that membership in the Electric Power Club should be recognized as a sincere desire to advance the best interests of the industry, to promote confidence, business stability and good will, to discourage trade abuses, to refrain from unfair competition and price discrimination, and involves a definite acceptance of moral obligations toward all other manufacturers in the industry and of a definite code of ethics in relation both with competitors and with customers.

While the work of the club has been very largely devoted to setting up technical standards for the commercial products manufactured, it is obligatory on the membership that the products manufactured conform with the standards established. Mr. Collens is personally in favor of an open price policy both to the public and the industry. He also feels that the club should investigate and adjust differences developing between members, especially cases involving patent infringement. He proposed a code of ethics covering competitive business relations.

COÖPERATION IN INDUSTRY

Secretary William C. Redfield of the Department of Commerce addressed the meeting on Saturday, May 25, on coöperative relations between industry and the Department of Commerce and the opportunities offered by the Industrial Coöperative Service Bureau. Mr. Redfield drew examples from other industries to show to what extent the Department of Commerce had assisted manufacturers. He also dwelt on the world situation and the opportunities which were open to electrical manufacturers, particularly in France and Italy. European nations, he said, owe us stupendous amounts of money, and unless the United States assists those countries and their industries to become profitable, their ability to repay the debts in any reasonable time is open to question.

The French Republic and Italy are greatly in need of coal for power in their industries, but immense water-powers in the Alps and Pyrenees could be developed to supply this needed power. He suggested that this is a field awaiting American enterprise and application of American machinery. Secretary Redfield is a firm believer in developing the water powers of the world and characterized their non-development as a social crime of no small magnitude.

Other speakers at the Saturday session were Judge Zollar, who spoke of national and state taxation, and Gilbert H. Montague, who spoke on foreign trade combinations under the Webb bill.

Officers were elected as follows: President, James Burke, Burke Electric Company, Erie, Pa.; vice-president, A. L. Doremus, Crocker-Wheeler Company, Ampere, N. J.; secretary, C. H. Roth, Roth Brothers & Company, Chicago; treasurer, R. J. Russell, Century Electric Company, St. Louis, Mo. Four members of the board of governors were elected as follows: E. R. Harding, Holtzer-Cabot Electric Company, Chicago; James Burke, Burke Electric Company, Erie, Pa.; H. F. Stratton, Electric Controller & Manufacturing Company, Cleveland, and A. L. Doremus, Crocker-Wheeler Company, Ampere, N. J.

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LARGE BUSINESS OF THE WESTINGHOUSE COMPANY

Sales Billed in Year Ended March 31, 1919, Aggregate $160,300,000—Unfilled Orders on April 1 Amount to $76,200,000

Sales billed by the Westinghouse Electric & Manufacturing Company and its proprietary companies in the fiscal year ended March 31, 1919, reached the large total of $160,379,943. This represents a great increase over the preceding year, when the total was $95,735,407. Sales billed as stated in the report of the company include shipments by the New England Westinghouse Company and the J. Stevens Arms Company from Jan. 1, 1918, although the aggregate amount of these shipments is not given separately. The fact that there would be a heavy increase in the volume of business during the year just closed was fully forecast by a statement in the annual report for the year ended March 31, 1918.

It was stated there that as of April 1, 1918, the value of unfilled orders on hand was $147,857,580, of which $110,185,007 was for regular products of the company. After the elimination of contracts and orders canceled as a result of the signing of the armistice, the value of unfilled orders on April 1, 1919, was $76,248,000.

Operations of the company for three years compare as follows:

	Year Ended March 31— 1919	1918	1917
Gross earnings—sales billed	$160,379,943	$95,735,407	$89,539,442
Cost of sales—cost of manufacture, including depreciation of property and plant and all selling, administration and general expenses and all taxes	*144,667,402	80,225,937	72,077,752
Net manufacturing profit	$15,712,541	$15,509,470	$17,461,690
Other income	1,623,262	1,325,263	1,386,547
Gross income from all sources	$17,335,803	$16,834,733	$18,848,237
Less—Inventory adjustments, inactive apparatus and materials stripped, bad accounts and extraordinary items of expense charged to income	†	†	†
Net income applicable to interest and other charges	$17,335,803	$16,834,733	$18,848,237
Interest charges	2,276,795	1,429,052	768,348
Net income available for dividends and other purposes	$15,059,008	$15,045,681	$18,079,889

*Includes $15,395,846 federal income and excess profits taxes.
†Included in cost of sales.

Gen. Guy E. Tripp, chairman of the board of directors of the company, refers to important changes—affecting the various plants.

"The equipment of the Essington Works with machine tools," General Tripp says, "was completed in the early part of the year, and these works have been wholly engaged in the manufacture of equipment for cargo and naval ships for the United States government. When this work shall have been completed, the original plan to remove the manufacture of turbines and reduction gears from East Pittsburgh to this plant will be carried out, which will make available much needed additional manufacturing space for the other operations of your company at East Pittsburgh.

"The plant of the New England Westinghouse Company at East Springfield will hereafter be devoted to the manufacture of industrial motors and automobile starting and lighting apparatus, which will relieve an overcrowded condition at Newark and certain departments in East Pittsburgh. It is expected that these operations will begin at the Springfield plant about Sept. 1."

In speaking of the fact that the company has been operated during the last year under conditions unprecedented in the industrial world, Chairman Tripp says that the directors "take pleasure in recording their acknowledgment of the devotion and unremitting efforts of the officers and employees."

Among other matters dealt with in the report are the following:

During the year your company acquired the Franklin Electric Manufacturing Company, which was engaged in the manufacture of incandescent lamps at Hartford and Middletown, Conn. The accounts of that company are included in this report as a proprietary company.

The increase in investments is principally due to subscriptions made during the year to Liberty loan bonds. The company and its employees together subscribed to the five government bond issues to an amount in excess of $21,500,000.

Negotiations are in progress for the sale for cash of your company's 5 per cent prior lien debenture bonds of Electric Holdings, Ltd., of London, which were received in payment for your holdings of the British Westinghouse Electric & Manufacturing Company, Ltd.

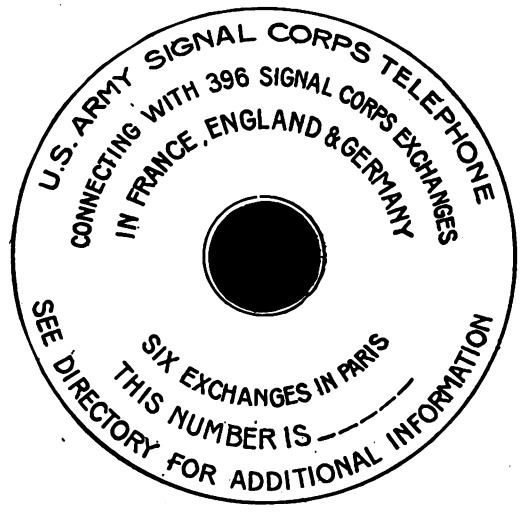
Every effort has been made to keep the investment in inventories at a minimum amount, with the result that they show a reduction of approximately $1,000,000 as compared with last year.

The current bank loans were reduced during the year by $7,420,000, and the balance of $5,280,000 is being paid as it matures. The accruals for taxes include an estimated amount on income for January, February and March, 1919, calculated under the present federal tax law, which will not be due for payment until 1920. The balance sheet shows ample reserves for the protection of accounts and notes receivable, inventories and other adjustments, substantial amounts having been added during the year.

More than 8000 employees entered the naval and military forces of the United States. During their absence steps were taken to protect their participation in the pension and relief departments, and favorable conditions have been established for the reinstatement of such employees who may apply for positions.

Special interest attaches to the earnings shown in the report because of the recent advance in the rate of dividend on the preferred and common shares from 1¾ per cent quarterly to 2 per cent quarterly.

Signal Corps Overseas Telephone Service



This is from an official photograph showing the card which is attached to every United States Signal Corps telephone overseas. The Signal Corps telephone system overseas has its exchanges in France, England and Germany and connects with 396 different Signal Corps telephone exchanges.

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LARGE CONSTRUCTION PLANS FOR SOUTHERN CALIFORNIA

Immediate Hydroelectric Construction Program of Southern California Edison Company—Part of Ultimate Outlay of $125,000,000

A short time ago the Southern California Edison Company completed its new financing for the present year by the sale of $16,000,000 of bonds and debentures, which was the first financing in the West on a large scale since the war was concluded. Announcement is now made by the company concerning the starting of active work on its gigantic hydroelectric construction program which the management has been waiting to inaugurate for some time past.

Twenty million dollars will be required to carry out the plans for the construction of new hydroelectric plants during the next three years, and their completion will mean the development of 66,000 hp. in new hydroelectric plants and an additional annual output of 310,000,000 kw.-hr. The new development on Kern River, 150 miles (240 km.) from Los Angeles, deriving its water supply from the watersheds in Kern and Tulare Counties, has a total installed capacity of 40,000 hp. This plant will be known as Kern River No. 3, the company already having two other plants on the same stream. The new plant will consist of two units of 20,000 hp. each. A feature of the construction will be a tunnel 12 miles (19 km.) long, 8 ft. by 10 ft. (2.4 m. by 3 m.) in dimension. Two pipe lines, each carrying 15,000 miners' inches of water, will require 1500 tons of steel pipe. The water drop will be 800 ft. (240 m.). It is on this project that 2000 men will work for eighteen months, and it is expected that the plant will be put into commission about September, 1920.

THE BIG CREEK PLANTS

Big Creek Plant No. 2, in Fresno County, 240 miles (384 km.) from Los Angeles, is also the scene of active work at the present time. The Big Creek system now consists of two plants with a total capacity of 88,000 hp., each plant containing two 2200-hp. generators. It is proposed to install immediately in Big Creek Plant No. 2 one additional generator of the same size, which will necessitate the construction of an additional pipe line requiring 1100 tons of steel. Later a similar unit will be required at No. 1 power house under practically the same conditions. It is expected that the additional installation at Big Creek Plant No. 2 will be completed and put into commission about the month of April, 1920.

The development of Big Creek Plant No. 3, which will be next in order, will use all the water supplied by Huntington Lake and will utilize it after it passes through the two existing power houses. The combined head of power houses No. 1 and No. 2 is 4000 ft. (1200 m.). Big Creek Plant No. 3 will make available 1350 ft. (405 m.) additional, and a fourth plant, which will be a later installation, will make available another 600 ft. (180 m.), resulting in the water being eventually utilized under a total drop of 5950 ft. (1785 m.). The first development at Big Creek No. 3 of 68,000 hp. will ultimately be increased to over 200,000 hp. The Big Creek Plant No. 3 will, however, not be started until after the completion of the work laid out and now under way for the three-year period.

The three-year program also includes the diversion of other waters in the Big Creek watershed in Huntington Lake, increasing the amount of water available for storage purposes. In later years additional reservoirs and water diversions are to be provided which will very largely increase the amount of water for the Big Creek power houses and justify the construction of additional plants. The immediate construction plans are really a part of a comprehensive program which will ultimately result in the development by the company of 750,000 hp. in hydroelectric plants, requiring an expenditure for plants, lines and substations which will reach a total of $125,000,000.

The service of the company now extends to ten counties in Southern California and the San Joaquin Valley, over 55,000 sq. miles (14,245,000 hectares), serving upward of 200,000 consumers in 233 cities, towns and intervening rural territory. The demand in this extensive region is now larger than ever before, necessitating the immediate construction of the additional water-power plants above referred to, together with transmission and distribution lines to reach agricultural territories and industrial activities now pressing for service.

DISTRIBUTING SYSTEM SALE IN LOS ANGELES

Terms of Proposed Purchase of Electrical Distributing System of Southern California Edison Company by Los Angeles

On May 14 a resolution was adopted by the City Council of Los Angeles authorizing the city attorney to prepare the necessary resolutions calling a special election on June 3, 1919, for the purpose of authorizing an issuance of $13,500,000 in power bonds. Although there will be a general election on the same date, the bond proposal will be on a separate ballot and there will be separate tally sheets for the count of the votes. The same election booths and polling places as are used for the general election will be used for the special election in connection with the bond proposal.

After months of negotiation between representatives of the Southern California Edison Company and the city of Los Angeles in conjunction with E. O. Edgerton, president California Railroad Commission, and Harley W. Brundige, a member of the same commission, an agreement has been reached covering the purchase of the electric distributing system of the Southern California Edison Company in the city of Los Angeles. The purchase price will be $11,000,000, including the physical valuation of the system and $2,453,067 severance damages for taking the business of the Edison company. Payment is to be made by Los Angeles to the Southern California Edison Company in cash before June 30, 1920. The agreement also includes the following details:

The company to make all extensions and betterments pending the final purchase. All money so expended by the company to be added to the purchase price. The company to maintain a depreciation fund of 3.36 per cent on the physical valuation of the system of $8,870,000 plus 3.36 per cent on extensions and betterments pending the conclusion of the purchase. The depreciation fund to be turned over to the city at the time of purchase.

The city agrees not to compete with the company for business in territory outside the city.

The city to purchase power required from the com-

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pany in addition to that generated in its own plants for a period of thirty years at a price to be fixed by the State Railroad Commission.

WERE DRIFTING TOWARD COMPETITION

President Edgerton of the State Railroad Commission has made a statement in part as follows in connection with the conclusion of the power negotiations:

The conference has come to an agreement on the sale of the Southern California Edison Company's electric distributing system in the city of Los Angeles for a cash price of $11,000,000. Of course, the final judgment as to whether this purchase will be consummated rests with the people, and the proposal in detail will be submitted to them. After full opportunity for consideration and discussion of this project, the people will have an opportunity to express themselves at an election hereafter to be called, wherein the ratification of the proposed new contract and a bond issue to make it effective will be presented. The people of the city of Los Angeles now have an opportunity to acquire at a reasonable price a complete electric distributing system doing a large and remunerative business.

This conference was first called by me, as president of the Railroad Commission, in August, 1918. The commission realized that there was a rapid drift toward a situation where either the city must allow its electric power generated on the aqueduct to go to waste or it must duplicate the existing distributing systems. This would mean a bitter competitive fight, resulting in serious loss both to the company and the city.

The city was represented by Frederic T. Woodman, mayor, and Albert Lee Stephens, city attorney; the Public Service Commission by Howard Robertson, president; W. B. Mathews, special counsel, and E. F. Scattergood, chief electrical engineer; the City Council by Ralph L. Criswell, chairman public service committee.

The company was represented by W. A. Brackenridge, president; R. H. Ballard, first vice-president; G. C. Ward, second vice-president, and Harry J. Bauer, general counsel.

The meetings of the conference have occurred frequently over a period of nine months, and many days have been consumed in an exhaustive examination of every important phase of the whole question. Each side has been vigilant and aggressive in protecting the interests of its constituents.

The officers of both the city and the company have shown a sincere disposition throughout the entire conference to further a settlement. While I will not attempt in this statement to give the details of the proposed contract, I will state that the city has gained decided advantages in this new arrangement, as may readily be seen by comparing the terms of the old and the new contract. This settlement, if ratified by the people, clears the path of the city of all obstacles to a complete and effective generation and distribution of electric power.

I give it as my unqualified opinion that this settlement is wise, businesslike and equitable. I base this opinion upon my familiarity with this whole subject, gained through presiding over the Southern California Edison Company condemnation case, in which the entire matter of value of plant and business of the company in the city of Los Angeles was exhaustively presented, and through presiding over all of these conferences.

The result of the work of this conference is submitted with the conviction that it will receive intelligent and serious consideration by the people of the city of Los Angeles.

President W. A. Brackenridge of the Southern California Edison Company has made the following statement in connection with the proposed agreement with the city of Los Angeles:

I feel that the consummation of the agreement outlined between the Southern California Edison Company and the city will be a reasonable solution of a number of troubles which have existed for some years past, and should be considered satisfactory to both parties.

While the company will sell its electric distributing system in the city of Los Angeles, it will retain and own all its transmission lines now erected or to be erected within the city limits and will continue to supply the power used within the city for all railway purposes. The city of Los Angeles will be eliminated from competition with the company in territory contiguous or adjacent to the city limits. Further, the city of Los Angeles will require to purchase large quantities of power for distribution and use within the city in excess of power produced by its own plants, and this excess power will be supplied by the Edison company for the next thirty years.

The Edison company occupies a large territory in southern California, and the area is capable of great extension and intensive development. The funds which may be made available by the sale of the Los Angeles distributing system will be put to good advantage in other directions, in the greater development of the territory now occupied and in additions thereto which will be made in the near future.

NEW ADDITION FOR THE GREAT WESTERN SYSTEM

Construction Begins on "Caribou" Plant to Give More Facilities for the Great Western Chain of Stations in California

Construction is beginning on a new hydroelectric plant in the Great Western chain of generating stations in California. The company recently completed the financing by the sale of $6,000,000 in bonds and $1,500,000 in preferred stock. It is estimated that the plant will be completed in about two years' time, the plan being to use the power in the general distribution system around the bay region.

The plant is to be built in the canyon of the North Fork of the Feather River about 9 miles (14.4 km.) above Belden on the Western Pacific Railroad. By means of tunnels both the Lake Almanor watershed and that of Butte Valley will be made available for the new plant. A tunnel about 2 miles (3.2 km.) will be driven from Lake Almanor into Butte Valley, whence water will flow into Butte Creek channel to a point near the junction of the north fork of the Feather River, where a dam is to create a small reservoir. A second tunnel, about 2 miles long, will be driven from this reservoir to a point directly above the power house, whence a 1100-ft. (335-m.) head will be made available through steel penstocks in rock tunnels. Water discharged from the Caribou Plant into the north fork of the Feather River will be used again at the Las Plumas plant, which is about 40 miles (64 km.) further down the river.

For the present the power house is to contain two 20,000-kw. units with transformer equipment for stepping up to 160,000 volts. The probable ultimate capacity of the plant, it is stated, will be 120,000 kw., with a possible increase to 136,000 kw. A 150,000-volt steel tower line is to be built from the Caribou plant to a point on the north shore of Carquinez Straits. For a considerable distance this line will parallel the existing 100,000-volt line from Las Plumas to Oakland.

Because of the 300,000-acre-feet storage capacity at Big Meadows and Lake Almanor, together with the high natural run-off from the Butte Valley watershed, it is expected that the new plant can be operated at a high percentage of installed capacity. This plant is part of a comprehensive scheme whereby the Great Western Power Company expects to develop a total of 635,000 hp. in plants above Oroville in the Feather River basin.

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SAMUEL INSULL COMMENTS ON HIS EUROPEAN TRIP

On His Return to the United States He Is Optimistic as to Outlook for Successful Business in England

"There are tremendous problems for the British to solve now that the war is over," said Samuel Insull, who has recently returned from a trip to Europe lasting about two months. "The industrial position may have been causing some anxiety, but the attitude of conciliation which seems general on the part of both capitalists and employees would seem to indicate that a solution will be found for labor problems.

"The spirit of the people is encouraging. I have never seen so little evidence of poverty or drunkenness in London as during this last visit, and I was there through the Easter holidays. Manifestations of this sort are hardly the forerunners of Bolshevism. It appears to me that a revival, and indeed an increase, of British export business is purely a matter of production.

"America does not know that she has been at war, and the American business man who thinks he sacrificed to the limit for his country's cause and is proud of the burdens he carried would trade his pride for humility could he visit the business centers of Europe and learn what the war cost industry and commerce there."

BYLLESBY COMPANY BECOMES AN OIL UTILITY CONCERN

Combination of Standard Gas & Electric with Shaffer Oil Companies Is Occasion for New Financing

The Standard Gas & Electric Company, the principal holding company managed by H. M. Byllesby & Company, Chicago, has acquired by consolidation the oil and refining interests of C. B. Shaffer and associates. A new company, the Shaffer Oil & Refining Company, of which Mr. Shaffer will be president and H. M. Byllesby chairman, has been formed to take over the property.

The Standard Gas & Electric Company was incorporated on April 28, 1910, and owns bonds, stocks and other securities of public utility systems serving 460 communities, with a total population of approximately 2,200,000, situated in sixteen Western states. The capitalization of the Standard Gas & Electric Company was as follows:

	Authorized	Issued	Retired and Canceled	Outstanding
Convertible 6 per cent bonds, due 1926	$30,000,000	$11,800,000	$4,687,000	$7,113,000
Collateral trust 7 per cent notes, due Sept. 1, 1921	750,000	750,000	.....	750,000
6 per cent scrip, due 1923	1,649,893	1,649,893	1,447,230	202,663
Twenty-year 6 per cent gold notes, due 1935	15,000,000	6,841,200	.....	6,841,200
Preferred stock	30,000,000	.....	.....	11,784,950
Common stock	15,000,000	.....	.....	9,343,150
Total	.....	.....	.....	$36,034,963

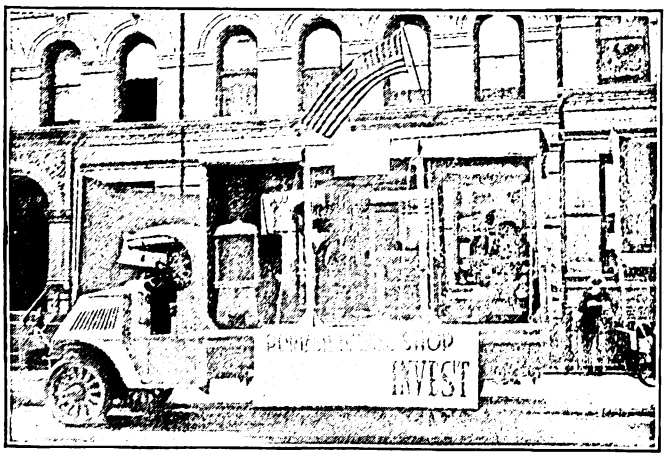
The oil properties which are turned into the consolidation comprise approximately 57,800 acres of fee and leasehold oil lands, pipe lines, a refinery and a marketing organization with the Deep Rock brand for refining products. The oil lands lie in Kansas and Texas, on which there are wells with an average daily production of around 4200 barrels. The refinery has a capacity of about 6000 barrels per day. The properties also include steel tanks and 508 modern steel tank cars. The capitalization of the Shaffer Oil & Refining Company, the new concern, is as follows:

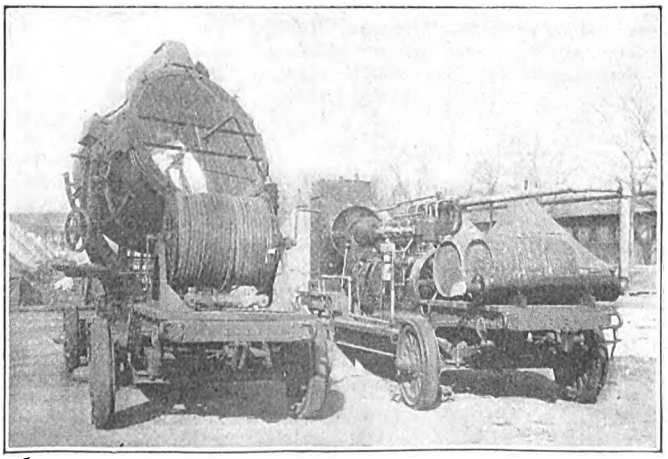
	Authorized	Outstanding
First mortgage convertible 6 per cent sinking-fund gold bonds, due June 1, 1929 (this issue)	$15,000,000	$12,000,000
Participating preferred 7 per cent cumulative stock $100 par	50,000,000	11,000,000
Common stock (shares of no par value) *, shares	500,000	200,000

* Standard Gas & Electric Company will own a majority of the shares of common stock, which will have sole voting power.

As a first step in financing, the $12,000,000 Shaffer Oil & Refining Company first mortgage convertible 6 per cent sinking-fund gold bonds, due June 1, 1929, are being offered to the public at a price of 95 and interest. These bonds, in denominations of $1,000, $5,000 and $10,000, are callable at various prices from 102 to 103 and interest, or are convertible at par into participating preferred 7 per cent cumulative stock of the Shaffer Oil & Refining Company at 105. The issue has been purchased by H. M. Byllesby & Company, Montgomery & Company and Bonbright & Company.

Motor Equipment of United States Army Engineer Corps





In the Victory loan parade at New York various floats illustrated the great flexibility of the motor truck as developed for use in the Engineer Corps of the army. The cut on the left shows a machine shop on wheels; that on the right shows a 60-in. barrel-type searchlamp. These are only two of a dozen or more uses to which the army motor truck has been put.

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FEDERAL GOVERNMENT'S DATA ON ENERGY SUPPLY

Report on the Production of Electric Power Compiled by the Geological Survey for the Month of February, 1919

This report, prepared by W. B. Heroy, is based on returns received from 3150 electric power plants engaged in public service, including central stations, electric railways and certain other plants the output of which contributes to the public supply. Mr. Heroy is chief of the division of power resources of the United States Geological Survey. Dr. George Otis Smith, director of the Geological Survey, writes that it is hoped to issue such a report each month. The returns received represent about 85 per cent of the total generating capacity. For plants which did not make returns or which were unable to furnish the data requested estimates of output were made from available information. The output for the month averages 110,000,000 kw.-hr. per day, of which 39 per cent was produced by water power.

State	Thousands of Kilowatt Hours Produced: By Water Power	By Fuels	Capacity (Kw.)	Combustion of Fuels: Coal, Short Tons	Petroleum and Derivitives, Barrels	Natural Gas, Thousands of Cubic Feet
Alabama	39,372	12,939	165,688	30,164	0	0
Arizona	3,967	16,395	91,363	483	109,450	0
Arkansas	77	6,275	32,358	13,267	442	0
California	190,462	38,295	852,956	0	199,074	0
Colorado	13,161	17,271	131,027	40,980	1,896	0
Connecticut	12,419	38,643	252,130	61,745	333	20,766
Delaware	0	5,549	20,617	8,590	0	0
Dist. of Columbia	0	18,094	66,450	21,418	0	0
Florida	678	11,257	59,304	3,424	25,084	98
Georgia	35,497	7,236	214,250	14,088	120	0
Idaho	42,050	259	115,439	125	10	0
Illinois	13,701	241,930	804,329	360,806	1,004	0
Indiana	3,761	56,151	319,348	152,218	436	2,160
Iowa	44,214	23,110	291,635	136,896	798	0
Kansas	1,267	29,203	156,114	46,987	40,543	67,937
Kentucky	4	18,900	104,889	41,636	381	0
Louisiana	0	14,034	52,639	14,240	30,788	55,092
Maine	16,611	132	92,927	525	7	0
Maryland	278	18,448	128,879	28,317	159	1,500
Massachusetts	19,147	102,844	748,698	133,965	21	0
Michigan	49,980	97,187	476,913	127,362	117	0
Minnesota	24,525	28,708	292,935	64,400	1,003	0
Mississippi	0	5,789	34,315	16,177	410	0
Missouri	4,297	37,212	291,170	84,472	32,198	0
Montana	69,220	1,552	237,476	5,008	539	1,008
Nebraska	810	16,022	90,462	29,237	5,488	0
Nevada	2,913	137	10,630	198	900	0
New Hampshire	4,660	2,188	47,938	5,205	20	0
New Jersey	165	79,153	343,214	107,035	95	121,000
New Mexico	59	1,272	12,830	2,875	1,060	0
New York	204,590	288,986	1,836,029	367,508	380	458,233
North Carolina	43,234	2,820	172,217	8,456	20	0
North Dakota	0	2,308	20,939	15,875	547	0
Ohio	2,309	181,766	829,161	313,309	786	271,454
Oklahoma	223	12,092	68,013	10,705	8,140	377,988
Oregon	27,034	3,259	112,008	139	14,716	0
Pennsylvania	55,066	243,098	1,132,174	443,892	15	53,045
Rhode Island	383	28,767	159,175	29,692	0	0
South Carolina	64,745	3,235	195,192	8,971	62	0
South Dakota	4,624	3,751	34,449	12,653	3,321	0
Tennessee	43,780	8,368	170,272	24,161	61	0
Texas	165	43,151	202,101	25,800	171,374	173,960
Utah	48,906	0	76,832	0	0	0
Vermont	13,777	209	86,071	642	0	0
Virginia	17,693	17,685	186,150	30,503	132	0
Washington	71,160	5,667	275,802	23,381	1,989	0
West Virginia	1,453	51,584	187,556	60,120	7	86,276
Wisconsin	28,284	32,709	351,215	65,901	584	0
Wyoming	251	3,542	21,031	13,264	8,260	2,884
Total	1,220,972	1,879,182	12,665,309	3,007,815	662,770	1,693,401
Combined total		3,100,154				

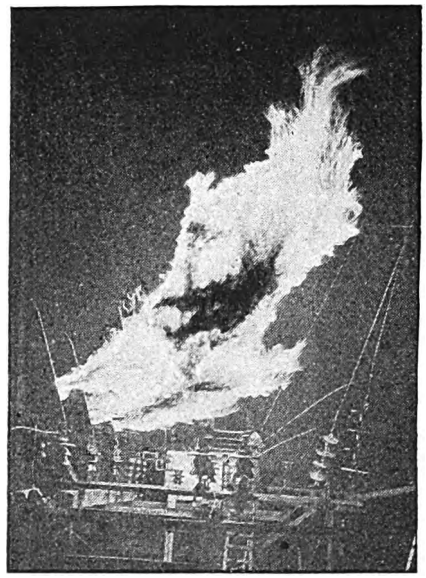
APPROPRIATIONS FOR THE POWER SURVEY ARE ASKED

Now Before Committee of the House of Representatives in Same Form as at the Last Session of Congress

With the opening of the Sixty-sixth Congress the movement to obtain appropriations for a power survey of the United States is again under way. The estimates of appropriation presented by Secretary Lane of the Department of the Interior to the last Congress have been renewed and are now before the appropriations committee of the House of Representatives. These appropriations, which, owing to the filibuster at the close of the last session, failed of passage, will, if made, permit the Geological Survey to expend $250,000 in studies of power supply during the coming fiscal year. Of this amount $50,000 is to be used in a general engineering and statistical survey of power resources.

The appropriations committee of the House of Representatives will probably begin consideration of the various items to be included in the sundry civil bill during the first week in June, and the power survey estimates will doubtless be brought to the attention of the committee. Director George Otis Smith of the Geological Survey expects to be called before the committee to explain the objects to be accomplished by the power survey. The committee is not fully organized and contains several new members who will doubtless need to be informed concerning the proposed work. Representative James W. Good of Iowa is the new chairman of the committee, having been the ranking Republican member next to Representative Gillette, who became Speaker of the present House.

An Arc Eighteen Feet Long



What happens when air-break knife switches are opened under no load and with only charging current flowing in the Tallulah-Atlanta (Ga.) 110,000-volt transmission line is shown in this picture. It was made in the night at Gainesville, by G. A. Iler, on the property of the Georgia Railway & Power Company. As can be seen readily from the picture, extra-wide spacing between phases would be required to prevent the arc drifting across all three phases and short-circuiting the line if such switching were regular practice. The arc is about 18 ft. (5.4 m.) long.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

International Association of Municipal Engineers.—The annual convention of this association will be held at Chicago, Sept. 23 to 26.

A. S. M. E., Baltimore Section.—"Oil Engines" was the subject of a paper by Leon Wygodsky and "Boiler Explosions" that of R. E. Munno at the April 29 meeting of this section of the American Society of Mechanical Engineers.

Electric Club of Chicago.—Motion pictures visualizing sound waves and electric currents and showing how the telephone talks were shown at the club's May 8 meeting, when Jam Handy of the Bray Studios, New York City, spoke on "Motion Pictures in Business."

Western Society of Engineers.—One hundred and forty-five members and guests of the Western Society of Engineers, Chicago, visited the Buffington plant of the Universal Portland Cement Company on May 10. The power station at this cement plant was of particular interest to engineers on account of the liberal use of concrete in the design.

National District Heating Association.—The annual convention of this association is to be held at the William Penn Hotel in Pittsburgh, Pa., on June 10, 11, 12 and 13, 1919. Exhibits have been arranged by a number of manufacturers for this meeting, which is to be held in conjunction with the summer meeting of the American Society of Heating and Ventilating Engineers in the same city.

I. E. S., Philadelphia Section.—At the May 16 meeting of this section of the Illuminating Engineering Society Dr. George A. Hoadley presented a paper entitled "The Relation of the Illuminating Engineering Society to Its Members," and Preston S. Millar spoke on "The Prospects and Possibilities of the Future." Many helpful ideas for the next year's work were advanced in the discussion which followed the prepared program.

New York Electrical Society.—A. M. Nicholson, Research Laboratory, General Electric Company, gave an illustrated lecture on "Speaking Crystals" at the May 26 meeting, explaining how common crystals can be utilized to transmit speech, music and sound. E. P. Craft, assistant chief engineer of the Western Electric Company, lectured on "War Developments in Electrical Communication, on Land and Sea and in the Air."

Jovian Electric League, Los Angeles.—S. M. Kennedy, general agent Southern California Edison Company, spoke on "The Man in the Street" at the May 14 meeting of the league.

New York Electrical League.—The monthly luncheon of the New York Electrical League, held on May 27, was addressed by the Rev. W. Warren Giles, who had for his subject "After-Thoughts on the Great War for Business Men."

Oklahoma Company Employees Organize Club.—At the first meeting of the Oklahoma Gas & Electric Company's Employees' Club, held on April 29, George B. Saunders was elected president and Miss Katherine Pierce was chosen secretary-treasurer.

Institute of Radio Engineers.—"Naval Aircraft Radio" is to be the title of a paper which T. Johnson, Jr., expert radio aid of the United States Navy, will present at the next meeting of the Institute, to be held on June 4 at 8.15 p.m. in the Engineering Societies Building, New York City.

West Virginia Public Utilities Association.—This association will hold a convention at White Sulphur, W. Va., from June 4 to 7. Electric light, power, railway and telephone men, as well as manufacturers of electrical equipment, will be represented. This will be the first convention of the organization since the beginning of the war.

Cleveland Electrical League.—The league is planning to hold its annual election and dinner on June 7 at 6.30 p.m. in the Hotel Statler ballroom. F. A. Wilson-Lawrenson, assistant to the president of the Union Carbide & Carbon Corporation, New York, spoke on "With Colonel Younghusband to the Sacred City Thassa" at the regular noon meeting on May 22.

American Institute of Electrical Engineers

Lynn Section.—Colonel James M. Andrews, 105 Infantry, U. S. A., gave some "Random Remarks on the 105th Infantry in France" at the meeting of May 28.

Boston Section.—"Utilizing the Time Characteristics of Alternating Current" was the subject of Henry E. Warren, who spoke at the annual meeting of the section held May 6.

Pittsfield Section.—Dr. George Otis Smith, directors United States Geological Survey, Washington, D. C., spoke on "America's Peak Load" at the annual dinner held May 28.

Fort Wayne Section.—A series of talks on fractional-horsepower motors were given by E. B. George, Roy Young, E. A. Schaefer and R. B. Roberts of the fractional-horsepower engineering and commercial departments, Fort Wayne Works of the General Electric Company, at the April 17 meeting.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Surcharge Allowed in California.—The Northern California Power Company has been granted authority by the Railroad Commission to add a surcharge of 10 per cent to its charges for electricity. This is less than one-half of the increase asked by the company, which asked increases of 14 to 25 per cent. The surcharge will not be applied to the rates for energy sold in that part of Butte and Colusa Counties where it competes with the Pacific Gas & Electric Company, those rates having been adjusted in a previous decision by the commission. Neither will it affect the rates charged by the company as a result of the tri-party contract which provides for the transfer over its system of power received from the California-Oregon Power Company for the Pacific Gas & Electric Company. The surcharge went into effect with the meter reading on May 1. When the rates for the company were fixed by the commission in decision No. 3624 there was excluded from the valuations property worth $1 336,773, held at that time to be non-operative and therefore not to be considered in the rate adjustment. Since 1918 this property has been fully devoted to the use of the consumers in addition to capital additions of $801,295 made between Sept. 30, 1915, and Nov. 30, 1918. Averaging the conditions in 1917 and 1918 "and what may reasonably be anticipated for 1919," the commission arrives at $973,043 as the average gross revenue received in this period—an allowed charge of $100,000 for maintenance, $180,000 for operation, $59,990 for taxes and $102,000 for depreciation. Deducting a total expense of $441,990 gave a net income of $531,453, or 7 per cent upon $7,595,385, the average capital for the three years. Under the conditions prevailing in 1919 the commission holds that the expenses for maintenance and operation will be increased to $531,990, and the net income from the present rates available for return would be only $441,053. With an increase in revenue of 10 per cent and making due allowance for the increase in taxes which will follow, the company will earn, on the basis of the average three years' revenue, a net of $532,508, available for return, which is 7.02 per cent of average capital for three years. If the surcharge be applied to the probable revenue for the year 1919, the company's net return will amount to $537,947, which corresponds to a return of 6.63 per cent upon the estimated capital of $8,116,007 for the year 1919.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Discuss Lighting of Air Ports.—W. D'A. Ryan of the General Electric Company, who had charge of the lighting effects at the Panama-Pacific Exposition at San Francisco, headed a delegation from the National Electric Light Association which discussed the science of illuminating air ports with members of the second Pan-American Aëronautical Congress at Atlantic City last week. The plan under consideration had to do with the illumination of the terrain to a sufficient degree to bring out its essential features, such as runways, ground hazards, wires and buildings, together with the limitations of the field, so that the flier may know how much space is available for landing.

Municipal Plant Operations in Cleveland.—In a recent interview Lighting Commissioner Davis of Cleveland said that the municipal plant showed practically no earnings in 1918. "All items of expense are not yet completed." Mr. Davis said, "but to all evidence we will come out even. The year 1919, in view of delay in construction of extensions to the plant, will be the most critical in the history of its municipal ownership. If we keep 3-cent light this year, it will be safe for all time. The figures for 1918 will show that our gross receipts were $1,600,800, of which $350,000 accrued from the sale of bonds for extension work. Our operating expense was $176,086 and maintenance $174,-124. Depreciation on the property was $155,092. We sent the sinking fund $109,795 for the retirement of bonds."

A New Electric Car Record.—Making the 124.6-mile trip in five hours and thirty-nine minutes, a passenger car of the Baker R & L Corporation has bettered by eighteen minutes the old electric vehicle record between New York and Atlantic City. The old record, made by a car of the same type, was five hours and fifty-seven minutes. It had stood since 1917. The trip was made under the auspices of the New York Electric Vehicle Association and in conjunction with the annual convention of the National Electric Light Association. Herbert Mould was the official observer, while De Peyster Stagg drove the car. The speedometer reading showed an actual mileage of 124.6. The energy consumption averaged 2.6 amp.-hours per mile and the speed averaged 22½ miles per hour. The trip was made by way of Staten Island and Lakewood, with a stop at the latter place at luncheon time for a battery boost.

Urges International Committee on Fuel Conservation.—Conservation of fuel was advocated by the International Parliamentary Commercial Congress, which met at Brussels the third week of May. The congress adopted a resolution inviting the Allied and associated governments to appoint an international committee with the object of centralizing information relating to fuel production, transportation and consumption.

No Wage Reductions, Illinois Labor Head Says.—John H. Walker of the Illinois State Federation of Labor, in a statement as to the attitude of labor regarding wage reductions, says: "Organized labor will oppose vigorously any attempt to reduce wages, whether by public utility corporations or by employers engaged in private enterprise. . . . I do not know whether rates charged by public utility companies are adequate to maintain the higher wage rate, but if they are found inadequate after investigation, then the rates should be increased sufficiently to guarantee the workers against wage reductions."

John Fritz Medal Presented to General Goethals.—The John Fritz medal, awarded for achievement in some branch of engineering, was presented to Major General George W. Goethals in recognition of his work as builder of the Panama Canal, at a meeting in the Engineering Societies Building, New York, on May 22. The presentation was made by Ambrose Swasey, past-president of the American Society of Mechanical Engineers. The speakers included Henry L. Stimson, former Secretary of War, and W. L. Saunders, past-president of the American Society of Mining and Metallurgical Engineers, who extolled General Goethal's work in high terms.

Doherty Men's Fraternity.—The organization committee of the Doherty Men's Fraternity is about ready to send out membership forms to employees of the concern. The applicant recognizes that membership in the fraternity demands of him: "(a) That I will study the principles upon which my country, of which I am a citizen, was founded, promote their continuance and do all that I can to destroy disloyalty to them. (b) A sincere belief in the business policies and business philosophy of Henry L. Doherty. (c) My best efforts to make the character, quality, merit, service, reputation and external appearance of all Doherty Company properties excel that of all contemporaries. (d) That I will strive as though the sole support of the standing of the Doherty Organization depended upon my own efforts. (e) That I will be kind and loyal to the men who supervise my work and to those whose work I supervise." The committee consists of B. C. Adams, W. J. Barker, M. R. Bump, F. R. Coates, S. B. Irelan, F. M. Lowry, H. R. Straight, R. A. Wotowitch and George Williams. A large membership of company employees is looked for.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Tampering with Meters.—Indictment charging interference by defendant with the sealing and testing of electrical meters by deputy and assistant state sealers of weights and measures, in violation of statute, the Supreme Court of Tennessee has held, is sufficient without stating the location of the meters alleged to have been changed or tampered with by defendant and the manner in which they had been changed or tampered with by its agents (210 S. W. 630).

Rights Conveyed in Deed for Flooded Lands.—The Supreme Court of Minnesota has held that the words "said dam may maintain the water at a height of seven feet," contained in a deed conveying 2.3 acres upon which was a mill dam, did not create an easment giving the grantees the use of a swale some 700 ft. above the premises conveyed for a permanent spillway. Nor did the deed by implication grant a right-of-way over the grantor's land above the tract conveyed to repair the erosion in the sod of the swale, where the waters in times of floods enter from the stream and threaten to cut a new channel. Even if defendant's first entry upon plaintiff's land might be held justifiable because of an unexpected emergency threatening destruction of private property, subsequent repeated entries, when the threatened destruction could not be said to arise from unexpected emergencies, must be held wrongful (171 N. W. 782).

Rights of Contiguous Owners on Streams.—The Court of Appeals of Kentucky has brought out the following points on rights of owners on a stream: (1) An upper proprietor has an easement in the land of the lower proprietor for the escape from his land of both surface water and that running in natural streams, which right the lower proprietor may not interfere with. (2) An upper proprietor cannot collect surface water into a volume and empty it upon the lower proprietor, nor can he by such means augment the flow of a natural stream so as to damage his neighbor below. (3) The essential fact entitling the plaintiff to the relief he sought having been put in issue and determined by the chancellor against him upon sufficient evidence, the court on appeal must affirm the judgment. (4) Where the evidence is conflicting and the mind is left in doubt as to the truth, some weight will be given by the court on appeal to the finding of the chancellor in the original trial (210 S. W. 163).

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

Ralph D. Cutler has been appointed sales manager of the Hartford (Conn.) Electric Light Company.

Dr. A. E. Kennelly of Harvard University and the Massachusetts Institute of Technology has served as acting head of the electrical engineering department since the early part of 1918, when Prof. Dugald C. Jackson entered the service as major in the Engineers' Reserve Corps. Through error, it was stated in the May 17, 1919, issue of the ELECTRICAL WORLD, in connection with the return of Professor Jackson to the Institute, that Prof. R. R. Lawrence had been acting head of the electrical engineering department.

Dr. William McClellan, who resigned recently as dean of the Wharton School of Finance and Commerce of the University of Pennsylvania, has been elected vice-president of the Cleveland (Ohio) Electric Illuminating Company. Dr. McClellan is a graduate of the University of Pennsylvania, and his technical experience covers a wide range of important work, including that of engineer in charge of construction of the Philadelphia Rapid Transit Company, supervising engineer with Westinghouse, Church, Kerr & Company, member of the firm of Campion & McClellan, and chief of the division of light, heat and power of the Public Service Commission for the Second District of New York.

WILLIAM M'CLELLAN

Brig.-Gen. George H. Harries, a vice-president of H. M. Byllesby & Company and formerly president of the Louisville (Ky.) Gas & Electric Company, has recently been twice honored on account of services rendered during the war. The American distinguished service cross has been conferred upon him by General Pershing in recognition of his services at Brest in the early part of the war. He has also been made a commander of the Legion of Honor by General Dupont of the French army as a further recognition of his work at Brest. General Harries was the first American officer in Berlin as the American member of the Inter-Allied Commission on the Repatriation of Prisoners of War. He assisted in the return not only of American prisoners but of those of Greece, Serbia, Rumania and Russia.

W. C. Hall of Kokomo, Ind., has been appointed superintendent of the municipal light and water plants of Anderson, Ind.

Major Ezra B. Whitman, of the firm of Norton, Bird & Whitman, Baltimore, Chicago and New York, until recently officer in charge of utilities, Quartermaster Corps, Camp Meade, Md., sailed on May 16 with a party of technical and financial experts for Poland. He has been engaged by interests in Poland to investigate municipal, sanitary and power matters and general developments for various cities in that country. Major Whitman will be away about three months, during which time he will visit and make reports on all the larger cities of Poland.

A. Emory Wishon, who was elected president of the Pacific Coast Section of the N. E. L. A. recently, is assistant general manager of the San Joaquin Light & Power Corporation, Fresno, Cal. Mr. Wishon was born at St. James, Mo., July 10, 1882. His father, A. G. Wishon, now general manager of the San Joaquin Light & Power Corporation, was one of the pioneers in hydroelectric development on the Pacific Coast. The first power plant that he promoted and built was the Mount Whitney No. 1 plant. This was in 1899. Since that time A. G. Wishon has continued in the financing, building and operating of hydroelectric plants in the San Joaquin valley, and he is largely responsible for bringing into prominence electrically operated agricultural pumping plants that have turned the arid plains of this valley into fertile producing farms. A. Emory Wishon took up electrical work at the Mount Whitney plant No. 1. He started as an oiler there and worked in different operating capacities before entering the Missouri School of Mines, from which he was graduated in 1908. For a number of years after returning to California he devoted his attention to the introduction of electric power in the oil fields with marked success. In 1910 he was placed in charge of the Southern division of the San Joaquin Light & Power Corporation, which included oil fields, agricultural districts, street railways and gas properties. In 1912 he was made assistant general manager and transferred to the main office in Fresno.

George M. Guilford has been appointed auditor of the Edison Electric Illuminating Company of Boston, Mass., succeeding the late L. M. Wallis.

Philip Cabot of Boston, Mass., has resigned as president of the Turners Falls Power & Electric Company. The completion of his plans for the development of the important steam and hydroelectric system of the company leaves Mr. Cabot free to devote himself to other interests. He is a member of the banking firm of White, Weld & Company of Boston and has attained the reputation of being one of the most advanced thinkers in the central-station industry in New England. To his constructive work in the development of the Turners Falls property was due largely the ability of the system to meet the demands of war industries in its section for power during the war. For a long period he has devoted his time to the solution of the larger problems of hydroelectric power economics and water conservation, including questions of interstate coöperation with regard to storage development.

PHILIP CABOT

William S. Murray, well known as the chief electrical engineer of the New York, New Haven & Hartford Railroad for many years, who has heretofore maintained headquarters at New Haven, Conn., has moved his engineering offices to 165 Broadway, New York City. He will devote his time to consultation on electrical generation and transmission, railroad electrification, and conservation of natural resources. Mr. Murray's connection with the New York, New Haven & Hartford Railroad covered the period from April, 1905, to December, 1916, during which time the single-phase electrification took place. For the first part of this time Mr. Murray was directly connected with the electrical engineering department, and during the latter part of the time he acted as consulting engineer, as a member of the firm of McHenry & Murray, now dissolved. More recently he has served as president of the Hoosatonic Power Company of New Haven.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

MOVE FOR GUARANTEE ON FLASHLIGHT BATTERIES

Manufacturers Feel that Action Along This Line Will Go Far Toward Gaining and Holding the Confidence of the Public

Because flashlight batteries depreciate while inactive upon the dealers' shelves, misunderstandings frequently arise when the buyer gets a battery that has been in stock for many months. The dealer is not always careful to dispose of his old stock completely before he sells from the fresh invoice.

Generally speaking, all flashlight batteries are of a good quality, and consequently there is no reason for any reputable manufacturer to fear the effects of a guarantee. Manufacturers for the most part are in favor of guarantees on shelf depreciation and minimum burning life and for as long a time in each instance as possible.

It is stated by manufacturers that the length of time which a battery may remain inactive and not depreciate 10 per cent varies with the size of the battery, the smaller battery depreciating more quickly. Consequently different guarantees would have to accompany different sizes. Various sizes, it is held, could be rated from three months to a year.

Some definite proposals in this matter are expected from the manufacturers in the near future. It is the consensus of opinion that a stand taken for liberal guarantees will go a long way toward gaining and holding the confidence of consumers.

CONSIGNED LAMP STOCKS NOT ABNORMALLY LARGE

Special Sizes and Types High in Some Localities— Dealers' Indifference Tends to Cause Excess Stocks

There has been a report that stocks of lamps consigned to jobbers in a certain section of the country were large and that steps were being taken to reduce them. Investigation shows that stocks are not as a rule abnormally large in the 40, 50 and 60-watt sizes, which are those that enjoy a steady market for household and commercial use with a three or four weeks' turnover. Stocks of tungsten vacuum and gas-filled lamps, it is stated, are slightly above normal in some sections. However, these stocks are not alarmingly large and exist because of the natural lengthening of daylight hours and also in a certain measure because of the daylight-saving law.

When jobbers' accounts on manufacturers' books show excess stocks it is becoming more and more the practice among manufacturers to investigate the case and either remove the excess or assist the jobber to create a market for that excess. Instances are too common where jobbers have little regard for their excess consigned stock, as it costs them little except storage space to carry it. The manufacturer is interested in eliminating slow stock, and when found it is generally shipped to a central warehouse or to a jobber who is in a position quickly to dispose of such a stock.

The case of one jobber showing excess stocks was investigated and the lamps were returned to manufacturer's warehouse. The jobber had been supplying a manufacturer of a commercial article with a special lamp which could be used virtually for only one purpose. The demand for this article decreased, and the jobber was left with a supply of this special lamp; but his books showed an excess stock sufficient for investigation.

Other instances concern dealers in certain localities with a stock of the larger types of lamp for which the demand is light and extremely intermittent. A dealer with an order for, say, ten lamps of a large size orders a case. The excess after this order has been filled has been known to lie in stock for a year or so and finally to be gathered in by the manufacturer. In the case in mind the dealer had an order for this stock the day after its removal. This could not be helped; it had stayed too long on the shelf.

MARCH INSULATED-WIRE EXPORTS AMOUNT TO $1,025,867

Month's Foreign Shipments of Electrical Goods, $7,876,353, Bringing Figures for First Quarter Up to $22,164,966

During March last the exports of insulated wire and cable went over $1,000,000 for the first time, the total being $1,025,867. March was another electrical export month, shipments amounting to $7,876,353.

Besides insulated wire and cable, batteries, generators, fans and heating and cooking appliances hung up new records The value of batteries exported was $579,708; generators, $390,765; fans, $269,934, and heating and cooking devices, $151,693. March was the first month in which the last item has reached the $100,000 mark so far as the records show.

Figures for the first quarter of the current year amount to $22,164,966, or 67.3 per cent more than the total for the first three months of 1918. At the present rate the exports of electrical merchandise should run close to $90,000,000 for 1919.

The figures in the accompanying table were compiled by the Bureau of Foreign and Domestic Commerce:

	March		Nine Months Ending March	
	1918	1919	1918	1919
Batteries	$289,251	$579,708	$2,502,333	$2,949,375
Carbons	181,617	98,923	1,163,653	1,264,900
Dynamos or generators	269,409	390,765	1,803,378	2,737,755
Fans	65,643	269,934	428,419	868,642
Heating and cooking apparatus	31,553	151,693	397,352	730,228
Insulated wire and cable	550,738	1,025,867	4,589,088	5,634,426
Interior wiring supplies including fixtures	129,703	172,622	1,116,983	1,247,571
Arc lamps	2,001	308	9,703	10,691
Carbon-filament lamps	8,840	14,039	122,952	103,768
Metal-filament lamps	236,817	426,128	2,119,690	3,047,945
Magnetos, spark plugs, etc.	318,333	321,499	2,608,501	2,197,181
Meters and measuring instruments	125,207	273,373	1,064,740	1,804,590
Motors	785,233	838,448	4,942,714	7,468,602
Rheostats and controllers	29,429	38,565	144,568	273,753
Switches and accessories	222,338	225,305	1,729,180	1,583,413
Telegraph apparatus including wireless	15,429	60,186	214,132	495,726
Telephones	368,338	255,154	1,867,423	2,046,298
Transformers	203,446	449,077	1,507,914	3,349,631
All other	1,334,087	2,284,759	11,608,387	16,457,312
Total	$5,167,412	$7,876,353	$39,941,110	$54,271,807

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THE DOMESTIC AND EXPORT TRANSFORMER MARKET IMPROVING

Increased Line Extensions and House-Wiring Campaign Bring Better Volume of Sales and Inquiries from Central Stations

The transformer market is reviving under the stimulus of business expansion throughout many parts of the country. Orders from the Middle West are active, the Pacific Coast is buying somewhat more freely, and the East is falling into line with increasing inquiries and better sales. Within a month one Middle Western central station has ordered no less than 54,000 kva. in transformers. Foreign business, notably from Spain and Norway, shows healthy gains, these being due largely to hydroelectric developments. Although much more building is to be started later in comparison with the present low volume, central stations are increasing their line extensions in many localities; house-wiring campaigns are yielding good results, and inquires are comng into the transformer factories at an unsurpassed rate.

METAL MARKET SITUATION

Copper Has Receded Slightly and Sales Have Decreased in Volume

The buying spurt of copper of a week ago has fallen to some extent, but transactions are reported in good volume. The price of spot has declined since last week ⅛ cent to 16.37½ cents, while the qotations of 16.75 cents, which then prevailed for June and July, have declined to 16.50 cents a pound.

Much of the copper recently sold went to electrical manufacturers, so that now the needs of this group are apparently covered for a short time. Wire-drawers purchased heavily on account of some recent orders for bare wire for transmission lines. This should merely be the beginning of such buying, as this work has received little attention for the last two years, and much interconnection of power lines is contemplated.

The London market is off nearly £1. Large exports of copper-wire bar to England have been reported, although that country already has heavy stocks of ingots. Antimony has increased ⅛ cent to 8.37½ cents, but little activity in the market is apparent. On the other hand, spot spelter has declined a fraction and its market is likewise quiet.

Most of the scrap metals have jumped up slightly, but there have been no large volumes of sales. Aluminum still appears to hold the most attention, although zinc and lead scrap are finding fair sales.

NEW YORK METAL MARKET PRICES

	May 20	May 27
Copper:	£ s d	£ s d
London, standard spot	79 5 0	78 15 0
	Cents per Pound	Cents per Pound
Prime Lake	17.00	17.00
Electrolytic	16.75	16.37½
Casting	16 00	15.87½
Wire base	18.00 to 18.50	18.00 to 18.50
Lead, trust price	5.25	5.25
Antimony	8.00	8.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.65	6.57½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent.	32.00 to 33.00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	13.75 to 14.25	14.00 to 14.25
Brass, heavy	7.75 to 8.25	8.00 to 8.50
Brass, light	7.00 to 7.25	7.25 to 7.75
Lead, heavy	4.37½ to 4.50	4.50 to 4.60
Zinc, old scrap	4.50 to 4.75	4.50 to 4.75

THE WEEK
IN TRADE

BETTER business in electrical lines is reported for the week. Wiring materials, labor-saving devices, portables, particularly those with silk shades, and fixtures are moving very well.

A number of advances in price are reported, including 20 to 25 per cent on non-metallic conduit, $3 per 1000 ft. on flexible armored conductor, and increases of a substantial nature in brass, push sockets and insulating cloths and oils. Wire advanced on Tuesday, due to higher copper and cotton-yarn prices. Much of the advance this week was due to the skyrocketing of cotton.

Collections appear to be holding up well.

NEW YORK

During the past week there has been evidence of returning confidence, and this has been reflected in a somewhat better tone to the jobbing and manufacturing trade. The impression is prevalent that better business is just ahead, and the expectation is that the latter part of the summer will see industries well on toward full swing.

Evidences of increased building and construction are found in all sections. Crane manufacturers have reported increased inquiries from stoneyards, showing the latter's preparations for renewed building. The house-wiring campaign of the Brooklyn Edison Company is reported very successful for April and May, and it is its intention to put on a store-wiring campaign in August and September.

Jobbers' reports this week are better than last week, and their reports on collections continue to show improvement. No new requests for extensions of credit have been found.

There is reported $200,000,000 worth of new construction on the drawing boards scheduled for New York City.

WIRE.—Rubber-covered base advanced on Tuesday from 20 to 21 cents because of higher copper and cotton yarn costs. Producers held off until it was felt that the rise in copper was not a fluctuation.

INSULATING MATERIALS.—Insulating cloths and oils are up considerably and advancing. Cloth is following the cotton market fairly regularly.

NON-METALLIC CONDUIT.—Advances of 20 to 25 per cent took place on May 22, and these prices were holding firm on Tuesday. This advance does not include the advances in cotton that have taken place since then.

SWITCHBOARDS.—There is a steadily improving market in switchboards and instruments. Up to about two weeks ago the inquiries and orders from industrial plants seemed to predominate, but recently the balance has switched to central-station requirements. One prominent manufacturer reports more proposition work for switchboards than at any previous time.

FEEDER REGULATORS.—Interest in feeder regulators, up to a month or so ago quite dead, continues to improve, in keeping with the opening up of central-station activities.

FLEXIBLE ARMORED CONDUCTORS.—An increase in price of $3 per 1000 ft. has been reported this week. The demand is still heavy, and no relief has been afforded in manufacturing capacity.

TRANSFORMERS.—New York stocks of distributing-pipe transformers up to 10 kva. have been reported moving especially well. One reason given for the demand for this capacity has been the increasing application of appliances and labor-saving devices in the homes. The overloading of transformers due to this cause has required attention,

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as complaints have come to central stations on account of poor operation of appliances. These have been traced back, according to one transformer manufacturer, to the addition of load without regard to transformer capacity.

SOCKETS.—Push sockets are reported up 3 cents each.

WASHING MACHINES.—Business is reported especially active, and prices are firm. The last advance reported was for the product of one prominent manufacturer, which was from $140 to $150 a few weeks ago.

CHICAGO

Jobbers report that the volume of business in the general line appears to be well maintained. There are many inquiries, but for smaller quantities than last year. Buyers are slower also, placing orders after receiving quotations. Prices appear to be unsteady, with a general trend toward bullishness. However, the jobbers are selling on a closer margin than they have been for a long time because the jobbers at present see the necessity for "making a market."

The War Department, headquarters central department, office departmental signal offices, Chicago, offered for sale under date of May 22, 1919, a list of material covering about three typewritten pages. It comprises brass products and copper products, including wire, insulating materials, fabric and wooden pieces. It is desired to close sales on this material by June 10. F. C. Ryan, inspection director, is in charge.

The general news which affects the trade is optimistic. Officials of the Illinois Central Railroad have agreed with the Chicago Commission on Railway Terminals and a subcommittee of the City Council committee on railway terminals for a fifteen-year electrification provision being written into the proposed ordinance for the improvement and electrification of the Illinois Central Railroad within Chicago.

Building permits for the week ending May 24 totaled $2,075,000 and the work projected totaled $6,040,000. This is a considerable increase over any of the recent previous weeks. It is nearly all of residential character.

NON-METALLIC CONDUIT.—An advance of 20 per cent was made on May 22, the discount being changed from 70 per cent to 50 per cent.

DRY BATTERIES.—While a decline in price is expected, no definite news as to the amount of the drop is available. Purchases for stock are at a minimum on account of the expected decline.

COPPER WIRE.—A considerably better market has been experienced during the last week, the average base price on weatherproof and rubber-covered moving up to 19 cents, while one company is quoting 20 cents.

LINE HARDWARE.—A steady demand continues to be felt by virtually all the manufacturers in the Middle West.

FIXTURES.—The standard styles are showing activity on account of the home-building program which is well under way.

PORTABLE LAMPS.—Some manufacturers of silk shades are sixty days behind on delivery, and certain brass parts for portable lamps are unobtainable in retail stores of Chicago.

CONSTRUCTION TOOLS.—A consolidation of companies is expected in the line construction tool business.

ELECTRIC FURNACES.—While the demand dropped off sharply with the signing of the armistice, there apparently is some activity in this field again.

ELECTRIC CONTROLLERS.—Manufacturers of electric control who sell to motor manufacturers find business especially brisk. The majority of the demand is for direct-current control.

AUTOMOBILE ACCESSORIES.—In order to get in closer touch with the South a group of Chicago automobile accessory manufacturers are sending a representative to take up headquarters at Jacksonville and Atlanta. He will work among the jobbers and dealers of the Southeastern territory.

BOSTON

Business is active this week, and one of the larger jobbers reports earnings 10 per cent in excess of those of the corresponding period of 1918. The demand for electrical household supplies is heavy, and in some lines it is hard to maintain adequate stocks. Prices reflect upward tendencies, wire showing a 1-cent increase in some classes over the quotations of last week. Armored flexible conductor is up $3 per 1000 ft. Stocks are well maintained, and collections are very good. The trade is feeling more optimistic than a few weeks ago and anticipates rapid expansion of building after the signing of the peace treaty. Certain makes of vacuum cleaners are running short, despite the efforts of manufacturers to enlarge their plant facilities.

Labor conditions are somewhat disturbed. About fifty workers in the mechanical department of the Western Electric Company's Boston office struck Monday morning, relations between the company and the union organization apparently being the cause of disagreement. It is announced that 82 per cent of returning Massachusetts service men are taking up work with their former employers, and that not a single electrical house has so far declined to reinstate a former employee who has been in the war service. Building activities are held back somewhat by high labor costs, but a good deal of work is being done none the less.

WIRE.—Bare wire is quoted at 19 cents base, weatherproof at 20 cents and slow-burning at 20.5 cents. The two first named are 1 cent higher than about a week ago, and the third is ½ cent up. Contractors are buying a bit more freely. Stocks are improved over a few weeks ago.

FANS.—Retailers have begun to buy fairly well, considering the moderate weather. Jobbers' stocks are in good shaps for early demands, but mid-season possibilities depend a good deal upon the thermometer. A protracted hot wave would soon exhaust many local stocks.

AUTOMOBILE STARTING AND LIGHTING SETS.—Trade is exceedingly brisk, and stocks are in good shape despite the heavy demand. Distributers are buying pretty consistently, however, and deliveries are well maintained

MOTORS.—Small alternating-current motors around 1 hp. are a bit "shy" in availability this week. The demand is confined chiefly to fractional-horsepower motors and sizes up to and including 5 hp.

RADIATORS.—A few radiators are moving for the seaside and mountain cottage trade. Stocks are generally in excess of immediate needs, and some price cutting appears to be under way as a temporary measure to dispose of an abnormal surplus.

WASHING MACHINES.—These outfits are being sold almost by the carload in New England, owing largely to the acute shortage of domestic labor. Prices are steady and sales have almost reached an automatic basis.

VACUUM CLEANERS.—A heavy demand and a supply restricted in some makes by limitations of factory output are evident.

DRY BATTERIES AND FLASHLIGHTS.—A moderate trade is reported, with ample stocks. Recent price weakness seems likely to facilitate summer buying.

FIXTURES.—Stocks are large in jobbers' warehouses recently visited. A fair sale of fixtures is noted, the demand coming chiefly from renovation activities.

FLEXIBLE ARMORED CONDUCTOR.—Prices rose $3 per 1000 ft. within a week, late quotations being $65 for one-strip and $68 for two-strip.

CONDUIT.—An excellent supply is on hand as regards immediate market requirements, though in some cases a larger accumulation of smaller sizes would ease the jobber's mind.

ELECTRIC COAL LOADERS.—The demand has picked up wonderfully within the past two months. One Massachusetts manufacturer reports orders in excess of present capacity, and his stocks have practically disappeared. Prices reflect stiffer costs.

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ATLANTA

Building and construction of all descriptions which started off slowly the first of the year has been gaining in its stride each month, and present indications point to a record-breaking year in the Southeast. The value of construction at Atlanta up to and including May equals the total value for the entire year of 1918. May building alone is ahead of any figures for the same month since 1912, which was the biggest construction year in Atlanta's history.

Jobbers and dealers report an increasing demand for schedule material from all quarters with a consequent firm price range. Electrical contractors are busy, and although the jobs on hand and under way do not assume the extensive proportions of last year, business is highly profitable. A number of jobbers are running well ahead of last year. Collections along the entire line from manufacturers to dealers and contractors are good.

FLEXIBLE STEEL CONDUIT.—The movement shows a decided decrease. Prices hold remarkably firm and shipments from factory on standard sizes are normal.

LAMP GUARDS.—The ordinary slump for this season of the year is offset by further economies put into effect by industrials on lamp protection, and sales are satisfactory.

FUSE PLUGS.—Following the demand for schedule material, the volume of transactions for this item is showing a steady increase. A few stocks are above par.

CONDUIT.—It is difficult to discover the reason for a slump in sales this week covering both the white and black rigid product. This is a temporary condition, however, and a substantial immediate demand is looked for. Southeastern stocks are well filled.

FIXTURES.—All types are moving fast. Jobbers are putting forth more effort, with a resulting increase in business. Inquiries and orders from the smaller towns are growing.

HEATING DEVICES.—The volume of transactions to date is running considerably above last year. With the exception of irons, prices remain firm. Stocks reached a normal condition.

PORTABLES.—Sales at this time are better than the corresponding period last year. Standard colors in silk shades are moving well. The demand for floor lamps has fallen off.

LIGHTNING ARRESTERS.—Normal atmospheric conditions have stimulated sales, and transactions this week show a marked improvement over a semi-dormant market which has existed for the past month. Prices have declined gradually since the high mark of the previous season.

MOTORS.—Coincident with a brisk market one manufacturer has reduced prices 5 per cent on fractional-horsepower sizes. Factory facilities are much improved, and prompt deliveries on nearly all sizes are being made from local stocks.

SEATTLE—PORTLAND

Jobbers report for the week about the same volume of sales as for the past three weeks. The major portion of business is being done with shipyards and allied industrials. Utilities are buying very lightly and in most cases for maintenance work only. Prices are holding firm and collections still remain excellent.

Manufacturing agents, jobbers and retailers in Portland report that business is reasonably satisfactory, although, of course, it is not up to pre-war or war-time standards. There has been no movement of any particular line for several weeks, and price changes have been insignificant with the exception of a very material stiffening in the price of copper wire. Domestic appliances are moving along well, and house-wiring device sales are moving with increasing momentum owing to the general building conditions, which continue good. Many towns throughout Oregon report unusual activity in residence building. In Portland a large number of one-story and two-story brick and concrete buildings for store and factory purposes are under construction or are on the boards in architects' offices for immediate action. A large number of permits for residences are being taken out daily.

According to official figures, this year will produce the greatest crop in the history of the Northwest. Equally optimistic reports are received from fruit sections in Washington and Oregon. Northwest lumbermen report that commercial business has now resumed in good volume.

WASHING MACHINES.—A considerable number of these appliances were sold during the past week in smaller towns adjacent to Seattle, where sales campaigns of some importance are being conducted. In Seattle both jobbers and retailers report sales keeping up well. Stocks are in excellent shape and prices show no change.

VACUUM CLEANERS.—Sales in the outlying districts in the Puget Sound country are surprising the most optimistic. Steady prices and ready deliveries from local stocks have materially tended to increase sales. In Seattle and Tacoma nearly every jobber reports good business and exceptionally bright prospects.

FIXTURES.—Demand is growing with increase in residential building. Jobbers' stocks are in good shape, and shipments are coming through regularly. Prices show no change.

SAN FRANCISCO

Business in all branches of electrical activity is brisk. Money is more plentiful than ever before, and crops promise to be bountiful. Recent rumors of less drastic prohibition laws are encouraging to California grape and brewery interests, in which a great deal of money is invested.

LAMPS.—The expiration of important municipal contracts has occasioned a lively scramble for their renewal. Many contracts that were fairly stabilized in the past are being surprisingly shifted.

MOTORS.—Stocks and deliveries are good, and the demand for sizes from 1-hp. to 7½-hp. inclusive is very good and running fairly level with the demand of last year without the factor of drought which necessitated many purchases last season. There are not so many orders for large sizes as there were last season. Prices are fairly steady.

SCHEDULE MATERIAL.—The demand is gradually gathering volume, although the tendency is to buy for immediate requirements or prospective demands of the next two or three weeks.

HOUSE GOODS.—Stocks of bells, push-buttons, annunciators, etc., are fairly good in certain sizes, but on account of the sporadic demand the Coast houses are gradually eliminating the number of varieties and standardizing on fewer styles.

RUBBER-COVERED WIRE.—Local stocks are good. The demand is steady and the price has not changed during the past month. No. 14 single-braid solid is selling for approximately $13 per 1000 ft. in car lots. The circular-mil sizes are rather quiet, but, contrary to what one might expect, better stocks are being carried on the Coast of these large sizes, and they are being increased.

POLES.—Prices have been very steady for a year and a half in spite of increased freight rates, increased cost of handling and other factors. Competition is very keen along the Coast, with its many forests and odd bits of timber land. The past quarter has witnessed a revival of former brisk pole conditions, for there are a number of jobs in sight requiring several thousand poles and many styles of insulators and pieces of pole-line hardware.

FLOODLAMPS.—Not only has the sudden cessation of war conditions and precautions cut down sales, but the abrupt nature of the change has left big Coast stocks, which show slight immediate prospect of sale.

RADIATORS.—The standard household radiator, portable style, is retailing for $10.50, but there is small demand for it. Dealers were left with large stocks on their hands because of the early spring. Comparatively few protection orders for next season have been placed.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	+ 20% to list
Coil to 1000 ft	List to 5%
	No. 12 Solid
Less than coil	+ 20% to list
Coil to 1000 ft	List to 5%

Twin-Conductor

	No. 14 Solid
Less than coil	$100.00 to $115.00
Coil to 1000 ft	82.50 to 100.00
	No. 12 Solid
Less than coil	+20% to list
Coil to 1000 ft	List to 5%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 20%
Std. pkg	23% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
1/8	250	$5.00
1/4	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
1/8	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
3/8	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
1/2-in.—	$25.00	$18.00	$16.00
1/4-in.—	30.00	19.50	17.50

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
1/2-in.—	$33.00	$17.50	$16.25
1/4-in.—	36.00	19.00	17.25

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/2 in. to 1 1/2 in.	2 in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/2 to 1 1/2 In.	2 to 3 In.
Less than 2500 lb.	+3% to 6.1%	+1% to 8.1%
2500 to 5000 lb.	2% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7 00 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00
Coil to 1000 ft	21.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–33%	10%–24%
$10.00 to $50.00 list	30%–45%	20%–32%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35
Standard package, 2200. List per 1000, $21 to $34	

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$17.85–$24.15
1/5 to std. pkg	14.70– 21.00
Standard pkg., 2200. List per 1000,	$20.00 to 21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg	11.20– 16.00	22.40– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
¼-in. cap key and push sockets	500	$0.33
¼-in. cap keyless socket	500	.30
¼-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20 to list
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-qmp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	23%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 50%	25% to 40%
$2.00 to $10.00 list	30% to 50%	25% to 40%
$10.00 to $50.00 list	30% to 64%	25% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.40–$0.41
No. 18, full spools	.35– .38

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.46 to $0.53
No. 18, full spools	.41 to .47

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	$18.18	18.18	$13.64
10	24.30	24.30	16.20
8	33.12	27.60	22.08
6	52.50	43.75	35.00

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$17.50	$9.50	$8.90
12	21.63	21.63	18.54
10	28.91	28.91	24.78
8	39.34	33.72	33.72
6	61.74	52.92	52.92

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$25.00–$29.25
25 to 50 lb	25.00– 25.25
50 to 100 lb	24.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$23.75 to $24.50
25 to 50 lb	23.75 to 24.50
50 to 100 lb	23.75 to 24.50

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NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

White-Glass, Tipless Gas-Filled Lamp

A white-glass lamp which is highly diffusing has been developed by the Mazda interests—that is, the Edison and National Lamp Works of the General Electric Company, at Harrison, N. J., and Cleveland, Ohio, respectively, and the Westinghouse Lamp Works, 165 Broadway, New York City—but is not ready for distribution at the present time. It is designated as the "Mazda C-4" and is markedly different from any other lamps in that it has no tip and the bulb diffuses the light so completely that the filament is not visible to the eye. The lamp will be furnished in the 50-watt size with the PS-20 bulb, and the dimensions will be approximately the same as in the 40-watt and 50-watt B lamp. The average life rating will be 1000 hours. A soft mellow illumination is afforded whether the lamp is concealed or exposed to the eye.

Electrically Heated Oven for Drying Out Lamps

Electrically heated ovens which are especially designed for drying out incandescent lamp bulbs before they are exhausted have been brought out by the William H. Dalton Company, 4 Charlotte Street, Salem, Mass. The ovens operate on 110-volt circuits and have energy consumption of about 600 watts. A temperature of between 575 and 750 deg. Fahr. (300 and 400 deg. C.) is obtained, the maker states.

Brass-Set Screw Connectors

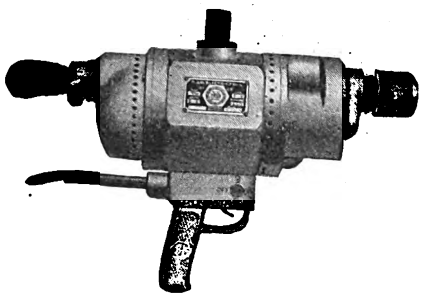
Brass-set screw connectors in two styles—one with a dividing wall and for use with standard cable and the other with wire holes extending clear through and for solid and stranded ca-

SOME STYLES HAVE TWO SCREWS

bles—are now being manufactured by the H. B. Sherman Manufacturing Company of Battle Creek, Mich. They are made from solid brass rod and the screws are heavily galvanized, making them rust-proof and enabling the connectors to be used over again when removed from temporary work. The connectors are supplied with two or four screws in sizes for Nos. 12 and 14 to No. 0000 B. & S. gage stranded wire and in sizes for No. 12 to 0000 and No. 8 to 0000 B. & S. gage solid and stranded cables.

Compact Portable Electric Drill

Compactness, strength and durability are obtained in the $\frac{9}{16}$-in. (14-mm.) size drill recently added to the line of portable electric drills made by the Black & Decker Manufacturing Company, 105 South Calvert Street, Baltimore, Md., through the attachment of the No. 1 Morse taper socket. This is in the form of a separable sleeve secured to the drill spindle by a large knurled nut. By unscrewing this nut



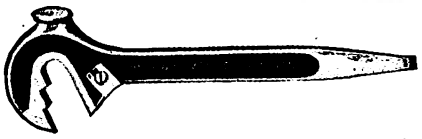
AIR-COOLED MOTOR FURNISHES POWER FOR DRILL

the entire taper socket is easily removed from the spindle. The drill shank, which protrudes slightly beyond the socket's end, is freed from the latter by a slight tap. This drill has a capacity of 0 in. to $\frac{9}{16}$ in. (14 mm.) in steel and is said to drill a $\frac{9}{16}$-in. (14-mm.) hole through machine steel at a rate of 1½ in. (38 mm.) a minute without overloading the motor. It is also stated that a pressure as high as 500 lb. (226 kg.) has been applied without stalling the drill.

In its construction this drill resembles the other sizes made by this company. Gears are grease-packed in a separate compartment, while the drill spindle runs in a long bronze bushing and against a ball thrust bearing. The electric motor is an air-cooled type. Easy control is afforded by a pistol grip and a trigger switch. The weight is 21 lb. (9 kg.). An interchangeable spade handle and breast plate, 15 ft. (4.5 m.) of duplex cable, separable attachment plug and detachable side handle are supplied with the drill.

Combination Wrench, Hammer, Screwdriver and Scraper

The weight of the tools usually carried by electrical workers can be reduced by 3 lb. (1.3 kg.) through the use of the "Four-in-one" terminal wrench



WEIGHS ONE AND A QUARTER POUNDS

recently brought out by the B. & K. Manufacturing Company of New Britain, Conn., for installing its bracket and pole-line hardware. It combines a wrench, hammer, screwdriver and wire scraper and is made from high carbon steel, drop-forged, correctly balanced, finished and tempered.

The wrench jaws are fitted to take ⅜, ½ and ⅝-in. (9.5, 12.7 and 15.8-mm.) standard U. S. nuts. By using the head of the wrench as a handle a screwdriver is obtained. The hammer portion of the tool is sufficient to handle the average lighting installation, and the scraper can be used in cleaning conductors before they are made up. The length of the wrench is 10 in. (25 cm.) and its weight is 1¼ lb. (0.5 kg.).

Combined Lamp and Smoking Set

With a French "seventy-five" shell as its base and a reflecting shade shaped like a trench helmet, an adjustable electric lamp is being marketed by Snead & Company, Flatiron Building, New York City. The shell is cut into four sections which form a smoking set to hold cigars, cigarettes, tobacco, ashes and matches. Each part fits and locks with the others by a simple turn. Both smoking set and lamp can be used at the same time. The sectional construction affords a number of different heights since one, two or three parts may be removed and the lamp still used.

The shell is polished and lacquered to prevent tarnishing. The finish of the shade is brushed brass, and its interior is provided with an efficient reflecting surface. The bulb is controlled by a push-button switch in the socket. The assembled lamp stands 19 in. (48 cm.) high, the diameter of the base is 6½ in. (16.5 cm.) and the helmet shade is 10½ in. (26.6 cm.) in diam-

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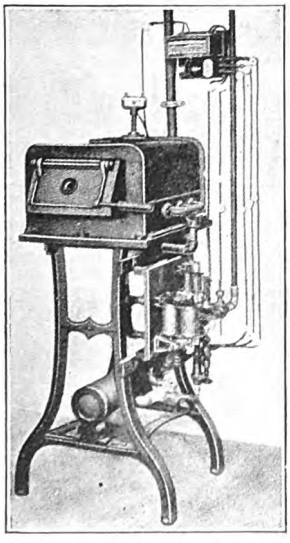
eter. A 6-ft. (1.8-m.) length of insulated cable with a two-piece screw or plug attachment is furnished with the lamp, which can also be furnished with a decorated parchment shade

Automatic Temperature Control for Gas Furnaces

For automatically controlling the temperature of gas furnaces the Brown Instrument Company of Philadelphia has developed an automatic temperature-control pyrometer. This instrument is similar to the Brown high-resistance pyrometer, except that the pointer is depressed upon the contact-making devices at intervals of every ten seconds. No current passes through the pointer itself, the circuit being completed by the upper platinum-tipped contact touching the lower one. The contact-making device is adjustable throughout the scale range of the instrument, and an index pointer shows the point at which the temperature is being controlled. The space between the two contacts on the high and low side, separated by insulating material, is equivalent to 1 per cent of the scale range. Control of the temperature of the furnace is therefore possible within 1 per cent of the total scale range. If a suppressed scale is used, a control twice as close can be obtained than where the first scale is used.

The energy for operating the relay which in turn operates the valve is very small, being about 1/10 amp. A small alternating-current or direct-current motor for 110 volts is employed to depress the pointer at the regular intervals and can be used on 220-volt circuits by using a resistance in series with it.

The illustration shows a gas-oven

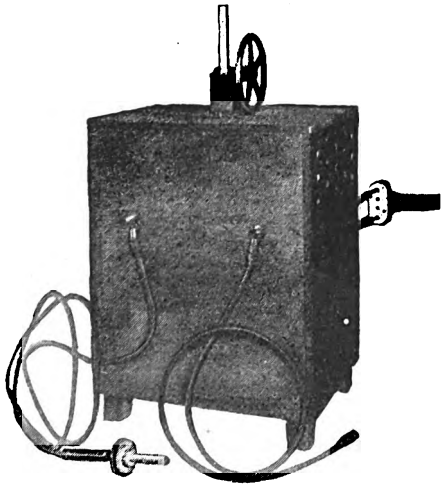


ALSO APPLICABLE TO STEAM, OIL OR ELECTRIC FURNACES

furnace with one of these automatic-control instruments and the solenoid-operated relay and valve. A thermocouple of base metal or platinum rhodium is installed in the furnace and actuates the pyrometer on the wall. This control is also applicable to steam or oil, and by the use of a switch it may be employed with electric furnaces.

Alternating-Current Electric Welder

The important feature of the Zeus electric welder pointed out by the Gibbs Instrument Company of Detroit, Mich., its maker, is its adaptability to overhead welding and cast-iron welding, both of these classes of welding having heretofore given considerable trouble with arc-welding equipment. Instead of a motor-generator set with the disadvantages of bulk and moving parts, a transformer without any moving parts is used. It is said that this transformer consumes from 20 to 40 per cent less energy than the motor-generator type. Another feature of the



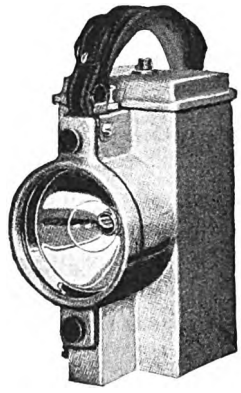
BUILT IN UNITS SO THAT ADDITIONAL CAPACITY MAY BE EASILY ADDED.

welder is said to be its arrangement for regulation. It is not necessary in any way, the maker points out, to change the connections in regulating the arc. A wheel extending through the top of the case raises and lowers the secondary and provides for the current regulation necessary for different sizes of electrodes. The inherent reactance of the welder is declared to stabilize the arc for different arc lengths automatically.

The welder is comparatively small and is portable. It is built on a unit system whereby a 150-amp. machine may be installed, and should the work become heavier, a duplicate may be connected in parallel with the original machine.

Light-Weight Safety Mine Searchlight

A shaft of light can be projected over 500 ft. (152 m.) with the smoke-proof, gas-proof and waterproof mine-type hand electric searchlight recently developed by the Grether Fire Equipment Company, Dayton, Ohio. It is constructed throughout of aluminum and is practically indestructible. No tools are required for its operation, and it is provided with a safety circuit-break attachment. An "Edison" non-spillable two-cell alkaline storage battery having a rated capacity of 125 amp.-hr. is employed.



SMOKE, GAS AND WATER PROOF

The normal charge and discharge rate is 3.75 amp. Two styles of reflectors are supplied—one a silver-plated spotlight type and the other an aluminum-faced "no-glare" type. The searchlight is furnished complete with a leather carrying shoulder strap.

NOTES ON RECENT APPLIANCES

Siren Fire Alarm

The Interstate Machine Products Company, Rochester, N. Y., is making a motor-driven fire-alarm siren.

Blower with Many Uses

A combination blower which can be used as a heater, an air washer, a fan, a hair drier or a deodorizer has been placed on the market by the Claxo Company of Iowa City, Iowa.

Stucco-Applying Machine

Portable motor-driven machines which project stucco onto walls by centrifugal force are being made by the Hodges Stucco Machine Company, Union Central Life Insurance Building, Cincinnati, Ohio.

Pipe Threader with Separate Die Heads

The Borden Company of Warren, Ohio, is manufacturing Beaver Junior pipe threader No. 3, which is equipped with separate die-head units for pipes from ⅛ in. to 1 in. (3 mm. to 25 mm.) in diameter.

Heavy-Duty Disconnecting Switch

Disconnecting switches for isolating oil switches at the generating end of switching stations and for line sectionalizing have been developed by the Maxwell Engineering & Manufacturing Company, 61 Broadway, New York City.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Belgium (No. 29,325) wishes to purchase electrical automatic pumps. Correspondence may be in English.

A company in India (No. 29,414) desires to be placed in communication with firms, with a view to securing representation for the sale of electrical supplies.

The president of a firm in this country (No. 29,335), who is about to make a trip to Cuba and South and Central America, desires to secure agencies for the sale of electrical supplies, motors and generators.

The purchase and agency for the sale of electrical material are desired by a firm in Spain (No. 29,380). Quotations should be given f.o.b. New York. Payment, cash against documents at port of shipment. Correspondence should be in Spanish.

The purchase of small electrical material, such as sockets, rings, insulators, keys and switches, is desired by a firm in Spain (No. 29,382). Terms, cash against shipping documents at destination. Correspondence should be in Spanish.

A firm in Spain (No. 29,346) desires to secure agencies on a commission basis for the sale of electrical material and apparatus, such as lamps, motors, fans, plates, stoves and water-heating apparatus. Correspondence should be in Spanish.

A firm in Belgium (No. 29,304), having a representative in this country, desires to purchase and secure agencies for the sale of electric motors of 5 to 8, 10, 12, 15, 20, 22, 24, 30, and 50 hp., three-phase, 220 volts. Correspondence may be in English.

Electric heating and cooking appliances, electric light fittings and electric wire are required by a firm in New Zealand (No. 29,369). Agencies will also be accepted. Quotations should be given f.o.b. port of shipment. Terms, cash against documents under New York letter of credit.

Agencies are desired by the head of a firm in New Zealand (No. 29,420), who is now in America, for the sale of electric trucks of ½-ton to 7-ton capacity, and electrical machinery and supplies, including motors, generators, batteries, wire and cable.

The French agent of an American company (No. 29,412) is in the market for a number of mechanical shovels driven by electric motor, for use in mines. The mine shaft is not higher than 7 ft. 2 in., and the equipment should be of corresponding size. Further details and sketch will be furnished by the company upon request. Terms cash.

The Société Française d'Action Economique, 1 rue des Italiens, Paris, France, which is represented here by Daniel T. Pierce, 149 Broadway, New York, reports that it has inquiries from French firms who desire agencies in France for electrical supplies.

IMPORTS INTO COLOMBIA.—Imports of electrical goods into Barranquilla, Colombia, in 1917, amounted to $198,000 from the United States, $3,325 from the United Kingdom, $195 from France, and $3,980 from Spain, totaling $205,500.

FOREIGN TRADE OF SOUTH AFRICA.—Imports into the Union of South Africa for 1917 and 1918 respectively are: Electrical cable and wire, $261,000 and $441,000; electrical fittings and posts, $1,006,000 and $1,394,000; electrical machinery and parts, $731,000 and $615,000.

ELECTRICAL TRADE WITH BRITISH COLUMBIA.—Of the merchandise imported into the Province of British Columbia, Canada, that passing through Vancouver and Victoria comprised approximately 85 per cent in 1918. Electrical apparatus, motors, etc., amounted to $197,844 at Vancouver and $38,728 through Victoria. Electrical fittings to the amount of $18,531 were exported to the United States in 1917 from Vancouver, Victoria, Prince Rupert and Fernie, with no figures available for 1918.

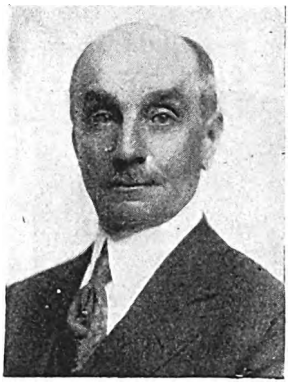
Western Electric Sales Changes

The following changes in the sales personnel of the Western Electric Company will take effect June 1:

J. ALPHONSO PIZZINI, for a number of years sales manager at the New York office, has been appointed assistant manager at the same place. Mr. Pizzini went to the Western Electric Company in 1901 as a member of the supply sales organization at New York and became sales manager in 1907 and manager of the domestic sales department in 1911.

W. J. DRURY, until recently manager of the Cleveland house, has been appointed sales manager at New York. Mr. Drury joined the company in 1904, in the educational course, and became a member of the engineering department at the Hawthorne Works in 1906. Several years later he joined the sales organization and became telephone sales manager at St. Louis in 1911. In 1912 he joined the specialty sales organization in New York and was later in the same year transferred to Dallas to become sales manager there. In 1917 he became manager at the Cleveland house.

ARTHUR M. COLLINS, who becomes manager of the Cleveland office, became connected with the company in the engineering department at Chicago in 1906. He became sales manager of the Indianapolis house in 1910, returning to Chicago in 1914, where he remained until he became sales manager of the Detroit office in 1917.



J. A. PIZZINI

A. R. MAYNARD, until recently connected with the Chicago sales department, succeeds Mr. Collins as manager of the Detroit office.

WALTER TREAT WALKER has been appointed manager of the Buffalo office. Mr. Walker first joined the Western Electric in 1906 and in 1909 took charge of power apparatus sales in the New York office. During the war he served as first lieutenant in the Signal Corps, U. S. A. On his discharge from the service he was appointed manager of the Newark office, in February, 1919.

GREGORY BROWN has been appointed manager of the Newark house to succeed Mr. Walker. Mr. Brown joined the company in 1905 as a member of the engineering department. He jointed the general telephone sales organization in 1911 and became acting assistant manager of the Cincinnati office in 1914. In 1916 he went to the New York house as supply specialist.

J. M. SHINKLE, formerly connected with the engineering department, has been appointed assistant manager of the government department, with headquarters at New York.

NEW JOBBING HOUSE AT SOUTH BEND.—The Interstate Electrical Supply Company is the name of a new electrical jobbing house which has been established at South Bend, Ind., with an authorized capitalization of $100,000. Many of the local electrical contractor-dealers are taking stock in the institution along with other local interests.

TRADING WITH THE FAR EAST.—A comprehensive volume dealing with the above subject is being distributed by the Irving National Bank of New York City.

1920 FOREIGN TRADE CONVENTION.—The seventh national foreign trade convention will be held in San Francisco, Cal., on May 12-15, 1920. It will be the first of these important conventions to be held on the Pacific Coast, previous conventions having been held at Washington, D. C., New Orleans, St. Louis, Pittsburgh, Cincinnati and Chicago. In deciding on San Francisco for the convention city, the National Foreign Trade Council was influenced by the growing importance of the Pacific Coast in the foreign commerce of the country and by the enthusiastic support which the Far West has given all previous foreign trade gatherings.

INCREASED MANUFACTURE OF ELECTRIC HEATERS IN SWEDEN—The use of electricity for heating purposes is comparatively new, but since the enormous water power in Sweden and Norway has been increasingly utilized, and especially because of the acute shortage of fuel during the war, electric heating has become more and more extensive in Scandinavia. Elektriska A. B. Volta was organized in Stockholm in 1915, for the manufacture of electric heating apparatus. In the beginning this factory employed forty men, but at the end of 1917 the number had increased to 500. Extensions are now being made which are expected to be finished in the fall of 1919, when the number of employees will be about 1200. The factory makes all kinds of heating apparatus for cooking, ironing, etc., and all kinds of lamps and heating materials.

THE STANDARD ELECTRIC & ELEVATOR COMPANY, INC., Baltimore, Md., has opened a New York office at 280 Broadway, in charge of C. A. Yarrington, formerly sales manager of the company.

THE H. C. TAFEL ELECTRIC COMPANY, Louisville, Ky., has filed amended articles of incorporation, changing the name to the Tafel Electric Company and increasing the capital stock from $75,000 to $125,000.

ROLAND B. PAGE has recently been appointed Eastern district manager for the Lea-Courtenay Company, manufacturer of centrifugal pumping machinery. His new offices are at 810 Broad Exchange Building, Boston.

LIEUT. JOHN K. SELLECK, who has recently been discharged from the United States Army, has returned to the employ of the National X-Ray Reflector Company, Chicago, and has been made advertising manager.

E. C. CAMP has been elected assistant treasurer and assistant to the president of the Solar Metal Products Company, Inc., Columbus, Ohio. He continues his work as sales manager in charge of sales and advertising.

L. G. LE BOURVEAU has retired as secretary and sales manager of the American Electric Company, Chicago, and has moved South to engage in the automobile accessory business at Atlanta, Ga., and Jacksonville, Fla.

W. H. WILLIAMS and THOMAS E. BEASLEY, formerly representing the Electric Controller & Manufacturing Company, in the Chicago district, have established themselves as electrical sales engineers at 343 South Dearborn street, Chicago.

THE FRIGIDAIRE CORPORATION, Detroit, Mich., has put out its first number of a publication on the utility of frigeration in homes, stores, clubs, hotels, etc. It is merely further evidence of automatic frigeration in small and large capacities.

A. E. HITCHNER has been appointed manager of the mining section of the industrial sales department of the Westinghouse Electric & Manufacturing Company, with headquarters at East Pittsburgh, Pa. Mr. Hitchner is a graduate of Rutgers College, class of 1904. He served a two-year apprenticeship with the Baldwin Locomotive Works and spent three years with the Link Belt Company on construction work before joining the Westinghouse sales organization as industrial salesman in its Philadelphia office in 1909. In 1912 he was sent as sales representative to the anthracite coal field and placed in charge of the Wilkes-Barre office. In his new position Mr. Hitchner will handle the sale of all apparatus made by the Westinghouse company for use in the mining industry.

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THE WALTER A. ZELNICKER SUPPLY COMPANY, St. Louis, has just appointed F. X. Meehan as advertising manager.

THE TRIUMPH ICE MACHINE COMPANY announces that T. W. Kloman is located at 30 Church Street, New York City, in charge of the New York office.

THE HOOVER SUCTION SWEEPER COMPANY'S New York salesroom is now on the eighth floor of the Bush Terminal Sales Building, West Forty-second Street.

W. N. MATTHEWS & BROTHER, INC., have discontinued their Washington office and have moved their New York office to 50 Church Street. Warren M. Heim is Eastern District manager, in charge of the New York office.

THE NATIONAL METAL MOLDING COMPANY, Pittsburgh, manufactured the conduit, sheraduct, used throughout the new Hotel Pennsylvania, the electrical work of which was described in the ELECTRICAL WORLD for May 10.

M. H. JONES, who has been connected with the Westinghouse Electric & Manufacturing Company for the past fifteen years as assistant to the manager of the Philadelphia District, has resigned his position with that company to become sales manager of the Standard Electric & Elevator Company of Baltimore.

PAUL W. KOCH & COMPANY announce that Pacific Coast offices have been opened at 114 San Fernando Building, Los Angeles, 324 Rialto Building, San Francisco, and 342 Sherlock Building, Portland, Ore. These offices will handle the company's business on the "Jiffy" adjustable cutter, "Jiffy" speed and punch and other "Jiffy" labor-saving tools.

JOHN E. MUHLFELD has associated with him several other engineers and has formed the Railway and Industrial Engineers, Inc., with offices at 25 Broad Street, New York City, to act as consulting and advisory engineers between the bankers, railroad and industrial corporations. For the last three and one-half years he has been president of the Pulverized Fuel Equipment Corporation, but he has resigned as president of this corporation to devote his entire time to engineering work. Mr. Muhlfeld retains his interests in and remains a director of the Pulverized Fuel Equipment Corporation.

THE HENDERSON-MOCKENHAUPT Company, Chicago, has been organized to act as sales representative for manufacturers of electric material. A. F. Henderson, president of the company, was formerly secretary and general sales manager of the Electrical Material Company. B. J. Mockenhaupt, secretary and treasurer of the new company, was formerly vice-president of the W. P. Crockett Company. Among the lines being handled by the Henderson-Mockenhaupt Company are those of the Independent Lamp & Wire Company, Electric Railway Equipment Company, National Enameling & Manufacturing Company and Rattan Manufacturing Company. A. C. Perrin, formerly railway and mine specialist for the Electrical Material Company, is also associated with the Henderson-Mockenhaupt Company.

THE WHITE LILY MANUFACTURING COMPANY, Davenport, Ill., has begun work on its $150,000 plant, according to Sam T. White, president of the washing-machine concern. The addition to the present plant will comprise seven buildings 30 ft. by 225 ft. in dimensions, using the sawtooth type of factory construction; a factory building 225 ft. by 200 ft. with floor space of 45,000 ft., and a warehouse 30 ft. by 225 ft. Unfilled orders totaling $50,000 which the Davenport concern could not turn out with the old plant were the cause of beginning this big addition immediately. Last year the White Lily Manufacturing Company did a gross business of $1,000,000. This year the demand for electric washing machines was so large that the big plant has been literally swamped with orders. One hundred and fifty men are now employed at the washing-machine factory. This number is being increased as fast as skilled labor can be secured. President Sam T. White has recently returned from a five weeks' business trip through the East. While there he placed the White Lily output in eight stores of the New York Edison Company and made contracts with large firms to handle the Davenport product in the following cities: Cleveland, Akron, Buffalo, Boston, Philadelphia, Baltimore, Wilmington, Del.; Lowell, Mass., and Manchester, N. H.

Trade Publications

IRONER.—Dealers' catalog No. 40 has been prepared by the American Ironing Machine Company, 166 North Michigan Avenue, Chicago, to cover its Simplex ironing machines.

IRONING BOARDS.—"Standpat" ironing boards for laundries are illustrated and described in a circular from the American Ironing Machine Company, 166 North Michigan Avenue, Chicago.

ASH DISPOSAL.—The American Steam Conveyor Corporation of 326 West Madison Street, Chicago, has just issued a booklet on the ash-handling question called "Reducing Ash Disposal Costs."

WASHING MACHINE.—The "White Way" twin-tub washer is shown and described in a folder that the White Lily Manufacturing Company of Davenport, Iowa, has recently issued.

STEAM TURBINES.—Type 6 steam turbines have been made the subject of catalog No. 256, a well-prepared booklet, which the B. F. Sturtevant Company of Hyde Park, Boston, has issued.

PORTABLE ELECTRIC GRINDERS.—The Van Dorn Electric Tool Company of Cleveland, Ohio, illustrates some uses of its portable electric grinder in a descriptive folder recently distributed.

FANS.—A small catalog of its electric fans for the 1919 season has been printed by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York City.

FANS.—The Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York City, are distributing a four-color folder illustrating a number of their electric fans.

MINERS' HAND LAMP.—The Grether mine safety-type electric searchlight is the subject of a leaflet issued by the Mine Safety Appliance Company, 908 Chamber of Commerce Building, Pittsburgh, Pa.

VACUUM CLEANER.—The Federal electric vacuum cleaner, model 19, is described in detail by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago, in a loose-leaf sheet, dated March 1, 1919.

WASHING MACHINES.—The White Lily Manufacturing Company of Davenport, Iowa, describes its "De Luxe Junior" revolving bench washer and swinging wringer washer in a folder of recent preparation.

SEMI-INDIRECT LIGHTING FIXTURES.—The schedule R published by the Wheeler Reflector Company, 156 Pearl Street, Boston, contains descriptive material on "Mellowlight" semi-indirect lighting fixtures.

DRYING CABINETS.—Drying cabinets and electrically driven ventilating fans for laundries are the subject of bulletin No. 39-0 issued by the American Ironing Machine Company, 166 North Michigan Avenue, Chicago.

IRONER.—Operating the Simplex ironing machine is explained in an illustrated booklet of twenty-four pages that has been published by the American Ironing Machine Company of 166 North Michigan Avenue, Chicago.

TEMPERATURE CONTROL INSTRUMENTS.—The Taylor Instrument Companies of Rochester, N. Y., have issued a general industrial catalog of instruments, containing 422 pages of interesting temperature information.

IRONER.—"Clean Linen in Abundance" is the title of an interesting booklet prepared by the American Ironing Machine Company, 166 North Michigan Avenue, Chicago, to tell some of the advantages of its Simplex ironing machines.

IRONER.—Directions for wiring, connecting and testing the electrically heated Simplex ironing machine made by the American Ironing Machine Company, 166 North Michigan Avenue, Chicago, are contained in a recently distributed folder.

HEATING APPLIANCES.—The G-E Division, Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is sending to dealers an attractive folder explaining in detail its plans for national publicity for G-E electrically heated household appliances.

New Incorporations

THE SOUTH HOUSTON (TEX.) ELECTRIC COMPANY has been incorporated with a capital stock of $2,500 by I. W. Clark, F. I. Churchill and W. T. Hicks.

THE BELZO ELECTRIC MOTOR COMPANY of New York, N. Y., has been incorporated with a capital stock of $250,000 by H. C. McCullum, L. F. Schwartz, Jr., and H. C. Field, 34 Nassau Street, New York City.

THE LYONS IGNITION COMPANY of Paterson, N. J., has been incorporated with a capital stock of $200,000 to manufacture spark plugs and ignition equipment. The incorporators are: Winfred T. Chisholm, Lemuel Skidmore, Jr., and Walter H. Griffin.

THE UNION ELECTRIC & MACHINE COMPANY of Charlestown, W. Va., has been chartered by Arthur Brounlow and associates. The company is capitalized at $25,000 and proposes to manufacture electrically operated machinery and general electrical specialties.

THE UNITED ELECTRIC COMPANY of Dubuque, Iowa, has been chartered with a capital stock of $15,000 to do general electrical contracting business and to deal in eletcrical supplies. The directors are: Joseph Lowe, president and treasurer, and Clarence J. Willging, secretary.

THE BELL-SCHOENLEBER MANUFACTURING COMPANY of New York, N. Y., has been incorporated by T. H. Bell, J. G. Schoenleber and W. A. Ritchie, 201 West Fifty-third Street. The company is capitalized at $100,000 and proposes to manufacture electrical specialties.

THE GRAVENITE PRODUCTS, LTD., of Toronto, Ont., has been incorporated by William S. Morlock, 85 Bay Street; Reginald H. Parmenter, 93 Dunvegan Road; Sydney E. Wedd and others. The company is capitalized at $240,000, and proposes to manufatcure machinery, electrical devices, etc.

THE KAWAKITA ELECTRIC CORPORATION of New York, N. Y., has been incorporated by E. D. Spunt, N. Osugi, 15 Park Row, and I. Opas, 526 West 211th Street, New York City. The company is capitalized at $200,000 and proposes to manufacture electric devices, motor, meters, etc.

THE R. & P. MANUFACTURING COMPANY of New York, N. Y., has been incorporated with a capital stock of $30,000 by Alvin H. Rosenbaum, Sidney L. H. Phillips, F. B. Klose, 100 Forty-fourth Street, Brooklyn. The company proposes to manufacture and deal in gas and electric fixtures, etc.

THE PITTSBURGH ELECTRIC FURNACE CORPORATION of Pittsburgh, Pa., has been chartered with a capital stock of $5,000 by Frank Wright, 217 South Mathilda Street, East End; W. G. Kifer, Penn Street, and H. F. Alter, 1527 Brownsville Road. The company proposes to manufacture electric furnaces.

THE PENOBSCOT LIGHT & POWER COMPANY of Lincoln, Me., has been incorporated with a capital stock of $10,000 to supply electricity for lamps and motors in the towns of Winn and Mattawamkeag. The officers are: Fred D. Sherrard, president; B. Frank Wyman, treasurer, and Robert Carll, clerk, all of Winn.

THE BAETZ BROTHERS SPECIALTY COMPANY of Kitchener, Ont., has been incorporated by Jacob H. Baetz, Walter J. Fleischauer, of Kitchener; William H. Beney, 121 Lee Avenue, Toronto, and others. The company is capitalized at $40,000 and proposes to manufacture electrical apparatus, machinery, instruments, etc.

THE TERREBONNE (QUE.) ELECTRIC POWER & STEEL COMPANY has been incorporated with a capital stock of $2,500,000 to manufacture machinery, implements and kindred articles in which iron or steel is used. The incorporators are: Sydney W. Waters, Cecil V Rogers, Joseph T. Murray and others, all of Montreal.

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New England States

NASHUA, N. H. — Extensive improvements are contemplated by the Nashua Manufacturing Company at the Jackson mills, involving an expenditure of about $2,500,000. The proposed work will include the erection of a new mill and a new water-power plant at the lower dam, increasing the power capacity from 1100 hp. to 1900 hp. Lockwood, Greene & Company of Boston, Mass., are engineers.

MONTPELIER, VT.—The City Council has authorized the installation of electric street lamps from the present terminus to the town line at Wrightsville. It is estimated that thirty-one lamps will be required to complete the circuit. The street-lighting service is furnished by the Montpelier & Barre Light & Power Company.

LEOMINSTER, MASS.—The installation of a new street-lighting system in the business district is under consideration.

BRIDGEPORT, CONN.—The city has appropriated $150,000 to erect a garage on Washington Avenue. J. A. McElroy is city engineer.

STAMFORD, CONN.—The Electric Specialty Company is contemplating an extension to its works, 41 ft. by 100 ft., two stories, to be equipped with electrically driven machinery.

WATERBURY, CONN.—A permit has been granted to Benedict & Burnham, branch of the American Brass Company, for the construction of a power house to cost about $50,000.

Middle Atlantic States

MONTAUK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 11 for construction of power house at Montauk, to cost about $4000. A deposit of $10 will be required for plans.

NEW YORK, N. Y.—The New York Edison Company is planning to erect a transformer station at 421 and 423 East Sixth Street.

NEW YORK, N. Y.—Plans have been prepared by E. J. Moeller, architect, 103 Park Avenue, for the erection of a ten-story building for the Hudson Motor Company, 1842 Broadway, on Sixty-second Street and Amsterdam Avenue, to cost about $550,000.

NIAGARA FALLS, N. Y.—Plans have been completed by the Niagara Falls Power Company for the erection of an aërial high-tension transmission line from the hydraulic power plant in the lower milling district, along the canal and river and up the river bank along Adams Avenue to the foot of Sugar Street, and across to the new transformer station now being erected between Sugar and Union Streets. The plans provide for an ultimate load of 400,000 hp., to be transmitted at 80,000 volts. The company has been granted permission to cross the city streets.

SALAMANCA, N. Y.—The Council contemplates calling an election to vote on the proposal to issue $15,000 bonds for the installation of new fire alarm and telegraph systems.

SOLVAY, N. Y.—Work has been suspended on the construction of the new electric power plant of the New York Central Railroad Company at Solvay. The cost of the proposed plant is estimated at about $500,000, and it has been designed to furnish energy for the company in this district, including shop, buildings, etc. Construction work, it is said, will be resumed upon return of the road to the company by the government.

SYRACUSE, N. Y.—The New York State Railways is contemplating improvements to its transmission and trolley lines, track repairs and paving, involving an expenditure of about $200,000.

FREEHOLD, N. J.—Bids will be received by the Board of Supervisors of Monmouth County until June 4 for construction of hospital building, including power house and laundry, water supply system and sewerage disposal system near Allenwood, Wall Township. W. M. Bergen is director.

NEWARK, N. J.—Bids will be received by the board of education of the County of Essex, Newark, until June 17 for construction of the Seymour Vocational School, to be erected on Sussex Avenue, between First and Second Streets, including general construction work, heating, ventilating and power apparatus, engines and generators, electric work, plumbing and vacuum cleaner. Blanks and other information may be obtained at the office of John H. and Wilson C. Ely, architects, Firemen's Building, Newark. R. D. Argue is secretary.

BEAVER FALLS, PA.—The City Council has accepted plans submitted by the Beaver County Light Company of New Brighton for the installation of a new street-lighting system for the city.

BLAIRSVILLE, PA.—Plans are being prepared by Crooks & Cooley, architects, Jones Law Building, Pittsburgh, for construction of hospital and group of buildings near Blairsville, consisting of administration building, power house, laundry, four ward buildings, sewage disposal plant, reservoir, auditorium, nurses' home and morgue. The cost is estimated at about $2,000,000. G. S. Idell, 34 South Sixteenth Street, Philadelphia, Pa., is the consulting architect.

CAMBRIA, PA. — Extensive improvements to its Cambria plant, calling for an expenditure of about $14,000,000, are under consideration by the Midvale Steel & Ordnance Company. Several additions are contemplated, including the erection of a new machine shop and an axle plant.

COATESVILLE, PA.—The Chester Valley Electric Company, it is reported, is planning to erect a new transmission line from Coatesville to Downingtown, to cost about $80,000.

FARRELL, PA.—The City Council has engaged H. Whitford Jones, consulting engineer, of Cleveland, Ohio, to prepare plans for the installation of a new street-lighting system, including ornamental lamps in the business district. The cost is estimated at $25,000. The Shenango Valley Electric Light Company furnishes street-lighting service in Farrell.

MAUCH CHUNK, PA.—The Carbon Transit Company, it is reported, is contemplating the purchase of new equipment for its power plant and also improvements to its power lines.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company has been granted a permit to erect an addition, 22 ft. by 29 ft., to its power plant at 963 Beach Street.

PITTSBURGH, PA.—Work has been started on the construction of a 60,000-kw. electric generating plant at Cheswick for the Duquesne Light Company. It is planned eventually to install another unit of 60,000 kw., increasing the output to 120,000 kw. The cost of the initial unit is estimated at between $10,000,000 and $15,000,000.

SOUTH BROWNSVILLE, PA.—The West Penn Power Company of Pittsburgh has submitted to the Borough Council a proposal to install a new street-lighting system. It is proposed to replace the lamps now in use with six 600-cp., thirty-nine 400-cp., forty-two 250-cp. and fifty-four 80-cp. lamps.

MONKTON, MD.—Contract has been awarded by the Monkton Roller Mills to E. H. Mosher, Munsey Building, Baltimore, for the construction of a 300-hp. hydroelectric plant, to cost about $30,000, in connection with flour mill. Otis E. McCoy, of Mount Washington, Md., is president.

SPARROWS, POINT, MD.—The Bethlehem Steel Corporation is contemplating further extensions to its local plant, involving an expenditure of between $25,000,000 and $40,000,000, consisting of new tin mills, a new hearth furnace and the adding of ten ships to the present ore fleet of the corporation. This will be in addition to the $50,000,000 improvements now under way.

WASHINGTON, D. C.—Bids will be received by the office of the chief of engineers, development branch, equipment section, until June 20 for development of a distant searchlight control and indicator.

North Central States

ALGONIAC, MICH.—Negotiations are under way between the City Council and the Detroit (Mich.) Edison Company for the purchase of the municipal electric plant. A special election will be held to vote on the proposal. If the sale is approved by the voters, the company will apply for a franchise to operate in the town, village and township.

MOUNT PLEASANT, MICH.—Plans have been prepared by the Transport Truck Company for construction of power plant, 40 ft. by 50 ft., and assembly plant, to cost about $80,000. J. J. Bachman of Flint is architect.

NEWTON FALLS, OHIO.—The Akron Maderite Tire & Rubber Company of Akron is planning to erect a plant in Newton Falls. The first unit will be 60 ft. by 240 ft., three stories. A power house will also be erected. N. A. Walcott of the Packard Electric Company is president.

OXFORD, OHIO.—Bids will be received by the trustees of Miami University, Oxford, until June 14 for an engine and generator, together with switchboard changes and wiring and piping connections, for the central heating and lighting plant of the Miami University. Plans and specifications are on file at the office of Walter G. Frantz, consulting engineer, Cincinnati, Ohio, and at the office of the president of Miami University, Oxford.

SPRINGFIELD, OHIO. — The Clark County Lumber Company is planning to erect a planing mill, to be equipped with electrically operated machinery.

ASHLAND, KY.—Bids, it is reported, will be received about June 10 by the Commissioner of the Water Works Department for construction of a 2,000,000-gal. filtration plant, electrically driven centrifugal pumps and necessary appurtenances. The cost is estimated at about $90,000.

FORT WAYNE, IND.—The Board of Public Works has authorized bids to be advertised for installing ornamental lamps on Crescent Avenue between State and Lane Avenues.

KOKOMO, IND.—Plans have been perfected by the Haynes Automobile Company for extensions to its local plant, including a power plant of 750 hp. A. G. Seiberling is general manager.

SOUTH BEND, IND.—The Union Electric Company has acquired the property formerly occupied by the Indian Engraving Company on South St. Joseph Street, on which it will erect a large building.

BAYFIELD, WIS.—The municipal electric plant was partially destroyed by fire recently, causing a loss of about $10,000.

BLACK RIVER FALLS, WIS.—Tentative plans have been adopted by the Council for improvements to the municipal hydroelectric power plant on Black River. The proposed work will cost about $25,000 and will include the installation of an additional waterwheel, vertical type, and a 400-kw. umbrella-type generator. Proposals, it is understood, will be asked for within the next two weeks.

MERRIMACK, WIS.,—The Merrimack Electric Light Company is contemplating the installation of an electric lighting system to supply electricity in Merrimack.

MILWAUKEE, WIS. — Bids, it is reported, have been received by the Robert A. Johnson Company for the erection of a new factory at Thirty-fourth and National Avenues, to cost with equipment about $750,000. The structure will be 190 ft. by 310 ft., six stories, with a separate power plant.

STOUGHTON, WIS. — The Stoughton Wagon Company is planning to install a 400-kw. steam-driven generating unit to replace a 150-kw. unit now in use. An extension is now being erected to the power house.

WATERLOO, WIS.—Bids, it is reported, are being asked by the Board of Public Works of Waterloo for the installation of a 100-kw. generator directly connected to a Corliss or uniflow type engine in the municipal electric light plant. W. J. Hugo of of Madison is consulting engineer.

FAIRMONT, MINN.—Plans are under consideration by the Water and Light Commission for extensions to the municipal electric light plant, to cost about $15,000.

HASTINGS, MINN.—Bids will be received by the State Board of Control, St. Paul, until Aug. 1 for construction of building, 45 ft. by 140 ft., and power house at the Hastings State Hospital, to cost about $125,000. C. H. Johnston, Capital Bank Building, St. Paul, is architect.

ROCHESTER, MINN.—Bids will be received by the Minnesota State Board of Control, State Capitol Building, St. Paul, until June 5 for construction of a dormitory for men employees, State Hospital, Rochester, including general contract heating and ventilating, plumbing and electrical work, and repairs to power house. Separate bids to be submitted. Copies of plans and specifications may be obtained at the office of the State Board of Control, Institution, and C. H. Johnson, architect, Capital Bank Bldg., St. Paul.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

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ST. JAMES, MINN.—Contract has been awarded to the Sterling Electric Company, 33 South Fifth St., Minneapolis, for the installation of an ornamental lighting system in St. James, to cost $19,700.

ST. PAUL, MINN.—An appropriation of $20,000 has been made by the Legislature for improvements to Itasca State Park, of which $2,000 will be expended for a new electric lighting plant. At present oil lamps are used.

ULEN, MINN.—The sale of the municipal electric light plant to J. F. Heiberg, owner of the electric plant at Heiberg, is under consideration by the Village Council. If favorable action is taken by the voters, Mr. Heiberg proposes to install a second generating unit in his plant, which is located on Wild Rice River, 3 miles from Twin Valley. The transmission line will be about 15 miles long. The plant now supplies electricity to Twin Valley and Gary. The proposed extension will supply electricity to Syre and to farmers along the line, as well as Ulen.

WELLS, MINN.—The construction of an electric power plant and distribution system and concrete reservoir, to cost about $40,000, is under consideration by the City Council. The C. L. Pillsbury Company, Metropolitan Building, Minneapolis, is engineer.

CEDAR RAPIDS, IOWA. — The Iowa Railway & Light Company is reported to be contemplating an extension to the Old Soldiers' Home.

CENTERVILLE, IOWA.—The Southern Iowa Utilities Company is contemplating the erection of an electric transmission line from Diagonal to Shannon City and Tingley, a distance of about 20 miles.

HUMBOLDT, IOWA — The Northern Iowa Gas & Electric Company is contemplating extending its electric transmission lines from Ruthven to Lost Island Park.

KEOKUK, IOWA.—The capital stock of the Keokuk Power Transmission Company has been increased from $200,000 to $800,000.

NEWTON, IOWA.—Plans have been prepared by Archer & Stevens, engineers, New England Building, Kansas City, Mo., for improvements to the municipal electric plant, to cost about $175,000.

DE WITT, MO.—The city of De Witt has voted to install an electric lighting service. Electricity will be secured from the plant at Carrollton.

KANSAS CITY, MO.—The City Council is considering the installation of a 1000 or more additional electric lamps in the outlying districts this year. An appropriation of $250,000 for street lighting is recommended by the Council, an increase of $30,000 over last year.

MEXICO, MO.—The Mexico Power Company is reported to have awarded a contract for the installation of a new generating unit, to cost about $40,000.

ST. LOUIS, MO.—Plans are being prepared by the Motor Garage & Realty Company, 46 Kingsbury Place, for the erection of a three-story building, 250 ft. by 250 ft., on the block bounded by Seventeenth, Eighteenth, Pine and Chestnut Streets, to cost about $300,000. N. W. Ewing is president.

MINOT, N. D.—A movement is on foot to establish a municipal electric plant in Minot. The Northern States Power Company is reported to have offered its plant to the city, the price to be determined by engineers selected by the city.

PEMBINA, N. D.—The Pembina Light & Power Company is planning to equip its plant for a twenty-four-hour service. Additional equipment, it is understood, will be purchased by the company.

MADISON, S. D.—Bonds to the amount of $100,000 have been authorized for the construction of a municipal electric light plant to replace the one recently destroyed by fire.

HUBBELL, NEB.—Bonds have been authorized for the installation of a municipal electric light plant.

LIBERAL, KAN.—Plans have been perfected by the City Council for establishing a new lighting system on the principal thoroughfares in the city.

ST. JOHN, KAN.—An election will be held June 10 to submit to the voters the proposal to issue $50,000 in bonds for extensions to the municipal electric light plant and waterworks system.

WICHITA, KAN.—The Wind Electric Sales Company, 407 East Douglas Street, recently incorporated, is preparing plans for the erection of a factory to be located north of Wichita, for the purpose of manufacturing power plants for suburban homes, utilizing wind to generate electricity.

Southern States

DURHAM, N. C.—Preparations are being made by the city for the installation of an ornamental lighting system to cost about $30,000. Contract for the standards has been awarded to the Durham Traction Company. The work will be done under the supervision of Mr. Waddel, electrical engineer.

HOBGOOD, N. C.—The installation of a municipal electric light plant in Hobgood is under consideration.

EHRHARDT, S. C.—The Ehrhardt Manufacturing Company, recently organized, is planning to install electric and telephone systems, ginnery and ice factory.

LYERLY, GA..—Work has started on the construction of the power plant of the Chattooga River Power Company on the Chattooga River in East Lyerly. It is expected that arrangements will be made with the company for lighting the streets in Lyerly and for furnishing electricity for commercial and residential lighting purposes.

KEY WEST, FLA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning to erect a power house and install a fire protection system at the local navy yard, to cost about $20,000. Specification 3896.

MOORE HAVEN, FLA.—C. M. Bush, president of the South Florida Farms Company, has presented the town with an electric light and water plant.

WINTER GARDEN, FLA.—At an election to be held June 2 the proposal to issue $75,000 in bonds for the installation of water, lighting and sewer systems will be submitted to the voters. The work will include two 30-hp. motor-driven pumps, directly connected, 40,000-gal. iron tank on a 75-ft. tower, power house and 2½ miles of sewer with septic tank. W. H. Reams is Mayor.

LAFAYETTE, TENN.—The installation of an electric lighting system in Lafayette is under consideration.

RIPLEY, TENN.—Bonds to the amount of $150,000 have been voted to construct lighting, water and sewer systems.

CLARKSDALE, MISS. — Bonds to the amount of $300,000 have been voted for improvements to the municipal electric light plant, waterworks system, sewer system, paving streets, etc.

JACKSON, MISS.—Application has been made to the City Council by the Citizens' Public Utility Company of Jacksonville to operate electric lighting, gas and street railway systems in Jackson. The company contemplates the construction of a new plant here.

EDMONDSON, ARK.—The Edmondson Stockson & Improvement Company is contemplating the installation of an electric light plant in connection with a laundry and ice-manufacturing plant. W. C. Bauchman is secretary.

HELENA, ARK.—The Helena Cotton Oil Company is contemplating equipping a plant for the manufacture of cottonseed products, including presses, power plant, etc.

BEGGS, OKLA.—Bids will be received by the Board of Trustees of the town of Beggs until June 18 for erection of a mechanical filter plant with a capacity of 500,000 gal. per twenty-four hours at the waterworks plant; also for one triplex pump and a 25-hp. electric motor.

OKLAHOMA CITY, OKLA.—The Oklahoma Gas & Electric Company is planning to install one 100-cp. lamp every 150 ft. a distance of two miles along the diversion dam and at other points of the city water supply, to provide for night or emergency work. The most economical method of supplying energy to the waterworks is also under consideration.

MERCEDES, TEX.—The installation of an electric light plant in Mercedes is under consideration. W. M. Bancroft of New Orleans, La., and Hiram Hart of Brownsville, Tex., are reported interested in the project.

Pacific and Mountain States

FERNDALE, WASH.—The Commissioners of Whatcom County have granted the Puget Sound Traction, Light & Power Company of Seattle permission to erect electric transmission lines along the county roads in Ferndale.

AVALON, CAL.—A special election will be held on June 3 to submit to the voters the proposal to issue $88,999 in bonds for construction of electric light plant and waterworks system and $55,000 for gas works.

HOLTVILLE, CAL.—Plans are under consideration by the Holton Power Company for installing electric generating equipment in the dismantled power house at Holtville. The cost is estimated at $75,000 and it is estimated that 1000 hp. can be developed. E. A. Judy is district manager.

LOS ANGELES, CAL.—At the general election to be held June 3 a proposal to issue $13,500,000 in power bonds will be submitted to the voters. Of this sum $11,000,000 is required for the purchase of the distributing system of the Southern California Edison Company; $2,250,000 to complete power plant No. 2 in the San Francisquito Canyon, and $250,000 to carry out development work at Owens Gorge, where further water-power development is contemplated.

SAN FRANCISCO, CAL.—Extensions and improvements involving an expenditure of $3,400,000 are contemplated by the Pacific Gas & Electric Company during the current year. Of the money to be expended $2,028,845 will be for new electric work. Lake Spaulding and Fordyce dams are to be raised at a cost of about $490,000.

SAN FRANCISCO, CAL.—Surveys are being made by the Great Western Power Company of San Francisco for the erection of an electric transmission line between the Butt Valley power house and Prattville. The proposed line is to furnish power for work in connection with the tunnel from Prattsville to Butt Valley, which will carry the waters of Lake Almanor to the power plant which is being built at a cost of about $5,000,000.

SALT LAKE CITY, UTAH.—The Telluride Power Company, it is reported, contemplates establishing a power plant on one of the streams of the national forests in the southern part of Utah. A. L. Waters is superintendent of the company operating in southern Utah.

LIBBY, MONT.—The telephone system serving Libby and Troy has been purchased by E. H. Cookingham and B. P. Snowden of Spokane, Wash. The new owners contemplate the erection of a new line from Libby to Bonners Ferry, Idaho, and from there to Warland and Eureka, Mont.

MELSTONE, MONT.—The Montana Power Company of Butte has submitted a proposition to the Council offering to extend its transmission line from Carpenter Creek to Melstone on condition that an extended franchise is granted the company. It also offered to purchase the old municipal electric light plant.

TORRINGTON, WYO. — Arrangements have been made whereby electricity for operating the local system will be supplied by the government plant south of Lingle.

Canada

WINNIPEG, MAN.—Contract for the construction of a new power house at Tuxedo Park has been awarded to Carter-Halls-Aldinger, Ltd., of Winnipeg.

GLENCOE, ONT.—Plans are under consideration by the Glencoe Council and Industrial Board as to the advisability of procuring electricity from the Hydro-Electric Power Commission of Ontario.

PARRY SOUND, ONT.—A by-law has been prepared providing for an issue of $165,000 in debentures for the purpose of a hydro-electric development at the present municipal electric light and power plant and elsewhere on the Seguin River. The plans provide for the erection of a new power house and installation of machinery. J. D. Broughton is secretary and treasurer.

WINDSOR, ONT.—The City Council is considering the construction of a power house.

WINGHAM, ONT.—Plans and estimates are being prepared by the engineers of the Hydro-Electric Power Commission for the proposed connection to supply electricity in Wingham and other towns in Huron and Bruce Counties.

Miscellaneous

PANAMA.—Bids will be received at the office of the Panama Canal Commission, Washington, D. C., until June 6 for furnishing tool steel, wire rope, leather belting, mica tubing, conduit bushings, conduits, etc. Blanks and further information pertaining to this circular (1280) may be obtained at the above office, or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 604 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

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(Issued May 13 1919)

14,646 (reissue). COMBINATION TIMER, DISTRIBUTOR AND INDUCTION-COIL APPARATUS; Joseph H. Lehman, Hasbrouck Heights, N. J. App. filed June 15, 1915. Metal shaft utilized as core of transformer.

14,647 (reissue). RAIL BONDING; Gustav A. Merkt, Worcester, Mass. App. filed Sept. 21, 1915. Perfect and large contact.

1,303,226. PROCESS OF ELECTROLYSIS; Herbert I. Allen, Portland, Me. App. filed Feb. 1. 1917. For the recovery of metals from the soluble salts.

1,303,230. WELDING TOOL; Ralph Baker, Wilkinsburg, Pa. App. filed Nov. 3, 1917. Protects the handle from heat.

1,303,241. ELECTRIC CURRENT METER; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 4, 1916. An escapement device with electromagnetic means for controlling or restoring its oscillating member in accordance with any desired conditions.

1,303,242. AMPERE-HOUR METER; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 4, 1916. For controlling the operation of movable members so that they will rotate in accordance with the first power of the current.

1,303,243. AMPERE-HOUR METER; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 4, 1916. Escapement device oscillates in accordance with the force applied.

1,303,244. MAXIMUM-DEMAND METER; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 12, 1916. Indicates the average value of load.

1,303,273. ELECTROTHERAPEUTICAL DEVICE; William A. D. Evans, New York, N. Y. App. filed July 25, 1914. Portable.

1,303,274. ELECTROTHERAPEUTICAL DEVICE; William A. D. Evans, New York, N. Y. App. filed July 25, 1914. Portable.

1,303,281. NON-INDUCTIVE INTERFERENCE SYSTEM; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Sept. 28, 1917. Inductive interference minimized and power factor controlled.

1,303,282. DISTRIBUTING SYSTEM FOR MINIMIZING INDUCTIVE INTERFERENCE; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed Aug. 9, 1915. An alternating-current railway system.

1,303,284. KNIFE-BLADE SWITCH; Harrison J. L. Frank, Detroit, Mich. App. filed Aug. 7, 1918. Supports and clips which are held in proper adjustment to receive the switchblades.

1,303,286. ELECTRIC BATTERY; Harry F. French, Fremont, Ohio. App. filed Dec. 17, 1915. Requires no diffusion of liquid.

1,303,291. SPEED TRANSFORMER; Maximilian M. Goldberg, Dayton, Ohio. App. filed July 10, 1915. Allows variable speeds when attached to constant-speed motor.

1,303,307. CONTROL SYSTEM; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed June 19, 1915. Motor accelerated by a small motor-generator, thus reducing energy losses.

1,303,308. CONTROL SYSTEM; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed July 12, 1915. Series field winding excited by armature current during regenerative operation.

1,303,309. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Aug. 10, 1915. Regenerated currents of plurality of parallel-connected dynamos maintained.

1,303,310. SYSTEM OF CONTROL; Rudolf E. Hellmund, Pittsburgh, Pa. App. filed Jan. 10, 1916. Regenerative currents obtained with heavy armature currents.

1,303,311. STORAGE-BATTERY CONNECTOR; Clarence W. Hazelett, Lakewood, Ohio. App. filed Oct. 30, 1916. Detachable.

1,303,319. MOTOR CONTROLLER; Albert J. Horton, White Plains, N. Y. App. filed Feb. 10, 1917. Effects synchronous operation of plurality of motors.

1,303,323. HEATER SYSTEM; Lee P. Hynes, Albany, N. Y. App. filed June 14, 1918. Car-heating apparatus.

1,303,324. ELECTRIC INSULATOR; Ray P. Jackson, Edgewood Park, Pa. App. filed May 14, 1915. Hollow cylinder allows for creepage.

1,303,325. SPARK INTENSIFIER; Hugh James, Montrose, Ill. App. filed July 18, 1917.

1,303,337. CONTROL APPARATUS FOR INDUCTION MOTORS; Edwin Lehr, Pittsburgh, Pa. App. filed Sept. 10, 1915. Relay limit switch.

Record of Electrical Patents

Notes on United States Patents

1,303,342. SYSTEM OF CONTROL; Walter O. Lum, Wilkinsburg, Pa. App. filed March 30, 1914. Stores energy during light load.

1,303,349. CONTROL APPARATUS; Robert D. McManigal, Jr., Pittsburgh, Pa. App. filed July 6, 1917. Air brakes applied automatically at end of regenerative period.

1,303,351. HOOK SWITCH AND CIRCUITS THEREFOR; Ray H. Manson, Rochester, N. Y. App. filed Dec. 18, 1916.

1,303,360. VOLTAGE REGULATOR; Archie F. Moray, Cedars, Quebec, Can. App. filed Aug. 21, 1914. Voltage raised or lowered by an excitation circuit.

1,303,383. TELEPHONE PROTECTIVE APPARATUS FOR TELEPHONE LINES PARALLELING POWER LINES; Ralph W. Osborne, Hamilton, Ont., Can. App. filed Jan. 28, 1918. Uses ordinary telephone apparatus.

1,303,396. MAGNETIC ORE SEPARATOR; Lewis G. Rowand, Brooklyn, N. Y. App. filed June 21, 1917.

1,303,397. MAGNETIC SEPARATOR; Lewis G. Rowand, Brooklyn, N. Y. App. filed June 21, 1917.

1,303,398. MAGNETIC ORE SEPARATOR; Lewis G. Rowand, Brooklyn, N. Y. App. filed June 21, 1917.

1,303,404. RESISTANCE UNIT; Arthur Simon, Milwaukee, Wis. App. filed Oct. 9, 1914. Resistor and terminals are integral.

1,303,417. GOVERNOR; George S. Tiffany, Summit, N. J. App. filed Aug. 7, 1914. For electrically driven phonographs.

1,303,422. DIRECTION-SIGNALING MECHANISM FOR MOTOR VEHICLES; Paul W. Vanderhoff, Topeka, Kan. App. filed May 1, 1917.

1,303,423. SWITCH FOR MOTOR-VEHICLE SIGNALING DEVICE; Paul W. Vanderhoff, Topeka, Kan. App. filed Feb. 27, 1917.

1,303,453. ELECTRIC BATTERY; Raymond C. Benner and Harry F. French, Fremont, Ohio. App. filed Dec. 2, 1916.

1,303,457. MAXIMUM-DEMAND METER; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 4, 1916. Escapement device retards time of operation.

1,303,459. ELECTRIC BELL; Carl H. Buhl, Cleveland, Ohio. App. filed Jan. 16, 1917. Gives three separate sounds.

1,303,464. DISTANT-CONTROL-SWITCH SOCKET FOR ELECTRIC LIGHTS, ETC.; James M. Davis, Dallas, Tex. App. filed June 8, 1917. Switch plugs in at socket.

1,303,469. IGNITION GENERATOR; Ignatius P. Galantin, Chicago, Ill. App. filed Nov. 16, 1918.

1,303,478. STORAGE-BATTERY GRID; Leon E. Hills, Lakewood, Ohio. App. filed Nov. 15, 1916. Readily machined.

1,303,481. METHOD OF SERIES ARC WELDING; Otis A. Kenyon, New York, N. Y. App. filed Jan. 9, 1918.

1,303,484. ELECTRICALLY CONTROLLED CLUTCH; Walter Langdon-Davies, Weybridge, Eng. App. filed June 3, 1916. Speed controlled.

1,303,496. SELECTING SYSTEM; Paul M. Rainey, West Hoboken, N. J. App. filed Feb. 19, 1917.

1,303,511. INSULATION FOR ELECTRICAL APPARATUS; William J. Shackleton, Scotch Plains, N. J. App. filed Aug. 16, 1917. High dielectric strength.

1,303,513. STORAGE BATTERY; Thomas Spencer, Philadelphia, Pa. App. filed Sept. 30, 1916. Method of applying the active paste.

1,303,519. ELECTROLYTIC CELL AND ELECTRODE THEREFOR; Alexander T. Stuart, New York, N. Y. App. filed Aug. 27, 1918. Polarization and internal resistance are reduced.

1,303,523. TIMBER-DISTRIBUTER MECHANISM; Edward J. Tomlinson, Newark, N. J. App. filed Nov. 3, 1917.

1,303,524. BINDING POST FOR ELECTRIC CABLES; Edward J. Tomlinson, Newark, N. J. App. filed Feb. 18, 1918.

1,303,528. TELEPHONE-EXCHANGE SYSTEM; Joseph L. Wright, Cleveland, Ohio. App. filed June 23, 1916.

1,303,558. BATTERY CELL; Harry T. Hipwell, Pittsburgh, Pa. App. filed March 6, 1918. Allows good connection.

1,303,575. WELDING ELECTRODE; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed March 22, 1918. Provided with a removable metal lining.

1,303,579. SYSTEM FOR SUCCESSIVE AMPLIFICATION OF ENERGIES; Alexander McL. Nicolson, New York, N. Y. App. filed April 16, 1915.

1,303,582. PANELBOARD CONSTRUCTION; Edwin A. Olley, Syracuse, N. Y. App. filed Aug. 2, 1915. Widthwise dimension reduced.

1,303,600. MAGNETO FOR INTERNAL-COMBUSTION ENGINES; Herman Schmid and Gottlob Fuegel, Brooklyn, N. Y. App. filed July 18, 1917.

1,303,609. ELECTRIC PLUG AND SOCKET CONNECTION; William Stewart, West Kogarah, New South Wales, Australia. App. filed Aug. 21, 1917. Uses locking bond.

1,303,625. RECEIVING INSTRUMENT FOR WIRELESS SIGNALING; Alessandro Arton, Turin, Italy. App. filed Nov. 2, 1917.

1,303,626. ELECTRICALLY GOVERNED KEY-OPERATED MECHANISM; John T. Austin and Basil G. Austin, Hartford, Conn. App. filed Jan. 11, 1919.

1,303,627. TREATMENT OF IRON OR STEEL OR OTHER ARTICLES; Henry C. Baines, Springfield, Mass. App. filed Aug. 10, 1916.

1,303,634. PUSH-BUTTON SWITCH; Joseph O. Cadieux, Meriden, Conn. App. filed Dec. 27, 1918. Easily assembled.

1,303,655. TELEPHONE SYSTEM; Georg Grabe, Nikolassee, near Berlin, Germany. App. filed Oct. 15, 1913.

1,303,669. HEATER SYSTEM; Lee P. Hynes, Albany, N. Y. App. filed May 21, 1918. Car heating thermostatically controlled.

1,303,670. HEATER SYSTEM; Lee P. Hynes, Albany, N. Y. App. filed May 21, 1918.

1,303,681. ELECTRIC WELDING; Otis A. Kenyon, New York, N. Y. App. filed Jan. 9, 1918. Artificial line resistance.

1,303,688. TROLLEY HANGER; John Leisenring, Springfield, Ill. App. filed Sept. 21, 1915.

1,303,729. WIRELESS SIGNALING SYSTEM; James H. Rogers, Hyattsville, Md. App. filed Jan. 10, 1919.

1,303,730. RADIO SIGNALING SYSTEM; James H. Rogers, Hyattsville, Md. App. filed Jan. 11, 1919.

1,303,771. IGNITION DEVICE; Melvin M. Caster, Lowell, Mass. App. filed June 25, 1917.

1,303,776. ELECTRIC REGULATION; John L. Creveling, Auburn, N. Y. App. filed May 17, 1915. Speed and output regulated.

(Issued May 20, 1919)

1,303,843. ELECTRIC BATTERY; George N. Antonoff, London, Eng. App. filed Aug. 12, 1918. Dry primary cell.

1,303,844. ELECTRIC BATTERY; George N. Antonoff, London, Eng. App. filed Aug. 12, 1918. High output of dry cell.

1,303,863. ELECTRIC PERFORATING AND RECORDING MACHINE; George H. Davis, West Orange, N. J. App. filed July 10, 1914. Perforates music paper.

1,303,876. ELECTRIC SWITCH; Arthur E. Francis, Cleveland, Ohio. App. filed Oct. 2, 1917. Automobile.

1,303,901. ELECTRIC SIGNALING DEVICE; William M. Horton, Cleveland, Ohio. App. filed July 19, 1916. Solenoid and armature are electrically energized.

1,303,906. MULTIPLE SPOT-WELDING MACHINE; Otto H. Jobski, Cleveland, Ohio. App. filed Aug. 29, 1916. Operates simultaneously.

1,303,919. SPOT-WELDING ELECTRODE; Laurence S. Lachman, New York, N. Y. App. filed July 19, 1918. Concentrates flow of current and pressure.

1,303,937. TELEPHONE SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Nov. 25, 1914.

1,303,958. AUTOMATIC TELEPHONE SYSTEM; Winfred T. Powell, Chicago, Ill. App. filed July 19, 1915.

1,303,960. CONNECTING CIRCUIT FOR TELEPHONE SYSTEMS; Ralph L. Quass, Hawthorne, N. J. App. filed July 19, 1917.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, June 7, 1919 *Number* 23

Tax on Intelligence

THE publishers of the ELECTRICAL WORLD announce that on and after July 1 it will be necessary to add an extra dollar to the subscription price for all readers residing west of the Mississippi River. This will be done partially to cover the increase in postage that becomes effective on that date.

The zone law enacted by the last Congress and covering second-class postage divides the United States into eight zones, with a different rate of postage applying to each. Under the old law the postage on a copy of the ELECTRICAL WORLD to San Francisco or any other part of the United States was approximately 56 cents a year. On July 1 it becomes $2.49 a year for the eighth zone, which includes the Pacific Coast, and $2.28 and $1.87 in the seventh and sixth zones, in which the states west of the Mississippi lie. Under this zone postage system there will be another increase in 1921 making the postage on a copy of the ELECTRICAL WORLD $4.33, $3.92 and $3.10 respectively in the eighth, the seventh and the sixth zone.

When the first postage increase of the zone system became effective in July, 1918, its unfairness seemed so evident that the publishers decided to bear the burden, in the belief that the law would soon be repealed. One year has passed, however, with every prospect that an unfair and discriminatory piece of class legislation against educational periodicals will be perpetuated unless readers make it their business to demand the repeal of the present zone postal law.

The ELECTRICAL WORLD'S function is to express nationally the point of view of the industry. We have no desire to discriminate against readers west of the Mississippi River and are anxious to present the Pacific Coast point of view to the industry, thus making its ideas a part of national ideas and not merely local issues. It is most unfortunate that Congress should erect such a barrier at a time when unanimity in thought, action and deed is so essential. The reëstablishment of the zone system, which was declared obsolete and abolished in 1863, is certainly a step backward and should be quickly repealed.

The government under public ownership could probably raise new capital much more cheaply for a time than the majority of the utilities, but the savings obtained in that way would easily be obliterated by extravagance and lack of concentrated and continued responsibility under such a program. With public ownership and operation once instituted, its advocates would find no deficiencies; the latter would be hidden in the annual appropriation and tax bills, or else covered by continued rate increases.

External-Anode Vacuum Tubes

THE three-electrode vacuum tube is now a well-known device in electrical engineering and has recognized utility and a wide range of application. While it was originally developed as an amplifier for radio-signaling, it is also readily used as a detector. It has also been availed of as an oscillating-current generator, or as a transformer from direct to alternating currents, and has been used as an automatic regulator in various circuits.

In the typical three-electrode vacuum tube all three electrodes are supported inside the exhausted chamber. One is a filament, or electrically heated cathode wire. The second is a metallic grid, or control electrode, which serves to regulate the electron flow, or current, from the hot cathode. The third is the metallic plate, or anode, which is connected with an external direct-current scurce. This source supplies the electric energy released or utilized in the device.

An interesting and promising form of three-electrode tube, in which only two of the electrodes—namely, the cathode filament and the grid—are inside the exhausted chamber, is described in this issue by H. P. Donle. The third electrode—*i.e.*, the plate—is a silver coating on the outside glass wall of the chamber. In this device the electron flow reaches the anode by electrolysis through the heated glass wall.

Electric flow is supposed to occur in conductors by a transfer or handing on of electrons from one molecule of the conducting substance to the next in line. In non-conductors the flow occurs, as is believed, in a different way. In gaseous non-conductors free electrons are projected along the lines of electric force, and they tend to disrupt the molecules that lie in their paths. The electrons released from the débris of the injured molecules are free to join in the stream, and so a powerful current flow or discharge is precipitated as soon as the electric field reaches the blasting strength. In liquids the distances between molecules is not ordinarily sufficiently great to permit of electrons acquiring high trajectory velocities; so that the peaceable migration of free electrons is supposed to be involved, the movement being initiated by the impressed electric force acting through the volume of electrolyte. The electrons are so mobile within the electrolyte that a relatively small electric field intensity will set up a powerful procession or strong electric current.

In non-conducting solids the process of conduction is supposed to be of the same general nature as in non-conducting liquids; but, owing to the relative rigidity and immobility of the substance, a much more powerful electric field must be impressed on them in order to induce free electronic motion, and their velocity of transition through the solid substance is naturally much

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less. The rate of electronic flow is, however, greatly assisted by heat, which, in giving vibratory agitation to the molecules, permits the electron more easily to shuffle through. The result is that the electrolytic current through solid non-conductors often increases very rapidly with rise of temperature.

In the new vacuum tube, with external plate coating, the glass wall becomes warmed by the heated filament up to the point at which it conducts electrolytically with sufficient ease to permit of carrying the relatively small current density supplied to the device. The temperature does not rise, however, to the point at which the glass walls soften or rapidly deteriorate.

The curves accompanying the article indicate a sharp and sudden bending of the anode current at a certain critical control potential applied to the grid. This abrupt change of the virtual conductance in the plate path is a valuable feature when the tube is applied as a detector. It means that the tube can virtually rectify an alternating potential difference between the filament and grid by giving rise to a pulsating unidirectional current in the plate circuit.

The simplicity, compactness and ruggedness of construction in these external-anode tubes commend them for many purposes, especially when portability is desired. It is to be hoped that, in actual service, the tubes will be found to come up to expectations.

Plant efficiency is seldom a simple function of station capacity. Small central stations often exhibit surprisingly good economy when run under favorable load factors. Skill in utilizing available resources counts heavily in the race for low production costs.

Engineering-Civic Associations

FROM Duluth, from Youngstown, from St. Louis, from Milwaukee and from other points news has come of a new and different sort of engineering-civic activity. Electrical engineers and electrical business men are combining with all other engineers—civil, mechanical, chemical, etc.—for a common end. They are forming centralized local associations or clubs which have an engineering background. These bodies are, from judgment based on their statements of aims and objects, the result of a desire for several things. They fill a need for a common meeting place for all engineers, a clearing house for general engineering discussion and a mobile organization through which the best engineering thought in the community can be effectively applied to the local civic and political problems.

To the individual engineer—and especially to the younger men—such an organization offers an opportunity for a broader viewpoint, a wider acquaintance and a sort of post-graduate education. To corporations based on engineering it can also be helpful in assisting the lay public to a better understanding of the technical problems with which the city is concerned. The public also gains by bringing straight-thinking engineering minds to bear on public works that are now too often handled entirely from a political standpoint. Locally, therefore, the clubs are a good thing and deserve to meet encouragement.

However, many of the local bodies are not entirely content with a limited sphere of action. They want a national affiliation. Some have even written into their constitutions clauses to the effect that the organization shall affiliate itself with a national body when one is formed which has aims and objects similar to their own. Just where this national body is to spring from no one appears as yet ready to say. That it can do excellent national work is fully admitted. As an instance of the kind of work it might take up, attention may be called to the necessity for some such organization to handle certain phases of promotional activity in the movement for a national department of public works headed by an engineer. At any rate, this general engineering-civic movement is well under way and is important enough to merit the attention of those who have genius for properly organizing an industry.

It is in the public interest that the capital required for the enlargement and betterment of utility service should be voluntarily furnished by private investors under the attraction of a satisfactory rate of return and degree of safety. Regulation must be both responsible and reasonable.

Some Details of Industrial Equipment

WE TAKE pleasure in adding to the article by E. E. George on "Industrial Maintenance and Rehabilitation Methods," printed last week, some interesting details of arrangements adopted in the plant with which he is connected to meet conditions that would in many cases be found difficult. One of the not unusual annoyances in industrial plants is the collection of current for the often numerous cranes in use. Perhaps the commonest arrangement is a shoe contact made with a supply wire rather flexibly supported on rollers. It works well under conditions of accurate alignment but wears out shoes rather rapidly and gives trouble if there is any end play of the crane on its rails. It is apt also to catch and pull the line down and wear the wires rather severely. Investigation in this case showed that the most satisfactory of all systems is that with double third-rails as applied to big shipyard work. This method is extremely efficient but rather expensive and difficult to apply to crane runways not originally built for it.

After a careful study of the situation the engineers designed a rather simple trolley system which has turned out extremely well. It consists of a standard street railway wheel and fork mounted on a short pole with a vertical motion imparted by a spiral spring pressing it against the trolley wire. This was a No. 0000 size, pulled very taut, the flexibility of the contact being given by the up-and-down motion of the pole, which slid in two well-fitted brass collars and was kept in electrical connection by flexible cable. The original equipment is still in use after twelve months, so that from the standpoint of durability as well as efficiency the contact leaves little that could be desired by any one in the circumstances under notice.

In wiring the buildings, including the office portions, exposed standard conduits were used, it being wisely decided that this conduit was quite as ornamental and less conspicuous than steam, gas and sprinkler pipes. The results have been entirely satisfactory. All portable and adjustable lamps in the offices were done away with and a first-class system of indirect lighting was installed. The service wiring was mainly along the roof trusses with high-grade rubber-covered wire run in rigid conduit for the service leads. For the various

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motors manual starting boxes were discarded and automatic starters took their place. For reversible and variable-speed motors automatic starters with push-button control were freely used, and in general the knife switch with fuse, so common in motor installations, was once and for all put out of the way. Another very useful innovation had to do with the illumination of the plant. In working at night overhead and in crowded basements or other space a good deal of difficulty is found in getting sufficient illumination, the ordinary service lights being hardly sufficient for the unusual duty of lighting for special repairs in out-of-the-way places. To meet this necessity a portable floodlamp with a 1000-watt gas-filled lamp in a suitable reflector was fitted up. The reflector was given universal motion and the whole thing clamped on a small truck with rubber-tired wheels and provided with a 100-ft. (30-m.) cord attachment. This outfit could be trundled around wherever necessary and brought into action in dark corners where the regular lighting or portable lamps would not make any serious impression. The labor saving in maintenance operations secured in the way indicated proved to be very material.

Finally, the line shafts were supplied with ball bearings, which were estimated, and probably correctly, to save at least 20 per cent on the power consumption of the machine-shop motors, and which incidentally obviated the need of an extra generator, the load in this way being kept down to the readily available capacity. Even the loose pulleys were eventually supplied with ball bearings which relieved a very considerable part of the ordinary repair work.

All told, this is a record of very efficient equipment and management, and it teaches an extremely useful lesson as regards ultimate results in plants for industrial purposes.

Now and then a medium-sized installation gives a plant half a dozen times its size a close rub in economic performance per unit of output. The day of superplants is here, but they must justify their "place in the sun" by their works. Meanwhile the smaller stations should strive to attain the best that lies within them.

Installation and Testing of Primary Meters

WHEN a consumer's plant covers a relatively large area it becomes possible to supply energy to it at a number of points, each with its step-down transformer and watt-hour meter, or else to supply energy to it at a single point, through a single watt-hour meter, and distribute from this point over 2200-volt mains. In the latter case the metering is simplified, but the meter records energy delivered at a relatively high pressure. It then becomes desirable to standardize the meters for this higher-pressure service. There are three possible bases for standardization. One is to install 2200-volt meters in the circuits, both as regards voltage and current. A second is to use, say, a 220-volt meter, with both voltage and current transformers. A third is to use a 220-volt meter with voltage transformers but without current transformers, the meter windings being inserted in the main circuit.

The advantages of these various methods are discussed in an article this week by Halbert R. Thomas. A plea is made for consistent procedure, so that whatever plan is adopted in one installation should be followed, as far as possible, in all similar installations supplied by the same system.

The nub of proper supervision lies in seeing that hurtful discriminations in rates or service do not exist and that the price schedules yield an adequate but not an excessive return upon the investment. Supervisory interference with managerial functions without responsibility for results adulterates the regulative ideal and deprives the public of normal utility development based upon mutual interests and the most expert administration.

Cost Comparison of Transformer Types

IN THE early days of alternating-current transformers their designs fell into two distinct classes, namely, core-type and shell-type transformers. In the former the copper winding was distinctively on the outside of the steel core. In the latter the steel core was the salient external structure within which the copper winding was embedded. There was much difference of opinion concerning the relative merits of these two types, in relation to various features, such as convenience of manufacture, efficiency, heating and cost. Each type had its strong protagonists. As time went on, however, and transformer design became carefully studied, it was found that the differences between the behaviors of the two types diminished, and at the same time the structural differences between them diminished. The problem before the designer is to link an electric circuit system with a magnetic circuit system in such a manner that the electric current density in the former and the magnetic flux density in the latter attain suitable working values while preserving mechanical convenience and electrical insulation. The process of design then often leads to a structure which is hard to classify between the core and shell types.

Prof. B. C. Dennison gave last week an analysis of the most economical design conditions for five types of 75-kva. single-phase transformers using the same working current density and the same iron space factor throughout. The designs being conducted according to rule, the weights of iron all come out within 9 per cent above or below the mean of the five types, and the weights of copper within 7 per cent. The total costs come out with 5 per cent above or below the mean. The computed efficiencies are all within 0.08 per cent of the mean. It is evident that, although the differences in cost are not negligible, the differences taken as a whole are relatively small considering that five different types are compared.

There are, however, various details of structural convenience and incidental economy which affect the selection of type in a factory and which it is very difficult to reduce to quantitative form. These minor considerations often play a leading part in making a decision. Nevertheless, it is always well to have the matters of geometrical construction reduced to arithmetic so far as may be possible. Inquiries of the kind dealt with in the article will therefore always be worth while. In particular, it would be desirable to have them extended to polyphase transformers. In Europe the preference has always been given to polyphase transformers for polyphase systems, whereas in America single-phase transformers in groups are nearly always adopted.

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External-Anode Vacuum Tube

Results of Investigations Carried On with a New Type of Three-Electrode Vacuum Tube in Which Electrolytic Conduction Through Glass Performs an Important Function

BY H. P. DONLE
Radio Engineer Connecticut Telephone & Electric Company, Inc.

COMMERCIAL types of electron-tube amplifiers, detectors and oscillators in their present forms, although remarkable for adaptability and efficiency, have been developed along more or less well-defined paths and have deviated very little in principle from the original forms. However, a vacuum tube has been developed by the writer which not only differs radically in construction from those available heretofore but depends for its operation on what is believed to be a new phenomenon, namely, electrolytic conduction in a hot dielectric.

Aside from the simplicity, compactness and ruggedness of the tubes, they are especially interesting because their characteristic curves contain a right-angle bend which makes the tubes unusually sensitive detectors. By proper proportioning of the tube components this bend can be made to occur at zero-control potential. Operation without a polarizing potential on the control is a considerable advantage, because, although it is a comparatively simple matter to polarize the control by shunting the series condenser with a resistance of several megohms, these resistances, as made at present of loose particles, introduce considerable noise into the receiving circuit owing to their variable resistance. One form of the tubes is made to operate at an anode potential of 4 volts, which should be attractive wherever it is desirable to minimize the battery expense, reduce the weight or secure compactness. The exceptional oscillating properties of the tubes make them particularly adapted to use as regenerative or oscillating detectors. The construction and assembly of the tubes is so simple that manufacture on a quantity basis is considerably more feasible than with many other types now available.

A filament, a control electrode and an anode are employed as in other three-electrode vacuum tubes, but these elements are disposed differently, as shown in Fig. 1. The filament is shaped like a hairpin, and surrounding it is the control electrode, which consists of a helical coil of drawn-tungsten wire. These two elements are the only ones inside the tube, the anode being a silver coating applied directly to the outside of the vacuum tube on that portion surrounding the filament and control electrode.

The vacuum tube proper is very small, being hardly more than $\frac{3}{8}$ in. (9.5 mm.) in diameter where the electronic action takes place and only $\frac{5}{8}$ in. (15.9 mm.) at the base, where more space is required for assembling and sealing the tube after it is evacuated. With the outer glass shell in place, which is provided for protection against drafts and mechanical injury, the tube measures only $\frac{7}{8}$ in. (22 mm.) by $3\frac{3}{8}$ in. (85.7 mm.), compared with $1\frac{3}{8}$ in. (34.9 mm.) by 4 in. (10 cm.) for one form of vacuum tube which was very popular in the Signal Corps during the war.

Although very light in construction, this new tube is entirely unaffected by vibrations and uninjured by jars so that it is unnecessary to mount it on cushions as is done with some kinds of tubes. The alignment of the filament and control with respect to each other and the anode is not at all critical; it is only necessary that the filament be placed as near the center of the control as possible, and that the filament be

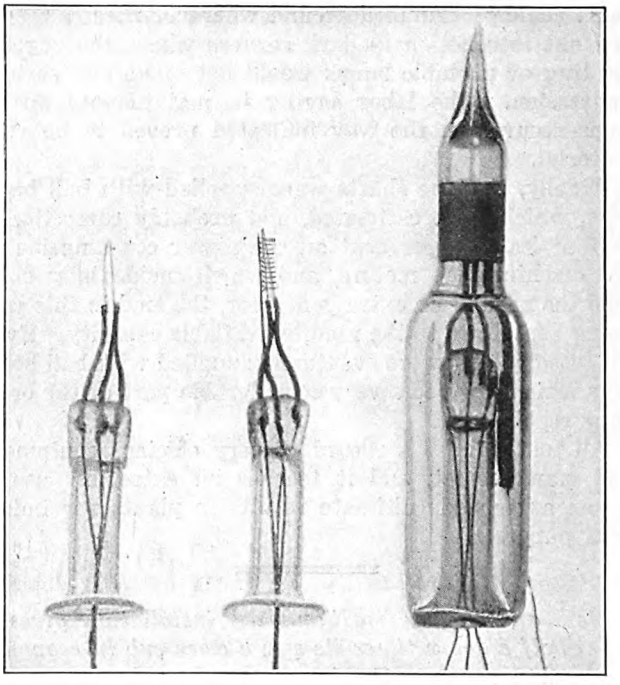

FIG. 1—FILAMENT OR CATHODE, CONTROL HELIX SURROUNDING FILAMENT, AND SILVER DEPOSIT ON OUTSIDE OF TUBE SERVING AS ANODE

somewhere near the center of the tube in order that the temperature of the glass shall be uniform.

At first it was expected that commercial variations in the glass thickness would materially affect operation, but such is not the case, for when made under ordinary conditions the tubes may be interchanged in any circuit without the necessity of readjustments.

In operation the tube is connected like any other three-electrode vacuum tube, except that the control electrode does not have to be polarized when the tube is acting as a detector. Since this tube is exhausted to the highest obtainable vacuum, the filament, when heated by its battery, is the source of a pure electronic emission which forms the connecting link for the battery between the filament and the anode electrode, the resistance of this connecting link varying with the potential of the control.

The point of immediate interest is the passage of current through the glass. Up to the present time glass has been looked upon as a fair insulator, at least, although it has been known that at or near the melting point it becomes a good conductor. This property of becoming strongly conductive when heated

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to a semi-fluid state is probably shared by all other so-called dielectrics; but it is obvious that it would be absolutely impossible to operate a vacuum tube at such a temperature since glass begins to soften at approximately 425 deg. C. and does not attain red heat until heated to about 600 deg. C. However, when glass is in contact with certain elements, it becomes a good conductor at far lower temperatures than these. The conduction through it when in this condition is purely electrolytic, and all the phenomena accompanying conduction through a liquid electrolyte, such as decomposition, polarization, etc., are present in hot glass.

Before making these tubes conductivity tests of glass in contact with various elements were made by pre-

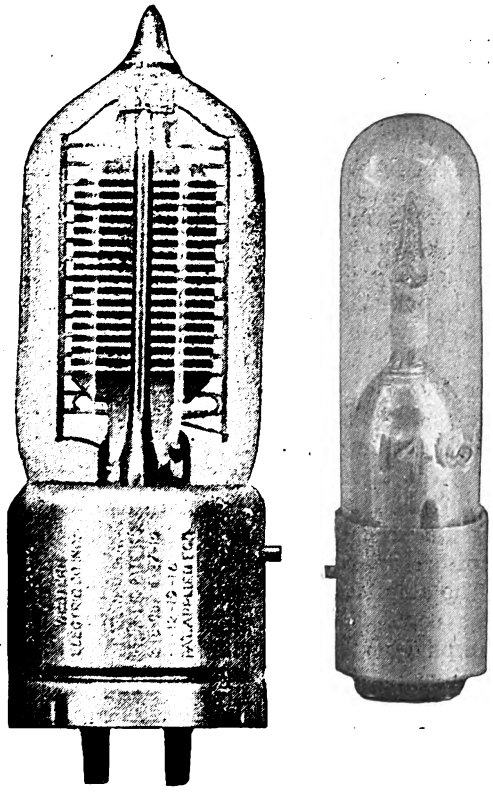


FIG. 2—RELATIVE SIZES OF ARMY VACUUM TUBE AND RECENT DEVELOPMENT

paring short lengths of glass tubing with a band of the metal surrounding the outer circumference near the middle of the tube and a second band of the same metal inside the tube immediately under the outer band, this tube being heated to the required temperature in an electric oven. It was found that when using electrodes of such elements as copper, tin, iron, nickel, platinum, etc., an apparent polarization took place which very greatly increased the resistance of the combination. This is without doubt due to an electrolytic action at the anode surface which renders it almost non-conductive. If the source of potential be short-circuited while the glass is in this condition, the energy held on the electrode surfaces will be returned through the circuit. All of these phenomena, although, of course, perfectly commonplace in a liquid conductor, have, it is believed, up to the present been unknown in a solid.

With silver electrodes polarization is almost entirely absent; so much so that glass with one electrode of silver and one of nickel will at the proper temperature become a fair conductor when the silver is the anode terminal of the applied emf., but will have a very high resistance with silver as the cathode. Current-temperature curves for two glass samples, one with both electrodes of silver and the other having two platinum electrodes, are shown in Fig. 6, the applied potential in each case being 20 volts.

It might be supposed that the electrolytic disassociation of the glass walls would make it impracticable to operate a tube in this manner. However, this was

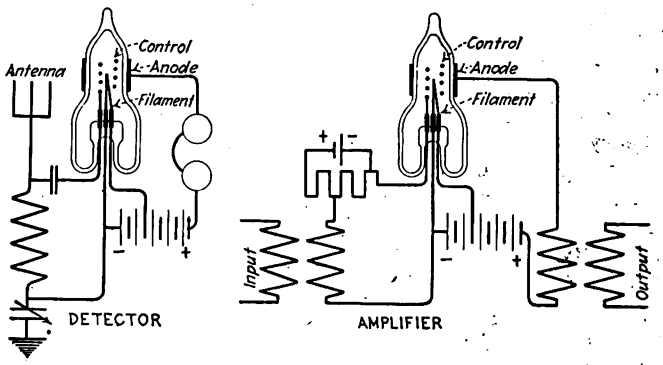
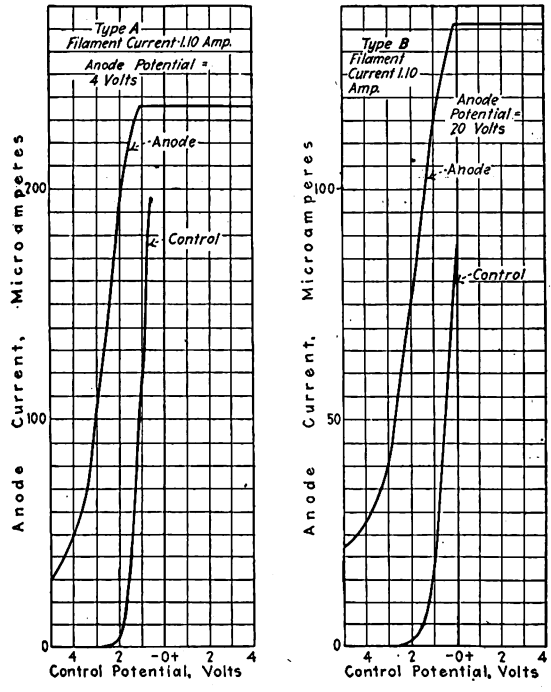


FIG. 3—METHOD OF CONNECTING THE NEW TUBES WHEN USED AS DETECTORS AND AMPLIFIERS

found not to be the case; for it is entirely feasible to so distribute the current density and magnitude that disassociation will take place at a very low rate and the glass life will be one of the smallest factors in the tube life.

Several types of tubes operating by the conductive properties of heated glass have been designed, the glass being heated to the required degree by the filament and maintained at its proper temperature by inclosing the tube within an outer shell of glass. This is



FIGS. 4 AND 5—CHARACTERISTICS OF TYPES A AND B TUBES.

provided with vents at its lower end in order that the temperature shall not exceed the proper value.

The evacuation of a tube of this type is extremely simple, for, owing to the very small metallic areas exposed (only several square millimeters instead of as many square centimeters) and their close proximity, it is possible to scavenge the tube of gas by simply

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lighting the filament and applying a low potential between one leg of the filament and the external anode. The aging potential applied is usually twice the normal operating value. With the first application of this potential there is an emission of gas from the glass tube which is drawn off by the pump, but after a few minutes this ceases and there is apparently no further emission from this source during the life of the tube. During the process of glass disassociation there is a continuous liberation of metallic sodium from the heated portions of the tube, which deposits in the form of a bright silvery coating in the cooler portions of the glass. The presence of this active element within the tube partly accounts for the cleaning up of any occluded gases which may be caused by melting of the constricted portion that connects the tube with the pump when the tube is sealed. With these tubes the presence of gas is very noticeable after sealing, but after a few minutes of normal operation it is to all indications no longer present.

The characteristics of these tubes show one peculiar feature, namely, the flattening of the anode current-control potential curve at or near zero-control potential. The cause of this is readily explained as follows: In this tube there are in effect two resistances—that from filament to inner wall of the tube R_s and that of the glass walls R_g. The latter is nearly a fixed value, determined largely by glass temperature and somewhat by current passing through it, but R_s depends entirely upon the charge residing on the control. It is obvious therefore that as the control is made more positive this resistance is decreased until a point is reached where it is inappreciable compared to R_g. In this condition R_s is the controlling factor in current flow between filament and anode.

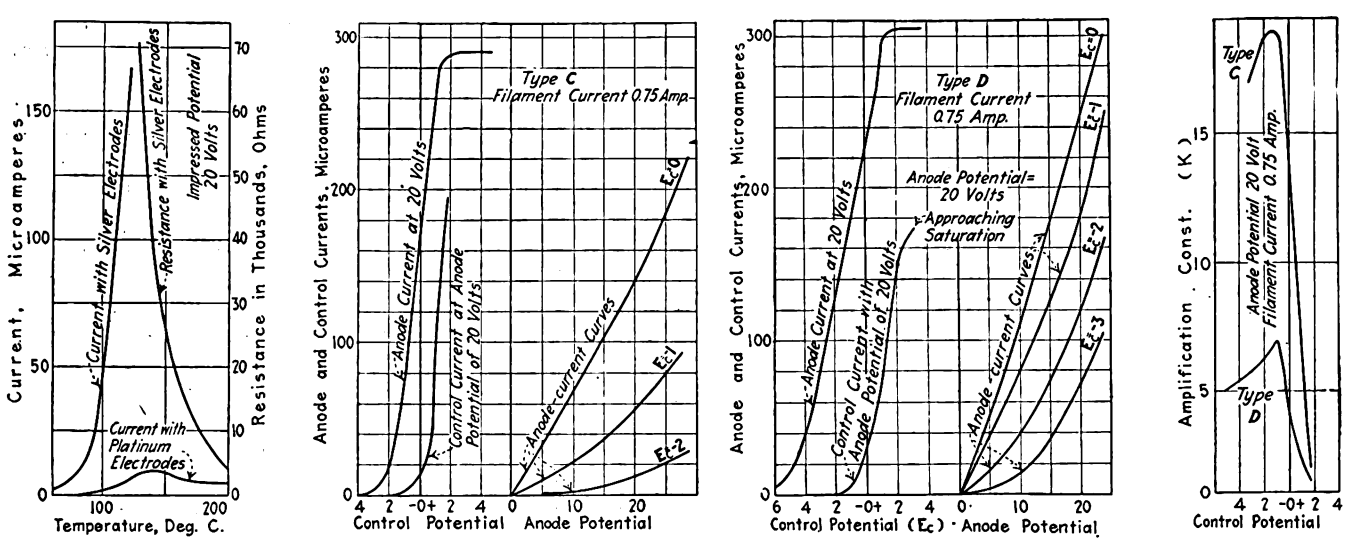
The characteristics of the four types of tubes now being made are shown by the accompanying curves. Under normal conditions of filament current and anode potential, for example, the right-angle bend in the anode-current curve of a type A tube occurs at —1 control volts and with 236 microamperes flowing in the anode circuit. With a type B tube the right-angle bend occurs at zero control volts and 172 microamperes. Types C and D, on the other hand, have the bend occur at positive control potentials (1 volt to 2 volts) and with 290 and 304 microamperes flowing respectively.

Used as detectors or oscillators, these tubes operate best when a condenser is in series with the control element, although they will operate on the lower portion of their characteristic curves with the control charged negatively. However, the latter method of operation is not so satisfactory as the first.

Decreasing the anode potential causes the bends to occur as usual at more positive control potentials and with less anode current. Because of these right-angle bends it is preferable to operate the tubes at the control potential where they occur if the best detecting characteristics are desired. When used as amplifiers, the control potential is maintained at that value giving the greatest increases or decreases of anode current with variations of the control potential. In this connection it may be noted that the type C tube is particularly adapted to amplification because of the steep current curve, which is still further improved by lowering the anode voltage. The characteristics of the type D tube are particularly interesting because they show the enormous effect produced by the control element, which has only 70 per cent of the turns in type C. The amplification constants of these two tubes at varying control potentials are shown in Fig. 9, type C amplifying more than nineteen times under best conditions. These constants were calculated by the method described by Leslie Miller in the *Proceedings* of the Radio Institute.

NORMAL OPERATING CONDITIONS OF THE VARIOUS TUBES

Type of Tube	Filament Current (Amp.)	Anode Potential (Volts)	Acting as Detector	Acting as Amplifier
A	1.1	4	Condenser in series with control	.....
B	1.1	20	Condenser in series with control....	.....
C	0.75	20	Condenser in series with control....	Control polarized—1 volt
D	0.75	20	Condenser in series with control....	Control polarized—1 volt



FIGS. 6, 7, 8 AND 9—CHARACTERISTICS OF GLASS AS A CONDUCTOR, AND PERFORMANCE OF TYPES C AND D VACUUM TUBES AS DETECTORS AND AMPLIFIERS

The characteristics of these tubes have been checked by Dr. Chaffee of the Cruft Laboratory, Harvard University, and the author wishes to express his appreciation of his most valuable coöperation.

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Improvements in Industrial Plant Operation

Simplicity in Electrical Construction Methods Makes Interruptions Less Frequent, and These Are Readily Remedied—A Substantial Crane Collecting Device—Records Enable Engineers to Select Best Apparatus

BY E. E. GEORGE
Electrical Engineer, Chicago, Ill.

DEFINITE information regarding improved methods of electrical construction and operation in the plant of the Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, was set forth in an article contributed by the author of this paper, under the title "Industrial Maintenance and Rehabilitation Methods," published in the last issue of the ELECTRICAL WORLD. Equally important developments at this plant are reported in the present article. In particular a crane collecting device is described in detail which the author considers much better than any such device heretofore available. Features of interior wiring methods are given which make for simplicity and ready repair. Portable floodlight units are shown to be useful in maintenance work. And, finally, it is pointed out that records should be kept which enable the engineer to select apparatus and supplies on the basis of the experience which the company has actually had with such material.

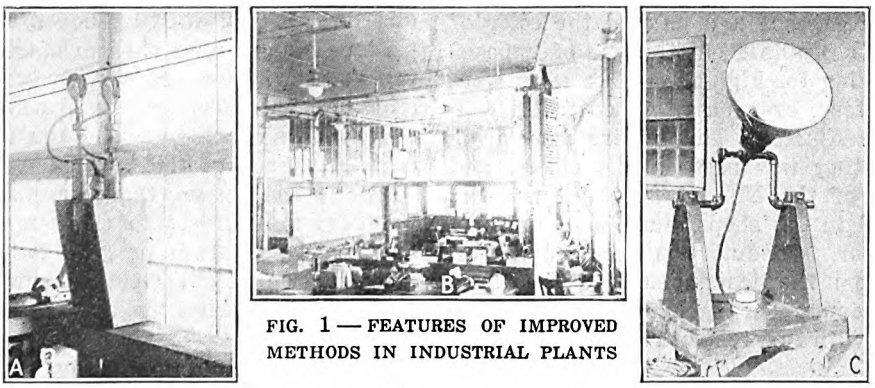

FIG. 1 — FEATURES OF IMPROVED METHODS IN INDUSTRIAL PLANTS

A—New design of crane collector. B—Office ceiling showing exposed conduit work. C—Portable floodlight for maintenance work; rubber tires prevent breakage of 1000-watt lamp.

Circuit breakers were installed to replace fuses on all crane circuits. Fuses would not blow quickly enough to prevent burning the wires in two if they got shorted by any means. Later the entire crane system was redesigned so that the wires could not get together. The ordinary arrangement of crane wires vertically over each other, fastened rigidly only at each end, with intermediate roller supports to reduce the sag, has been a source of trouble in nearly every industrial plant, but it is the usual arrangement, particularly on outside cranes. When this system was in use the costly bronze sliding shoes required renewal about every two weeks. They jumped the wires if there was the least lateral misalignment or any end play of the crane on the runway. After being slightly worn they caught on every splice and often pulled the line down, which, being in one long span, was difficult to pull up and replace on the supports. They wore out the wires very rapidly. They could only be used on vertically arranged floating trolley wires, which were unsatisfactory in a long building.

An investigation of industrial crane systems led the writer to the following conclusions:

(1) The double third-rail system, recently developed for heavy shipyard cranes, is the only really satisfactory crane collector device on the market. This system is expensive to install, but it is very desirable for extra-heavy cranes. It is usually difficult to apply to runways not specially designed for third-rail supports.

(2) The sliding-shoe system for floating vertically arranged trolley wires has not been a success.

(3) The rigidly mounted roller system for floating vertically arranged trolley wires cannot collect heavy currents and is subject to the usual troubles inherent in a system of long, floating trolley wires.

(4) The short trolley poles commonly used on rigidly supported trolley wires will not operate backward any more successfully than the ordinary street-car trolley poles, except on tight wires at low speeds.

(5) The pantograph collector would be extremely serviceable, but it is expensive to construct and requires much more head room than is usually available.

A device described in the following paragraphs was designed by W. O. Sims, the company's tool engineer, and by the writer and was built in the company shops. After twelve months' trial it has given perfect satisfaction, and it has lately been standardized for all future installations. A standard street-railway trolley wheel and harp (or fork) was chosen, as it was easily available and its design had not the test of heavy service. To avoid the necessity for manual reversal, the pole was mounted vertically, with a helical spring pressing it up against the trolley wire. There being little friction of the wheel on its pin, the only horizontal thrust on the trolley pole would be due to the sagging downward or curving upward of the trolley wire, so that the force passing through the center of the wheel and perpendicular to the wire would not be exactly vertical. This effect was reduced to a minimum by using No. 0000 wire, supported with "Sure Grip" clamps on 18-ft (5.5-m.) centers, and pulled very tight before and after partly tightening the clamps. In fact, the trolley wire was almost level with 30-lb. (14-kg.) pressure on the wheel at the center of the span. The trolley harp was insulated from the pole by a G. E. insulating hanger, threaded on both ends. The pole was a piece of cold-rolled steel rod, $\frac{3}{4}$ in. (1.9 cm.) in diameter and about 2 ft. (0.61 m.) long. The bearings for the pole consist of two brass collars, one 10 in. (25 cm.) above the other, $\frac{3}{8}$ in. (9.5 mm.) thick, 2 in. (5 cm.) in diameter outside, and reamed to a sliding fit on the $\frac{3}{4}$-in. (1.9-cm.) poles. A single heavy iron casting bolted to the end sill of the crane carried the brass bearings

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for the two poles, 8 in. (20 cm.) apart horizontally. A Dossert lug was bolted to each harp above the insulating hanger, and a piece of automobile battery-starting cable (extra flexible) was connected from the "Dossert" to the leads to the cab panel. The springs were designed just the right length to fit between the top brass bearings and the bottom of the insulating hangers. The wheels, poles and brass bearings can be renewed very cheaply, but after twelve months' service the original ones are still on the job. The standard malleable harps were widened about ¼ in. (6.3 mm.) and longer pins were put in, so that the wheels could have ⅛-in. (3.2-mm.) side play each way. The poles are not prevented from turning except by the grooves of the wheels following the wires.

Interior Wiring Methods

A radical change was made in the interior wiring of the offices. Previously all wiring had been concealed in wooden or metal molding or carried behind partitions or under floors. It was decided that electrical conduit was as ornamental as steam, gas and sprinkler pipes, so all conduit for fan, light, telephone and annunciator wiring was installed exposed and painted the color of its background. The results from the use of exposed standard conduit wiring for high-class office work were particularly satisfactory, even on white enameled ceilings. Portable and adjustable lamps were done away with. Indirect lighting was used in the offices, and Benjamin reflectors of the No. X5437 or of the No. 6127 type were used in the shops, hung at a uniform height above the floor. Conduit was provided for all telephone wires, from the instruments to the PBX switchboard. Intercommunicating telephones were discarded and replaced with Bell telephones having outside connections.

The ordinary support for wires and cables running along or over roofs is a wooden trestle of some kind, which is unsightly, makes objectionable holes in the roof covering, cannot be increased in insulator capacity easily, and deteriorates rapidly because of weather conditions. To meet these objections a unit-type steel pole or pin support was designed by C. E. Sinnige and put in service on all outside lines not carried on standard wooden poles. This "pin tower" consisted of a cast-steel pedestal, 18 in. (46 cm.) high, flanged at the base to about 6-in. (15-cm.) diameter, and tapering to a 1¼-in. (3.2-cm.) round boss at the top, which carried a No. 80 Pierce steel pin the long shank of which was bolted to the boss. The flanged base was drilled for four ½-in. (1.3-cm.) lag screws or through bolts, so that the "tower" would stand dead-end and corner strains without guying. The wires were thus supported about 24 in. (7.3 m.) above the surface on which the "towers" were mounted, which was sufficient for 36-ft. (11-m.) spans of "million cable" with large sags.

On lifting magnets Crouse-Hinds No. BPEA plugs and No. BRHD receptacles were used, one set on the magnet and one on the trolley carriage or in the cab. This permitted the magnet to be easily detached from the crane hook and prevented the leads being pulled out of the magnet. For all electric drills, office devices, portable lamps, electric grinders, etc., C-H No. RQ 302 plugs and No. RQK 302 receptacles were used. Several hundred receptacles were mounted in the shops, so that the 50-ft. (15-m.) cords on all portable devices would permit them to be used at any location. For outdoor work extension cords were made up with plugs on one end and receptacles on the other.

Simplicity in Service Wiring

Most of the feeders were run along the roof trusses. Owing to the inaccessibility of cut-outs in the branch or service wires where they left the feeders and the consequent tendency to overfuse or to "copper" them, the Underwriters gave special permission to omit all ceiling branch cut-outs dependent on high-class construction and protection in the branch or service leads. Accordingly the service leads were double-braid, rubber-covered Okonite wire, run in rigid conduit to Detroit inclosed knife switches with non-renewable fuses or to Cutter circuit breakers, double-pole, with low-voltage releases, set to trip much more quickly than the low-voltage releases on starting boxes.

It was found that the depreciation was very high on all knife switches and starting boxes handled by the ordinary machine operator. In the matter of knife switches this was remedied to some extent by using the highest grade of switches available, such as the Glover type A, Crouse-Hinds type B, Walker type C, etc. All manual starting boxes were replaced by the Cutler-Hammer multiple-arm starters. For all reversing and variable-speed service current-limit automatic starters controlled by push-buttons or drum master switches were selected. On the new installations circuit breakers were used instead of fused knife switches. When placed near the operators ordinary circuit breakers are subject to the same objections as open knife switches. It is regrettable that no manufacturer has yet brought out (to the knowledge of the writer) a standard circuit breaker inclosed in a steel box or otherwise protected from chips, shavings, oil and from accidental contact with the operator or moving objects. Such a breaker is urgently needed in many industrial plants where the machine operators must have the control equipment quickly accessible. High-class breakers are not easily built for front connection, and it is difficult to erect and connect a back-connected breaker in a standard steel panel box. The nearest approach to an inclosed breaker is the General Electric "government type" circuit breaker. Strange to say, it seems that the government arsenals are ahead of private concerns in realizing the need of high-class equipment of this type. This G. E. breaker is really a magnet switch, as it is held closed by an inductive shunt coil, and as such it cannot perform all the functions of a circuit breaker, but it is a step in the right direction. Perhaps the fact that circuit breakers were originally designed for switchboard use exclusively has much to do with their present appearance. The Crane company of Chicago centralizes all of its service breakers in one room, thus realizing switchboard conditions and insuring attention by electricians; but this commendable practice is not possible except in certain new plants. All power receptacles were protected by service cut-outs of the Crouse-Hinds No. YKK 302 type, mounted in YKC 33302 boxes, and were installed as carefully as motor circuits.

In spite of carefully planned illumination for all productive work, the electricians, millwrights, belt men, pipefitters, riggers and the rest of the maintenance gang usually have to contend with semi or total darkness on all work overhead, in basements, behind boilers, in attics, etc., especially at night. To meet this difficulty,

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a portable floodlight was rigged up. It consisted of a 1000-watt nitrogen lamp in a Benjamin deep-bowl reflector, mounted on a U-shaped pipe support, which was clamped to a small truck with rubber-tired wheels. By loosening the clamps the lamp could be rotated in a vertical plane, while the truck could be moved to rotate the lamp horizontally. A 100-ft. (30-m.) cord and RQ 302 plug were attached to the reflector socket. This light was particularly valuable for work behind switchboards, over counter-shafting and belting, in closed attics and in other places where the ordinary portable lamp hardly made any impression on the dark surfaces and large spaces involved. It was often borrowed by the painters, photographers, carpenters, etc., saving at least 20 per cent on all labor of the maintenance department at night.

All line-shaft bearings were changed to the S. K. F. ball-bearing type. This saved at least 20 per cent on

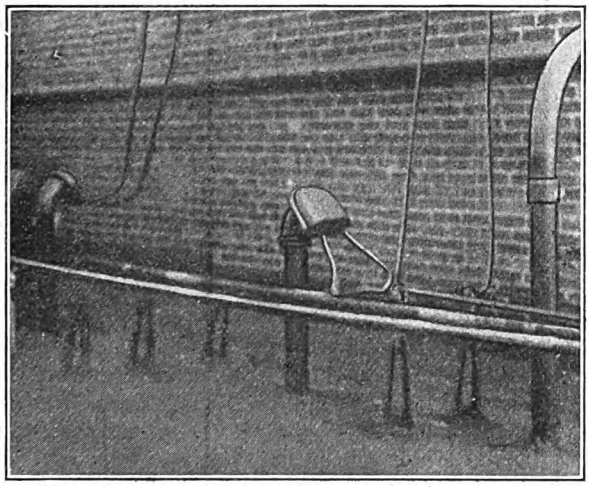

FIG. 2—HEAVY CABLES MOUNTED ON 18-IN. "PIN TOWERS"

power consumption of the machine-shop motors and obviated the necessity of purchasing an additional generator. Casting rattlers, fans, grinders, etc., were equipped with ball bearings. Later a ball-bearing loose pulley was designed and applied to countershafts and machines in place of friction clutches or plain-bearing loose pulleys. This ball-bearing pulley eliminated half of the millwright repair work, which consisted largely of rebushing worn-out loose pulleys. From the industrial electrical engineer's standpoint the use of ball bearings is an effective means of relief from overloaded generating equipment.

MAINTENANCE RECORDS

All dimension prints, surveys, foundation plans, wiring diagrams, etc., were copied by the photostat machine on 8½-in. by 11-in. (22-cm. by 28-cm.) prints and filed in folders. The originals were destroyed, unless valuable. Before photostating, a 3-in. by 5-in. (7.6-cm. by 12.7-cm.) card, on which was typewritten an index number and an appropriate title, was laid on one corner of the original so that it appeared on the print. A card index was kept of these letter-size prints. Layouts of the water piping, sprinkler piping, telephone circuits, fire alarm, gas mains, heating lines, electrical lines, etc., were kept up to date. The large-size tracings of these as well as the 8½-in by 11-in. (22-cm. by 28-cm.) prints were kept accessible.

As a perpetual inventory was kept of all equipment, a rather unusual classification of electrical purchases was made, dividing all materials into "expense" or "equipment" so that they could be charged to the proper account when bought, rather than when taken from the electrical storeroom to be used on a job. As the equipment accounts were subdivided by materials instead of by buildings or locations, it was not necessary for the maintenance or cost departments to keep any records of where and when materials were used. Strict rules were

SAMPLE PAGE FROM STANDARDS BOOK

Article	Solder	Salesman	
Preference	First	Address	
Manufacturer		Trade Name	
Address		Price	
Agency			
Address			

Our standard grades are:

Data N. L. No.	Per Cent Tin	Per Cent Lead	Melt. Deg. Fahr.	Strength	Use
...	66	34	356	Extra high	Brazing copper, etc.
iii	50	50	401	High	Standard electrical
333	45	55	424	Medium	Sheet metal
777	40	60	446	Low	High melting electrical
...	33	67	488	Very low	Plumbing

All grades come in 1½-lb. (approximately) bars, in No. 10. B. & S. gage wire, and in No. 8 B. & S. gage wire. The wire is put up in 25-lb. coils and on 65-lb. spools.

enforced regarding the "scrapping" of equipment, and the cost department's representative always got a record of such items.

Every material that proved superior to its competitors or gave continuously good service in the absence of competition was standardized, and a record was kept of the maker, jobber, type, catalog number, technical data, etc., in a set of loose-leaf binders, called the "Standards Books" and highly valued by the works engineer and by the maintenance and purchasing departments. All requisitions were written by the works engineer, using these standard sheets for his information, or adding new sheets if the article was ordered for the first time.

The policy of standardization followed for the last three years was made possible largely by the vigorous support of the works manager, F. G. Kent. During the first two years, the writer was works engineer, while during the last year Stanley Nicholson has been in charge of the electrical work.

THE export of raw or semi-finished articles unquestionably adds to national wealth, but gives little aid to industry. We must export cotton in fabrics and not in the bale, iron and steel in machinery and implements, leather in shoes and other finished articles, use our coal under our own factory boilers and in every way multiply the overseas movement of products of hand and brain which our recognized manufacturing and inventive skill, unequaled by any other country of the world, so eminently fits us to produce. There always will be opportunities for distinctive American specialties, unique in character, the product of American originality, but to secure export trade in volume we must be prepared to supply what the foreign buyer regularly uses and always calls for.—*Edward Prizer, President Vacuum Oil Company.*

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National Planning for Electric Power

Efficiency Must Lower Cost and Power and Human Resources Must Be Conserved—Secretary Lane's Proposed Survey Is Economic and Will Measure Present and Future Power Requirements

BY DR. GEORGE OTIS SMITH
Director United States Geological Survey

In his address before the National Electric Light Association at Atlantic City Dr. Smith presented the plans of Secretary of the Interior Lane for a survey of power resources.

THERE has been, fortunately, some progress in our ideas of what is the true relation between government and business. Governmental coöperation with business is the next step. In manufacturing, as in public service, the trend must be, not toward price lowering through competitive marketing, but toward cost lowering through competitive effort for efficiency. The idea that competition is productive of low prices has been over-emphasized in our laws, because public opinion has believed in that way of keeping big business under constraint and under control; but average prices cannot for any very long period be lower than average costs. Of course there is an exception to this—government operation can be camouflaged so that the taxpayer and not the consumer pays the cost. The government bureau, board or commission that seeks to protect the consumer will do well to help in the organization of industry on lines that will work out lower costs. The time is therefore opportune for broad planning, and there is no more urgent need than that of a power program.

To tell the National Electric Light Association at its forty-second annual convention that electric energy is man's best servant may be too much like "carrying coals to Newcastle." As I see it power is the great industrial need of the day—without it the speeding up of our nation in its recent great effort to help save the world would have been impossible The transportation of raw materials and manufactured products even in peace times calls for herculean energy—a power demand measured by more than 5,000,000 continuous hp.

In terms of cost, the best figures available indicate that motive power accounts for fully 30 per cent of the expense of operating steam railroads and for about 10 per cent of the well-managed electric railways. Aside from this difference in power cost, electric energy must be credited with the greater efficiency it makes possible.

The power element is smaller in manufacturing than in transportation, but not less important. In the making of cotton cloth about 2 per cent of the value of the product can be charged to power, while in the production of electrolytic zinc the power cost is around 12 per cent. In general, 2 per cent may be taken as a conservative figure for the power item in total manufacturing cost, and this may seem almost negligible; but the wider use of power in mills and shops has a larger effect than is measured by its own cost—the kilowatt-hour may double the product of the man-hour, and men cost more than kilowatts.

Electric power, as furnished from the large central stations, is favored by that happy economic law whereby the load factor works both ways. Lowering the cost of electric energy invites greater use, and greater and more diversified use permits lowered cost. That is no vicious circle; it is the virtuous upward curve of progress.

The future of power use is so encouraging that I dislike to pause and speak of the less attractive present. The story of wastes in our national career is not a pleasant one. American pride prefers to dwell upon those things that America does well. We have much to be proud of in our record of invention and construction and operation—indeed, the term "electrical" seems to describe something of purely American origin that has to be translated into the life of other peoples. Yet here in its birthplace and home the electrical industry is not so efficient as it should be. Your best engineers see the trouble—the growth has been so rapid that we have given too little thought to systematic development. Wonderfully well-thought-out units are scattered here and there, but these are widely separated islands in a sea of poorly planned or obsolescent plants.

INEXCUSABLE WASTE PERMITTED

The net result of this lack of system is that we permit wastes which are large items on the wrong side of our national ledger. You gentlemen know far better than I the wide span between your best records in large up-to-date central stations and the results obtained in smaller and too often obsolescent private plants. Measured by coal burned to the kilowatt-hour the ratio is one to two or three, or even more. Where else do we find such opportunities to cut down the coal bill? We can see even greater savings when we consider the advantages of hitching up American rivers and American coal—they work best in double harness. I believe that we are far from making full use of the water powers that lie undeveloped within easy transmission distances of our largest power markets. It is, moreover, time to count the rising costs of labor in the steam plant, where the coal miner as well as the fireman is an employee in fact, whether you see the miner's name on your payroll or not. The figures presented by the Alabama Power Company in its comparison of steam plant with hydro plant show the ratio of men employed as eighty-four to one. To the 1000 kw. of capacity twelve and one-half men in the steam plant and coal mine adjacent compare with one-sixth of a man in a hydroelectric plant. Conservation of human energy calls for the immediate and full development of every water power that is feasible.

The Secretary of the Interior offers a power program, and his program is inspired by a vision of future needs. He regards the almost insatiable demand for power created by war industries as foreshadowing future danger of power famine in the industrial districts of the Northeast. The signing of the armistice happily averted the power crisis that otherwise we should now be facing. Now, however, a policy of preparedness for peace expansion should be adopted.

We lack many of the basic engineering facts upon

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which intelligent planning may rest. To fill this need the Geological Survey has undertaken a power survey of the United States. This survey is economic in its aim; it seeks simply to learn the facts relative to the sources from which power may be obtained and to compile all the facts relative to the existing plants, the quantity of power produced and the growth of power requirements.

As the first field of work, Secretary Lane has selected that area of maximum power density which he has chosen to call the North Atlantic industrial district. In this area, extending from the vicinity of Boston to that of Washington or Richmond and covering 50,000 square miles, is concentrated one-fourth of the power-generating capacity of the whole country.

The need of knowing the facts is realized when we try to measure even present power requirements, not to mention future demands. The Boston-Washington region uses 600,000,000 kw.-hr. a month, most of it derived from coal. The central stations alone consume fully 10,000,000 tons of coal a year. Add to this say 25,000,000 tons for the railroads in this area, and we begin to appreciate in a general way the part coal plays as a source of motive energy.

In conducting these inquiries the Geological Survey must of course rely upon the coöperation of the electrical industry, and, as was expected, this coöperation has been almost universally given, the Survey's analysis of February operations representing over 92 per cent of the output of the country. You will realize that a monthly report of the country's power output makes the most sensitive of business barometers, for unlike coal and steel records it is unaffected either by any carried-over surplus or by orders for future delivery.

I trust, too, that this coöperation is not one-sided, for the government bureau is in a position to assist your industry in many ways. I may mention one way: The manufacturer seeking a location for a new plant comes to the Geological Survey with his statement of requirements in raw materials, transportation, power and labor. From the knowledge obtained from you gentlemen this government bureau is able to suggest localities where he will be likely to get power at reasonable rates and to refer him to several power companies that can meet his requirements.

My own picture of the super-power system that would effect the economies demanded by the rapid growth in this industrial region includes a multiple transmission line of high voltage with its thousands of steel towers extending from Boston through our Eastern States, crossing the Connecticut near Springfield, the Hudson at Poughkeepsie, the Delaware near Easton, and the Susquehanna below York, and so on to Washington and Richmond. Into this unified system large-unit steam-electric stations at tidewater and near the mine mouths and hydroelectric stations—twenty or more—at old and new sites would deliver energy as required, and from this great power main would flow the energy to serve a score of railroads, hundreds of public service companies, thousands of manufacturing plants and millions of homes.

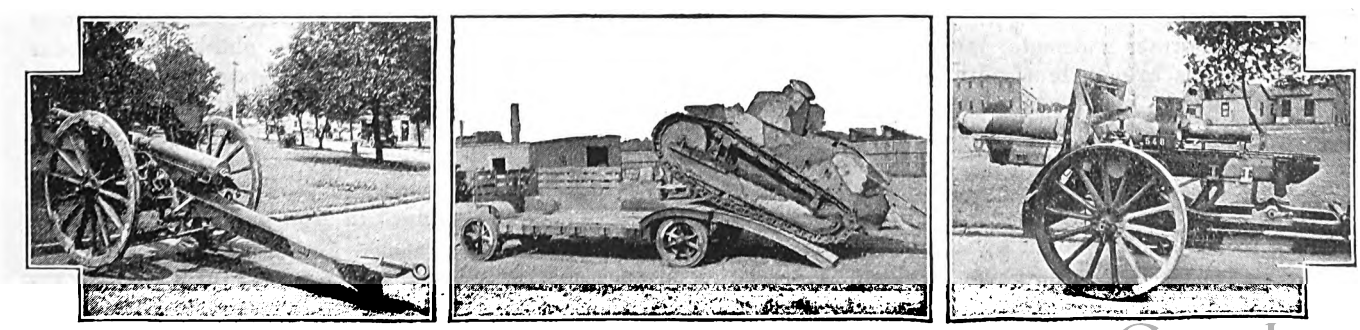
As one of my engineer friends remarks, this project would appear a "large order," and at first it staggers the imagination; but such a super-power line extending from Boston to Washington cannot be termed only a dream. If you take your map of the United States and make the West move East—which I admit is contrary to human experience—you can take one end of an existing trunk power line, which is at Tonopah, Nev., and lay that on Boston, and then the other end of the line, which is actually at Yuma, Ariz., can be placed at Norfolk, Va. What we dream for the East exists in the West, where the extreme tentacles of one system of interconnected power plants now have a reach of nearly 500 miles (800 km.).

The public interest in such an interconnected power supply is preëminent, but whoever suggests that the project is one for the government even to investigate independently neither appreciates the magnitude of the scheme nor realizes the limitations which hedge about a government bureau. If Congress authorizes this engineering study, your coöperation will be sought because needed.

As a nation bounded by the two oceans we own 55 per cent of the world's supply of coal, yet the tonnage of steam coal remaining in the great producing fields of the East is so limited as to make coal saving a topic deserving the best thought of those concerned in power generation. And coal from the more distant fields will be more expensive coal.

But Secretary Lane's program means more than saving in coal; it means saving in man power. One outstanding lesson of the war was the value of the workman behind the lines, and labor shortage became one of the limiting factors in the industrial support which we were able to give to our soldiers in France. Skilled labor is a resource in which no nation is richer than America, but this human resource also deserves to be conserved. The modern machine multiplies man power, and the increase in our use of mechanical energy is a true index of the ever larger value we are giving to the workman behind the machine.

Our interest as citizens in these plans for cheaper energy is far more than a commercial interest. Public service is a term that has come to attach itself to your industry, and not without reason. To improve living conditions for all our citizens must be the aim of those to whom is given the privilege of leadership in industry. To make this America of ours a better place to live in is the program for the electrical industry; that is your part in public service.



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Installation and Testing of Primary Meters

This Matter Demands More Attention at the Present Time than Formerly Because Tendency Is to Supply Large Consumers with Electrical Energy at 2200 Volts, Metering on the Primary Side

BY HALBERT R. THOMAS
Southern California Edison Company

THE supply of electrical energy to private consumers at potentials of 2200 volts and more marks one of the increasing tendencies of modern distribution practice. Comparatively few years ago an industrial consumer whose plant covered a considerable area was usually supplied at a number of points, a bank of transformers and a meter being installed at each. To-day such a consumer is more likely to be served over his own 2200-volt lines from a centrally located substation, energy being brought to it at a suitable high voltage and stepped down by a single bank of transformers. The total is then metered at 2200 volts at the distribution bus. Besides simplifying the reading and billing, this arrangement is often of material benefit to the consumer in enabling him to take advantage of rates based on load factor. Furthermore, with the overcoming of insulation difficulties both large and comparatively small motors can now be wound for a sufficiently high voltage to make it unnecessary to use transformers between them and 2200-volt primary lines.

Standardization of Meter Equipment and Installation

Such conditions are demanding more and more standardization in primary meter equipment and installation. When high-potential metering was seldom found outside of stations the installation was part of the station lay-out and was strictly in accordance with the plans of the designer. Meters would be ordered on specifications stating capacity and would be furnished as a unit with their transformers. For consumers' installations, on the contrary, the equipment is usually ordered on a standard specification and kept in stock to be utilized as needed.

The practice, often followed, of rating meter and instrument transformers as a unit, using a register constant of 1, 10, 100, etc., has both advantages and drawbacks. The simplification of the constant and consequent ease of calculating consumption makes it more convenient for permanent installations, and it is highly desirable for stations where a large number of meters are employed. On the other hand, flexibility of equipment becomes of increasing importance in considering the average consumer's installation. Frequent changes of capacity are demanded by varying industrial conditions, while the location of the installation some distance from direct supervision increases the possibility of transformer and meter burn-outs.

When changes are made of either meters or transformers which are installed under the unit system the greatest care is necessary in order to keep the meter records correct. Both register and disk constants are necessarily altered with a change of transformer ratio, and a new register of different gear ratio must be installed to keep the register constant a power of 10. Several changes of this kind cause complications which may easily result in serious errors in constants.

In the alternative system the meter used is standardized, being always rated at 5 amp. and 110 volts with a register constant of 1. When installed with transformers the constant is invariably equal to the transformer ratio, and this ratio is all that it is necessary to refer to in checking up the constants. The meters are interchangeable and when not in use may be stored and handled independently of transformers.

The resulting constants, when transformers of standard ratio are used, will usually be convenient multiples of 10, although slightly more difficult to handle than the powers of 10 used in the former system. It is highly undesirable to mark the constant on the dial face, on account of the confusion resulting if the meter is later used with different transformers. A removable plate on cover or dial may be used to show the multiplier, this to be changed whenever necessary under supervision of the meter department.

Standardization of connections is also more important as the number of consumers' primary installations increases. Such installations are not subject to conditions of strict design as is the case in stations, and are often made by linemen and others unfamiliar with the finer points of meter work. The result is apt to be very unfortunate from a metering standpoint, particularly when the men use past experience rather than diagrams as a guide.

The remedy is, of course, to adopt a standard set of connection diagrams for all primary meters, supplying them in convenient form to be carried by all men engaged in meter installation and insisting that they be strictly followed. Under ideal conditions such meters would also be installed only by experienced metermen, but this is unfortunately impracticable in many cases. The use of instrument wire with various colored braids has also been found an excellent practice. It not only simplifies installation but is an important aid in checking out connections. Samples of diagrams that serve these purposes are shown in Figs. 1 and 2.

Testing of Primary Meters

The testing of primary meters after installation may be done in various ways, depending upon available facilities and accuracy desired. As the standard meters employed must have low voltage for their potential circuits, potential transformers are necessary in any case. These may be either the meter transformers or portable standards carried by the testers. The current for the standard meters may be obtained from the meter current transformers, from portable standards, or directly from the primary circuit—the standard meters in the latter case being connected in series with the high-voltage line.

These various methods of obtaining current and potential may be combined in any way desired, with one exception. If single-phase standards are used with current coils connected direct in the primary circuit, their potential must not be taken from the meter

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secondaries, as this would place primary potential across the insulation of all meters.

The connection of single-phase standards in a primary circuit without intervening transformers, provided that proper precautions are taken, is an accurate and perfectly feasible method of testing primary meters. It eliminates corrections except for the test meters and their potential transformers. The meters should be thoroughly insulated from each other and ground, and if rotating standards are used they should be started and stopped by an independent observer for each instrument.

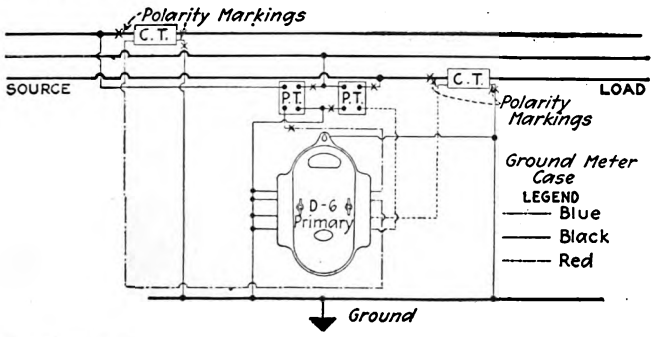

FIG. 1—SAMPLE DIAGRAM FOR SIMPLIFYING METER INSTALLATION AND AIDING CHECKING OF CONNECTIONS

Applies to a standard type of three-phase, three-wire meter requiring current and potential transformers. The black wire indicates common connection, while the red and blue wires are the phase wires.

In several instances known to the writer successful tests have been made by this method, using rotating standards on potentials as high as 30,000 volts. Each instrument was placed on a separate insulating stool with its potential transformer, the secondaries, frames and cases of meters and transformers being tied to the primary to avoid static strains. A telegraph key was included in each secondary potential circuit to start and stop the standard. These keys were manipulated by light wooden poles.

In two or three cases standards were cut in at the above voltage by men who handled the live primaries from stepladders with no protection except rubber gloves. The same men then started and stopped the test meters with ordinary pendent switches. This is by no means cited as an example worthy of emulation, and any methods involving such a hazard would certainly be prohibited to-day by the same organization. It is, however, worthy of note if only to show what risks careful men may incur and still "get away with it."

The method of cutting standards directly into a circuit of not over 2200 volts has been practiced to an extent which indicates that it is quite safe in the hands of careful, experienced men. Nevertheless, the fact that other methods offer equal accuracy with decreased risk will always militate against it, and it may be expected ultimately to fall into disuse.

If standard current transformers are cut into circuit, it will be possible to insulate these effectively and keep the high potential away entirely from the standard meters. The test may be made with entire safety without impairing its thoroughness or accuracy. The transformer insulation should be tested frequently, and during the meter calibration all secondary wiring should be grounded as a measure of precaution.

A very satisfactory home-made current transformer consists of silicon-steel laminations cut in annular form and provided with one secondary winding of any desired number of turns. On this transformer a temporary primary winding is placed, the number of turns and carrying capacity of which is determined by the load conditions under which it is desired to test. The transformer may be insulated for high voltages by the use of fiber and cambric between the primary and secondary, and the secondary may then be grounded during the test. Such insulation should always be tested just before being used by applying double the potential at which it is to operate. A current transformer of this kind, the primary winding of which is temporary and variable at will, affords the most flexible equipment for testing meters of many different current capacities, whether the voltage be high or low.

By connecting the current coils of the standards in series with those of the meter and the potential coils in parallel, all current for operating the test meters is taken from the meter transformers. This is a familiar method of testing and the only one used by many companies. Its chief recommendations are low cost, convenience and simplification of equipment. Not only are no testing transformers necessary, but the standard meters used need be rated at only 5 amp. and 110 volts. On the other hand, it must be remembered in using this method that the calibration obtained is of the meter only. No indication will be afforded of defective transformers, unless the trouble is so serious as to be practically self-evident.

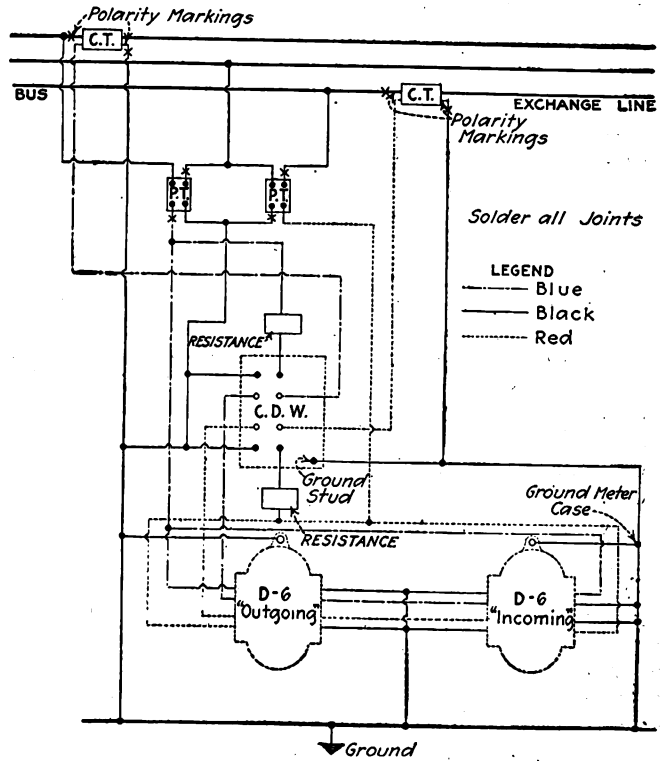

FIG. 2—SAMPLE DIAGRAM FOR CONNECTION OF METERS USED IN MEASURING ENERGY EXCHANGED BETWEEN INTERCONNECTED SYSTEMS

Two three-phase watt-hour meters and a graphic wattmeter are represented. Each meter registers in the forward direction only, being provided with a ratchet which either prevents backward rotation of the disk or disengages the registering mechanism under such conditions. With the connection shown, the left-hand meter will register all "outgoing" and the right-hand meter all "incoming" power. The graphic instrument has a central zero mark and is preferably of 10-amp. capacity or at least so designed that full-load current on the current transformers in either direction will not cause it to exceed the scale limits. The simplification of this diagram as compared with one requiring individual connections between all meter and transformer terminals is quite evident.

If it is known before installation that subsequent tests are to be made by the secondary method, the

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meter should receive a previous calibration in the laboratory, where it is tested as a unit with its transformers. It should be adjusted as close to correct as possible from light to full load and from unity power factor to the lowest likely to occur in service. The meter should then be disconnected from its transformers and tested independently, the results being embodied in a curve to which the meter is adjusted on all subsequent service tests. Care must be taken that the meter is installed on the same phase rotation as used when calibrated.

All of the methods previously discussed are based on the assumption that the consumer's running load is used in making the service test. A close calibration at varying loads and power factors is usually impossible under such conditions. If such a test is desired, the meter and its current transformers should be disconnected from the line and a suitable artificial load at 110 volts applied through the transformer primaries, with reactors or phase shifters to vary the power factor. Corrections for the potential transformers may be made from their previously determined characteristics. Such a test practically amounts to a laboratory calibration, even if made on the consumer's premises. Whether the increase in accuracy warrants its use must be determined by individual conditions.

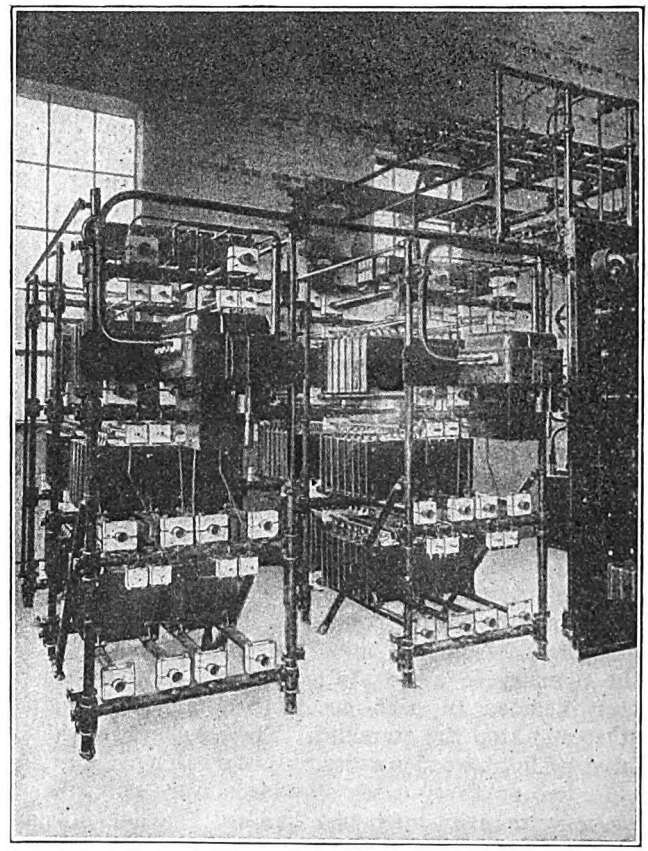
Whatever method of testing is used, it is always advisable to provide means of opening the primary circuit at suitable points for the insertion of test apparatus. This is particularly the case if it is necessary to test without interrupting the service. For voltages not exceeding 2200 a pair of receptacles for plugs in series with each current transformer and connected by a removable link form a very satisfactory means of cutting in testing instruments. A less expensive device consists of a pair of lugs such as are used for transformer terminals, bolted together and placed in series with the line. The tester clamps his leads on either side of the lugs and removes the bolts. Such lugs should never be of the interleaved variety, as an attempt to separate them on an energized circuit without disturbing test connections is both difficult and dangerous.

A SUCCESSFUL STATIC CONDENSER INSTALLATION

By This Means Brockton Edison Company Effects a Line-Loss Saving of 235,000 Kw.-hr.— Voltage Regulation Improved

By the installation of static condensers which cost $7,500 in place, the Brockton Edison company has relieved its transmission lines to Stoughton, Mass., from overload, has effected an annual saving estimated at $2,800 and improved the voltage regulation at the Stoughton substation. The company was faced with the problem of meeting increasing loads for essential industries in the vicinity of Stoughton and the feeders in these sections were already loaded to capacity. The load was about 750 kw. at a power factor of 65 per cent to 70 per cent. It was made up of a considerable number of small installations, all within a radius of two miles (3.2 km.) and within one mile (1.6 km.) from the Stoughton substation.

This station was supplied by a three-phase transmission line about 12 miles (19 km.) long and operating at 13,200 volts, 60 cycles. The line consisted of three No. 4 wires, and the construction was overhead through most of the distance, but a mile and a half of it was underground. The underground section very definitely limited the carrying capacity of the line due to the possibility of danger from overheating. The problem was therefore how to supply this increased load with facilities at hand. The only means seemed to be an improvement of power factor. Such an improvement would reduce the current flowing in the line and thereby cut down both the voltage drop and the transmission losses.



FRONT VIEW STATIC CONDENSER AND CONTROL APPARATUS, STOUGHTON SUBSTATION

A survey of the locality revealed the fact that no customers' installations appeared to offer the advantageous location of synchronous motors, and no changes in customers' premises seemed possible which would raise the power factor of the central station sufficiently to help in solving the problem.

ADVANTAGES OF STATIC CONDENSERS

In considering the choice between the synchronous condenser and static condensers located at the substation, the static condensers were decided upon owing to many advantages which were anticipated. The static condensers could be set up without a special foundation and placed in such relation to the switchboard that the wiring problem was a simple one. The condensers needed no attention other than connection or disconnection from the line. They required no maintenance as there are no wearing parts. The losses, however, were guaranteed to be less than 1 per cent. The construction was such that the condensers could easily and cheaply be disassembled and assembled again in some other location.

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The chief drawback to the use of static condencers appeared to be the fact that the corrective effect cannot be readily changed according to changing loads. This disadvantage was partially overcome by ordering the desired capacity in two units, thereby allowing the connection of either one-half or the whole capacity as desired.

Two sets of 200 kva. each were therefore installed. The result may be briefly stated as follows: The load varied from 700 kw. to 780 kw. Without the condenser the average power factor was 70 per cent, giving 1,057 kva. with a voltage of 12,400. The connection of the condenser raised the power factor to 90 per cent, giving 822 kva. with a voltage of 12,850. These results checked very closely with the original calculations. The annual savings in transmission-line losses are estimated at 235,000 kw.-hr. The financial aspect of this installation may be roughly shown as follows:

Cost of 400-kva. capacity	$7,200.00	
Expense of transportation and installation	300.00	
Cost of set installed		$7,500.00
Annual fixed cost, 15 per cent		1,125.00
Increased capacity made available in Stoughton, 300 kw. Value of capacity, 300 kw. at $50 per kw. ($50 per kw. taken as the cost of transmission and conversion investment.)		15,000.00
Annual fixed cost, 15 per cent		2,250.00
Reduction in losses, 225,000 kw.hr.		1,687.50
Annual saving		3,937.50
Annual cost		1,125.00
Net annual saving		2,812.50

This static-condenser installation was described in an article by W. A. Forbush in the *Stone & Webster Journal*, March, 1919.

Data on Lamp Operation and Maintenance

Records Are Kept Which Show the Life of All Lamps Used in Park System—Faults in Supply Apparatus Are Detected by Lamp Records—Data Indicate that Life of Lamps Depends Greatly on Switching in Circuit

BY C. H. SHEPHERD
Electrical Engineer, Commissioners of Lincoln Park, Chicago

IN THE operation and maintenance of street-lighting systems employing large, high-efficiency units it is essential that adequate operating records be kept of all units installed, both for checking the guaranteed life of the lamps and for determining the engineering data applying to these units under actual service conditions. Individual lamp records may lead to the detection of faults in compensators or transformers which, unnoticed, would rapidly destroy the lamps. Data thus far obtained by the writer indicate an unexpected curtailment of lamp life due to normal switching in the lamp circuits.

To keep these records requires close coöperation between the maintenance and operating departments, but by proper systematizing the operation of the record system becomes to a large extent automatic, requiring only that each man keep up his particular part of the records. This, if it is properly done, takes only a very small part of each man's time. The separate parts of the records, while each is made out by a different man, may be so interlocked and correlated that at the end of each month or year, as the case may be, the recapitulation of all the records requires a very short time.

Extensive Use of Lamps

Such a system has been evolved for the electrical department of the Commissioners of Lincoln Park, Chicago. This organization supplies power, light and water to the entire Lincoln Park system, comprising six parks —namely, Lincoln, Lake Shore, Seward, Stanton, Hamlin and Welles—with a total area of 630 acres (250 hectares) and with about 22 miles (35 km.) of boulevards, including the world-famous Lake Shore Drive and Sheridan Road. The outside lighting requires at present 1561 gas-filled tungsten 400-cp., 15-amp. lamps, operating on eighteen series, 60-cycle, 7.5-amp. circuits, each with its individual transformer and regulator. Special outside lighting requires about 300 special multiple, large-sized units and floodlamps from the 1000-watt size down, while the inside lighting comprises some 6500 outlets of various sizes. The series lighting was at one time accomplished by arc lamps, but this has now been changed. Since then the results obtained from the incandescent units have amply justified the change, because savings in operating costs since 1914, when the changes were begun, have paid the cost of the substitution several times over. The records published here cover four years of actual operation since that time.

System of Recording Lamp Data

When lamps are received from the factory they receive an individual test, and all defective lamps are rejected. The good ones are placed in storage and are drawn out as they are required for replacements.

When a lamp is placed in service it is designated by the location of the particular standard on which it is placed and is noted on a record card (Fig. 1). On the face of this card is recorded information covering the location, circuit, make, size, filament and principal dates of the installation, while on the back of the card are recorded the electrical data on the compensator or transformer serving this particular lamp, including the ratio of transformation of the unit, the primary reactance, etc. This card is held on file until the lamp burns out or is replaced for any other reason, at which time the closing entries are made on the card.

The burn-outs are recorded on the outage report (Fig. 2), which is filled out daily, first by the patrolman, who records the outage, and later by the trimmer, who records the replacement. These records are made out in duplicate, the original remaining on the operator's file, the copy being taken out in the morning by the trimmer and returned in the evening as part of his daily report. From this report the operator completes the filling out of the record card, after obtaining the data on the life of the lamp.

The figures covering the data on the life of the lamp naturally depend on the daily length of run of the cir-

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cuit on which the lamp is operating. The length of run in turn depends on the time of cutting in and cutting out the circuit each day. This time is entered each day on the daily substation load record, together with such other data as may affect the operation. From this record the daily length of run is entered on the monthly trimming schedule. From the first to the last day of each month the daily length of run is recorded and a progressive total is carried through for each month on the length of run of each particular

POST No. 1 2nd lamp west of High St. N. S. Diversey TYPE "C" RECORD 1. 29

MAKE	SIZE	FILAMENT	LOCATION	INSTALLED	BURNT OUT	HOURS RUN
W.H.	400 C.P.	1	Div. Pk. Way	9-11-15	2-4-16	1740
"	"	"	"	2-5-16	5-18-16	852
"	"	"	"	5-19-16	1-2-17	1965
W.E.	"	"	"	2-3-17	3-4-17	800
W.R.	"	"	"	3-5-17	7-5-17	1169
"	"	"	"	7-6-17	3-2-18	2490
"	"	"	"	3-3-18	8-19-18	672
"	"	"	"	8-20-18	1-9-19	804
Col	"	"	"	1-10-19		
				E. H. Shaffner		
		573		ELEC. ENGR. IN CHARGE		

FIG. 1—RECORD CARD GIVING INFORMATION CONCERNING LAMPS AT GIVEN LOCATION

circuit. Knowing the date of installation of any lamp and the length of run of its circuit from that date to the time the lamp is renewed, month by month and also daily, it is apparent that it is a comparatively simple matter to figure up the life of any lamp.

The date of renewal and the life of the lamp in hours are then entered on the lamp card, together with the data on the replacing lamp, after which the whole process starts all over again.

VALUE OF RECORD FOR EACH INDIVIDUAL LAMP

While these processes may at first appear to be more or less complicated, still the operation of any system becomes a matter of routine as the men doing the work become more accustomed to it, and it has been found that the recording of the performance of each and every lamp, compensator and transformer often results in the discovery of irregularities which would otherwise result in serious losses and which might run on indefinitely without being found out. The equipment necessary to carry on such a system costs very little; the time required to carry it on is dovetailed into the work of the various men in such a way that their other duties are not affected, and the results obtained more than justify the expenditure incurred, from any point of view.

In order to illustrate the nature of the life data obtained from the actual workings of this system, there is presented here a monthly summary and the progressive totals covering the number of lamps used, the corresponding lamp-hours and the average lamp life in hours. The various makes of lamps are designated by the letters A, B, C, D and E. From an inspection of the various figures it is evident that the presentation of these data in graphical form would show a number of points which might serve to further the analysis of the data. Since the lamps in question have been operated on circuits running all night, or approximately 4000 hours per year; half night, or about 2200 hours per year, and alternate, or about 3100 hours per year, all ordinary conditions of operation are represented, all of which tends to maintain a true average. The record of lamp-hours during any given period supplies a stable basis in the determination of unit costs. Knowing the cost per lamp, the calculating of unit material and total costs is facilitated.

The keeping of apparatus records in conjunction with the lamp records offers an easy method of checking the

LIFE DATA FOR INCANDESCENT STREET LAMPS—FIVE DIFFERENT MAKES—LINCOLN PARK, CHICAGO

	A		B		C		D		E	
	No. Lamps	Average Life	No. Lamps	Average Life	No. Lamps	Average Life	No. Lamps	Average Life	No. Lamps	Average Life
1915	158	1454	299	1185	....	....	....	....	....	....
1916	546	2924	1020	1555	87	296	....	....	....	....
1917	543	3560	768	1251	1490	987	....	....	....	....
1918	108	6102	2218	1276	346	2651	14	4614	126	1279
Total, 1915-1918	1355	3261	4305	1333	1923	1252	14	4614	126	1279

Total number lamps to date 7,723
Average life in hours 1,662

performance of this apparatus and provides a sure and ever-present indication of any trouble occurring—or, in many instances, on the point of occurring—on such equipment.

AN INTERESTING DISCOVERY

An interesting point which was discovered in analyzing the life records is that in a preponderant number of cases lamps installed on the same date, on circuits operating all night, half night and alternate, will not give the same life but will burn at approximately the same date. This would seem to indicate that the life of a lamp operating under these particular conditions depends to a large extent on the number of times the

THE COMMISSIONERS OF LINCOLN PARK
ELECTRICAL DEPARTMENT
DAILY TYPE C. LAMP OUTAGE REPORT DATE Jan 4-1918

CIRCUIT	TYPE & FIL OF LAMP BURNED OUT	TYPE & FIL OF LAMP ON	DATE OF BURNED OUT LAMP INSTALLED	LIFE OF BURNED OUT LAMP	LOCATION
R52	W E A	W E A X	1-4-18	Defective	1 N. Wayeland E. S. Sher Rd
R38	" " "	" " " X	10-22-17	866	3 N. Hawthorne E S " "
R1	W E V	" " " X	8-22-17	1727	N Lamp Concrete Pl, triangle
G39	W E A	" " " X	11-9-17	843	Arlington & Lake View
G27	W E I	" " "	12-12-17	331	W of boat pl.

FIG. 2—OUTAGE RECORD FOR DETERMINING LAMP LIFE

Reverse side of card states that lamps operated from compensator No. 2331, which on test showed 7.5 amp. primary and 15 amp. secondary current, giving an accurate ratio at a load of 256.5 watts.

lamp in question is cut in and cut out—to a greater extent perhaps than on the number of hours of actual operation.

Records of this nature are capable of extensive analysis. The fact that these records are taken from actual operation, under any and every kind of operating condition, makes them especially valuable as an adjunct to the results which are obtained in the experimental laboratory.

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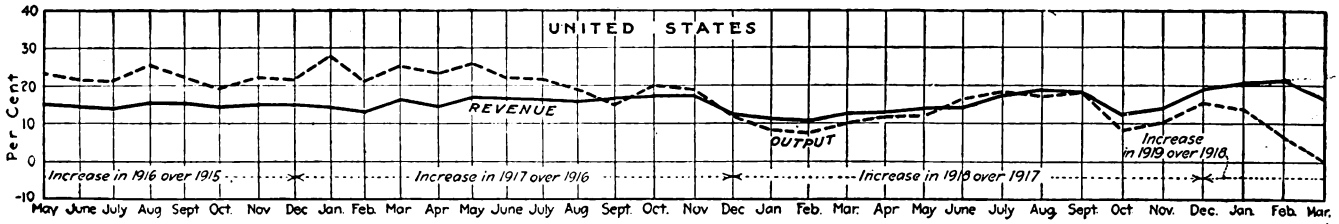
Central Station March Operations



CURTAILMENT IN INDUSTRIES CAUSED A SLIGHT DECLINE IN OUTPUT, BUT REVENUE CONTINUED TO GAIN

CURTAILMENT in industries in March affected the returns of central stations for that month. Reports received by the ELECTRICAL WORLD from central stations representing 52 per cent of the industry show a slight decrease in output as compared with March of the preceding year. The reduction is but 0.1 per cent, and of course it may be altered by the full returns from the larger proportion of the industry usually represented in the compilation. One-tenth of 1 per cent is insignificant. In total sales aggregating 1,200,000,000 kw.-hr. a fraction of 1 per cent does not mean much alteration in volume of output. The demand upon central stations is still enormous, and it will grow in spite of any momentary halting due to inactivity in industries here and there.

The cessation of war preparations meant necessary changes in industries, in many cases abrupt. Plants which had been operating under pressure to turn out materials for the war could not be converted over night into peace-time enterprises. Some of the large central-station properties showed decreases in February as a result of the lack of markets for the output of their heaviest consumers of energy. Others had a lessening of demand that foreshadowed possible reduction. Since the development of these changes little if any improvement has taken place in such industries as copper and iron and steel. It is evident that recession went still further in these or in other industries in March.

It is a great source of strength to the central-station industry as a whole that its service is rendered to all industries. Though its output is therefore in proportion to the entire industrial activity of the nation, its service is just as adaptable to the approaching stupendous needs of peace as it was for the war.

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Industry Represented	Revenue from the Sale of Energy			Kw.-Hr. Output		
		1918	1917	Per Cent Increase	1918	1917	Per Cent Increase
Apr.	60	$25,864,000	$22,966,000	12.6	1,450,221,000	1,294,561,000	9.4
May	62	25,365,000	22,426,000	13.1	1,537,527,000	1,297,843,000	11.5
June	60	26,070,000	22,599,000	15.3	1,531,099,000	1,372,935,000	11.9
July	56	21,935,000	18,559,000	18.2	1,370,461,000	1,319,444,000	16.0
Aug.	61	26,891,000	22,690,000	18.5	1,647,510,000	1,156,692,000	18.5
Sept.	60	28,051,000	23,810,000	17.8	1,579,149,000	1,417,150,000	16.3
Oct.	56	26,254,000	23,228,000	13.0	1,517,866,000	1,348,820,000	17.0
Nov.	57	29,883,000	25,894,000	15.4	1,528,836,000	1,392,359,000	9.0
Dec.	56	32,058,000	27,128,000	18.1	1,539,161,000	1,383,747,000	10.5
		1919	1918		1919	1918	
Jan.	57	33,294,000	27,589,000	20.6	1,522,660,000	1,369,542,000	12.3
Feb.	54	28,130,000	23,162,000	21.4	1,249,806,000	1,157,275,000	7.9
Mar.	52	25,027,000	21,392,000	16.9	1,207,373,000	1,208,683,000	—0.1

While output showed a slight decline, revenue for March continued to maintain an increase. The gain of 16.9 per cent in revenue is the logical outcome of rate increases made to offset the higher cost of production. Electric utilities need to be financially strong in order to borrow the capital they need for expansion.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States			Atlantic States			Central States			Pacific and Mountain States		
		Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase	Percentage of Industry Represented	1918	1917	Per Cent Increase
REVENUE	April	62	$2,890,000	$2,578,000	12.1	59	$10,054,000	$8,946,000	12.4	53	$8,431,000	$7,103,000	18.7	84	$4,489,000	$4,339,000	3.5
	May	62	2,810,000	2,530,000	11.5	64	9,929,000	8,613,000	15.3	53	8,217,000	6,956,000	18.1	83	4,805,000	4,327,000	12.0
	June	63	2,925,000	2,584,000	13.3	63	10,048,000	8,761,000	14.7	49	8,124,000	6,824,000	19.0	84	4,973,000	4,432,000	12.2
	July	62	3,037,000	2,511,000	20.9	62	9,278,000	7,961,000	16.5	42	4,998,000	4,116,000	21.4	88	4,622,000	3,971,000	16.4
	Aug	63	3,138,000	2,585,000	21.4	63	10,147,000	8,722,000	16.3	51	8,223,000	6,823,000	20.5	85	5,383,000	4,560,000	18.0
	Sept	64	3,268,000	2,811,000	16.2	57	10,143,000	8,631,000	17.5	51	9,251,000	7,703,000	20.1	86	5,389,000	4,665,000	15.5
	Oct	63	3,360,000	3,036,000	10.6	51	8,822,000	7,924,000	11.3	50	9,218,000	7,848,000	17.4	81	4,854,000	4,420,000	9.8
	Nov	64	3,695,000	3,238,000	14.1	55	11,877,000	10,400,000	14.2	50	9,277,000	7,704,000	20.4	81	5,034,000	4,552,000	10.6
	Dec	64	4,097,000	3,449,000	18.7	55	11,927,000	10,199,000	16.9	50	10,781,000	8,836,000	22.0	79	5,253,000	4,644,000	13.1
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan	63	4,253,000	3,443,000	23.5	60	13,444,000	11,168,000	20.3	47	10,410,000	8,484,000	22.7	77	5,187,000	4,494,000	15.4
	Feb	63	3,895,000	3,048,000	27.7	53	10,894,000	8,943,000	21.8	45	9,305,000	7,484,000	24.3	73	4,036,000	3,618,000	11.5
	March	63	3,573,000	3,008,000	18.7	52	9,856,000	8,666,000	13.7	40	7,737,000	6,330,000	22.2	75	3,861,000	3,388,000	13.9
KW.-HR. OUTPUT			1918	1917			1918	1917			1918	1917			1918	1917	
	April	62	117,416,000	101,888,000	15.2	59	497,460,000	431,786,000	15.2	53	437,054,000	392,304,000	11.4	84	399,126,000	372,465,000	7.1
	May	62	121,751,000	105,601,000	15.3	64	512,202,000	455,977,000	12.3	53	441,202,000	404,560,000	9.0	83	462,372,000	406,797,000	13.6
	June	63	125,809,000	103,292,000	21.8	63	527,773,000	461,396,000	14.4	49	423,439,000	366,382,000	15.5	84	454,078,000	388,374,000	16.9
	July	62	135,960,000	105,373,000	29.0	62	518,566,000	439,464,000	18.0	42	254,189,000	216,296,000	17.5	88	461,746,000	395,559,000	16.7
	Aug	63	143,566,000	114,017,000	25.9	63	567,672,000	490,505,000	15.7	51	447,829,000	399,278,000	12.1	85	488,433,000	413,350,000	18.1
	Sept	64	133,901,000	114,279,000	17.1	57	520,312,000	445,154,000	16.8	51	471,594,000	408,320,000	15.5	86	453,342,000	381,067,000	18.9
	Oct	63	139,784,000	128,970,000	8.3	51	481,222,000	440,268,000	9.3	50	479,990,000	442,054,000	8.5	81	416,870,000	381,067,000	9.4
	Nov	64	138,559,000	123,033,000	12.6	55	542,699,000	495,812,000	9.4	50	444,012,000	396,665,000	11.9	81	403,566,000	368,237,000	9.6
	Dec	64	145,543,000	129,838,000	12.1	55	475,253,000	421,973,000	12.6	50	489,864,000	443,544,000	10.4	79	428,906,000	374,187,000	14.6
			1919	1918			1919	1918			1919	1918			1919	1918	
	Jan	63	143,254,000	124,632,000	14.9	60	525 322,000	458.545,000	14 5	47	463,394,000	403,127,000	14.9	77	390,690,000	371,156,000	5.2
	Feb	63	128,660,000	109,993,000	17.0	53	406 702,000	374 958,000	8 4	45	426 965,000	378,912,000	12 6	73	287,479,000	293,492,000	—2.0
	March	63	123,044,000	121,248,000	1.4	52	384 605,000	396 850 000	—3 1	40	389,379,000	375 200,000	3.6	75	310 345,000	315,385,000	—1.6

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STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

PRIMARY CONNECTIONS MADE WITH IRON PIPE

Hog Island Substation with Capacity of 24,000 Kva. Is One of Many Built in War Time and Found Satisfactory

The 24,000-kva., 66,000-volt outdoor substation at Hog Island is one of the many substations built during the war in which iron-pipe conductors are used. In that installation all primary connections except those to transformer terminals were made of iron pipe. Other companies in different parts of the country used iron pipe for high-tension busbars and for primary connections in substations. The practice has proved so satisfactory that many companies are continuing to use iron pipe for these purposes, though the war restrictions on the use of copper have been removed. The iron buses on outdoor substations are usually galvanized.

BOILER-SCALE PREVENTION

Pounds of Coal Wasted per Ton Fired with Boiler Scale of Different Thicknesses

Professor Schmidt of the University of Illinois has conducted an extensive investigation into the decrease in boiler efficiency due to scale, with these results:

TABLE I—EFFECT OF SCALE ON BOILER EFFICIENCY

Character of Scale	Average Thickness of Scale in In.	Composition of Scale	Loss of Efficiency, Per Cent
Hard	1/50	Mostly carbonate	5.4
Soft	1/32	Mostly carbonate	7.2
Hard	1/32	Mostly carbonate	8.5
Soft	1/25	Mostly carbonate	8.0
Hard	1/25	Mostly sulphate	9.3
Hard	1/20	Mostly sulphate	11.1
Soft	1/16	Mostly sulphate	10.8
Soft	1/16	Mostly carbonate	11.0
Soft	1/16	Mostly carbonate	12.4
Hard	1/16	Mostly carbonate	12.6
Soft	1/11	Mostly carbonate	15.0
Hard	1/9	Mostly sulphate	15.9

The first thin layer of scale was found to be the most injurious, because the insulating effect varies as the square root of its thickness. To show the loss due to the insulating qualities of the scale, in terms of coal, Table II has been compiled.

Instead of allowing scale to form, however, engineers endeavor to eliminate the scale-forming elements before the water enters the boiler. The use of boiler compounds helps conditions, but they seldom, if ever, accomplish really satisfactory results. If the compound is a chemical and reacts on the scale-forming material in the water, it may be expected to change this material into what is commonly known as sludge. When this occurs the sludge is deposited on the boiler heating surfaces as a soft mudlike substance which is not scale but which has an insulating effect and which, if excessive, may actually result in burning the plates of the boiler. To avoid its becoming excessive the boiler is blown down frequently, which causes a direct loss of heat and waste coal.

The ideal condition is perfect cleanliness, and after figuring the losses due to scale and the cost of removing it the treatment of the feed water seems the logical solution in most cases. An investigation of the cost of proper water treatment generally points to its being a very profitable investment, even when the water is as pure as that obtained from Lake Michigan.

TABLE II—COAL WASTED BY BOILER SCALE

Average Thickness of Scale in Inches	Coal Lost from Every Ton Fired, Lb.	Average Thickness of Scale in Inches	Coal Lost from Every Ton Fired, Lb.
1/50	100	1/16	220
1/32	140	1/11	300
1/25	180	1/9	320
1/20	200		

COILS OF TRANSFORMERS CLEANED AFTER REPAIRS

An Arrangement Devised for Giving Coils a Bath of Hot Oil to Remove Foreign Substances Before Reassembling

After making some repairs on the primary and secondary coils of a 5000-kw., 100,000-volt transformer at one of its substations, the Union Electric Light Company of St. Louis devised a scheme of washing the coils before they were placed back in the case. Strong timbers, measuring about 4 in. by 4 in. (10 cm. by 10 cm.), were used to clamp the coils in a permanent position to permit their being handled without injury. The coils were then suspended from a crane hook at such angle that oil would flow through from one end of the coil assembly to the other and wash the exposed surfaces. The crane held the coils about 10 ft. (3 m.) above the floor and the oil which was poured in at one end was collected in a suitable receptacle when it came out at the other end.

The oil-circulating outfit consists of a heater and a filter press. The heater, which was a 1000-watt inclosed-wire oven unit connected to a 110-volt circuit, was placed in the oil tank. This kept the oil hot while it was being circulated. The oil coming from the press was run through the coils, and as it came out was collected in a tarpaulin which was arranged to serve as a half funnel to drain the oil into a 50-gal. steel oil drum with the head knocked out. This arrangement is said to have worked successfully in removing foreign matter from the coils.

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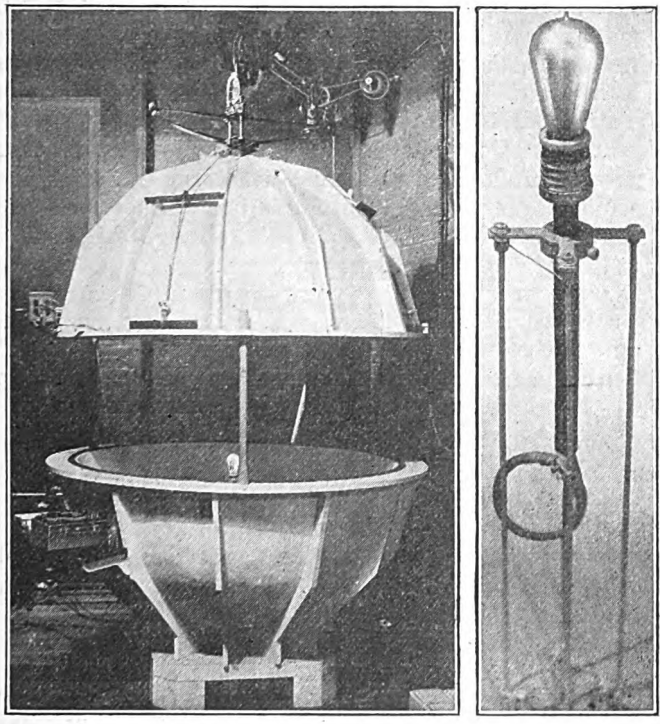
HOME-MADE PHOTOMETER SAVES MONEY FOR UTILITY

Spherical Photometer, Built Under Supervision of Utility Lighting Department Officials, Satisfactory in Operation

A spherical photometer 5 ft. (1.5 m.) in diameter was recently designed and built by the Hartford (Conn.) Electric Light Company, under the supervision of Harry L. Thomson, head of the lighting department, and H. J. Blakeslee. The cost of building this photometer was $425, compared with market quotations of around $700 for equipment of the same size.

A special feature of the photometer is its horizontal subdivision into two halves, the upper half being arranged for raising and lowering by a ¼-hp. motor in about twelve seconds. The photometer can be easily controlled by one observer seated beside the lower rim. A reversing switch mounted below the rim stops the motor and enables the upper half to be held at intermediate positions if desired. A Sharp-Millar photometer is mounted on the upper hemisphere so that the eyepiece of the telescope is brought to a convenient height when the sphere is closed on a felt pad 0.125 in. (3-mm.) wide and 0.25 in (6-mm.) thick.



FIGS. 1 AND 2—PHOTOMETER AND ADJUSTABLE HOLDER FOR LAMP

The combination lamp standard and conductor lead rack (right) is adjustable for purpose of centering lamps in sphere. Upper half of complete photometer (left) is raised and lowered by ¼-hp. motor, which is shown with limit switch, etc., on ceiling. The Ford automobile spring absorbs the shock to the top section when stopping at upper limit. Measuring instruments for photometer are to the left of the picture.

The hemispheres were built up by interconnecting 5-in. by 0.875-in. (127-mm. by 22-mm.) pine ribs with wire lath and plastering the latter to a thickness of 1.25 in. (32 mm.). The inside was given two or three coats of white lead paint. The surfacing was accomplished by rotating a wooden quadrant with a metal cutting edge about the axis of the sphere and great care was taken to produce a smooth surface. The wooden framing is supplemented by four sets of 1.5-in. by 1.5-in. by 0.125-in. (38-mm. by 38-mm. by 3-mm.) angle-iron cross-braces tied to the supporting top by 0.312-in. (8-mm.) stranded copper cables. The upper hemisphere weighs about 300 lb. (136 kg.), is counterbalanced by a cylinder filled with sand and travels vertically through 28 in. (71 cm.) The axial lamp standard consists of four brass rods terminating in spiders at top and bottom. The test-lamp base is supported on a piece of piping adjustable up and down in the spider ring to center different sizes and types of lamps properly.

HANDLING EMERGENCIES AND PROFITING BY EXPERIENCE

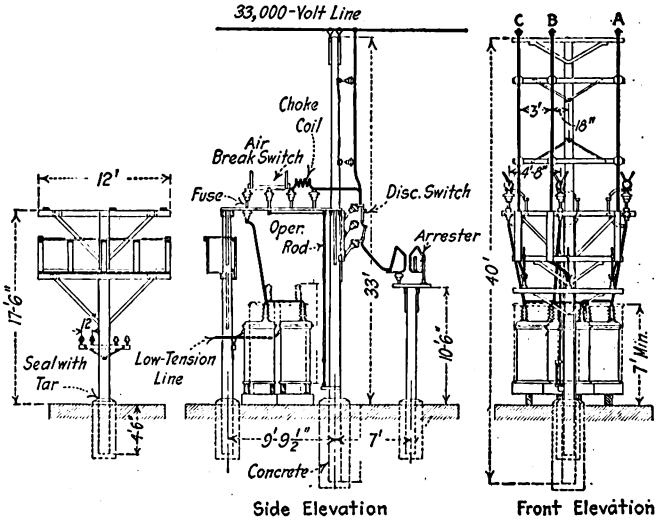
A Few Reminders That May Not Be Amiss, and Suggestions of Information That Should Be Collected Immediately After Disturbance

When trouble occurs the operator should take time to think, decide what he is going to do, and do it quickly and accurately. He must not be influenced by alarming reports of inexperienced persons or those not connected with the operation. Operating attendants should, when not engaged in other matters, try to anticipate the effects of different trouble and decide beforehand what to do under such emergency conditions.

After a disturbance on the system or an interruption of service the following information will be required: Exact time of interruption, load in kilowatts at that time, nature of interruption (state whether total or partial loss of load or simply disturbance unaccompanied by loss of load), nature of trouble (state whether ground, short circuit or open circuit and on what part of system), cause of trouble if known, details of action of relays in station, details of all switching done in trying out and restoring service with time noted, particulars of connections used in restoring service, cause of delays if any, damage if any to apparatus in station and suggestions which may prevent future trouble.

Pole-Type Substation Used for 33,000 Volts

The illustration shows a recently standardized 33,000-volt outdoor substation in which the supporting structure consists of only one line pole and one stub. The dimensions allow for the use of three 150-kva. transformers, but by increasing the height and placing the poles further apart this station can be made to accommodate transformer installations up to 600 kva.



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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

THE COMPARATIVE COST OF ELECTRIC LIGHTING

Small Expense of Lighting a Household as Contrasted with Other Costs in These Days Pointed Out by H. W. Peck

In these days of high living cost comparisons of electric lighting expense with other items in the household budget make a strong case for the central station. H. W. Peck, vice-president and general manager Schenectady Illuminating Company, in a recent interview in the Schenectady *Gazette*, pointed out that during the last year the average bill of lighting customers, exclusive of the business section, was $1.98. He compared this with various commodity costs as follows:

Commodity	Yearly Bill	Daily Average Cost
7 tons of coal at $10 per ton	$70.00	$0.192
Milk, 1 qt. a day	54.75	.15
Bread, one loaf a day	47.45	.13
Car fare, two trips daily per family	36.50	.10
Telephone	30.00	.082
Ice, twenty-four weeks, 150 lb. a week, 80 cents per 100 lb	28.80	.171*
Electric service	22.67	.062

* The daily cost of ice is calculated on the basis of days refrigeration is used.

Mr. Peck also gave the average cost of appliances per month, determined by special meter installations or by calculation, as follows: Electric iron, 50 cents; electric toaster, 40 cents; electric washing machine, 50 cents; electric mangle, 50 cents; electric vacuum cleaner, 25 cents; electric range, $4.

ADVERTISING VALUE OF SOCKET DEVICES

Even Though Requiring Only Small Amounts of Energy, They Help to Teach the Public to "Do It Electrically"

In considering central-station sales policies the wisdom of pushing particular lines of socket devices is sometimes questioned. The value of appliances requiring inputs of hundreds of watts each or utilized for protracted periods at fairly regular intervals is seldom disputed. When one comes to the class of equipment driven by fractional-horsepower motors and used intermittently, or consuming for stationary service of some sort anywhere from a few watts up to 50 or 100, some hard-headed director is likely to put the question, "Why waste effort on apparatus of such modest earning power at the meter?"

The answer is not far to seek. The advertising value of electrical methods, even in such small devices as automobile radiator warmers, pencil sharpeners, bell-ringing transformers, electric clocks and numerous other conveniences of low revenue yield on the monthly bill, is very large. It is probably impossible to estimate accurately the missionary work which such appliances accomplish when in service. They give point to the slogan "Do it electrically," and arouse the interest of the public which comes in contact with them as most other means of exploitation cannot.

Passing to bulkier devices, the same thing is true. While washing machines and vacuum cleaners, for example, are small consumers of energy, it is advisable to push their sale, because many such devices installed on a single system create a desirable total kilowatt-hour output and by saving their users genuine physical weariness develop a good will toward things electrical which is of immense value. Where such equipment is distributed to the public at the full retail price, the central station takes advantage of the fact that the greater profit from such sales will carry the expense of selling larger energy consumers but smaller profit-per-sale devices.

RATE EXPERT DISCUSSES FUTURE OF EMERGENCY RATES

Until Readjustments in Cost Take Place, Commissions Are Justified in Maintaining Temporary Relief Measures for Indefinite Period

"What constitutes the so-called war emergency in utility rate matters has been a subject for wide divergence of opinion, and the measure of relief afforded is as variable as the range is wide," said E. F. McKay, rate expert for the Empire Gas & Fuel Company, speaking before the Oklahoma Public Utilities Association. The Georgia commission, considering a rate appeal, said: "If, because of war, the operating expenses of a public utility are increased to such an extent (with reasonable certainty that still further increases are inevitable) that after paying the same the remaining revenues are insufficient to provide for the reasonable preservation of the property in use, the payment of government charges, such as taxes, public improvement assessments, interest on lawfully issued bonds, contractual obligations such as reasonable rental for property used and necessary in its business, but not owned, and such a reasonable return upon owned property in use as will sustain its credit, a combination of such circumstances exists which calls for immediate action or remedy." And then this commission added: "It follows that when such a combination of circumstances no longer exists the necessity for emergency relief ends. Emergency rates, therefore, should be temporary and only for the period of abnormal conditions which necessitates them."

"Several commissions have attempted to forecast the probable duration of war conditions," continued Mr. McKay, "and have been so sure of the accuracy of their respective forecasts as to limit the effectiveness of relief orders in accordance therewith. The period forecast varies in different jurisdictions from sixty days to three years." Mr. McKay added:

The Missouri commission in numerous cases limits effectiveness of emergency rates to one year. Nebraska last

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summer thought six months would see the emergency over for telephone companies. New Hampshire saw the same period of emergency for electric utilities, while Oregon considered the six-month emergency period correct but applied it to gas utilities. Indiana thinks two years sufficiently soon to expect recovery. Pennsylvania, in a telephone case, puts the emergency at three years and in a water case says war costs will prevail for several years thereafter. California says all war-time rates are abortive and indicates a discreet disinclination to going on record. A majority of the states, including Oklahoma, have made emergency rates effective indefinitely. The advances in these states are permanent unless or until the new rates are challenged and, on order after hearing and due showing, superseded.

If it were true that an automatic readjustment of conditions constituting the war emergency could have been expected with cessation of fighting in Europe, the time limit or rate and other relief measures would have been logical, but with the impossibility of such readjustment, either automatic or otherwise, until cost of fuel, transportation of fuel, supplies and transportation of supplies, and cost of labor shall have resumed a normal level, assuming pre-war costs to be normal, it is clear that there cannot be a revision to pre-war rates without injustice to the utilities and impairment to the public interest

CENTRAL-STATION POLICY ON UNDESIRABLE LOADS

Business Should Be Taken Despite Its Nature if Central Station Is to Fulfill Its Functions—Ultimate Results Beneficial

BY C. I. CRIPPEN*

The modern central station has a very definite function to perform in its territory; namely, to serve with its product all those who have need for such a commodity. It is granted by leading operators that the future prosperity of the central-station companies lies in carrying out this ideal by increasing the use and density of business within a given area. In practically all communities one of the larger fields, if not the largest, of load is industrial business, lighting, motor service and electric heating, including welding. It follows then that if the plants are to progress toward their ultimate goal, the loads that are available must be taken care of. This naturally includes the industrial load, a part of which is the electric welding load. Some of this welding business is not particularly attractive in itself, and central-station companies would not care to load up their plant with it; but it is a minor part of the industrial load, so it is very good policy to include the whole load, thus doing the things for which the central stations are in business.

It often happens that service for welding installations offers the entering wedge into a plant which it has been impossible to place on the line. Given this start, the alert commercial man will enlarge the opportunity as occasion permits, until with good service and fair treatment the entire plant is being supplied. Take the case of a manufacturer operating a direct-current plant for motors and light. He sees that the installation of a spot welder will eliminate a riveting operation with an apparent decrease in cost and an improved product. He requires alternating current to run the welder. The central-station company might be loth to take the business on account of its low load factor, poor power factor and low earning power. However, it would be wise to accept the business of the welders, then night lighting may follow, then a few motors may be put on, and later the whole plant load may be taken over, making a valuable addition to the central-station load.

*This information was presented by Mr. Crippen before the Ohio Electric Light Association at Youngstown, Ohio.

STATEMENT OF THE RATE SITUATION IN ILLINOIS

Public Utilities Commission in Its Defense Before Senate Committee Compares 1914 and Present-Day Conditions

The Illinois Senate committee on public utilities on May 7 requested the Public Utilities Commission of that state to make a reply to criticisms passed upon it and to give also any information concerning the administration of the public utilities law generally and with particular reference to emergency rates made during the war. In complying with this request the commission answered all complaints with facts and responded with data on administration of the law. The report also includes some observations on the so-called "home rule" of public utilities. Two tables that are included in the data represented are reprinted in part here.

TABLE I—COMPARISON OF RATES FOR ELECTRIC SERVICE

As of Jan. 1, 1914, 1918 and 1919, in cities of over 1000 population

	Electric Lighting Service Number	Per Cent
Cities in which 1918 rates exceeded 1914 rates	13	5.2
Cities in which 1918 rates were less than 1914 rates	126	50.0
Cities in which 1918 rates were same as 1914 rates	113	44.8
	252	100.0
Cities in which 1919 rates exceeded 1914 rates	115	45.7
Cities in which 1919 rates were less than 1914 rates	102	40.5
Cities in which 1919 rates were same as 1914 rates	35	13.8
	252	100.0
Cities in which 1919 rates exceeded 1918 rates	147	58.1
Cities in which 1919 rates were less than 1918 rates	5	2.0
Cities in which 1919 rates were same as 1918 rates	101	39.9
	253	100.0

Table I shows recent rate movements in Illinois by comparing the rates for electric service for various years—the rates for 1918 with 1914, for 1919 with 1914, and for 1919 with 1918.

TABLE II—RELATION OF EFFECTIVE ELECTRIC RATES WITH FRANCHISE RATES

As of Jan. 1, 1914, 1918 and 1919, in cities of over 1000 population

	Electric Service Number	Per Cent
Cities with rate-restricting ordinances	162	62.0
Cities without rate restrictions in ordinances	87	33.5
Ordinances not available	12	4.5
Total cities considered	261	100.0
Cities in which 1914 rates exceeded ordinance rates	10	6.5
Cities in which 1914 rates were less than ordinance rates	112	72.7
Cities in which 1914 rates were same as ordinance rates.	32	20.8
	154	100.0
Cities in which 1918 rates exceeded ordinance rates	4	2.5
Cities in which 1918 rates were less than ordinance rates	120	76.5
Cities in which 1918 rates were same as ordinance rates.	33	21.0
	157	100.0
Cities in which 1919 rates exceeded ordinance rates	40	24.8
Cities in which 1919 rates were less than ordinance rates	107	66.5
Cities in which 1919 rates were same as ordinance rates.	14	8.7
	161	100.0

Table II gives the relation of rates in effect in the state on various dates to the rates provided for by ordinance.

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Power Supply in Germany.—C. REINDL.—The problem of providing cheap power in spite of the great increase in prices of materials, machinery and labor is discussed, and it is recommended that power machinery should as far as possible be standardized and arranged for high speed and efficiency. Large waterfalls should be assigned to the great chemical industries, which depend entirely upon cheap power, and the smaller ones to electrical transmission lines. A number of small turbine installations can often be built as cheaply as one large one and prove more profitable when continuously feeding a transmission line than would be the case if installed in separate factories, flour mills, etc. Railways should be driven electrically, normally from water power, peak loads being supplied by high-efficiency steam-turbine installations built at the pit. Coal should only be used for heating and the production of gas. The erection of coal-fired power stations for constant service should in future be prohibited, while existing ones should be regarded as stand-by equipment only. Those in conjunction with hydro-power works without storage should, as far as possible, be operated continuously and excess of output taken by hydro-power-stations with water storage facilities. This would effect a saving of 11 per cent of fuel compared with self-contained power stations.—*Technical Supplement to Review of Foreign Press*, April 29, 1919. (Abstracted from *Zeits. für das Gesamte Turbinenwesen*, Feb. 20 and 28, 1919.)

Conservation of Tin in Bearing Metals, Bronzes and Solders.—G. K. BURGESS and R. W. WOODWARD.—Recommendations are made for conserving tin in bearing metals, bronzes and solders by substitution of other alloys with constituents of the alloys. The tables given show the properties of the substituted alloys.—*Technologic Paper No. 109*, Bureau of Standards.

Carbon Brushes Considered in Relation to the Design and Operation of Electrical Machinery.—P. HUNTER-BROWN.—Properties of carbon brushes are discussed and curves are given showing the relation of the contact drop to the current density. A curve shows the coefficient of friction and contact drop at 40 amp. per square inch of a pure graphite brush. The design of brush is also discussed, and methods are shown for making the selection of grades.—*Journal of the (British) Institution of Electrical Engineers*, February, 1919.

A 45,000-Kw. Turbine Generator for Narragansett Electric Light Company, Providence.—This unit is the Westinghouse cross-compound double-unit type, consisting of a high-pressure and a low-pressure turbine, each connected by a flexible coupling to its own generator, having a capacity of 22,500 kw. and mounted on separate plates supported on foundations lying parallel to each other. The unit was designed to operate at a steam pressure at the throttle of 200 lb. (14 kg. per sq.cm.) with 100 deg. (55 deg. C.) superheat and a vacuum of 29 in. (737 mm.) in the exhaust. The generators have a rating of 23,750 kva. at 11,000 volts, three-phase, 60-cycle, at 0.95 power factor, the high-pressure element having a speed of 1800 r.p.m. and the low-pressure element one of 1200 r.p.m.—*Street Railway Bulletin*, March, 1919.

Lamps and Lighting

Transmission of Colored Light Through Fog.—C. L. UTTERBACK.—Measurements were made on thick, medium and slight fogs, but the data given in the paper are for medium fogs only. The fogs studied were produced in air which was filled with dust particles, and it is believed that such a fog is typical of outdoor fogs in the large cities. The data show that the transmission is highest for wave lengths from about 5300 to about 5200 (yellow) and falls off very rapidly toward the red but not so rapidly toward the violet end of the section.—*Transactions I. E. S.*, April 30, 1919.

Some Experiments on the Eye with Different Illuminants.—C. E. FEREE and G. RAND.—In the first part of this paper results are given showing the comparative effect of the following incandescent lamps on the power of the eye to sustain clear and comfortable seeing: The carbon metallized-filament lamp, the tungsten vacuum lamp, the gas-filled lamp and the "daylight" lamp. Welsbach gas mantles of different proportions of ceria and thoria were taken up in the second part, and the results obtained with these were compared with the kerosene flame.—*Transactions I. E. S.*, April 30, 1919.

Generation, Transmission and Distribution

Resistance and Reactance of Three-Phase Armored Cable to Third Harmonics.—SWYNGEDAUM.—When a three-phase star-connected generator is earthed and feeds isolated loads there is a possibility of over-voltages in the system. The third harmonics of the emf. develop synchronous capacity currents in the three conductors of the cable. These currents set up lines of force round the conductors inside the sheathing and outside the cable. In order to predict these surge voltages, it is necessary to know the effective resistance and reactance of the cable. In order to determine the effective resistance and reactance of a cable, a loop was formed with two three-phase cables leading from a substation to a transformer station, and the impedence and effective resistance were determined by the aid of current and pressure measurements. With 3 × 100-sq.cm. cables having 4-mm. lead sheaths and two armorings 0.8 mm. thick, the effective resistance at 50 cycles was about 0.5 ohm per kilometer; *i.e.*, fourteen times the ohmic resistance to direct current. Measurements at frequencies of 50, 150 and 450 cycles showed the resistance to vary almost linearly with the frequency; *i.e.*, according to the law $r = a + bF$. From 0.5 ohm per kilometer at 50 cycles the effective resist-

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ance increases to 0.9 ohm per kilometer at 450 cycles; that is, it is not doubled though the frequency is ninefold. The effective reactance follows a similar law and is about 0.8 r. It is doubtless owing to the powerful damping effect of the metallic sheath of the cable, as regards third harmonics, that so few cases of overvoltage trouble are encountered, notwithstanding the importance and frequency of cases in which the third harmonic is concerned. The values of resistance per kilometer (r) and reactance per kilometer (x) were about 25 per cent higher in the case of cables in the same trench. For the cables tested and for the third harmonic of the fundamental frequency, 50 cycles per second, r varied from 0.67 to 0.78 and x from 0.45 to 0.56 ohm per kilometer.—*Science Abstracts, Section B.* (Abstracted from *Comptes Rendus*, Dec. 16, 1918; *Revue Générale d'Electricité*, Feb. 1, 1919.)

Development of Hydroelectric Installations in Spain.—A large number of applications for concessions for waterfalls varying in capacity from 20 hp. to 3600 hp. have recently been made to the Spanish government. The machinery, etc., required for the smaller installations is to be supplied by Spanish firms, while the higher capacity will probably be obtained from abroad, especially Switzerland. The Chamber of Commerce at Valencia has instituted a public inquiry with a view to the development of the falls of the River Jucar (Albacite) and of the transmission to Valencia of 6400 hp. of electricity. The Sociedad Minera y Metalurgica de Penarroya has installed a number of transport lines for power, one of these, at 70,000 volts, connecting the central station at Penarroya to the hydroelectric plant at Linares, the property of the Compañia Mengamor. Another line, at 30,000 volts, will connect the same central station with Cordoba. Three other secondary lines for the various mine operations of the Penarroya company are now under construction. A Spanish company with a capital of $30,000,000 has been floated for exploiting the falls of the Douro near the Spanish-Portuguese frontier. The power available, estimated at 150,000 hp., will be conveyed to Madrid and Bilboa, and a proposal is on foot to utilize it for electrifying the railways of northern and eastern Spain.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstracted from *Rivista Tecnica d'Elettricita*, Feb. 25, 1919.)

Installations, Systems and Appliances

Large Mercury-Vapor Rectifiers in Hirschberg Electricity Station.—J. OBACH.—The reasons for installing high-power mercury rectifiers in this station are explained, the three-cylinder rectifiers for 750 kw. are described, and the results of the first year's working as regards maintenance, depreciation and efficiency are summarized. It is concluded that, owing to the relatively low first cost, small maintenance and depreciation, and in particular the high efficiency, such ironclad mercury rectifiers have a great future in competition with rotary converters. The three rectifier cylinders are side by side on a common base which accommodates isolating knife switches for the anodes, the supply cables and the cooling outlets. The three rectifiers (750 kw. total) and the vacuum pump occupy about the same floor space as a 100-kw. rotary and weigh only 4100 kg. Details are given of the electrical and water-cooling arrangements. In emergency a water injector supplied from the town mains can be used to accelerate the flow of cooling water. Connections are shown by which the rectifiers are operated in parallel with the rotary converter. Data are given from a year's experience of the rectifiers in service. Such defects as arose were easily corrected and are not likely to recur. The total capital cost of the three 250-kw. rectifiers, including switch gear, accessories and erection, was 56,589 marks. The average over-all efficiency for the year was 90 per cent, including all losses in transformers, induction regulators, auxiliary machines and cables. As regards efficiency, attendance and maintenance, the rectifiers are considered to be much superior to rotary converters and applicable to much larger installations than the present one.—*Science Abstracts, Section B*, Jan. 31, 1919. (Abstracted from *Elektrot. Zeits.*, Oct. 17 and Oct. 24, 1918.)

Ellectricity in Household Service; Motor-Driven Domestic Devices.—T. W. BEHAN.—The writer discusses the general principles of various types of electric washing machines, vacuum cleaners, sewing machines, refrigerating plants, etc. — *General Electric Review*, March, 1919.

Electric Propulsion of Ships.—J. F. NIELSON.—After tracing the transition from the propulsion of ships by reciprocating steam engines to direct-coupled turbine machinery, the author draws attention to the problem presented to marine engineers of how to overcome the antagonism between turbine and propeller efficiencies which led up to the adoption of mechanical, hydraulic and electrical transmission gears. The development of electrical transmission gears is then traced and particulars of recent notable installations of such systems are given in detail. The advantages peculiar to this system are then stated, discussed and compared with the results obtained and guarantees given by the advocates of mechanical gearing. Emphasis is laid upon the greater immunity from total breakdown possessed by the electrical method, owing to the possibility of utilizing a plurality of motor and generator units.—London *Electrician*, April 11, 1919.

Electrophysics and Magnetism

Natural Frequency of a Circuit Containing an Iron-Cored Inductance.—H. G. CORDES.—A mathematical paper in which the natural frequency of an oscillatory circuit containing an iron-cored inductance is treated. An expression in which the effect of eddy currents in the iron has been taken into account is found for the natural frequency of the circuit.—*Science Abstracts, Section B.* (Abstracted from *Proceedings Inst. Radio Eng.*, February, 1919.)

Electrochemistry and Batteries

Electrical Characteristics and Testing of Dry Cells.—This circular summarizes the available information on dry cells. A brief description of materials of construction and elementary theory of the operation of the cells is given. The various kinds and sizes of dry cells are mentioned and electrical characteristics of the cells and methods of testing them are discussed.—*Circular No. 79*, Bureau of Standards.

Electric Smelting of Domestic Manganese Ores.—H. W. GILLETT and C. E. WILLIAMS.—The conclusion to be drawn from this investigation is that although the electric smelting of manganiferous slags and low-grade domestic ores is unlikely to be profitable at times of

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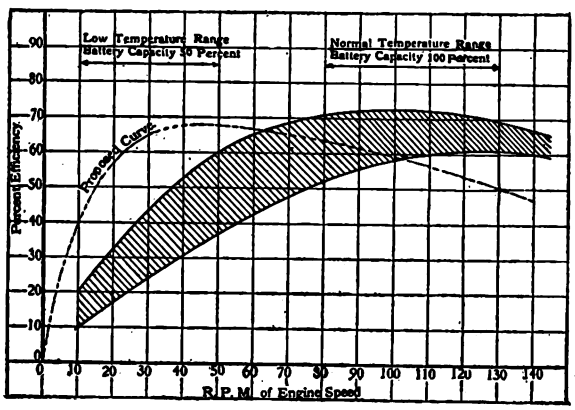
normal costs and prices, such smelting is metallurgically possible and could be done profitably in times of high prices.—*War Minerals Investigations, Series No. 10,* Department of the Interior.

Characteristics of Starting and Lighting Batteries of the Lead-Acid Type.—O. W. OETTING.—The author analyzes the problem of the design of starting and lighting batteries for automobiles to give better performance during the winter months. He points out the fact that the lead storage battery has about 50 per cent of its normal capacity at a temperature of 10 deg. Fahr. and also that the voltage characteristics drop off more rapidly with discharging currents of low temperature than at normal temperature. The suggestion was made to change the characteristics of the efficiency curve of the starting motor so as to increase the total efficiency



HIGHEST EFFICIENCY OF STARTING MOTOR SHOULD OCCUR AT LOW CRANKING SPEEDS

of the starting system for cold-weather conditions. The proposed change is shown in the accompanying curve sheet, indicating that the highest efficiency of the motor should be obtained at lower speed, such as might be experienced in cold weather.—*Electric Journal,* April, 1919.

Telegraphy, Telephony and Signals

The Vertical Grounded Antenna as a Generalized Bessel's Antenna.—A. PRESS.—By taking account of the variable distribution of inductance and capacity along a vertical grounded antenna the general expression for the current at any point of the antenna is obtained. Fo. the case of an antenna having zero current at the top and maximum current at the (unloaded) bottom, the particular solution for current and voltage distribution is obtained.—*Science Abstracts, Section B,* March, 1919. (Abstracted from *Proceedings Inst. Radio Eng.,* December, 1918.)

Electromagnetic Theory of the Telephone Receiver.—By A. E. KENNELLY and H. NUKIYAMA.—In the theory of the motional-impendance circle certain phenomena have been left out of consideration for the sake of simplicity, and especially that component of alternating magnetic flux passing through the coils which is due to the displacement of the diaphragm from its zero position when freely vibrating. The result has been that the motional-impedance circle failed to reveal the power expended parasitically in the magnetic circuit. It was the object of this paper to supply the above-named omission and thus offer a closer approximation between the theory and the observed behavior of the telephone receiver as an electromagnetic motor. The limitations of the new theory are discussed and the magnet circuit and vibrating system are outlined, together with simplified magnetic and mechanical circuits of the bipolar receiver. Other discussions are given on the magnetomotive force damped and free, magnetic flux damped and free, electromotive force damp and free, impedances damped and free and motional electric power damped and free, mechanical velocity damped and free, mechanical displacement, force diagram damped and free, motional electromotive-force diagram, motional impedance and motional power. The effect of the apparent increment in the mechanical resistance is to introduce a slight distortion of the motional-impedance power diagrams from a strictly circular locus, assuming the force factor and other constants to remain substantially the same at all frequencies, but the distortion is not serious from a practical standpoint.—*Proceedings A. I. E. E.,* April, 1919.

Units, Measurements and Instruments

Analysis of Alternating Currents with the Vibration Galvanometer.—A. BLONDEL.—Two cases are compared, (1) in which the galvanometer circuit is non-conductive, (2) in which it contains one or more condensers. In the first case the sensitiveness at resonance varies inversely as the resistance of the circuit, the total (mechanical plus electromagnetic) damping and the frequency. In the second case the sensitiveness is proportional to the capacity and varies inversely as the mechanical damping, but is independent of the frequency. The sensitiveness of the galvanometer to frequencies other than that for which it is tuned is investigated. The suppression of harmonics lower than that being measured is best effected by the condenser circuit. The reverse is the case for higher harmonics. As an illustration results are given from measurements on the wave form of the Paris supply, showing the separation of the thirteenth harmonic. In the practice of the method it is necessary to remember that the mechanical damping varies with the length of the vibrating system and to calibrate the galvanometer for each length it is desired to use. A combination of mechanical with electrical resonance affords more perfect suppression of other harmonics but involves considerably more complication.—*Science Abstracts, Section B,* March, 1919. (Abstracted from *Comptes Rendus,* Nov. 11, 1918.)

Miscellaneous

College of Engineering and Engineering Experiment Station of the University of Illinois.—The value of engineering education in military work is indicated in tables. Charts are also given which show that about 75 per cent of graduates of engineering are directly or indirectly engaged in engineering work. The work of the engineering experiment station is outlined and a list of publications is given.—Published by the University of Illinois, Urbana, Ill.

Publications of the Bureau of Standards.—Summaries of scientific papers, technologic papers, circulars and miscellaneous publications are listed in this bulletin.—*Circular No. 24,* Bureau of Standards.

Industrial Education Survey of the City of New York.—This is the second booklet on inside electrical work and tells about the qualifications and training of electricians together with average wages of union men. It points out the opportunities for young men to enter into the electrical field as electricians and details the sort of work which they are required to do.

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Elimination of the Purple Color in Lamp Globes

To the Editor of ELECTRICAL WORLD:

SIR: It is a fact of common observation that lighting glassware exposed to radiation rich in ultra-violet rays such as are emitted by arc lamps and the sun often assumes a purplish tinge. This color, which is due to manganese, becomes more and more conspicuous as the time of exposure increases. X-rays also develop this purplish tinge in glasses containing manganese. In an article[1] published in 1917 the writer mentioned among other things a discovery which he had made, namely, that the purple color could be made to disappear by the application of heat at a temperature below that at which the glass lost its rigidity. Recently Alfred Herz[2] published an article in which he described in detail the heat treatment of arc-lamp globes on a commercial scale and showed that the removal of the purple discoloration was practicable in the case of glass containing manganese.

However, the chief aim of the former article has itself been overlooked, and it appears worth while to renew the proposal made. Many samples of street-lighting glassware were studied, and it was found that such glassware still remained in use when the purple color which gradually developed had become very highly absorbing. Many samples showed that the transmission factor had been reduced from about 90 per cent for clear glass to as low as 60 per cent. Glassware which went out of service merely through accidental breakage showed transmission factors as low as 50 per cent of clear glass. Purple is a surprising color in this respect; that is, its absorption is extremely high per unit of "colorfulness." In other words, the manganese purple is really a gray purple, and it can be very highly absorbing before its color is likely to be noticed by the casual observer.

As is well known, manganese is used in glass to counteract the greenish tinge of iron compounds which exist in most sands. This use is purely for esthetic purposes and is camouflage in its purest sense. For household glassware, decorative lighting glassware, etc., this greenish tinge is objectionable, but it is not so objectionable in street-lighting glassware as to warrant the introduction of manganese, which is an evil in every sense. The initial introduction of manganese causes a decrease in transmission factor of a few per cent, and as already noted the gradual development of this purplish tinge by ultra-violet radiation makes manganese in lighting glassware an ever-increasing evil. But manganese has been used so extensively in glassmaking that it has become to many an essential ingredient.

The point emphasized in the earlier paper was the elimination of manganese from glassware exposed to sunlight or to other illuminants rich in ultra-violet rays. There should be no objection to a slight greenish tinge in lighting glassware to be used outdoors. It was suggested in that article and is emphasized here that specifications for street-lighting glassware demand the elimination of manganese.

M. LUCKIESH.

Nela Research Laboratory, Cleveland, Ohio.

[1] "Purple Color of Lamp Globes," *General Electric Review*, August, 1917.
[2] ELECTRICAL WORLD, Nov. 16, 1918.

Readers' Views and Comments

Electric Heating and the Impropriety of Its Use in War Time

To the Editor of ELECTRICAL WORLD:

SIR: The writer desires to register a protest against the spreading of such "Hunnish" propaganda as that contained in a Canadian publication dated Feb. 1, 1919, bearing the heading "Heating Our Homes with Electricity —A Pioneer Installation in Toronto Which Proves that Electric Heating Is Entirely Practical—Cost Not Prohibitive for the Well-to-do Citizen."

In the first place, may I point out that while the installation in question may be the "pioneer in Toronto," it is an exact duplicate, apart from automatic control, of one which was operated in McCormick's drug store on Sparks Street in Ottawa, Ontario, "just twenty years ago." The latter installation was very successful in so far as maintaining agreeable temperatures was concerned, but it was of course abandoned as soon as the misguided enthusiast who bore the cost of the work woke up to an appreciation of the facts surrounding the problem of electric heating.

In Italy during the war it is said to have been an indictable offence to use any electric heating device between the hours of 4 p. m. and 10 p. m. daily or to sell any electrical heating device whatever. May I ask if conditions were so very different in Toronto that "domestic electric heating" in the winter of 1917-18 was so "entirely practical" as to deserve special commendation? Many of your readers surely heard of the efforts made to prevent the wasting of electrical energy in and around Toronto on account of the power shortage in that vicinity. Darkened streets and windows were intended to remind thoughtless ones we were at war!

An illustration used with the article referred to showed electrical energy continuously used for heating, a record of one of the most flagrant cases of wanton waste in war-time which have come to my attention. I am tempted to speak with vigor upon the above subject because I am one of the multitude who sacrificed time and energy, as well as such money as I had at my command, to help the cause of humanity. My very hardest work and most trying experiences were connected with the effort to get kilowatt-hours released from non-essential undertakings so that they would be continuously available for badly needed war work; and my efforts were made in the very district where this electric heating crime was being perpetrated! Were there many other such installations in Toronto as the one so highly praised? Are there many other extravagant persons in that vicinity who spent $480.18 for the luxury of electric heat when coal costing only $144 would have done the same heating?

The case in question would not have been so bad if the electrical energy used in that heating installation came from absolutely independent hydroelectric plants; but, as is common knowledge, old steam plants were pushed to the limit at that time, and the United States authorities none too willingly allowed coal to come into Ontario for producing power, in order that the outputs of overloaded Niagara hydroelectric plants might be supplemented by steam power and in this manner render further aid to the production of munitions. Just think of the criminally farcical nature of this state of affairs! A Torontonian drawing electrical energy which he uses for heating out of a system during periods when from five to ten times as much coal had to be burned (to put that same amount of electrical energy back into the system) as would have heated his house! All this at a time when coal was costly and scarce and when electrical energy was never so badly needed in this world for every legitimate purpose.

At the meeting of the Engineering Institute of Canada in Toronto, in March, 1918, electric heating was clearly and unanimously shown to be practically impossible. At that meeting, with the needs of the Allies in plain view and with the horrible Niagara power shortage before us, I protested not only against using electrical energy for heating but also against the putting into force throughout Ontario, a short time before the meeting, of a secondary or tertiary rate for the use of electrical energy which tended to encourage the putting on of wasteful heating loads. If my memory serves me, I asked the meeting if such tactics—which would surely interfere with war work—were for the purpose of "making the Kaiser grin"?

That is exactly what I mean to imply now in the opening paragraph of my letter when I refer to "Hunnish propaganda." The Hun did not want us to help to win the war; he did everything in his power to block us, and even now he does not want us to conserve or to make proper use of our resources.

JOHN MURPHY.

Ottawa, Canada.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

BOSTON EDISON RATE HEARINGS CONTINUED

Main Case Will Proceed, According to Present Plans, on June 30 — Company Completes Replies to Interrogatories of Petitioners

At a continued hearing on Monday of this week, on the petition of various customers of the Edison Electric Illuminating Company of Boston for reduced rates, it was decided to continue the hearings to June 30, when the main case will go forward. The company has now practically completed all its responses to the interrogatories of the petitioners. The latter endeavored Monday to force the company to file complete lists of customers in the public record in the case. The company objected to this, in view of the inimical use threatened by the petitioners, and was sustained by the commission. It was agreed that the petitioners may have the privilege of scrutinizing representative lists of customers.

A. I. E. E. WILL CONVENE AT LAKE PLACID, N. Y.

Modification of Institute's Activities to Receive Thorough Consideration — Papers in Technical Program Announced

The American Institute of Electrical Engineers holds its thirty-fifth annual convention at the Lake Placid Club, Lake Placid, New York, from June 24 to 27. In order to leave ample time for consideration and discussion of the Institute policies at conferences under the auspices of the committee on development, the technical program has been somewhat curtailed. So many modifications in the activities of the Institute are being suggested that it has been thought advisable for the entire membership to review and study them.

The annual presidential address by President Comfort A. Adams will open the convention on Tuesday morning and will be followed by the introduction of President-elect Calvert Townley. Three papers, presented under the auspices of the protective devices committee, will complete this session. They are entitled: "Present Day Practice of Transmission and Tie-Line Relay Protection," by H. R. Woodrow, D. W. Roper, O. C. Traver and P. MacGahan; "Grounding the Neutral of Generating and Transmission Systems," by H. R. Woodrow, and "Grounded Neutrals," by William E. Richards.

At Wednesday morning's sesson the annual reports of the technical committees will be presented and discussed. They cover the activities of the various committees for the past year and the advances made in the fields of these committees. At a luncheon following this session there will be a conference of the committee on development, section delegates and Institute officers.

Thursday morning's session is to consist of an open conference held by the committee on development, including the section delegates and Institute officers, to which all the Institute members are invited.

The transmission and distribution committee is to hold a technical session on Friday morning, when these four papers are to be given: "High-Tension Single-Conductor Cables for Polyphase Systems," by W. F. Clark and G. B. Shankin; "Electrostatic Field in Electric Power Cables," by R. W. Atkinson; "Commercial Problems of 220-Kv. Power Transmission," by A. E. Silver, and "The Effect of Transient Voltage on Dielectrics—II," by F. W. Peek, Jr.

An informal reception and dance will occupy Tuesday evening, and the convention committee is arranging an unusually complete program of games, contests and other entertainments to fill all the available spare time.

GENERAL ELECTRIC ACQUIRES THE COOPER HEWITT COMPANY

Control Bought by Acquisition of All the Common Stock—Directors to Represent New Ownership—W. A. D. Evans President

The General Electric Company has secured control of the Cooper Hewitt Electric Company by acquiring all the common stock. For the past sixteen years the Cooper Hewitt Electric Company has built up an extensive business in industrial and photographic lighting among large industrial manufacturers, motion-picture studios, photographers and photographic laboratories. The company will be operated under the regulation and management of the General Electric Company, and the following directors assumed office on June 3: C. E. Patterson, comptroller General Electric Company, New York City; C. W. Stone of the General Electric Company, Schenectady; N. R. Birge of the General Electric Company, Schenectady; G. C. Osborne of the Edison Lamp Works of the General Electric Company, Harrison, N. J.; W. R. Burrows of the Edison Lamp Works of the General Electric Company, Harrison, N. J.; L. P. Sawyer of the National Lamp Works of the General Electric Company, Cleveland, Ohio; W. H. Roberts of the National Lamp Works of the General Electric Company, Cleveland, Ohio; Grosvenor Calkins, attorney, Boston, and W. A. D. Evans of the Cooper Hewitt Electric Company, Hoboken, N. J.

W. A. D. Evans, who has been connected with the Cooper Hewitt Electric Company since its inception, will be in actual charge of the company as president and treasurer. N. R. Birge is vice-president, C. P. Hamilton assistant treasurer and E. E. Davies secretary and auditor.

The present policy of the company in its field of industrial and photographic lighting will be continued. Increased facilities will be provided shortly to take care of the rapidly increasing business.

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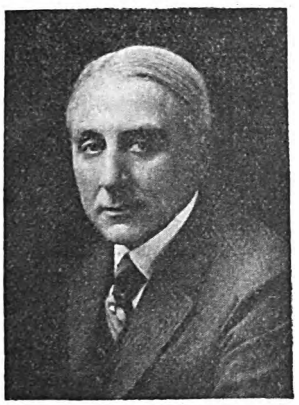
Vice-Presidents of the N. E. L. A. Will Have Active Part in Association Work Under the Organization of President-Elect Ballard



MARTIN J. INSULL
First Vice-President
Mr. Insull is senior vice-president of the Middle West Utilities Company, Chicago, Ill.

MILAN R. BUMP
Second Vice-President
Mr. Bump is chief engineer of the Henry L. Doherty Operating Organization.

FRANK W. SMITH
Third Vice-President
Mr. Smith is vice-president and general manager of the United Electric Light & Power Company, New York.

WALTER H. JOHNSON
Fourth Vice-President
Mr. Johnson is vice-president of the Philadelphia Electric Company, Philadelphia.

PLAN OF ORGANIZATION OF N. E. L. A. FOR THE COMING YEAR

President-Elect Ballard, Remaining in East After Atlantic City Convention, Arranges for Active Participation of the Vice-Presidents

President-elect R. H. Ballard of the National Electric Light Association came to New York at the close of the Atlantic City convention to discuss matters affecting the activities of the association during the coming year. A number of conferences were held at association headquarters with different men interested in the welfare of the industry, and much progress was made in the settlement of various questions.

One of the most important matters which were finally arranged is a new plan for the active participation of the four vice-presidents in the real work of the association. Such a plan is especially desirable under the conditions of this year because of Mr. Ballard's residence on the Pacific Coast. It, however, serves also the good object of decentralizing the burden of responsibility upon the president and of bringing the vice-presidents into close contact with certain phases of the association work.

The plan approved by President-elect Ballard is as follows:

President Ballard will devote himself specially to matters of a general executive character.

Martin J. Insull, the first vice-president, will be executive vice-president. He will be present to preside over all meetings of the executive committee in case of the necessary absence of the president.

M. R. Bump, second vice-president, will supervise the work of the Technical and Hydroelectric Section. Mr. Bump will also specialize on the preparation of plans for organizing the entire country into geographic districts and sections.

Frank W. Smith, the third vice-president, will supervise the Accounting Section in the same way that is outlined for Mr. Bump with the Technical and Hydroelectric Section. Mr. Smith will also supervise the work at association headquarters.

W. H. Johnson, the fourth vice-president, will supervise the activities of the Commercial Section and the Electric Vehicle Section, following the same method as the other vice-presidents with respect to other sections. Mr. Johnson will also specialize on the enlargement and development of company sections.

The arrangement, by which the work of the sections is assigned to the various vice-presidents, does not, of course, preclude a chairman of a section from taking up any matter directly with the president if he so desires.

Another matter which was under discussion during the visit of Mr. Ballard in New York is the possibility of two or more general executive conferences of the company members at appropriate times during the year. The object will be to discuss some of the questions affecting the entire industry. It is suggested that possibly one of these conferences might be in New York and one in Chicago.

Mr. Ballard spent two weeks in the East after the convention, visiting several large cities before going to Los Angeles. He plans to return to New York in September for a stay of considerable length. He will return again in December or January. In order to complete plans for the 1920 convention he will come East again in April of that year. With these visits and the new plan of organization of the vice-presidents, supplemented by correspondence, Mr. Ballard expects the association work to go ahead on the broader and more active lines which are outlined for the coming year.

Hydroelectric Energy for Operating Oil Wells

Since 1908 the San Joaquin Light & Power Corporation has been actively engaged in the introduction of electric power in the drilling and pumping of oil wells. What has been done by the company shows in an interesting way just how hydroelectric power can compete with other fuels. At the present time the San Joaquin Light & Power Corporation is operating 2255 oil wells by hydroelectric power, where natural gas and oil at field prices are available. A. E. Wishon, assistant general manager of the San Joaquin Light & Power Corporation, is largely responsible for the marked success of the company in this field.

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ENGLAND'S PLANS FOR SUPPLYING ELECTRICITY

Government Bill Reaches Second Reading in the House of Commons—Some of the Provisions for Unifying Sources of Supply

Companies in this country will be interested in the general trend of legislation to foster central-station development in England, which is far behind the United States in providing electric power facilities.

The electricity supply bill of England, the government measure, has been introduced in the House of Commons and had its second reading on May 14. Some of its principal provisions are summarized in an abstract which has been made from London contemporaries and appears below:

For "promoting, regulating and supervising the supply of electricity" there shall be established the "Electricity Commissioners," who shall have such powers as are conferred by the act and shall act under directions of the Board of Trade. The commissioners, not exceeding five in number, shall be appointed by the Board of Trade, which shall fix the term of two, the others holding office during His Majesty's pleasure.

The Board of Trade may exercise through the Electricity Commissioners any powers or duties under the electric lighting acts or orders made thereunder.

The Electricity Commissioners may, subject to approval of the Board of Trade, either by themselves or through any district electricity board established under the act, or any authorized undertakers, conduct experiments or trials for improvement of the methods of supply and incur necessary expenditure therefor.

The commissioners may appoint a committee from members of district electricity boards or other specially qualified persons for advice and improvement and development of supply.

The commissioners may, after holding local inquiries, create districts with boards, having as members representatives of local authorities, companies and persons who are authorized undertakers within the district, of large consumers of electricity within the district and of labor, and where any councils, not being authorized undertakers, agree to afford financial assistance to the board, also of representatives of those councils. The commissioners may appoint as chairman of the district board a person experienced in the control of large industrial undertakings. Areas included in the districts shall be grouped in such manner as may seem to the commissioners most conducive to efficiency and economy of electricity supply.

"A CHEAP AND ABUNDANT SUPPLY"

It shall be the duty of every district board to provide or secure the provision of a cheap and abundant supply of electricity. Such board shall have such powers and duties with respect to the acquisition of generating stations, acquisition or use of main transmission lines of authorized undertakers, supply of electricity (including construction of generating stations, main transmission lines, etc.) and acquisition of undertakings or parts of undertakings of authorized distributers and power companies.

All generating stations within a district, other than private stations, and such main transmission lines as may be specified in the order constituting a district board, shall vest in the board subject to payment of the standard price but freed and discharged from all mortgages and other charges, and the proviso to Section 78 of the schedule to the electric lighting (clauses) act shall apply as if the generating stations and main transmission lines had been sold under Section 2 of the electric lighting act, 1888; in any case where it is proved to the satisfaction of the commissioners that any particular generating station is so small or so situated or equipped that it could not conveniently be used the commissioners may, after giving the owner an opportunity of being heard, exempt the district board, for such period as may be specified, from the obligation of acquiring the station. For the purposes of this section the standard price shall be: (a) generating station or main transmission line belonging to a local authority, one or more annuities for such period as an auditor appointed by the commissioners certifies to be required to indemnify the local authority against its liabilities for interest and sinking fund charges in respect of such sums borrowed to provide the generating station or main transmission line as are outstanding at the date of transfer, provided that if it is proved to the commissioners that a substantial part of the cost otherwise than for renewals has been defrayed from revenue, such annuity may be increased as the commissioners think just; (b) generating station or main transmission line belonging to a company or person, such sum as may be certified by an auditor appointed by the commissioners to be the cost of and incidental to the construction of the generating station or main transmission line and acquisition of the site thereof less depreciation; such cost and depreciation shall be determined according to regulations of the commissioners; in any exceptional case if it is shown to the satisfaction of the Board of Trade that the amounts determined would work injustice they shall, in default of agreement, be determined by an arbitrator. The commissioners may by order transfer an easement, right or benefit under a contract to the district board for such consideration as, failing agreement, may be determined by an arbitrator. A district board may, with consent of the commissioners, by agreement with the owners acquire any private generating station on such terms as may be agreed. When a district board acquires a station otherwise than by agreement there shall be an obligation thenceforth to supply to the authority, company or person not less electricity than could have been generated at that station at a price not greater than that at which it could have been generated. Where a station or main transmission line has been acquired by a district board the board may, subject to approval of the commissioners, agree that the former owner shall work and maintain it on behalf of the board.

Where a district board is authorized to acquire or use any land for a generating station no person may restrain such use.

NEW STATIONS

It shall not be lawful for any authority, company or person except a district board to establish a new or extend an existing generating station without consent of the commissioners, but this restriction shall not apply to private generating stations, provided that where a group of persons carrying on or intending to carry on businesses in which large quantities of electricity are used for purposes other than provision of mechanical power or light propose to establish a generating station for such businesses the commissioners may authorize establishment by or on behalf of those consumers of a generating station, subject to condition that any surplus electricity generated shall be supplied to the district board or any authorized undertakers or any authority, company or person at such prices as the commissioners think fit.

A district board may by agreement with authorized undertakers or authority, company or person or without such agreement if authorized by the commissioners use any main transmission line of undertakers, authority, company or person for such time and on such terms as may be agreed or in default of agreement determined by the commissioners.

A district board shall not have power to supply electricity within the district (a) in any area which for the time forms part of the area of supply of authorized distributers without the consent of those distributers, except to lighting authorities or to railway, tramway, canal or inland navigation companies or authorities for traction or haulage or for lighting vehicles and vessels for the haulage or traction of which electricity is supplied; (b) in any part of the area of supply of a power company for any purpose for which the company is authorized to supply electricity without the consent of the company provided that where the authorized distributers or power company re-

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fused consent the district board may appeal to the commissioners, and the Board of Trade on recommendation of the commissioners may dispense with such consent if in their opinion it is unreasonably refused. This act shall in relation to every district board be deemed a special act for purposes of the electric lighting acts, and every district board shall be deemed undertakers within the meaning of those acts, and for purposes of this section there shall be incorporated with this act the provisions of the schedule to the electric lighting clauses act, 1899, subject to such modifications as may be prescribed by the Board of Trade, provided that Sections 2 and 3 of the electric lighting act, 1888 (which relate to the purchase of undertakings by local authorities), shall not apply to undertakings of district boards. Subject to the limitations on the powers of a district board to supply electricity, the commissioners may after such inquiry as they think fit impose on any district board an obligation to supply electricity in such circumstances, within such areas and on such terms and conditions as may be specified.

Terms of Transfer

Any local authority authorized as distributer may with consent of the commissioners agree with the district board for transfer to the board of the whole or any part of the undertaking in consideration for the payment of annuities for such periods as an auditor appointed by the commissioners may certify to be required to indemnify the local authority against its liabilities for interest and sinking fund charges in respect of so much of the money borrowed for the undertaking as is outstanding at the date of transfer. Provided that where any generating station or main transmission line belonging to the local authority has previously been acquired by the district board under this act the interest and sinking fund charges in respect of money borrowed for providing the generating station or main transmission line shall not be taken into account. Where under the electric lighting acts or under any order thereunder or under any special or local act any right to purchase the whole or a part of the undertaking of any authorized undertakers is vested in any local authority (including a county council) the right shall be transferred to the district board and the board shall exercise such right except in any case where the commissioners consent to postponement; provided that (a) if the area of the local authority is divided between the districts of two boards the right shall be transferred to such board or divided between them as the commissioners determine, and (b) where the undertakers are a local authority the power transferred to the district board shall not be exercised except with consent of the commissioners. Where any such right becomes exercisible before the date of the transfer of the right to a district board the right shall not be exercised by the local authority without consent of the commissioners. A district board with the consent of the commissioners may at any time acquire the whole or a part of the undertaking of any authorized undertakers not being a local authority by agreement.

The commissioners may on application of a district board exclude from the area of supply of any power company any part of that area which at the time of application is not being supplied by the company and which it appears to the commissioners could be better served by the district board, and in consideration therefor may if they think fit confer on the company power to supply electricity for lighting purposes in other parts of the area of supply which do not at the time form part of the area of any authorized distributers.

The commissioners shall have power on application of a district board to require authorized undertakers to give such reasonable facilities for the supply of electricity as may be specified, including the provision of new works, and if any other authorized undertakers are unable or are unwilling to comply with such order, the Board of Trade on representation of the commissioners shall have power either (a) to order that the undertaking of the authorized undertakers shall be transferred to the district board on the terms prescribed by Section 2 of the electric lighting act, 1888, or (b) to confer on the district board power to supply electricity within the area of such undertakers or any part thereof.

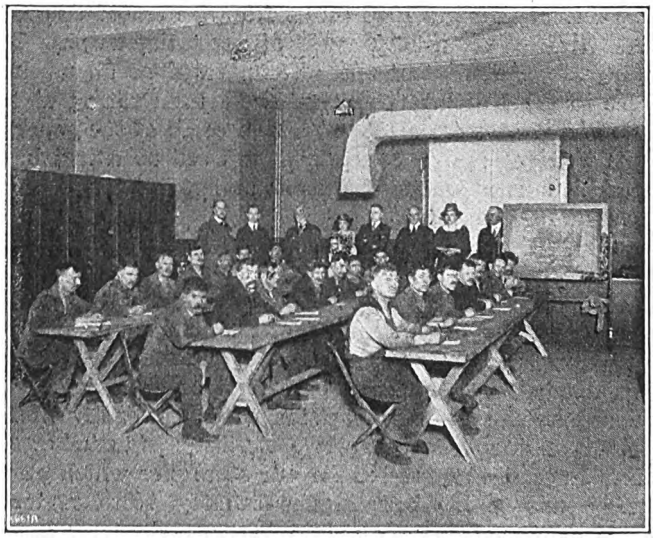
The Board of Trade, on representation of the commissioners, may authorize any district board to abstract water from any river, stream, canal, inland navigation or other source subject to conditions to be specified. A district board and any company or person may, with consent of the commissioners, enter into arrangements for the utilization for purposes of the board of water power, waste heat, or other form of energy which the company or person may be able to dispose of or for supply by the board of any form of energy other than electricity. A district board may with the consent of the commissioners dispose of any generating station, land or other work or property which appears to be no longer required.

The powers and duty as to generation and supply conferred by this act on district boards may be exercised by such boards by themselves or if so authorized by the commissioners through authorized undertakers or a company. For the purposes aforesaid a district board may lease its undertaking to any such undertakers or company upon such terms as, subject to approval of the commissioners, it thinks fit.

If within five years from date of vesting any generating station or main transmission line in a district board under this act any officer or servant who has been regularly employed in or about such station or line proves to the satisfaction of a referee appointed by the Minister of Labor that he suffered loss of employment or diminution of salary or wages otherwise than on grounds of misconduct, incapacity or superannuation and the district board does not show to the satisfaction of the referee that equivalent employment on like conditions as those obtaining before the said date was available the district board shall pay him such compensation as the Minister of Labor shall think just, including expenses which the officer or servant necessarily incurs in removing to another locality.

[Other provisions will be summarized in a later issue.—EDS.]

Americanization Classes at Chicago



Two classes like this at the Fisk Street station and one class at the Northwest station of the Commonwealth Edison Company, Chicago, are regularly conducted as a part of the company's Americanization work. These men are being taught English. Many who at the beginning were unable to talk, read or write English are able, after ten or fifteen lessons, to write simple sentences and to read passages from newspapers and begin to speak the language. Considering that the average age of the men is forty-five years, this is thought to be quite remarkable. The Americanization committee of the Commonwealth Edison Company is headed by D. W. Roper, whose office is superintendent of the street department.

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War Service of Commonwealth Edison Company*

How the Company Met the Requirements of War Time and Solved the Physical and Financial Problems

BY LOUIS A. FERGUSON

From Mr. Ferguson's Review of War Accomplishments

Holding the average rate at the old level was a war service of the first importance.

While economies in generation were probably the greatest war contribution, another great saving was by the rerouting of cables.

Careful investigation proved that enough light will increase output in almost any manufacturing establishment from 10 to 30 per cent at a cost of from 2 to 5 per cent of the payroll.

THE largest centralization of electrical generating equipment in Chicago is in the Fisk Street and Quarry Street stations, with a combined present rating of 249,000 kw. During the year 1917 these two stations generated more than 1,000,000,000 kw.-hr. The output for 1918 was somewhat less, owing to the greater activity of the Northwest station. The greatest single day's output of these two stations was on Dec. 20, 1916, the output for that day being 3,720,000 kw.-hr.

The third of the three major generating stations of the present system of the Commonwealth Edison Company is Northwest station, and to us in Chicago this is, for the moment, the last word in central-station construction. During 1918 this station generated 540,000,000 kw.-hr., about 36 per cent of our entire output. The largest generators of the system, rated at 35,000 kw., are in the Northwest station. The total rating of the station at present is 165,000 kw. For all of the generating stations coal is carefully purchased on a test basis and is burned under the constant supervision of competent fuel engineers.

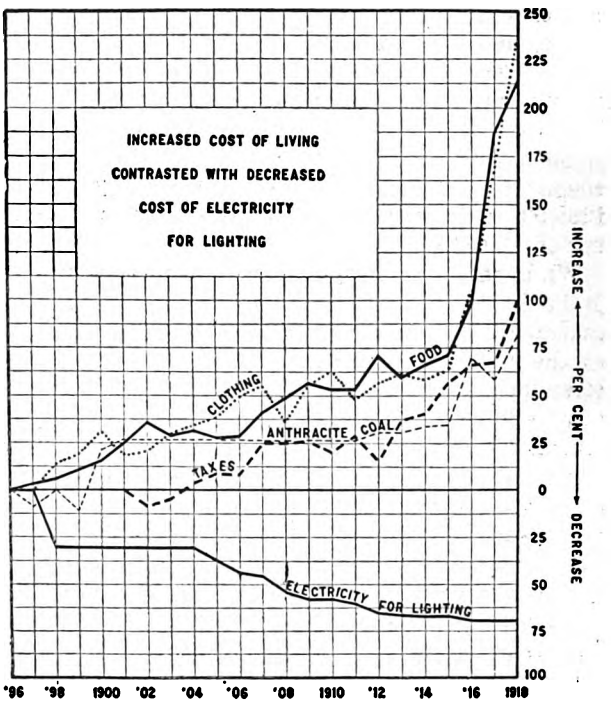
THE COMPANY'S AMPLE RESERVE

It has been the policy of the company to provide ample reserve in all elements of material equipment and to insist habitually on the highest grade of construction. Similarly, the financing of our enterprise has been characterized by the provision of exceptionally liberal reserves and by conservative stability. Samuel Insull has secured a reputation for our securities which places them among the best in the country. But material equipment and financing are only two of the three fundamentals in our enterprise. The third, perhaps the most important of all, is our personnel—the men and women who compose the Commonwealth Edison organization.

This organization gave 1376 men to the service of our country during the war. This is perhaps 30 per cent of our normal force. Of these men 473 have come back to us, and in addition we have already employed 238 soliders who were not in our organization before the war. But while the highest honor must be given to the men represented on the service flag, they were not the only ones who served. The other 70 per cent who stayed at home and operated the company also helped in no small way toward the winning of the war.

A diagram is presented to show the cost of living, in various items, compared with the cost of electricity in Chicago. It will be seen that while the prices of clothing, food, coal and taxes have shot up almost "out of sight," our product, which is no less essential to every citizen, has shown no increase whatever in price. Indeed, considering our retail lighting rates over the period of the last five years, there has been an actual decrease in the average price, and this in the face of an enormous increase in the cost of fuel and of all other materials which go into the making of our product. We feel that the holding of this price at the old level, giving a supply of power instantly as demanded, with a maximum of reliability, has been a war service of the first importance. This has been accomplished, too, in spite of the fact that in four of the principal departments of the Commonwealth Edison Company which report to me the salaries and wages of the men have been increased 52 per cent during the period of the war.

One reason why it was possible for the company to make this showing during the war was that our foresight in providing ample generating units of most efficient type led to a direct saving of at least $1,390,000 in 1918 alone. That is, had all our machines been of the older type (say of 1909 or 1910 design)—and an excellent type, too—the generating cost for the year 1918 would have been $1,390,000 more than it actually was. This amount makes up for a great deal of the increase in the cost of labor and material.



*This is condensed from a recent address by Mr. Ferguson, vice-president of the company, before a meeting of employees under the auspices of the underground-extension and new-business groups of the Commonwealth Edison Company Section of the National Electric Life Association.

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This economy of the latest and largest generating units is important. In the Northwest station, for instance, we have vertical 20,000-kw. units and horizontal 35,000-kw. units. The latter are the newer, and their output is generated at a saving of $19,000 per month in operating labor over what would be required with machines of the older type. This is in addition to the saving in fuel. In the larger units the water-rate curve is nearly flat. The steam consumption of a new unit at Northwest station is on the average 10.5 lb. (4.8 kg.), which is also the rate of the larger units at Fisk Street station. Taking into consideration the large type of boilers now being installed, this is equivalent to 2 lb. (0.9 kg.) of coal per kilowatt-hour for a newer unit compared with 3.13 lb. (1.35 kg.) per kilowatt-hour for the older (1910) units at Quarry Street.

COMPARISON OF ALL CENTRAL STATIONS IN UNITED STATES WITH COMMONWEALTH EDISON COMPANY FOR 1917

	Total United States	Commonwealth Edison Company	Ratio of Edison Company to Total, Per Cent
Output in thousands of kw.-hr.	25,438,611	1,488,080	6.1
Income	$502,100,346	$25,351,585	5.0
Income per kw.-hr. generated, cents	1.97	1.75	—
Capacity in kw.	9,001,872	465,980	5.2
Ratio of average kw. output to capacity, per cent	32.3	36.4	—
Average size of generating unit, in kw.	839	8650	—

Coal-Mine Ownership Helps

Another source of economy has been in the company ownership of its coal mines. This saving has been an important one, especially during the year 1918, when the price of coal was so high. During that year about 50 per cent of our coal was obtained from our own mines, and the average cost to us of all the fuel we burned was $3.15 a ton. The average market price during the year of such coal as we use was $3.60, so that we saved 45 cents a ton on all our coal. As we burned 1,963,000 tons during the year, the saving amounted to $883,000, to which should be added about $265,000 for profits from coal sold, making a total saving of $1,150,000.

While these economies in generating electricity were probably the greatest war contributions of our Chicago central-station organization, another great saving was by the rerouting of cables. By pulling out some of the older lines in districts where the demand has increased at a rather slow rate and installing them to supply the special war demands, we were enabled to employ copper which we had purchased at 15 cents a pound rather than enter the market for 30-cent copper. Here, of course, there was not only a saving in the price of the copper, but also conservation of the material, as copper was in special demand in the manufacture of munitions and ordnance. I think the major credit for this rerouting scheme is due to G. M. Armbrust. This rerouting plan was also applied to transfer load from less efficient Fisk and Quarry Street units to more efficient generating units at the Northwest station. In this cable rerouting we took advantage of our policy of an ample reserve supply of cable and also of our development of first-class men capable of meeting war conditions. The country got the benefit of this work.

Before the war any customer could secure renewal lamps delivered at his door within about twenty-four hours of his request. But with 30 per cent of our men in government service and with a great increase in the cost of operation and maintenance of vehicles it was necessary to ask our customers to do their own transporting for the time being. Therefore, in February, 1918, we took off all the lamp delivery wagons and established fifteen additional lamp renewal stations, bringing the total number of such stations to twenty-seven.

On the same principle we established a charge of 35 cents to cover a part of the cost of calling at customers' premises to replace fuses, make minor repairs or deliver lamps in those cases where the customer insisted that we bring them to him. Here again the change was accepted with good grace by practically all our patrons. These modifications of our policy were of much greater benefit under the war conditions than could be measured by the comparatively small amount of money collected. Many people are rather thoughtless in handling lamps and demanding renewals when new lamps may be obtained by mere telephone calls, but they become much more careful when it is necessary to make a trip to a renewal station. As a result we saved about 600,000 lamp renewals last year, and the number of service calls was reduced in about the same proportion.

Financing Line Extensions and Other Financing

We made a marked saving by a temporary ruling of the State Public Utilities Commission which permitted us to ask our customers to finance any considerable line extensions necessary in giving service. In pre-war times we went to perhaps extreme lengths in making underground and overhead extensions to obtain new business. Nearly 10 per cent of our new capital was expended in this way each year. When the United States entered the war no new capital could be obtained directly, and it became necessary, therefore, for the customer to pay for all except minor extensions. In most cases the money will be entirely refunded. On lighting business the refund was begun at once to the amount of 25 per cent of each monthly bill, and for power extensions the refund will be begun at the conclusion of peace, except in a few cases where the installation was purely for war work, and in these cases the customer will receive only the salvage value of the material.

It is interesting to recall that in 1917 and 1918 nearly 60,000 hp. of new power business for steel industries was connected. The greater part of this may be considered as for direct war production. Indeed, over half of it was for plants devoted entirely to munition manufacture. To be sure, some of it did not get into operation. The largest job of all, that of the Symington Chicago corporation, accounts for 25,000 hp. This plant was to have capacity for forging 15,000 6-in. (15.2-cm.) shells and completely machining 10,000 each day. All the machinery was to be electrically driven and would have had a maximum demand of between 12,000 kw. and 15,000 kw.

Along with these direct power applications we made a very distinct advance in lighting industries. By careful investigation we have been able to prove that the use of enough light will increase the output in almost any sort of manufacturing from 10 per cent to 30 per cent at a cost of from 2 per cent to 5 per cent of the payroll. This sort of efficiency made a special appeal to men engaged on government contracts.

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LOS ANGELES PLAN IS CARRIED AT ELECTION

Purchase by the City of the Distributing System of the Southern California Edison Company Is Approved by Voters

A heavy vote was registered at Los Angeles, Cal., on Tuesday of this week on the proposed issue of $13,500,000 bonds by the city for the purchase of the electric distributing system of the Southern California Edison Company. The proposal was carried by 1300 votes more than the necessary two-thirds majority. The question of authorizing the sale of the surplus aqueduct power to the Edison company was also carried, receiving 300 votes over the necessary two-thirds of the total vote cast.

As stated in last week's issue of the ELECTRICAL WORLD, the purchase price is divided between $11,000,000 including the physical valuation and $2,453,067 severance damages for taking the business of the company. For thirty years the city is to purchase from the company power required in addition to that generated in its own plants, the price to be fixed by the State Railroad Commission.

The Edison company retains all of its business outside the city and also the traction load within the city.

MAKERS OF MATERIAL-HANDLING MACHINERY ARE TO MEET HERE

Coalition Meeting to Be Held in New York on June 11 with Three Sessions, Preceded by Conference to Form Advertising Council

All manufacturers of mechanical handling machinery and equipment and accessories in the United States are invited to attend the coalition meeting of the Material Handling Machinery Manufacturers' Association at the Hotel Astor, New York, June 11. This includes all manufacturers of cranes, winches and hoists, elevators, gravity and power conveying machinery and apparatus, industrial trucks, tractors and trailers, bulk-handling machinery, and all makers of equipment and accessories such as storage batteries, bearings, ropes for hoists, buckets, electric controllers and apparatus, etc.

The advertising managers of the companies manufacturing these products are also invited to hold a preliminary conference at the Hotel Astor at 8 o'clock in the evening of June 10. It is planned to form an advertising council of the Material Handling Machinery Manufacturers.

Among the speakers for the day meeting is James H. Collins. Mr. Collins will tell of the many successful results of coöperative promotion and the value to manufacturers of coöperative investigation and educational work.

Francis Holley, director of the Bureau of Commercial Economics, will tell how it is distributing educational and industrial moving-picture films.

A general "forum" discussion will be conducted in the afternoon. All manufacturers will be asked to participate. The discussion will take up ways and means for promoting a more general knowledge of economies which may be effected through mechanical handling of equipment, the value of conserving physical energy, the bearing which modern machinery has on foreign trade and kindred topics.

For the evening meeting a mass gathering is planned. Addresses will be made by Theodore E. Burton, former United States Senator and now director of the Merchants' National Bank, and by Murray Hulbert, Commissioner of Docks, New York.

The committee in charge is: W. J. L. Banham (chairman) of the Otis Elevator Company, Frederick Stadelman of the Wellman-Seaver-Morgan Company, and E. Logan Hill of Heyl & Patterson.

PLANS FOR MEETINGS OF THE ASSOCIATED MANUFACTURERS

Large Attendance Promised for the Summer Section and Other Meetings Scheduled for June 16 to 18 at New London, Conn.

A large attendance is promised for the summer section meetings of the Associated Manufacturers of Electrical Supplies, to be held at the Hotel Griswold, New London, Conn., on June 16 to 18. As reported in last week's issue of the ELECTRICAL WORLD, there will be, in addition to the meetings of the various sections, meetings of the general association and of the international trade committee. In addition to the business matters to be considered at the general association meeting it is anticipated that other subjects of much interest will be on the program.

An indication of the scope of business of the sections is given by the following outline by C. A. Bates, secretary of the Fuse Section, for the meeting of that section, which is to be held at 2 p.m. on June 16:

1. Report of the industry conference on the renewable fuse standard. Final action on this standard will be requested at this meeting.
2. Consideration of a proposed standard on plug fuses.
3. Report of the committee on engineers in reference to recommendations made by the Hydro-Electric Power Commission, Canada.
4. Report of the nominating committee and election of officers for the ensuing year.

GOVERNMENT WAR POWER OVER UTILITIES UPHELD

United States Supreme Court Decides that Authority Given by Congress Is Complete and Federal Government Has Authority on Rates

In a decision rendered on June 2, the United States Supreme Court upheld complete control by the federal government over telephone, telegraph and railroad rates under the war powers conferred by Congress. Justice Brandeis dissented from the majority opinion in the telephone and telegraph rate cases, but on the railroad rate case the opinion was unanimous.

Chief Justice White said in rendering the railroad opinion:

No elaboration could make clearer than do the act of Congress of 1916, the proclamation of the President exerting the powers given, and the act of 1918 dealing with the situation created by the exercise of such authority, that no divided but a complete possession and control were given the United States for all purposes as to the railroads in question. But if it be conceded that, despite the absolute clarity of the provisions concerning the control given the United States and all-embracing scope of that control, there is room for some doubt, the consideration of the general context completely dispels hesitancy.

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THE ILLINOIS COMMISSION EXTENDS TEMPORARY RATES

Still Retains Policy of Not Fixing Value on Properties, Holding Instead that Value Is at Least Certain Amount

The terms of some of the temporary rates fixed by the Illinois Public Utilities Commission last year have expired, and extension of the same temporary rates has been granted to the interested companies. None of the present extensions runs beyond June, 1920.

The companies wnich were recently granted extensions are the Southern Illinois Light & Power Company, the Dekalb-Sycamore Electric Company, the People's Power Company, the Logan County Gas Company, the E. G. Light Company and the Lena Electric Light & Power Company. The present policy of the commission in fixing rates is to follow its war-time practice of not fixing values, holding instead that a property is worth at least a certain amount.

AMERICAN ENGINEERING STANDARDS ASSOCIATION

Revision of Constitution of Organization Now Proposed to Carry on the Large Work of the Committee Originally Suggested

A statement regarding the proposed scope of the American Engineering Standards Association has been made by C. B. Le Page, the acting secretary. It is in part as follows:

In many lines of engineering much excellent standardization work had been done before the war. The war emphasized its importance and showed most clearly the need of coöperation to prevent the confusion caused by the promulgation of overlapping standards by independent bodies. During the war the government departments coördinated these efforts in certain lines and greatly assisted in unifying them. The American Institute of Electrical Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers and American Society for Testing Materials, recognizing the value of what had been done, invited the government departments of War, Navy and Commerce to appoint representatives to act with them to continue this work. The body so formed is the American Engineering Standards Committee.

The American Engineering Standards Committee has just completed and adopted a revision of its constitution which has been sent to the governing boards of all the departments and societies represented on the committee with a request for its ratification. The new constitution changes the name to American Engineering Standards Association. The objects are stated as follows:

1. To unify and simplify the methods of arriving at engineering standards, to secure coöperation between various organizations and to prevent duplication of the work.
2. To promulgate rules for the development and adoption of standards.
3. To revise and pass upon recommendations for standards submitted as provided in the rules of procedure, but not to initiate, define or develop the details of any particular standard.
4. To act as a means of intercommunication between organizations and individuals interested in the problems of standardization.
5. To give an international status to approved American engineering standards.
6. To coöperate with similar organizations in other countries and to promote international standardization.

Means are provided for increasing the number of representatives in the association by invitation or on request. Any organizations may request the association to approve standards which it has formulated or to approve committees that it has appointed, and by so doing becomes a sponsor society. At the request of the sponsor, approval of the standards is given when they are the substantially unanimous conclusions of a committee made up as follows:

(a) Sectional committees dealing with standards of a commercial character (specifications, shop practices, etc.) shall be made up of representatives of producers, consumers and general interests, no one of these interests to form a majority. General interests include independent engineers, educators and persons who are neither consumers nor producers, as defined above.

(b) Sectional committees dealing with standards of a scientific or non-commercial character shall consist of persons specially qualified, without regard to their affiliations.

It is anticipated that in nearly all cases the approval of standards and committees by the association will be requested. In case it is considered advisable, the association is authorized to call a meeting of those who would be interested in the formulation of a new standard or the revision of an old one, to select one or more sponsor societies. The sponsor society or societies will appoint a sectional committee to formulate or revise the standard. This sectional committee will report to the sponsor when its work is completed. The sponsor may then request the association to approve. The association deals only with the sponsor and acts only at its request. Provision is made in all publications that a standard must be referred to as that of the sponsor, using whatever title the sponsor has given it, followed by the statement "approved by the American Engineering Standards Association." The approval may be given in one of three ways as "recommended practice," "tentative standard" or "standard," the expectation being that nothing will be approved as standard until it has shown that it is generally acc ptable.

BUSINESS CONFERENCE HELD AT AUGUSTA, ME

Central-Station Representatives Meet Under Auspices of Advertising and Publicity Committee of New England Section, N. E. L. A.

A conference of central-station interests under the auspices of the advertising and publicity committee of the New England Section of the National Electric Light Association was scheduled to be held at the Augusta House, Augusta, Me., June 4 and 5.

The program was as follows:

Wednesday morning, good-will and courtesy meeting; subjects: publicity, various forms, specimens, letters to customers, press advertisements, ways in which employees can show courtesy, educating directors and stockholders. Wednesday afternoon, lighting sales campaign; subjects: old and new house wiring, extension of wiring, plan of outlets, special features, forms of campaigns, specimens. Wednesday evening, Central Maine Power Company "booster" meeting; P. H. Whiting, chairman.

Thursday morning, appliance sales; subjects: special attention to range campaigns, discussion of rates, advantages of electric cooking, specimens of advertising, follow-up letters, booklets of N. E. L. A. Commercial Section. Thursday afternoon, appliance sales and specialties; subjects: vacuum cleaners, lamps, small appliances, coördinate advertising and sales campaign schedule, industrial appliances, bake ovens, etc.

L. D. Gibbs of the Boston Edison company is chairman of the New England Section committee on publicity. It is planned to hold a second conference at Providence, R. I., June 16-18.

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SURCHARGE STILL NEEDED, SAYS NEW JERSEY COMPANY

Witnesses at Public Utility Inquiry Assert Higher Costs Make Continuation Necessary if Company Is to Remain in Power Business

Evidence as to general increase in operating expenses and consequent need for larger revenue was submitted by the Public Service Electric Company of Newark, N. J., at hearings concluded this week before the New Jersey Board of Public Utility Commissioners. The commission instituted the proceedings on its own initiative for the purpose of ascertaining whether in the face of existing conditions the war surcharge upon large contracts for electric power should be discontinued or modified.

The commission in February, 1918, allowed the company to make a surcharge of 25 per cent to wholesale customers. Application had been made for a charge of 33⅓ per cent to make up an estimated deficit for the year 1918 of $1,800,000.

The Manufacturers' Council of New Jersey, which opposed the continuation of the surcharge, contended, through its counsel, State Senator Clarence E. Case, that the emergency which the surcharge was originally intended to meet had passed and that if the company needed higher return it should apply for a general increase in rates. It was not fair, he declared, for the wholesale user to stand the entire cost. He also pointed out that the company's gross revenue for 1918 had exceeded estimates made at the time the surcharge was originally granted by $2,300,000, and that continuance of the charge was unnecessary.

Chairman Slocum sustained the contention of the company that the divergence between the estimated and the actual revenue was due not to the surcharge so much as to increased business. The expressed intention of the board at the time the surcharge was allowed was, he said, that wholesale customers who in the board's opinion were getting power too cheaply should pay the increase, and even now, with the surcharge added, he said, this class of business is not paying in proportion to other classes, such as lighting customers.

The company introduced or entered the appearance of twenty-three wholesale users of power, who expressed entire satisfaction with the present rates. In addition, Thomas N. McCarter, president of the company, introduced as evidence approximately 100 letters from wholesale customers expressing willingness that the surcharge be continued. These customers, he pointed out, were some of the biggest manufacturing concerns of the state, their connected load aggregating 28,060 kw. and their payments to the company in 1918 amounting to $1,012,000. Most of the large manufacturers, the company claimed, preferred to pay the surcharge rather than to run the risk of having their power shut off, while those who objected to the charge were comparatively few.

Mr. McCarter and E. J. Allegaert, general auditor of the company, declared that the reason the company wished to continue the surcharge, instead of applying for a general increase in rates, was that the emergency had not yet passed. The high prices of materials, especially of fuel, were here to stay, and no one could tell what would be needed in another year. The company preferred to let the present charge stand until conditions were changed in one way or in the other.

A. S. Lyon, statistician and accountant for the commission, testified that the company's statement for 1918 showed an increase in revenue, including the surcharge, of $2,675,270, or 19.3 per cent over 1917 figures.

Operating costs were much higher in 1918 than in 1917, said Mr. Allegaert. This was due to increases in the cost of coal, labor and materials, which considerably exceeded the estimates. The increase in the item of fuel was the principal source of added expense which made the surcharge necessary. This exceeded even the company's estimates. The cost of coal in 1918 was $5.782 per gross ton as against a figure of $5.41 used in the estimates.

Mr. Allegaert declared that operating cost for 1919 would be even higher than last year. The cost of coal for the rest of the year, based on a careful estimate of coal receipts, was placed at $5.824 per gross ton. The cost for the first four months of 1919 was $6.028, making the average cost for the entire twelve months $5.89 per gross ton as against the $5.72 paid last year.

Mr. McCarter said in effect that unless the company were allowed to make the surcharge it could not afford to remain in the wholesale power business. In his opinion the company must pay dividends of more than 8 per cent to get the funds for needed extensions. It was vitally to the interest of the state, he thought, that the company continue as a wholesale dispenser of power. The power business had lowered the average rate for all sorts of power from 6.5 cents per kilowatt-hour in 1910 to 3.9 cents per kilowatt-hour in 1918. The rate for wholesale power went down also, from 4.3 cents per kilowatt-hour in 1910 to 2.44 cents, surcharge included, in 1918. The basis of cheap power was that it kept the plant going during the day and built up an additional load, said Mr. McCarter.

Mr. McCarter said that if the company continued its power business it would spend in the neighborhood of $6,000,000 a year for extensions amounting on the average to 25,000 kw. for all purposes. If the power business should be abandoned the company would have to install only 6500 kw. per year at an annual cost of $1,500,000. Mr. McCarter placed the gross earnings from the wholesale distribution of power in 1918 at $8,109,000. He said that sale of power represented 65 per cent of the company's business on a basis of kilowatt-hours, while on a basis of income it represented 31.27 per cent.

Among the other witnesses called by the company were L. P. Hammond, president of the Colorado Power Company, and Donald G. Geddes, of Clark, Dodge & Company. Testifying as to the general situation among public utilities, the latter declared that stocks of public utilities were selling, almost without exception, far below par. He attributed this condition to bad credit, which he said was due to higher operating costs. If utilities were to make needed extensions, they must reëstablish their credit, and this could only be accomplished through higher earnings which would leave a surplus after payment of dividends. Mr. Geddes thought the company should have a surplus of 50 per cent after payment of dividends; if an 8 per cent dividend were declared, there should be left a surplus of 4 per cent.

Both sides in the case were directed to file briefs within three weeks, following which the board will give its decision.

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Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 1251 of this number.

Rochester Engineering Society.—The annual meeting and election of officers is to take place on June 13 at 8.15 p.m.

Electric Club of Chicago.—At the May 15 meeting Dr. Morrison described his travels through France and England as the guest of the governments of those countries. Charles N. Wheeler, correspondent of the Chicago *Tribune*, addressed the May 22 meeting.

Physics Conference to be Held at Cornell University.—A physics conference and reunion will be held at Cornell University, Ithaca, N. Y., on June 19 and 20. Among those who will speak are Dr. S. J. Barnett, Capt. Ralph Bown, Prof. George W. Stewart, Dr. Ernest F. Nichols, L. B. Marks, Dr. P. I. Wold, E. C. Crittenden, Dr. C. H. Sharp, Dr. P. G. Nutting and Dr. Wheeler P. Davey.

A. S. M. E., Chicago Section.—On May 29 the Chicago Section of the American Society of Mechanical Engineers held its last meeting of the season. The speaker of the evening was Dr. William S. Sadler, who gave a very interesting address on "Stress and Strain," dealing with physical engineering from the health standpoint. For the coming season these section officers were unanimously elected: A. L. Rice, chairman and G. R. Brandon, secretary.

New York State Association of Electrical Contractors and Dealers.—Arrangements have been completed for holding the annual convention of the association at Saratoga Springs, N. Y., from June 23 to 25. The program of the national association and the advantages of membership will be outlined by W. C. Peet and W. H. Morton. Overhead costs and estimating on construction work will be treated by C. C. Dailey. T. J. Casey will set forth the most modern methods of merchandising and advertising. J. T. Huchings, president Rochester Railway & Light Company, will discuss the effect of lighting company rates for energy on the contracting business. A paper on the channels of distribution between manufacturers and consumers will be read by Samuel A. Chase. Safety-first devices as applied to the national code and relations of the National Fire Protective Association and the Bureau of Standards will be discussed. Relations between jobbers and contractor-dealers will be dealt with by J. J. Raferty. Up-to-date methods of conducting retail stores and advantages of coöperative selling campaigns will be discussed at length. W. L. Goodwin will also speak.

National Electrical Credit Association to Meet.—The annual meeting of this organization will be held on June 13 and 14 at the Hotel Gibson, Cincinnati, Ohio.

National Association of Electric Inspectors.—A meeting of this association is to be held in Springfield, Mass., on Oct. 13 and 14. Thomas H. Day, Hartford, Conn., is chairman of the committee on arrangements.

Joint Meeting in Toronto.—The Toronto Sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held a joint meeting on May 16. A discussion on the metric system was lead by Dr. E. F. Burton.

Telephone and Telegraph Division, American Railroad Association.—This organization, which was formerly the Association of Railway Telegraph Superintendents, will hold its first annual meeting at the La Salle Hotel in Chicago from June 11 to 13.

Jovian Electric League, Los Angeles.—Dr. Baker P. Lee spoke on "Olympus and Service" at the May 28 meeting of the league, and Charles W. Duncan, sales manager of the Foster & Kleiser Company, gave a short address on "Electricity in Advertising."

George J. Murphy Addresses Electrical Contractors in Boston.—At a recent meeting of the Massachusetts State Association of Electrical Contractors and Dealers at Boston George J. Murphy of the Pettingell-Andrews Company, Boston, spoke on cost accounting, giving an exhaustive explanation of the use of forms and credits. During a brief intermission in Mr. Murphy's remarks M. R. Griffith of the General Electric Company gave a lantern-slide talk on interesting lighting and power installations.

American Institute of Electrical Engineers

Chicago Section.—A. F. Riggs is the new chairman of this section and A. C. King the new secretary.

Baltimore Section.—"The Engineer and the Public" was the title of a talk given at the April 25 meeting.

Ithaca Section.—R. E. Wagner of the General Electric Company spoke on "Electric Arc Welding" at the May 16 meeting.

Spokane Section.—At the annual meeting held on May 16 J. E. E. Royer was elected chairman and Foster Russell secretary-treasurer. The latter also gave a talk on "The Development of the Airplane" at the meeting.

Toronto Section.—The new officers of the section are A. B. Cooper, chairman, and D. M. Fraser, secretary. "Some Voltage Limitations of Current Transformers" was the subject of W. B. Buchanan, who adressed the meeting of April 25.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Extensions Beyond 100-Ft. Limit.—The New York Public Service Commission, First District, rendered recently a decision in the matter of the hearing on motion of the commission concerning the furnishing of gas and electric energy beyond the 100 ft. referred to in Section 62 of the transportation corporation law and the filing and posting of a service provision, rider or form of contract in respect thereto. Its conclusion was that while each case of an extension beyond the 100-ft. limit must be treated upon its own circumstances to determine what would be reasonable, each company should have and enforce such regulations as will insure, first, publicity of the terms and conditions under which an extension will be built and, second, the avoidance of favoritism or discrimination. The commission adopted an order requiring the filing and posting by gas and electric companies of a schedule or supplement setting forth the rules or regulations governing application for extensions of transmission lines beyond the 100-ft. limit in question.

Sale of Energy for Resale.—The New York Public Service Commission, First District, has rendered a decision regarding the complaint of the Acker, Merrall & Condit Company against the New York Edison Company as to the alleged refusal to furnish break-down service. The Edison company contended that the complainant is an "electrical corporation" under the statute, that as such it had no right or authority to sell electric energy to any one outside its building, and that therefore the Edison company should not be required to furnish energy with which the applicant would do an unauthorized and unlawful act. The commission held that a wholesale grocery corporation which generates and sells electric energy to two or three neighboring buildings is not as a matter of law, or necessarily as a matter of fact, engaged in a public calling or comprised within the statutory category of an "electrical corporation." It also disclaimed any belief that the Public Service Commission law relates to every corporation which generates and sells electricity or that every sale of energy is subject to the commission's control. The Public Service Commission law confers jurisdiction over the public calling, the business of selling electricity to the general public as a means of revenue, not the incidental disposal of surplus electrical energy to buildings situated in the vicinity of the plant.

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Farmers Demand Repeal of Daylight-Saving Law.—Farmers all over the country are becoming insistent in their demands for the repeal of the daylight-saving law, according to members of Congress from agricultural states. Senator Arthur Capper of Kansas, who expects to take the lead in bringing about the repeal, stated recently that this is the one thing most earnestly desired by farmers of the Middle West. It is claimed that the operation of the law has proved ruinous to the farmers since the extra hour of daylight in the evening is useless to them, as farm laborers insist that their day is over at 6 p.m. and cannot be induced to work after that hour.

Development of Army Searchlamp.—A review of the work of the Army Engineer Corps in the war, first issued by the War Department, says that the corps produced a new form of searchlamp more powerful than any that had preceded it in any army, with which the Second Field Army had been partially equipped. "It weighed," the report says, "one-eighth as much as lamps of former design, cost only one-third as much, was about one-fourth as large in bulk and threw a light 10 per cent stronger than any other portable projector in existence." The engineers were at work when the fighting ended upon a mechanism which would enable them to control searchlamps from a distance.

Engineering Courses Popular.—One of the most popular divisions of education made available to disabled soliers by the Federal Board for Vocational Education is that of engineering, in the various branches of which there are now 178 students, thus giving refutation to a somewhat prevalent idea that the vocational education available for disabled men is confined to manual trades, or necessarily must be in wage-earning occupations. In this general classification, six men are taking architectural engineering, two chemical engineering, and eighty are preparing to be civil engineers. Electrical engineering takes thirty, general engineering twenty-five, mechanical twenty-two, mining seven, and steam eight. Indicating the character of institutions at which these men are pursuing their education, the following are being used: Harvard University, Massachusetts School of Technology, Franklin Union, Boston; Hawley School of Engineering, New Bedford Industrial School, Saunders Trade School, New York Electrical School, Pratt Institute of Brooklyn, Rensselaer Polytechnic School, Columbia University, Heffly Institute, Lawrenceville Trade School, Carnegie Institute, Pennsylvania State College, Johns Hopkins University, Georgia School of Technology and Colorado State School of Mines.

Coal Jobbers Use Electric Truck.—A. Jackson Marshall, secretary of the Electric Vehicle Section, National Electric Light Association, calls attention to the fact that in Boston, Chicago, New York and elsewhere electric trucks are employed extensively in the movement of coal from the yards to consumers. A study of comparative operating costs indicates that in large cities coal is moved at a lower cost per ton-mile by electric trucks than by any other form of transportation. This fact is being realized by many coal companies, and as a result far-reaching developments are contemplated in the further application of the trucks to this particular class of business.

Welcome Home Reception.—A rousing reception was given at the Dayton (Ohio) Power & Light Company's recreation hall recently for those employees who have returned from the war. More than 300 fellow employees were present to do them honor. The event of the evening was an illustrated talk by Lieut. Howard Tansey, who was with Battery "D" and had some exciting experiences. Other talks by Junior Lieutenant William Shuler of the navy and Lieut. Frank Kendig of the artillery were well received. Three of the company's boys—Ray Collins, G. D. Stivers and Michael Monahan—made the supreme sacrifice for their country in the war, and in their honor the entire assemblage stood with bowed heads for three minutes.

Gross Rate Justified in Massachusetts Opinion.—Gas companies, and inferentially electric companies, according to an opinion by Attorney-General Attwill of Massachusetts, in response to a Senate inquiry, may lawfully, after establishment by the Gas and Electric Light Commission of a maximum net rate to be charged their consumers, establish a gross rate in excess of the net which must be paid by all customers who do not prior to a specified date pay the net rate. The inquiry was whether the action of the commission in fixing a net price prohibits the charging thereafter of a gross price to the consumer who does not pay the charges when due. It is held that the charging of a gross rate is a long-continued practice, acquiesced in by the public and not lightly to be disturbed; that when, by order, the commission deals solely with a net price it contemplates that a gross price in excess will be charged and impliedly authorizes such a charge. It is held that the gross rate must be reasonable and that the difference between the gross and the net rates must have relation to the expense to which the company is put by the failure of the users to pay the net rate when due.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Injury to Trespasser.—In a decision rendered by the Supreme Court of Kansas it was held that a telephone company is not responsible in damages for the death of a thirteen-year-old trespasser who climbs one of the company's poles, equipped with steps for climbing, and is killed at the top of the pole by coming in contact with an overhead uninsulated electric light wire placed, maintained and operated by the city in which the company conducts its business, but over which electric light wire the company has no control (180 P. 271).

Authority of an Agent in Adjusting Lighting Charges.—In the case of an agreement between an electric light and power company's customer and the latter's agent that the agent was to check up and audit customer's bills for light and power between certain dates, for which services the agent was to be paid 50 per cent account by reason of errors or overcharges, the Supreme Court of Oregon has held that the agreement gives the agent the power to agree with the company as to the amount it should repay the customer on account of errors and overcharges and to include authority to make settlement (179 P. 909).

Consulting Engineer Employed Under Retainer.—In a case where a company engaged another to act as consulting engineer at a retainer of $7,500 per year, the Supreme Court of New York has held that the contract was a hiring at will. The opinion of the court (175 N.Y.S. 219) also brought out the following points: (1) Recovery by an employee suing for salary must rest on his proof, and his action fails where he himself introduces in evidence letters between parties showing that employment was at will, and not for a year, as he claimed, and on which theory he bottomed his demand. (2) Where an engineer, in accepting a retainer for a year, stated that he assumed "entire responsibility for the design and construction of" his employer's "new works," the process being a new one in the experimental stage, the engineer did not intend to guarantee sufficiency of plant, but merely agreed to assume full charge of construction and to use his best endeavor. (3) Where the employer at will, though having right to discharge an employee at any time, did not assume to exercise it but offered, in consideration of employee's resignation, to pay him two months' advance salary, the obligation binding on employer resulted on employee's acceptance.

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George W. Lawrence has been elected president of the Turners Falls (Mass.) Power & Electric Company, succeeding Philip Cabot, who has recently resigned. Mr. Lawrence has been general manager of the company since its early hydroelectric expansion began.

Charles M. Cohn, vice-president of the Consolidated Gas, Electric Light & Power Company of Baltimore, has been elected president of the Industrial Corporation of Baltimore City, succeeding John R. Bland, who is now chairman of the corporation's board of directors. The Industrial Corporation is an enterprise which grew out of the Aldred Industrial Survey of Baltimore and has already assisted in the organizing and establishing in Baltimore of industries having an aggregate capitalization of more than $5,000,000 and employing more than 4000 workers. In addition to his connections with the companies mentioned, Mr. Cohn is director and secretary of the Industrial Building Company, director of the Fidelity Trust Company, director of the Arundel Sand & Gravel Company and director of the Hess Steel Corporation.

CHARLES E. KNOX

David A. Belden of Haverhill, Mass., on June 1 became associated with the Harry M. Engineering Company, Boston, Mass., in the capacity of vice-president. Mr. Belden was born in Aurora, Ill., about fifty years ago. He was educated at Racine College, Wis. From 1892 to 1901 he was general manager of various electric railways in northern Illinois, following which he became general manager of the Georgia Railway & Electric Company, Atlanta, Ga., where he remained until elected vice-president and general manager of the Birmingham Railway, Light & Power Company, Birmingham, Ala. He held the last-named position until called to New England as president of the group of railway, light and power companies controlled by the New Hampshire Electric Railways. Mr. elden is to continue as executive head and president of the companies with which he is now connected, but he will be less active in matters of operating detail, all of which work will be delegated to the local officials in Haverhill and Portsmouth. He expects to leave Haverhill in the fall and resume his residence in Boston, where he lived until September, 1917.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Obituary

Charles E. Knox, for many years one of the leading consulting electrical engineers of New York City, died June 1 at St. Luke's Hospital from blood poisoning. Mr. Knox was born at Atlanta, Ga., Sept. 17, 1871. After graduating from Columbia University School of Mines in 1892 with the degree of electrical engineer, he entered the employ of Queen & Company of Philadelphia in research work and later took a test course in the shops of the General Electric Company at Lynn, Mass. On Dec. 1, 1893, Mr. Knox became associated with C. O. Mailloux as engineering assistant in general consulting engineering work, and in 1907 the firm of C. O. Mailloux and C. E. Knox was formed. This existed until May 1913, when Mr. Knox opened an office as consulting electrical engineer at 101 Park Avenue, New York City. After that time he devoted his attention to the design of electric light and power equipments for industrial plants, office buildings, hotels, factories and hospitals, department stores and elevator installations. Among the prominent building installations where he acted as consulting engineer on the elevator and electrical equipment are those of the Woolworth Building, the New York City Municipal Building, the Equitable (elevators), the Metropolitan Life, the Travelers' Insurance (Hartford), the Pennsylvania and Commodore Hotels, the R. H. Macy and Abraham & Straus department stores, the Columbia University buildings, Bellevue and Mount Sinai Hospitals and the Metropolitan Museum of Art. During the war Mr. Knox had charge of much government construction work in New York City and surrounding territory. He was a fellow of the A. I. E. E. and a member of the Institute of Consulting Engineers, the New York Electrical Society and many other social and educational clubs of New York City.

George T. Hanchett, consulting electrical and mechanical engineer of New York City, died at the Battle Creek Sanitarium on May 6. Mr. Hanchett, who was born at Hyde Park, Mass., Sept. 4, 1871, was a graduate of the Massachusetts Institute of Technology and prior to 1895 was associated with E. P. Roberts & Company of Cleveland and C. O. Lenz, at that time in Providence, and with the Collyer Machine Company of Pawtucket, R. I., in electrical engineering work. In the fall of 1895 Mr. Hanchett came to New York and shortly after joined the editorial staff of the ELECTRICAL WORLD. He opened an engineering office in New York the following year and was thereafter engaged in consulting engineering work. As a result of experimental investigations on Röntgen rays, induction coils and electrolytic interrupters, Mr. Hanchett established several new principles in the construction and operation of induction coils and published the results of his researches of certain anomalous voltage and current phenomena in electrolytic interrupter circuits. With F. B. Gage he invented and placed on the market a direct-reading ohmmeter. Much of his work was in machine design and invention. He did considerable work for the Murphy Safety Third Rail Electric Company, and the Baltimore plant of that system in the tunnel of the Baltimore & Ohio Railroad was designed and installed under his supervision. In more recent years he was engaged in consulting engineering work for a number of automobile manufacturing companies. A large part of Mr. Hanchett's work was of a varied character, consisting of tests, expert opinions, investigations and the design of special machinery, work requiring much skill and judgment, but not of a kind that brings general professional recognition. Mr. Hanchett suffered a stroke of apoplexy a year ago, and the recurrence of that trouble is given as the immediate cause of his death. He was a fellow of the American Institute of Electrical Engineers and a member of a number of other organizations and was the author of a book on modern electric railway motors. He was buried at Antrim, N. H.

GEORGE T. HANCHETT

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

NO LOWER PRICES SEEN FOR OUTDOOR SWITCHING EQUIPMENT

Prominent Manufacturer Holds that Reductions Will Come Only as a Result of Buying in Order to Distribute Overhead

In a conversation held by a representative of the ELECTRICAL WORLD with a prominent manufacturer regarding price trend of outdoor substation and switching equipment, the manufacturer gave it as his opinion that prices could be lowered if production could be stimulated through buying. If his organization was to be kept together, after so much necessary expenditure to bring it to its present development, it was impossible to reduce the overhead. Consequently, with the low production due to curtailed buying in the last two years, the same overhead had to be distributed over a smaller number of units produced, thereby increasing the cost of each unit. If it were desired to let go of the trained organization over the short period of low production, then prices could be adjusted.

"The economic way to reduce the cost of the apparatus is to get back to quantity production," said the manufacturer. "That means that the power companies must get out of the rut of holding until prices lower. Prices will lower through buying, not through holding off. Peace is about to be concluded, the Victory loan is safely by, and Congress is now in session. This should have some stabiling influence on industry."

TRANSFORMER STOCKS ARE NOW PRACTICALLY NORMAL

Development Work Not Specially Active, but Producers Stand Ready to Build Machines for Continuous Pressures up to 225,000 Volts

During the period of low sales volume which followed the midwinter relaxation of war material production, manufacturers of transformers utilized the opportunity to build up stocks, and these are now practically normal. Prompt deliveries can be made on distribution transformers of standard design. On "power" transformers deliveries are now about as good as can be expected in view of the painstaking care necessary in building high-class units.

Generally speaking, the higher-voltage equipments require increased time in the factory for the proper handling of the insulation problem, and from two to three months is still requisite for the shipment of transformers of this class or of the larger sizes designed to meet special conditions and not ordinarily carried in factory stocks. Rush orders are now and then put through in shorter periods, but the design and construction of transformers which will withstand severe over-potentials due to surges and other causes is a problem requiring such technical skill that the time allowances above outlined represent conservative practice and should not be curtailed except for extreme needs.

While development work is not specially active at this time, it is noteworthy that transformer builders stand ready to produce equipment capable of continuous operation at pressures up to 225,000 volts. Line difficulties appear to be the limiting factor in present transmission engineering, decided advances having been accomplished within the last three or four years in dissipating the effects of excessive voltage peaks and interwinding strains in transformer equipment itself.

GROWING MARKET FOR ELECTRIC DRINK MIXERS

Sales, Already Large, Expected to Increase Considerably, as a Result of National Prohibition, After July 1

Electric drink mixers, so far as can be learned, are experiencing a greater sale than ever before. This is due, it is thought, to the establishment of many new soft-drink parlors. One of the largest manufacturers of drink mixers reports that it has not been able to anticipate this demand, because last year the War Industries Board declared drink mixers non-essential and prohibited their manufacture until after the signing of the armistice.

Current demand is steady and shows no signs of letting up, and there is every indication to believe that there will be a steady increase in business for some time. As one manufacturer put it: "A man accustomed to an alcoholic beverage will not be satisfied with the plain soft drink served at the soda fountain, but he will want fancy mixed drinks. The call, therefore, for this class of drink after July 1 will be very insistent, and it will be impossible to meet it except by means of the electric drink mixer."

Furthermore, history has shown that whenever prohibition has gone into effect the number of soft-drink parlors in the district has increased very rapidly and considerably. Prohibition, therefore, should offer a greatly increased market for drink mixers.

No changes in price have occurred since the first of the year, so far as could be learned.

COPPER AND BRASS PRODUCTS TO REACH A HIGHER LEVEL

Advances in Steps of About One Cent Each Expected to Bring Rubber-Covered Wire Up to 25-Cent Base or Better in the Fall

Within the past month buyers have seen copper products such as wires and brasses advance on a rise of a little more than one cent in the copper market. Indications are that this is but the first of a series of rises to last well into the fall months.

In spite of the fact that there are immense stores of copper available, current quotations may be considered as a bottom level. Current prices are not to be taken as any indication of the relation between supply and demand. Psychology rather than the old laws of economics governs the present market.

Copper has been steady now for a couple of weeks. Just as soon, however, as any consumer demand develops prices will advance again, and they will continue to advance just as long as buying continues. When buying begins to ease up prices will be stationary. There is no indication that a slump in buying will be accompanied by a falling market.

Advances will probably be made in steps of about one cent at a time. The upper limit which should occur in the fall is expected by those in a position to forecast more or less accurately to reach and perhaps exceed 20 cents. That would put rubber-covered wire on a 25-cent base or higher.

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GOOD MARKET FOR RANGES AND CLEANERS IN SOUTH

High Cost and Scarcity of Labor Have Been an Impelling Motive in Leading Southern Women to Turn to Labor-Saving Electrical Devices

Cheap colored help is no longer available to hold back the use of electrical household devices, especially those of the labor-saving variety, in the Southern States. Many of the colored servants of the South have either gone North in search of high wages or are able to live at home on the wages of some other members of the family. As a result, domestic help has become so scarce and expensive in many localities that large numbers of Southern women are now compelled to do their own housework, and electricity is taking the place of the colored servants. Colored cooks were not very successful in the operation of electric ranges, but now this range is coming into its own, and the demand for it as well as for the many socket devices used in the home is steadily growing.

METAL MARKET SITUATION

Few Price Changes—Market in General Is Stronger than It Has Been of Late

Metal prices of the past week have undergone little change. Electrolytic copper has held at 16.37½ cents, while prime Lake has eased off ¼ cent and casting copper has stiffened ⅛ cent to 16 cents. Spelter is slightly easier.

The two holidays of the past week, coming at the end of a month and following some hot weather, had a quieting effect on the metal market. The market is strong, however, and gains in bookings all along the line have been noted. The removal of copper import restrictions by France is regarded as an encouraging sign and intimates progress in the consumption of her own red metal. Italy has lifted her embargo on iron and steel and may soon do so on copper.

Domestic consumption of copper is increasing, and there is prospect of further increasing consumption in the next few months. At the same time foreign consumption is increasing, and the outlook in that direction looks better every week. However, it is expected that production of mines, smelters and refiners will not be increased, so that the prospect for reducing accumulations is encouraging.

The lead market is at present dull. There is an increasing consumption, however, for storage-battery and lead-covered cable use.

The scrap-metal market has been looking up of late. Heavy copper and wire scrap is the only item reported stronger in price, and it, with brass turnings, has found an encouraging market.

NEW YORK METAL MARKET PRICES

	May 27	June 3
Copper:	£ s d	£ s d
London, standard spot	78 15 0	79 5 0
	Cents per Pound	Cents per Pound
Prime Lake	17.00	16.75
Electrolytic	16.37½	16.37½
Casting	15 87½	16.00
Wire base	18.00 to 18.50	18.00 to 18.50
Lead, trust price	5.25	5.25
Antimony	8.37½	8.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.57½	6.50
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	32.00 to 33.00	32.00 to 33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.00 to 14.25	14.50 to 14.75
Brass, heavy	8.00 to 8.50	8.00 to 8.50
Brass, light	7.25 to 7.75	7.25 to 7.75
Lead, heavy	4.50 to 4.60	4.50 to 4.60
Zinc, old scrap	4.50 to 4.75	4.50 to 4.75

THE WEEK IN TRADE

BUSINESS generally last week was smaller owing in large part to the holiday. Demand, however, is increasing, particularly in wiring supplies. Appliances show a continuation of large sales and fans are beginning to move with the season's first real warm days. There seems to be a hesitation, however, on the part of dealers to lay in sizable stocks. Glowing reports of electric sewing machines come in from almost every section of the country.

Stocks for the most part are in good shape with the exception of flexible armored conductor, which is in very short supply.

Construction of dwelling houses and store repairs and remodeling are going ahead rapidly and are absorbing quantities of wire, wiring supplies and fixtures.

Collections are reported as being in good shape. Few new credits are being placed.

NEW YORK

The national holiday of last Friday and the impromptu holiday so generally observed on Saturday had the effect of slowing up trade for that week. However, the jobbing business for the month of May was generally in good condition, with great expectations for the near future.

Iron conduit and fittings have continued quiet, while flexible armored conductor is still shy in the market. Power cable and rubber-covered are moving better. The warm weather has had some influence on the fan market, but in general not what it should have.

In New York City there is a noticeably large amount of store-window alteration, calling for the requisite number of receptacles, conductor and lighting fixtures. Outside the city there has been found real evidence of home building of five-thousand-dollar to eleven-thousand-dollar houses. These are not necessarily community affairs but private enterprises.

CONTROL EQUIPMENT.—Controlling apparatus for industrial motor work is picking up in good shape. In the return to peace work there is sufficient time now for correct application of remote control. There is a better market reported for battery-charging control, as there is more attention being paid to electric truck delivery needs. Theater dimmers are in better demand, not only for new houses but for better lighting control of older houses which could not be supplied during the war.

FANS.—There have been some warm, 90-deg. and 92-deg. days recently, and still many dealers are withholding fan orders. Where they have been required to take ten fans when placing their contracts with jobbers, they have done so, but there is still a lack of repeat orders. One jobber however, reported no stocks of one make of 16-in. direct-current oscillating fans, and no quick factory deliveries. Consequently he was in the market for several hundred of another make. There has been found a quite general policy among jobbers to absorb the excise fan tax. Sales of 32-volt fans are reported better than last year.

ELECTRIC NOVELTIES.—The market for toys and novelties is in good condition and a better season than heretofore is expected. Not only is the domestic trade good but the foreign business is improving. Prices are firm.

BOXES.—Knockout boxes for iron conduit have been found off 4 points. Some sources attribute this to the poo market and unstable conditions.

MOTORS.—Some few orders for large motors have come in, but in general this end of the motor business is quiet. Sizes up to 10 hp. are finding a fair market. New York

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stocks of squirrel-cage motors of these smaller sizes are good and much better than those of direct-current motors.

FLEXIBLE ARMORED CONDUCTORS.—Some jobbers are practically out of stock. Deliveries to them are only percentages of their orders.

FRICTION TAPE.—Regardless of the recent advance of cotton, there has been reported no advance in price of friction tape.

WIRE.—Rubber-covered base averages the same as last week, namely, 21 cents. The only change reported is from 18 to 20 cents by one producer. Sales are picking up right along.

CHICAGO

Prices seem to be holding steadily with a few exceptions. The movement in prices is of such a nature that it is difficult to see a trend; however, the curve seems to be bending slightly upward at the present time. Jobbers report that the volume of their business for the first five months of this year is practically equal to that of last year, although in the month of May the 1919 business hardly equaled that of May last year, because May last year was a remarkable month.

A trip through the outlying towns in Illinois and Indiana shows the observer where the large quantity of small orders, which the jobbers have reported as replacing the larger war-order business, are coming from. In every small community people are building new residences, additions to old residences and small factories of a varied nature. It is this activity which in the aggregate is producing the volume of the business that the trade is enjoying to-day in construction material. Building permits for Chicago in the week ended May 31 totaled $1,546,450 and included permits for 142 small residences and apartments out of a total of 163 building permits. This situation also reflects that which exists throughout the outlying territory. In addition to this there are reported buildings projected totaling $3,795,000, out of which total $1,420,000 will go into apartment buildings.

The labor situation has been disquieting to some extent. Organized workers in some localities, especially Chicago, appear to be able to obtain their demands regardless of the justice of what they ask. A part of the spirit of unrest which prevails is thought to be reflected from the general Canadian situation.

Reports of government sales of materials of various kinds of goods are becoming more frequent.

COPPER WIRE.—The base on rubber-covered and weather-proof copper wire has been increased to 21 cents by Chicago jobbers, as of June 2.

CONDUIT.—The demand is somewhat better, the reflection of building conditions being apparent in the movement of this commodity.

FANS.—Electric fans have begun to move rapidly out of jobbers' stocks, and a good fan year is predicted if the warm weather which began within the last few days is continued.

HOLLOW WARE.—No especial buying has been noticed to fill the usual June demand.

DRY BATTERIES.—There has been no change in the price of dry batteries.

SCHEDULE MATERIAL.—The market is active in small-order business.

BOSTON

Business continues in good volume as to both commodity turnover and sales. Deliveries and collections are in the main very satisfactory. Prices do not show any great change, barring advances of about 10 to 12 per cent this week in covered wire. A scarcity of armored flexible conduit is still reported in this district. Building permit applications at Boston are about 43 per cent in excess of a year ago, garages predominating. At Hartford, Conn., building permits since Jan. 1 total over $4,000,000. At Springfield, Mass., it is estimated that the city is $10,000,000 behind its normal building expansion as a result of the war. About $3,500,000 in new building work will be done there this year, compared with about $1,600,000 in 1918. At Bristol, Conn., 400 cottages and a hotel are to be built this season. Labor conditions are somewhat unsettled in the southern Massachusetts textile area. The Western Electric telephone repair shop strike at South Boston was unsettled Monday, when a hearing was given by the State Board of Arbitration upon the situation and when conflicting claims were presented as to the amount of work available for suspended employees.

FANS.—Jobbers are well stocked for early fan business. Some of the larger distributers have purchased their estimated summer requirements, but many smaller dealers are not yet ordering. As yet no preference in type or size is noted, but it is expected that by another month the demand for 9-in. and 12-in. units will greatly exceed other calls.

ELECTRIC TABLEWARE.—Trade is brisk and stocks are being well maintained. Prices are holding firm.

WIRE.—Flexible armored conductor is running short in New England, as last week's market review indicated. Weatherproof wire is up 1 cent to a 21-cent base, and slow-burning wire is up 1 cent to 21.5 cents. Bare wire is steady at 19 cents and rubber-covered wire is up to a 21-cent base. Building operations are calling for large quantities of smaller-sized wire in central Massachusetts and Connecticut, compared with last year.

POLE-LINE HARDWARE.—The demand shows a tendency to increase. Prices are steady. Central-station expansion is proceeding slowly but surely and the market benefits accordingly.

IRON CONDUIT.—The demand varies considerably from week to week. Some stocks are low as to smaller diameters, but a good deal of pipe is now coming into New England. Prices are a little unsteady, with wavering tendencies from week to week.

WASHING MACHINES.—Business is booming, and small indication of a let-up can be seen. Price considerations appear to cut little or no figure in sales. This is also true of vacuum cleaners.

PORTABLE LAMPS.—Despite daylight saving, trade in portable lamps continues to be unusually good. These outfits are increasingly popular as gifts. Prices have been pretty well maintained so far, and little artificial stimulus of trade through cuts has been necessary.

FUSES.—The demand is far below the supply available. Rumors as to a price increase appear to be without foundation.

FARM-LIGHTING SETS.—Considerable summer residence business is being booked. Trade is well distributed throughout New England and eastern Canada, and deliveries range from stock on smaller sets to from two to four weeks on larger outfits. Prices hold firm.

WIRING MATERIAL.—The demand appears to have slackened a little, temporarily. Prices are firm and material plentiful. The report that key sockets are going to a 30-cent list price appears to be unreliable.

MOTORS.—General motor business is featureless, with a fair turnover, considering the moderate amount of industrial construction under way. A brisk demand for printing-press motors is evident. Motor deliveries range from stock to six weeks on press drives.

ATLANTA

The market for all lines of electrical supplies and equipment is becoming more active, and increases in the demand for many items are a feature in trade this week. The building boom that started several months ago is still unabated, and the number of building permits and values is growing from day to day. Activity in schedule material is further

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stimulated by a widening of trade channels for this material. Specialties of all kinds are enjoying a remarkable demand. Sales show a substantial increase over the corresponding period of 1918, and prospects are bright for a still bigger volume.

LAMPS.—Although the volume of business shows a slight decrease over last week, sales to date are running well ahead of last year, owing largely to an increased demand for larger units for street lighting. Eastern shipments are prompt and Southeastern stocks are well filled. There is no apparent shortage in any size.

METERS.—Manufacturers and wholesalers report an increasing demand from all central stations, which is particularly noticeable from the smaller municipalities. The market is stimulated by the great activity in residence and apartment construction. Prices remain firm and deliveries good.

TRANSFORMERS.—The call for power types has slackened, owing to inactivity of the industrials in marketing large extensions and the inability of power companies to offer large blocks of energy. The 2300-volt distributing types are moving fast. The lack this year of government orders which were a feature this time yast year is offset by the increased purchases by central stations. Deliveries are normal.

MEASURING INSTRUMENTS.—This item has been practically dormant for some time because manufacturers have not had the men available to push it.

SWITCHBOARDS.—Inquiries are numerous, but bona-fide transactions are disappointing. Nothing but a revival in industrial construction and extensions can materially improve the market. Equipment for small central stations is the only encouraging feature. Shipments have been greatly reduced.

WIRE.—The demand is increasing daily through the activity in construction and the call from central stations to handle small extensions. Prices saw no change over last week. Deliveries are good.

FANS.—An increasing temperature following the cool wave of last week has started a brisk movement of fans, and dealers are preparing for the rush later on. Stocks are in god condition.

PANELBOARDS.—The demand for this item has slowed up during the past two weeks, but with a firm price and no indications of an early change manufacturers are looking forward to a more active market shortly. Shipments are averaging two weeks.

MOTORS.—One manufacturer reports a readjustment of prices, which means a reduction running as much as 10 per cent on certain capacities. The call for sizes above 1 hp. continues moderate. Stocks are attaining their normal condition.

RECTIFIERS.—Jobbers and dealers report an active market. This line is being strongly pushed, which accounts for the present stimulation in sales. Factory shipments remain about the same with the exception of isolated longer deliveries.

SEWING MACHINES.—As a result of dealer and jobber effort the sale of these have shown a marked increase, and the present outlook points to a continued active market.

SEATTLE—PORTLAND

The volume of jobbers' business continues about the same as last week. Sales are light. Shipyards and allied industrial plants are buying only when necessary, awaiting official confirmation from Washington that canceled contracts will be renewed or that new contracts will be let. Dealers in Seattle, especially, report good business during the past week. Sales of domestic appliances showed a slight increase over last week, while house-wiring devices made a material increase. This is accounted for by the fact that during the month of May approximately 1400 wiring permits were issued.

Construction projects contemplated for Seattle during the summer will total nearly $10,000,000 in value. The value of building permits for the year to date about doubles the record of the first five months of last year. More optimistic authorities state that Seattle and the Northwest are on the high road to greater prosperity and industrial development in the immediate future, in spite of present unsettled conditions.

The Portland district reports no material change in conditions over last week. Business continues fair with no marked changes of any kind. A number of important things are under consideration, but nothing of really definite nature has come to the surface to date.

POLE AND LINE MATERIAL.—The work of caring for replacements, maintenance and general wear and tear is practically completed. Pole and line equipment sales are exceeding expectations, although they were not very heavy. Jobbers' stocks are in good shape.

MOTORS.—A good supply is now reported in standard equipment. Prices are firm with no increase in sight. Logging and lumbering interests contemplating electrifying continue to send letters of inquiry. These are followed in some instances with orders of considerable proportions.

ELECTRIC SEWING MACHINES.—Activity in this line increased during the past week. Established lines moved with increased rapidity. Stocks are in excellent condition and prices remain firm.

COLLECTIONS AND CREDITS.—In Seattle, Tacoma and Portland collections are reported as very good. In a lesser degree this can also be said of the rural districts served directly by these metropolitan centers. New credits of any importance are few and far between.

SAN FRANCISCO

More and more the contractor-dealer is becoming a dealer-contractor. This is due to a variety of causes, but principally to a nation-wide campaign by big manufacturers and jobbers and the promotion of a better spirit of merchandising among dealers. During the present year the Pacific Coast has seen more contractors turn into real electrical merchants than has been the case for a decade of years previously, and this tendency is intensified by the California Coöperative Campaign.

WIRE.—Rubber-covered wire has increased slightly owing to a slight change in the base of copper, the change being very slight in the standard sizes and more in the nature of a price adjustment. The same increase in copper has raised the price of weatherproof wire 50 cents per 100 lb., this being the first advance reported after many months of decline.

LAMP CORD.—The comparatively small quantity of copper in lamp cord in proportion to its total price has occasioned no change in the price because of the slight increase above noted, but heater cord has been refigured and the market is about 10 per cent less than previously.

INSULATORS.—The largest styles of porcelain strain insulators have increased in price about 20 per cent. Several big jobs are reported, with a keen scramble among competitors, who once again, after several years, have the stimulus of actual jobs upon which to figure.

INSULATING MATERIAL.—Although the market is not what it was in 1918, there is a very good demand, and the result of the unusual year has been that the complete insulating line is more generally distributed among jobbers than previously. Orders are consequently spread about more. Tape prices have been put on a new basis, generally speaking, in which the maximum quantity has been cut in half and the best price increased by about 10 per cent.

SEWING MACHINES.—The discovery of new factors in sewing-machine distribution, such as concessions for old machines and the like, has caused a change in long-standing prices, and vibrating models now generally retail on the Coast at $47 each and rotary styles at $57 each, an advance of more than 10 per cent.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges or account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	5%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Twin-Conductor

No. 14 Solid	
Less than coil	$100.00
Coil to 1000 ft	82.50
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 20%
Std. pkg	23% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
5/16	$0.05 1/2	1	$0.25
1/2	.06	1 1/4	.33
3/4	.09	1 1/2	.40
1/2	.12	1 3/4	.47
5/8	.15	2	.55
3/4	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
5/16-in.—	$25.00	$20.75	$21.50
1/2-in.—	30.00	21.50	20.50

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
5/16-in.—	$33.00	$17.50	$16.25
1/2-in.—	36.00	19.00	17.25

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 to 1/2 In.	3/4 to 3 In.
Less than 2500 lb.	+3% to 6.1%	+1% to 8.1%
2500 to 5000 lb.	2% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$7.90 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00
Coil to 1000 ft	21.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1¾, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1¾, 4 S.	30.00
103—C.A., 9, 4R, B 1¾	25.00
106—F.A., 7, C.S., 1¾, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–33%	10%–24%
$10.00 to $50.00 list	30%–45%	20%–32%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$17.85–$24.15
1/5 to std. pkg	14.70– 21.00

Standard pkg., 2200. List per 1000, $20.00 to 21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg	11.20– 16.00	22.40– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
¼-in. cap key and push sockets	500	$0.33
¼-in. cap keyless socket	500	.30
¼-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20 to list
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	23%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 33%	24% to 25%
$2.00 to $10.00 list	30% to 33%	24% to 25%
$10.00 to $50.00 list	30% to 45%	25% to 30%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.40–$0.41
No. 18, full spools	.35– .38

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.46
No. 18, full spools	.41

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	18.54	18.54	13.90
10	24.96	24.96	16.64
8	34.02	28.35	22.68
6	53.94	44.95	35.96

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$17.50–$18.50	$9.50–$10.00	$8.90–$10.00
12	22.05	22.05	18.90
10	29.68	29.08	25.44
8	40.39	34.62	24.62
6	63.84	54.72	54.72

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$25.00–$29.25
25 to 50 lb	25.00– 25.25
50 to 100 lb	24.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$24.50 to $24.75
25 to 50 lb	24.50 to 24.75
50 to 100 lb	24.50 to 24.75

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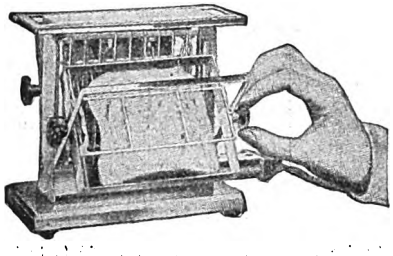
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Reversible-Rack Electric Toaster

When one side of the bread is toasted properly in the electric toaster now being manufactured by Manning, Bowman & Company, Meriden, Conn., a knob on the side of the holder or rack



TURNING THE KNOB TURNS THE TOAST OVER

is turned and the untoasted side of the slice is turned toward the heating element. The toaster, which is rated at 475 watts, accommodates two pieces of bread at a time and has knobs at each side of the holders. The knobs or handles are ebonized and non-heating. The toaster can be supplied either with or without a rack on its top to hold six slices of bread. The finish is nickel plate, and the base is furnished in either black enamel or nickel plate. Each toaster has a detachable plug, 6 ft. (1.8 m.) of cord and lamp-socket connections.

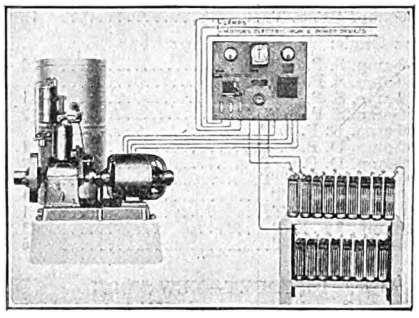
Glare-Eliminating Commercial Lighting Unit

To eliminate glare, the necessity for frequent cleaning and absorption or loss of light in the diffusing medium, the New Era Manufacturing Company, Leader-News Building, Cleveland, Ohio, has developed the New Era lighting unit. The fixture is said to be highly efficient and to give maximum candle-power on the plane of illumination. An important feature in the unit pointed out by the maker is the distribution of light on the walls. While the unit does not cast a brilliant light on the ceiling, thereby showing up discolorations and making frequent cleaning of the ceiling necessary, it does provide a light which entirely eliminates the harsh, sharply cut-off lines on the walls which are encountered in some fixtures.

Three styles of the unit are obtainable—pendent, decorative and porcelain-enameled. A replacement type for attachment to existing connections, a close ceiling type for low ceiling outlets, and the pendent type, including plain and decorative chain fixtures, may be obtained.

Semi-Automatic Farm-Lighting Plant

The switchboard equipment of the semi-automatic farm-lighting equipment being manufactured by the Globe Electric Company, 193 Broadway, Milwaukee, Wis., is provided with an ampere-hour meter with contacts at full charge and at 75 per cent of discharge. When the battery is fully charged the engine is automatically stopped, and when the battery is 75 per cent discharged the circuit is automatically opened, cutting off lights or any other devices that may be on the circuit, thus giving a signal to recharge the battery. This arrangement always insures a sufficient amount of reserve power to crank the engine. The



LIGHTS ARE CUT OFF WHEN BATTERY IS THREE-QUARTERS DISCHARGED

engine can be started at places remote from the installation.

The generator develops 32 amp. at 35 volts and is designed for charging sixteen storage cells. The engine, made by the Western Engine & Dynamo Company, Milwaukee, Wis., is of the four-cycle water-cooled type and provided with a thermo-siphon circulating tank. A vacuum system permits the use of a large fuel supply tank, which may be placed outside of the premises in which the engine is operated and below the level of the engine floor, thus preventing any danger of fuel leaking.

The engine is provided with a power pulley and has sufficient reserve power to permit charging the batteries at normal rates and developing about 1 hp. on the belt. It is provided with a throttling governor and shows a variation of less than 3 per cent from no load to full load.

The switchboard is provided with a counter-cell switch which cuts in one or more counter cells on the lamp circuit while the battery is being charged. An extra terminal for a power circuit is provided on the switchboard so that maximum voltage may be obtained while the engine is charging the batteries for the operation of an electric iron or motors, as these devices always require maximum pressure and are not subject to injury from the rise of voltage required for fully charging storage batteries.

Ammeter with Range 30-0-30 Amp.

The "Universal" V. P. ammeter, which has been brought out by the Roller-Smith Company, 233 Broadway, New York City, may be used on farm-lighting plant switchboards to indicate the condition of the batteries, and in addition it is applicable to all makes of automobiles, all types and makes of electric lighting and starting systems and all voltage systems. With the many different cars on the market and all the different type and voltage systems with which they are equipped, there is a need for a more suitable ammeter, since the ordinary ammeter, designed for lighting circuit work, will not operate under conditions where the ammeter must be installed in the cranking circuit. The new ammeter, the maker declares, will operate satisfactorily under any condition, being particularly designed for cranking circuit use. It has a scale with a range of 30-0-30 amp. and is of the flush type with a black finish. The diameter of the body is 2 in. (5 cm.); the over-all diameter is 2⅝ in. (6.6 cm.), and the depth behind the flange is ⅞ in. (2.2 cm.). S. A. E.

INDICATES WHEN BATTERY IS CHARGING OR DISCHARGING

standard mounting holes are supplied. Each ammeter is furnished with a full supply of mounting screws and nuts and washers.

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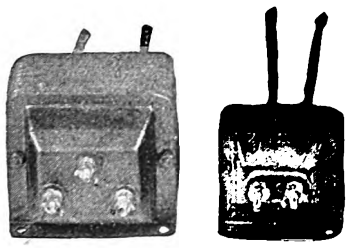
Bell-Ringing Transformer with Low Core Loss

The line of bell-ringing transformers just placed on the market by the General Electric Company of Schenectady, N. Y., are designed for high efficiency, core losses being exceptionally low. Careful attention has been paid to avoiding any hum. All current-carrying parts are completely surrounded by steel, thus meeting Underwriters' requirements, so that no additional steel box for inclosing the transformer is required in the installation.

There are nine of these transformers, all having standard ratings and divided into two general classifications. The household type is intended for the ordinary signal systems found in residences.



SUPPLIED IN HOUSEHOLD AND HEAVY-DUTY TYPES

The heavy-duty types are for larger and more powerful signal systems in office buildings, hotels, apartment houses, mines, industrial plants, etc. The household-size transformer is built in three ratings—for 110 volt, 50-140 cycle service; for 220 volt, 50-140 cycle service, and for 110 volt, 25-49 cycle service. The heavy-duty types are made in nominal rated capacities of 50 and 100 watts. Three secondary voltages are provided in these sizes, on account of diversified requirements met with in this class of installations.

The transformers are finished in green enamel. The parts in these transformers are also available for other transformers, such as toy transformers, special relay auto-transformers, etc.

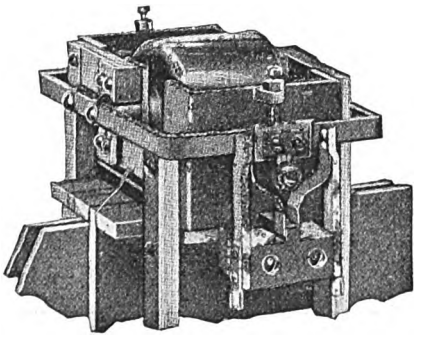
Unit-Type Interior-Illuminated Signs

The customary electric sign does not usually have the same advertising value in the daytime as in the night since the letters outlined in exposed lamp bulbs are not readable from any great distance owing to their lack of contrast with the background. This disadvantage is not present in the Oplex porcelain enamel unit signs which the Flexlume Sign Company of 1443 Niagara Street, Buffalo, N. Y., is manufacturing, since the white, glossy letters contrast well with the dark, high-finish background of porcelain enamel. As their name implies, these signs have a unit construction, that is, each letter is a separate and interchangeable part of the sign, so that the legend or words may be changed without the expense of a new sign. A durability resembling that of a bathtub is obtained in these signs because they are finished in porcelain enamel, which is impervious to heat, cold, moisture, grease and dirt.

The signs have a framework of heavy galvanized steel. The faces are composed of individual unit plates of heavy steel, finished in blue porcelain enamel with white trimmings and with white backs, which helps the illumination. In each place is a stencil or opening through which projects the raised opalescent glass letters, held in position by small, rust-proof bolts. The letters are illuminated by lamps in the interior of the sign directly behind each one. The bulbs are accessible through small doors in the top or bottom edges of the sign. Standard 12-in. (30-cm.) letters are supplied, and for extra lettering on the sign illuminated 4-in. and 6-in. (10-cm. and 15-cm.) letters on unit panels are also procurable.

Reverse-Current Relay for Direct Current

A reverse-current relay for direct current which is suitable for mounting on circuit breakers or directly on busbars or cables has been placed in the market by the Albert & J. M. Anderson Manufacturing Company, Boston,



CAN ALSO BE MOUNTED ON CIRCUIT BREAKERS

Mass. It is claimed to be absolutely uninfluenced by currents in neighboring conductors, regardless of the intensity or direction of the stray magnetic fields they produce.

This relay consists of two magnetic circuits of laminated transformer steel, surrounding the conductor of the circuit to be protected, and a powerful electromagnet. The ends of the latter are between the terminals of the two laminated transformer steel circuits. Each end of the electromagnet with its corresponding laminated steel circuit forms a powerful polarized relay, and the two are made to operate in unison by rigidly fastening the core of the electromagnet on a pivoted carriage which carries the relay contact.

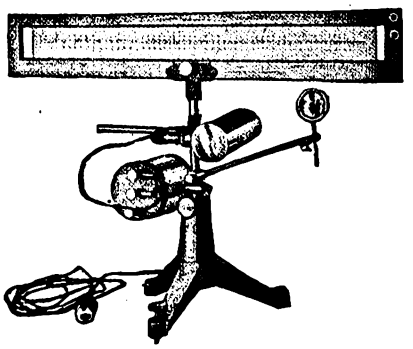
The action of either of the laminated magnetic circuits with the corresponding end of the electromagnet core is that of a reverse-current relay, of the ordinary type, which is susceptible to any stray magnetic fields in the neighborhood. However, any stray magnetic field which influences the pull of the electromagnet on one end counteracts itself by its influence on the opposite end, and the instrument as a whole behaves as though the stray field did not exist. The laminated magnetic circuits are very sensitive to low values of reverse current, and relays built for circuits of 14,000 amp. to 16,000 amp. are said to operate perfectly on reversals of less than 1 per cent.

Lamp and Scale Reflection Indicator

The lamp and scale reflection indicator now being made by the Pyro-electric Company, 636 East State Street, Trenton, N. J., is designed for use with wall galvanometers, or any sensitive laboratory instrument where the deflection is noted by the movement of a mirror fastened to the moving element. The parts are standardized as far as practicable, care being taken to employ the parts of automobile headlights as regularly sold.

Referring to the illustration, the projector, it will be seen, allows for both vertical and horizontal side adustment. It is so designed that lamps of bayonet base, single or double contact, or miniature screw base, may be used. The transformer supplied is designed for a primary voltage of 110 volts, 60 cycles, and its secondary has three terminals giving 6, 9 and 15 volts, with a capacity of 40 watts on the 15-volt circuit and proportionate current capacity for the other terminals. The outfit is thus adapted for any type of automobile headlamp up to 1¾-in. (3.1-cm.) diameter. As the lamp is inserted sidewise there is no distortion of the image due to the interference of the tip, no light from the end of the lamp being used for illuminating. The projector is fitted with a lens which renders the rays from the lamp parallel and evenly illuminates the indicator design in the fore end of the projector; that is, the end nearest the instrument.

Two indicator designs are supplied with each equipment, one giving a



ADJUSTABLE VOLTAGE TRANSFORMER ENERGIZES LAMPS

sharp black line and the other a white line on a black background, such as is suitable for use with vibration galvanometers. The billiance of the spot is determined by the type of lamp em-

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ployed and the size of the mirror on the galvanometer. With the ordinary 6-volt gas-filled lamp supplied with the equipment and a ⅜-in. (5 mm.) mirror, the spot is easily focused and made sharply visible in bright sunlight, though when slightly shaded from direct outside illumination, the spot is very distinct for 30 ft. to 50 ft. through a wide angle, rendering the indicator suitable for lecture demonstration.

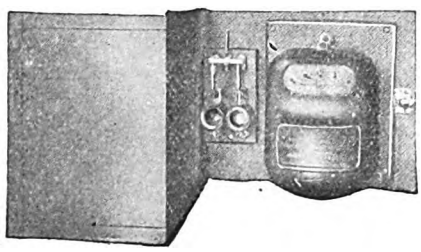
The adjustable arm carries a lens which may be adjusted in all directions. The function of this lens is to define the image sharply on the translucent scale, marked off in millimeters.

Safety Box for Outside Meter Reading

So that meters may be read and "blocked" or sealed from the outside of a building instead of from the inside the Electrical Manufacturing Company, 4149 East Seventy-ninth Street, Cleveland, Ohio, is making a safety meter box which is set in a hole cut through the wall of the house. The meter can be read or sealed regardless of whether the occupants of the building are in or not and at any time. This obviates the all too frequent annoyance of having the meterman track dirt or slush through the house in his passage to the meter installed in a dark cellar.

The box is made with a space in its exposed side for reading the meter dial. The rear side of the box holds the meter, the switches, the fuses and the entrance for the cables. Testing the meter is done from the inside of the building, but "blocking" it can be accomplished by an authorized person from the exterior.

Unsightly, dust-catching meter boards with exposed wiring and unprotected switches and fuses are eliminated with a consequent removal of fire hazard and electrical shock danger. In addition to its safety the box is proof against damp, water and rust. Three types of boxes are obtainable for one or two meters. One has a flange extending around its front part for covering uneven or ragged edges of the opening in the wall made to receive the box. The second style is for installation on the wall in the interior of the basement or on the outside of



METER IS READ THROUGH OPENING IN FRONT SIDE

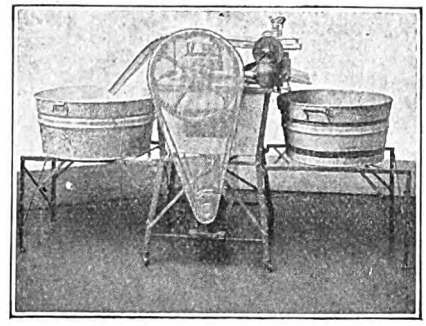
the building and is provided with angle lugs to offset it from the wall. The third type is the same as the second but does not have angle lugs and is for use in the foundation of buildings.

Heavy-Duty Deep-Bowl Reflectors

For general exterior and interior illumination, heavy-duty deep-bowl reflectors are being manufactured by the Henkel & Best Company and distributed by the Federal Sign System (Electric), Lake and Desplaines Streets, Chicago. They are heavily enameled in green on the outside and white inside. The fittings are heavy and will withstand hard usage. The reflector shell is clamped between thick leather washers, in turn held between a slotted metal washer and lock nut on the outside and a flanged fitter on the inside. Substantial studs, locking the position of fitter and socket, prevent these from turning as regards the reflector. The liberal-sized lock nut prevents maltreatment of the reflector, which is thus protected from corrosion and chipping off of enamel.

Electric Washer with Simultaneously Operated Wringer

A double folding tub stand has recently been added to the Wonder electrically driven clothes washer made by the Victor Manufacturing Company of Leavenworth, Kan., and all gears and the pulley wheel have been inclosed. It is now an easy matter, the maker



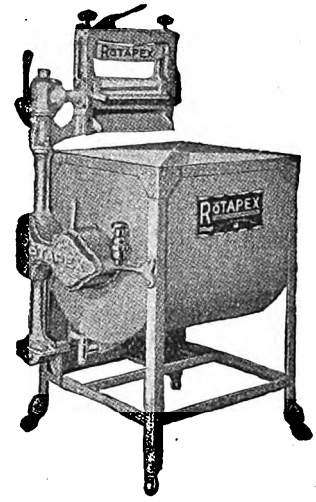
WRINGER AND WASHER MAY BE OPERATED AT SAME TIME

says, to wash a tubful of clothes and at the same time be wringing back other clothes from the rinse water to the bluing water without the two operations interfering with each other. The wringer control is placed on the side of the machine, making it possible for the operator to control the wringer with the left hand and have the right hand free for handling the washing. This does away with the necessity for reaching across the machine to control the wringer.

This washer may be had with "Armco" galvanized-iron tubs, cold-rolled polished-copper tubs or standard stave-leg wood tubs—all being of six-sheet capacity. The agitator is the same in all three styles. A ½-hp. electric motor connected to the ordinary lighting socket furnishes power to operate both washer and wringer at the same time. The two-roll reversible wringer has a malleable-iron frame, ball-bearing inclosed gears and a reversible water board. One convenient feature of the washer is that the power need not be shut off before the clothes are to be removed from the tub since raising the cover automatically disconnects the gear and removes danger of accidents.

Zinc-Cylinder Washing Machine

Because its light-weight cylinder is easily removable the tank of the "Rotapex" electric washer, recently de-



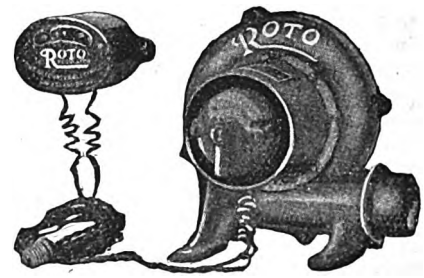
A FRICTION CLUTCH PREVENTS DAMAGE FROM OVERLOAD

veloped by the Apex Electrical Manufacturing Company, Cleveland, Ohio, can be thoroughly cleaned. The zinc cylinder is driven by means of a ¼-hp. motor with a high starting torque. A friction clutch prevents damage through overloading.

There are four units of control, namely, the motor with friction clutch, the worm-and-gear power transmission, the cylinder-operating mechanism and the winged control. Each of these units may be disengaged without disturbing the other. The cylinder-operating mechanism is practically noiseless in action.

Air-Cooled Blower

Because its motor is entirely inclosed the "Roto" blower made by the Rosewater Electric Company, 5516 Kinsman Road, Cleveland, Ohio, may be used in places where coal dust, ashes



AIR DRAWN AROUND MOTOR COOLS IT

and other dirt are present. It may be employed to create forced draft in connection with hot air, steam or hot-water furnaces, or it may be utilized for blowing and ventilating purposes.

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As the motor is placed in a jacket shown in the illustration, the air is drawn in around it and thus cools it. This jacket also adapts the blower for removing foul air from rooms and replacing it with fresh air.

The regulator supplied with the blower permits draft regulation from distant points; for instance, it may be placed in one of the upper rooms of a house where the blower and furnace are downstairs. In this way the temperature can be controlled without necessitating a trip to the cellar.

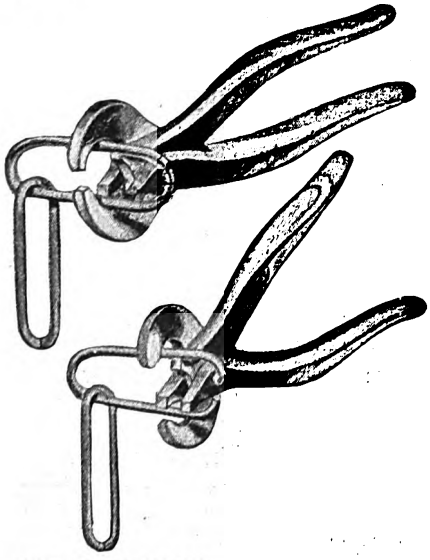
The blower and its regulator are supplied fully wired and can be connected by the plug with any lamp socket. They are furnished for 110 volts or 220 volts, alternating or direct current.

Single and Double-Pole Switch of Insulating Composition

"Rubber substitute," a non-elastic insulation composition, similar to hard rubber in appearance and heat-proof to 160 deg. F. (71 deg. C.); is the material used in manufacturing the Keystone single-pole and double-pole switches now being placed on the market by the International Insulating Corporation, 25 West Forty-fifth Street, New York City, and Mechanic Street, Springfield, Mass.

One-Hand Chain Pliers

The chain pliers which have been developed by the Lightning Chain Tool Company, Lathrop Building, Kansas City, Mo., open and close a chain link in one operation. After opening the link the pliers hold it for inserting or taking out another link or for attaching it to a lighting fixture and then



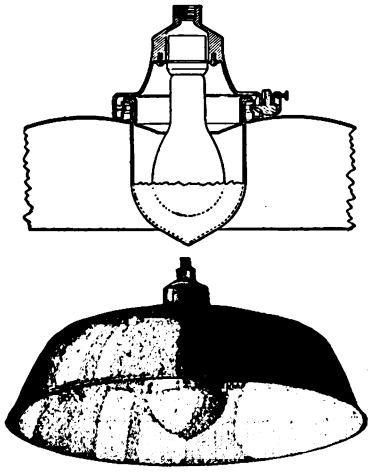
HELD IN ONE HAND; OPENS AND CLOSES CHAIN LINK IN ONE OPERATION

by a continued pressure of the hand the link is freed from the inner jaws and closed with the outer jaws. The tool, which is operated by one hand, is small and compact enough to fit the pocket, but because of its peculiar construction is said to be very powerful, so that opening and closing a chain link can be accomplished with little exertion.

Glareless Industrial Lighting Unit

Elimination of glare is said to be accomplished in the industrial lighting fixture recently placed upon the market by the Central Electric Company, 316 South Wells Street, Chicago. The shade is designed so that the reflection of the filament itself is not directed to the working plane. Moreover, there is no specular reflection between the angles of 0-45 deg. and 50-90 deg.

The unit is equipped with a dust-proof globe formed of glass, the upper half of which is clear. In combination with the reflector the cap eliminates



FILAMENT REFLECTION DIRECTED AWAY FROM WORKING PLANE

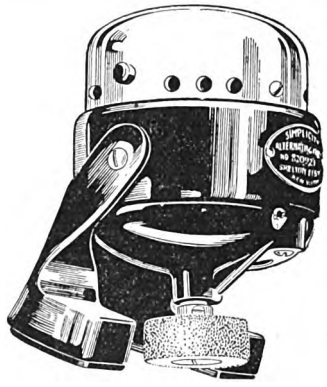
heavy shadows and makes drop cords unnecessary. A cast-iron set-screwless holder is provided with a lock clamp which permits quick and easy adjustment. It is claimed that the reflector cannot loosen under the most severe and continuous vibration.

Silk and Parchment Shade Portable Lamps

Especially designed for nurseries, bedrooms, etc., the "Dolly Dimple" lamps manufactured by Ferdinand Bing & Company, 67 Irving Place, New York, are decorated in natural colors. They can be made to match any decorations and are finished with silk or parchment shades. The framework is of cast metal and forms a substantial lamp.

Electric Motor for Phonograph

The electric phonograph motor operating in direct contact with phonograph turntables which has been developed by the Shelton Electric Company, 30 East Forty-second Street, New York City, is mounted vertically so that the rubber-tipped wheel on the motor spindle revolves the edge of the turntable. An automatic switch is furnished so that to start the phonograph it is only necessary to release the brake and rotate the turntable with the hand. To



OPERATES PHONOGRAPH BY DIRECT CONTACT WITH TURNBUCKLE

stop the motor the turntable is stopped either by the phonograph brake or with the hand.

This motor, known as the "Simplicity," can be used with Edison, Victor and Columbia phonographs. It is supplied either for direct current of 100 to 125 volts or for alternating current of 100 to 125 volts, 60 cycles. Being completely inclosed and insulated, any possibility of giving a shock while handled is avoided. A separating plug is inserted in the length of cord about 10 ft. (3 m.) from the motor, adding to the convenience permitted by the use of the motor.

NOTES ON RECENT APPLIANCES

Safety Electric Lantern

The Federal Sign System (Electric) of Lake and Desplaines Streets, Chicago, Ill., has placed on the market a safety electric hand lantern.

Adjustable Plier Wrenches

There are five wrenches in the series of adjustable plier wrenches which are being marketed by A. C. Allan, 6441 Eggleston Avenue, Chicago, Ill.

Electrically Driven Pressure and Vacuum Pumps

Several models of electrically driven pressure and vacuum pumps are now being marketed by the Utility Compressor Company of Detroit, Mich.

Electrically Driven Profiler

For producing duplicate irregular parts from sheet metal the Oliver Instrument Company of Adrian, Mich., is manufacturing an electrically driven profiler.

Vacuum-Cup Washing Machine

A single vacuum-cup electric washing machine known as Wayne No. 50 has been placed on the market by the Wayne Manufacturing Company, St. Louis, Mo.

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Trade Notes

BRITISH IMPORT RESTRICTIONS.—The War Trade Board announces that it has been informed that the Controller of Import Restrictions of Great Britain has issued notice that British import licenses will be issued admitting into Great Britain automobiles up to 50 per cent of the number (or shipping measurements) of the quantity imported up to Sept. 1, 1913. Under this ruling the term "automobile" covers motor vehicles of all kinds, including cycles and accessories. Electrical equipment is included in accessories.

BRITISH LAMP MANUFACTURERS ORGANIZE.—There has been formed recently the Electric Lamp Manufacturers' Association of Great Britain, Ltd. The objects, according to the *Electrician* of London, "include the promotion and protection of the interests of manufacturers of and dealers in electric lamps in the United Kingdom, the carrying on of research work for improving electric lamps, the formation of agreements between members and wholesale and retail dealers in electric lamps relating to manufacture, supply and sale of such lamps, etc."

MOTOR MANUFACTURER SUES VICTOR TALKING MACHINE COMPANY.—A Sherman law suit was begun on May 16 in the federal court at New York by the Shelton Electric Company against the Victor Talking Machine Company for triple damages aggregating $1,317,937.50, on a complaint charging that the defendant sought to deprive it of the benefits of its business as a dealer in phonograph motors. It is charged in the complaint that the Victor company compels dealers in its production to sign a contract which provides that no part of the Victor machine shall be taken out and replaced by any device not made by that company. By means of this contract, it is charged, the Victor company seeks to create a monopoly in electrically driven phonographs.

THE FORD MICA COMPANY, INC., is now at 14 Christopher Street, New York City.

THE HAAG BROTHERS COMPANY, washing-machine manufacturers, Peoria, Ill., has made arrangements for the construction of a new factory in East Peoria. This factory will permit the company more than to double its output. The company expects to be in the new building by Sept. 1. B. H. Lupton in the future will look after the sales end of the business.

F. J. RILEY has joined the organization of Fred W. L. Fullerton, Inc., of 15 West Twentieth Street, New York City, as a power engineer, and will devote his energies to caring for the concern's rapidly increasing business in electric motors, with its growing demand for expert service on power problems. Mr. Riley has been a power man for ten years, seven years of which he spent in the Western Electric Company organization and three years with the Eck Dynamo & Motor Company.

THE LEEDS & NORTHRUP COMPANY of Philadelphia has opened a pyrometer sales and service department in charge of Henry Brewer at 1304 Monadnock Block, Chicago. The announcement reads: "Service to pyrometer users and to prospective users will be rendered from this office. A complete standardization equipment will be maintained. Certification of thermocouples and of pyrometer equipments will be furnished in terms of standards certified by the United States Bureau of Standards. Particular attention will be given to maintaining equipment after installation."

THE EUREKA VACUUM CLEANER COMPANY of Detroit, Mich., expects to complete its new factory about July 1. In this plant there will be manufactured every part that goes into the making of the Eureka machine. The building will be three stories high and cover an area of over 19,000 sq. ft., with a floor space of over 50,000 sq. ft. An immense amount of up-to-date equipment will be installed to make possible the manufacturing of 1000 cleaners per day. At the present time the company, according to a statement from Fred Wardell, its president, is more than 12,000 machines behind, owing to the fact that it was swamped with orders since the war.

THE POOLE ENGINEERING & MACHINE COMPANY, Baltimore, Md., has removed its general sales office from Baltimore to 50 Church Street, New York City. W. C. Tyler, formerly district manager at New York, has been appointed general sales manager in charge of all the selling activities of the company.

E. B. LATHAM & COMPANY, New York City, announces as of June 1 the removal of its supply business from 4 Murray Street to the Tower Building, 326 Broadway. The offices and salesrooms will be at the 550-552 Pearl Street entrance and the warehouse at the 94 Worth Street entrance. All retail sales will be discontinued.

COL. DOUGLAS I. McKAY has been elected president of the Pulverized Fuel Equipment Corporation of 30 Church Street, New York, to succeed John E. Muhlfeld, who retires to return to consulting engineering practice. Since July, 1917, Colonel McKay has been engaged in war work. Leaving business at that time, he was commissioned major in the Ordnance Reserve Corps in charge of the raw-materials branch of the gun division and purchased all raw and semi-finished materials used by the Ordnance Department and contractors for the Ordnance Department. In January, 1918, he was promoted to be lieutenant-colonel in the National Army and appointed assistant director of purchases and supply. Here he had supervision over the purchasing operations of the several supply corps of the War Department, including the Ordnance Department, Quartermaster's Corps, Medical Corps, Corps of Engineers and Signal Corps. He was subsequently promoted to be colonel. Colonel McKay is a graduate of West Point and a former police commissioner of New York City. Upon resignation of the commissionership he became assistant to the president of J. G. White & Company, Inc., and two years later was elected vice-president and director, which position he held at the time he entered the service.

COL. D. I. M'KAY

GEORGE HOYT COX has been appointed New England district manager of the Westinghouse Electric & Manufacturing Company, with headquarters at 10 High Street, Boston. Mr. Cox is well known in the central-station field. He was born in Maine in 1880 and spent his early childhood at Taunton, Mass., being educated at Bristol Academy. In 1898 he entered the central-station field and was employed in the municipal lighting plant at Taunton, passing through all the intermediate grades to and including superintendent. Prior to becoming permanently connected with the Taunton plant Mr. Cox was for about a year a draftsman in textile machinery work, and he also was on the construction staff of the General Electric Company for a short period. Before leaving Taunton, also, he made a number of voyages to Europe on vessels of the Atlantic Transport Line, in connection with the reconstruction of marine electrical installations. In 1912 he became a supply salesman in the Boston office of the Westinghouse company, and in 1915 was made manager of the supply department, which position he filled until he was appointed district manager.

Trade Publications

ELECTRIC SIGNS.—The electric signs made by the Flexlume Sign Company of Buffalo, N. Y., are the subject of a recently issued twenty-four-page booklet.

FIRE-ALARM SIREN. — The Sterling motor-driven siren fire alarm is the subject of bulletin No. 12 from the Interstate Machine Products Company, Rochester, N. Y.

INSULATING MATERIAL.—"Micabond" electrical insulating material is dealt with in catalog No. 26 of forty-eight pages, distributed by the Chicago Mica Company, Valparaiso, Ind.

AUTOMATIC ELECTRIC COOK STOVE. —The Allmur Manufacturing Company of Marion, Ind., describes its automatic electric cook stove in a sixteen-page booklet of recent issuance.

ELECTRIC FANS. — The Knapp 8-in. "Handy" electric fan is the subject of a circular issued by the Knapp Electric & Novelty Company, 511 West Fifty-first Street, New York City.

PIVOTED BUCKET CARRIER.—Catalog No. 210, a cloth-bound ninety-four-page book about the Jeffrey pivoted bucket carrier, has just been published by the Jeffrey Manufacturing Company of Columbus, Ohio.

GRAPHIC METERS.—The latest issue of the Esterline Graphic is entitled, "Tangible Results" and shows the advantages of graphic records in industrial plants and in central stations. The leaflet may be obtained from the Esterline Company of Indianapolis, Ind.

ELECTRIC HOUSEHOLD APPLIANCES.—The Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is distributing a broadside in colors showing in a condensed form reproductions of the national advertising being done this spring by the three divisions of the company.

WIRING SUPPLIES, SPECIALTIES, ETC.—The Metropolitan Electric Manufacturing Company, Boulevard and Fourteenth Street, Long Island City, N. Y., announces that a series of thirteen bulletins covering its entire line of products is now ready for distribution. Two booklets, form No. 100, covering fuses, and form No. 101, covering wiring devices, may also be had.

New Incorporations

THE LION ELECTRICAL APPLIANCE COMPANY of New York, N. Y., has been incorporated by E. Miller, B. Seidman and R. J. Kupferman, 239 Penn Street, Brooklyn. The company is capitalized at $25,000.

THE S. O. S. WELDING CORPORATION of New York, N. Y., has been incorporated with a capital stock of $200,000 by V. D. Borst, W. A. Rosenbaum and J. E. Zelenko, 1 Park Row, New York City.

THE COLERAIN (N. C.) ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $1,500 by Estus White, L. B. Perry and C. B. Morris, all of Colerain. The company proposes to do a general utility business.

THE BURGLAR STARTER & BATTERY COMPANY of East Orange, N. J., has been incorporated by H. H. Picking, H. O. Geyer and E. R. Coburn. The company is capitalized at $50,000 and proposes to manufacture electrical equipment.

THE NORFOLK POWER-APPLIANCE CORPORATION of Norfolk, Va., has been incorporated with a capital stock of $25,000 to deal in power appliances, auto-tractor business, etc. The officers are: Paul F. Mueller, president, and J. W. Hough, secretary, both of Norfolk.

THE PEERLESS BRASS SPECIALTY MANUFACTURING COMPANY of New York, N. Y., has been incorporated with a capital stock of $25,000 by R. J. Kupfermann, 329 Penn Street; B. Seidmann, 127 Powell Street, and E. Miller, 1954 Sixty-fifth Street, Brooklyn. The company proposes to manufacture electric and gas appliances.

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New England States

ASHLAND, ME.—The local electric light plant, owned by George H. Mooers, was recently destroyed by fire, causing a loss of about $10,000.

FAIR HAVEN, VT.—The Tair Brothers Creamery Company has awarded a contract to the Western Vermont Power & Light Company for furnishing electricity to operate the new ice manufacturing and refrigerating machinery to be installed in its plant.

ATTLEBORO, MASS.—Plans are under consideration for improvements to the street-lighting system in the business district.

BOSTON, MASS.—A budget system has been established by the Boston Elevated Railway under which the company plans to expend $21,500,000 for improvements during the next five years. Among the improvements listed are the construction of a new car shop, the installation of a new turbine, rotary and stokers at the Lincoln power station, completion of the Somerville substation, installation of two rotaries in the Charlestown station, the provision of necessary conduit and cable construction, additions to the signal system, etc.

BROCKTON, MASS.—Contract has been awarded by the George E. Keith Company for the erection of a new one-story power house, 60 ft. by 70 ft., at its plant to Wescott & Mapes, 207 Orange Street, New Haven, Conn.

SHREWSBURY, MASS.—The installation of electric street lamps on North Quinsigamond Avenue is under consideration by the Selectmen.

WORCESTER, MASS.—The New England Power Company is planning extensions and improvements to its power plant and distributing systems, involving an expenditure of about $1,000,000, this year. The proposed work will include enlarging the power station at Vernon, Vt., and the installation of waterwheels and generators, increasing the generating capacity by 15,000 hp., the erection of additional substations, and also connecting the present system, which covers central and western Massachusetts and a large portion of Connecticut and Rhode Island, with the Metropolitan Board of Boston by erecting a feed line into and from the stations of the Edison Electric Illuminating Company of Boston.

COVENTRY, R. I.—The Narragansett Electric Lighting Company of Providence has been granted a franchise to erect a high-tension transmission line from Hope to Coventry Center to supply electricity to the plant of the Rhode Island Processing Company.

WESTERLY, R. I—Bids will be received by the Board of Water Commissioners, Westerly, until June 12 for construction of pumping station and equipment for same for sewerage system. Plans and specifications may be obtained at the office of the Water Commissioners, Town Hall, Westerly, or at the office of Samuel M. Gray, consulting engineer, Grosvenor Building, Providence, R. I. Thomas McKenzie is engineer of water department.

BRIDGEPORT, CONN.—The Nichols Underwear Company, 395 James Street, is planning to build a power house in connection with its proposed plant.

Middle Atlantic States

BELLMORE, N. Y.—Steps have been taken by the Board of Trade of Bellmore to secure the installation of an electric system in Bellmore. The Nassau Light & Power Company of Mineola has offered to extend its transmission lines from its main plant direct to Bellmore, provided that sufficient subscribers are procured from Bellmore, Wantaugh, Seaford, Merrick and Smithville to warrant the expenditure for the extension.

BORDER CITY, N. Y.—The Empire Gas & Electric Company of Geneva has purchased a site adjacent to its local plant, on which it proposes to erect a terminal and pumping station, equipped with two motor-driven pumps having a daily capacity of 2,500,000 gal.

BROOKLYN, N. Y.—Plans have been filed for the erection of a six-story factory building to be built by H. W. Cotton, Inc., on the entire block front on Fourteenth Avenue, between Thirty-sixth and Thirty-seventh Streets. The building will be 80 ft. by 800 ft., and will cost about $100,000. The company manufactures machinery. The Fred T. Ley Company, 19 West Forty-fourth Street, is contractor.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

LEROY, N. Y.—The Board of Water and Light Commissioners is considering the installation of an ornamental lighting system on Main Street, to be maintained by underground wires.

NEW YORK, N. Y.—Plans, it is reported, are being prepared by Sanderson & Porter, engineers, 52 William Street, New York City, for a new plant for the Andes Copper Mining Company at its works at Parquito, Chile, to cost, with equipment and machinery, about $1,000,000.

NEW YORK, N. Y.—Arrangements, it is understood, are being made by the New York Telephone Company for new construction work in New York City, to include new central-office installations and additions to existing installations, to cost about $12,000,000; station and outside plant equipment, about $9,300,000; a new toll board, about $1,125,000, and for completion of additions to central office equipment, about $950,000.

NEWARK, N. J.—The Public Service Electric Company is contemplating extensions to its electric power plant at Point-No-Point, to cost about $80,000.

NEWARK, N. J.—The L. E. Waterman Company, 191 Broadway, New York City, has acquired property on Peddie Street, near Johnson Avenue, on which it proposes to erect a six-story factory, 260 ft. by 475 ft.

NEWARK, N. J.—The Independent Lamp & Wire Company, 1733 Broadway, New York City, has acquired a site on Runyon Street, between Hillside and Belmont Avenues, on which it proposes to erect a new four-story building, 260 ft. by 580 ft. The present works of the company are located at Weehawken.

NEWTON, N. J.—The Public Utility Commissioners have granted the Newton Electric & Gas Company permission to erect an electric transmission line from Dover to Newton, to enable it to secure electricity from the New Jersey Power & Light Company. The cost of the proposed line is estimated at about $40,000.

PERTH AMBOY, N. J.—The Park Commissioners have recommended the installation of electric lamps in both Caledonia and Washington Parks.

PERTH AMBOY, N. J.—Plans are under consideration by the Board of Aldermen for equipping the municipal electric light plant to supply electricity for industrial purposes. The cost is estimated at about $60,000.

TRENTON, N. J.—Permission has been granted to the Trenton & Mercer County Traction Corporation to place all its heavy transmission lines in conduits which run along Lincoln Avenue from the power station.

CARLISLE, PA.—Bids are being taken by E. C. Beetem & Sons for the construction of a new power plant, 40 ft. by 46 ft. W. E. S. Dyer, Land Title Building, Philadelphia, is architect.

EAST BRADY, PA.—The Clarion (Pa.) Electric Company is reported to be considering the construction of a hydroelectric power plant in East Brady.

MILTON, PA.—A one-story power house, 50 ft. by 100 ft., will be erected in connection with the new factory building, 100 ft by 400 ft., at the local works of the Susquehanna Silk Mills, 149 Madison Avenue, New York, N. Y.

PHILADELPHIA, PA.—The ordinance recently introduced in the City Council for a proposed municipal loan of $14,750,000 for improvements, it is understood, provides that $300,000 of this amount will be used for electrical bureau construction, including extensions and improvement.

TYRONE, PA.—The Altoona & Logan Valley Electric Railway Company is considering extensions to its local electric power plant, to cost about $500,000.

BALTIMORE, MD.—Plans are being prepared by Samuel T. Williams, engineer, 223 North Calvert Street, Baltimore, for the construction of a power plant in the western part of Virginia.

HAGERSTOWN, MD.—The Hagerstown & Frederick Railway Company is reported to have purchased the property of the Northern Virginia Power Company, operating a large power plant at Millville, W. Va., and furnishing electricity for lamps and motors in Winchester and Berryville, Va., Charlestown, W. Va., and Hancock, Md. The company also has a steam generating plant at Berkley Springs and a hydroelectric plant at Capon on the Great Capon River in West Virginia. A company has been formed under the name of the Shenandoah Company, capitalized at $100,000, to take over the holdings of the Northern Virginia Power Company. The officers of the new company are: J. J. Houck, president, and E. H. Wade, secretary and treasurer.

CHARLESTON, W. VA.—Bids will be received by the State Board of Control, Charleston, until June 14 for the construction of sewage treatment works for the Weston State Hospital, Weston. The proposed work includes the erection of a sewage pumping station, equipped with two electric motors, two centrifugal pumps and automatic control equipment, and construction of a sewage sedimentation tank, sprinkling filter, sludge bed and chlorinating plant. Plans and specifications may be obtained at the office of J. S. Larkin, membor of State Board of Control, Charleston, or at the office of Charles E. Collins, consulting engineer, Drexel Building, Philadelphia, Pa.

HAMPTON ROADS, VA.—Contract has been awarded by the Navy Department, Washington, D. C., to Post & McCord, 101 Park Avenue, New York, N. Y., for the erection of additional buildings at the local airplane station, at $519,500.

HAMPTON ROADS, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 11 for the installation of electric distribution system at the local submarine base, to cost about $60,000.

HAMPTON ROADS, VA.—Plans are being prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the construction of additional buildings at Hampton Roads, including an administration and torpedo storage building, a storehouse, machine shop, an electrical shop and battery storage building, a subcharging and compressor building, two subcharging buildings and a railroad, to cost about $325,000 (Specification 3909). Plans may be obtained upon application to the chief of bureau of yards and docks, Navy Department, Washington, D. C. A deposit of $30 will be required.

WASHINGTON, D. C.—Bids will be received at the offic of the First Assistant Postmaster General, Washington, D. C., until June 19 for furnishing and installing mechanical equipment, including plumbing, heating apparatus, electric conduits and wiring, and interior lighting fixtures for the United States post office garage, to be located at First and G Streets, N.E., Washington, D. C.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until June 10, Mare Island, Cal., Schedule 4056—two motor generator sets and switchboard. Until June 17, South Charleston, W. Va., Schedule 4066—one oxygen hydrogen electrolytic generating plant. Until June 20, Washington, D. C., Schedule 4063—seamless copper tubing. Until June 10 Great Lakes, Schedule 4082—one 1½-hp. motor, one 2½-hp. motor and one 10-hp. motor; Schedule 4072—two 5-kw. direct-current motor-generators, two switchboard panels, one feeder and one generator. Gloucester, N. J., Schedule 8048½—fifty-six switchboards. Mare Island, Cal., Schedule 8049½—one boiler-feed pump, one feed-water heater and two tubular boilers; Schedule 8050½—Miscellaneous stranded cable; Schedule 8051½—eighteen watt-hour meters, one switchboard and equipment, turbo-generators and spare parts and one voltmeter. Application for proposal blanks should designate the schedule desired by number.

North Central States

DETROIT, MICH.—Plans have been prepared by A. Kahn, architect, Marquette Building, for the erection of a steel-manufacturing plant for the Detroit Seamless Steel Tube Company, Jefferson Avenue West and Nineteenth Street. The cost of the plant is estimated at $3,000,000 and will include three manufacturing units, 90 ft. by 550 ft., heating plant, 70 ft. by 100 ft., and a two-story administration. building.

MARQUETTE, MICH.—Bids will be received by the City Commission at the

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office of the city purchasing agent until June 16 for improvements to the municipal hydroelectric power plant as follows: (1) Construction of hydroelectric power house, 49 ft. by 97 ft., including tailrace excavation; (2) a reinforced-concrete surge tank, 30 ft. in diameter and 60 ft. high, including foundation; (3) concrete foundations with timber saddles for a wood-stave pipe line, 90 in. inside diameter, 1800 ft. long and 78 in. inside diameter, 285 ft. long. Separate bids to be submitted on power house and penstocks. Plans and specifications may be obtained at the office of Charles Retallic, superintendent of the Department of Light and Power Department, upon deposit of $25 for each set. Thomas W. Orbison of Appleton, Wis., is consulting engineer.

PORT HURON, MICH.—The City Council has approved the resolution to install ornamental lamps on several streets of the city, at a cost of about $19,000. The Port Huron Gas & Electric Company has the contract for street lighting.

CINCINNATI, OHIO.—The installation of ornamental lamps on McMillan Street from May Street to Woodburn Avenue and on Gilbert Avenue from Gilbert Avenue viaduct to Locust Street is under consideration by the City Council.

CINCINNATI, OHIO.—Preparations are being made for the erection of a large theater at the corner of Seventh and Vine Streets. A large amount of electrical apparatus will be required. The plans as now prepared call for thousands of electric light bulbs for exterior decorations. Ascher Brothers of Chicago, Ill., are interested in the project.

CLEVELAND, OHIO.—Plans have been prepared by the Leonard Electric Manufacturing Company, 433 Champlain Avenue, for the erection of a factory at 3907 Perkins Avenue, to cost about $60,000.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until June 13 for installing and pulling electric wire cables for filtration plant, division pumping station, division of water. Bids will also be received at the same time and place for weatherproof copper wire; also for a boiler-feed heater, both for the division of light and heat.

HAMILTON, OHIO.—The City Council has adopted an ordinance providing for an issue of $17,000 in bonds for improvements to the municipal electric light plant.

MARTINS FERRY, OHIO.—An election will be called on Aug. 12 to submit to the voters the proposal to issue $450,000 for extensions to the municipal electric light plant and waterworks system.

MINERVA, OHIO.—Bonds to the amount of $50,000 have been voted for the construction of a municipal electric light plant.

OAK HARBOR, OHIO.—The Northwestern Ohio Railway & Power Company of Toledo, it is reported, will place contracts at once for the construction of carhouse and repair shops at Oak Harbor.

SOUTH BEND, IND.—The Studebaker Corporation, it is stated, will expend $8,500,000 this year on plant expansion, instead of half of that amount this year and half next year as originally planned. The output of the plant will be more than doubled. A. R. Erskine is president of the company.

BELVIDERE, ILL.—The Rockford & Interurban Railway Company of Rockford is contemplating the construction of a new power plant in Belvidere. The construction of a new line from Belvidere to Rockford is also under consideration.

CARLOCK, ILL.—The construction of a 6600-volt transmission line from Hudson to Carlock and the erection of a distribution system in Carlock is under consideration by the Carlock Light & Power Company.

CHICAGO, ILL.—The Premier Electric Company, 1123 South Michigan Avenue, has purchased a site at the corner of Ravenswood Avenue and Grace Street, on which it proposes to erect plant.

CHICAGO, ILL.—The Packard Motor Car Company has taken a lease on a site at Thirty-seventh and Princeton Streets, on which it proposes to erect a two-story service station and factory, to cost about $600,000.

ELGIN, ILL.—The erection of a new power plant is under consideration by the Illinois Watch Case Company.

KINCAID, ILL.—The Peabody Coal Company is planning to build a power house, 45 ft. by 110 ft., to cost about $25,000.

MILWAUKEE, WIS. — The Chicago, North Shore & Milwaukee Railroad Company, of Highwood, Ill., it is reported, will soon begin work on the erection of a station at Sixth Street, between Sycamore and Clyborn Streets, Milwaukee, to cost about $250,000.

TWO RIVERS, WIS.—Lockwood, Greene & Company, consulting engineers, Chicago, Ill., have been engaged by the F. Eggers Veneer Seating Company to design and supervise the construction of an addition to its plant and an extension to a power house, 20 ft. by 40 ft., to cost about $100,000.

WOODSTOCK, WIS. — Bonds to the amount of $25,000 have been authorized for improvements to the municipal electric light plant.

MINNEAPOLIS, MINN. — The City Council is considering the installation of 100 additional fire-alarm boxes, new terminal switchboards and other improvements necessary to meet the requirements of the National Board of Underwriters. J. F. Wallace is chairman.

ST. JAMES, MINN.—Bonds to the amount of $30,000 been voted for improvements to the lighting and sewer systems.

CLEGHORN, IOWA.—An election will be held on June 12 to vote on the proposal to grant the Iowa Light, Heat & Power Company of Carroll a franchise to supply electrical service in Cleghorn.

STORY CITY, IOWA. — Bonds to the amount of $50,000 have been voted for rebuilding the municipal electric light plant.

ST. JOSEPH, MO.—The St. Joseph Railway, Light, Heat & Power Company has purchased a site adjoining its power plant extending west to the Missouri River.

WAKENDA, MO.—The installation of an electric light plant in Wakenda is under consideration.

FARGO, N. D.—Bids will be received by E. G. Guthrie, secretary board of education of Fargo, until July 2 for equipment for the new combination school, including machine-shop equipment, woodworking equipment, clocks, bells, telephones and fire-alarm system and electric light fixtures, etc.

SIOUX FALLS, S. D.—Work has begun on the erection of the addition to the power plant of the Northern States Power Company at the falls, to cost about $300,000.

WATERTOWN, S. D.—The installation of a central heating plant is under consideration by the City Council, to cost about $140,000. E. A. Larsen of St. Paul, Minn., is engineer. B. N. Hagna is chairman of heating project.

LAWRENCE, NEB.—The installation of an electric lighting system, to cost about $6,000, in Lawrence is under consideration.

OMAHA, NEB.—The City Council is considering replacing 800 gas lamps with electric lamps throughout the city.

OSHKOSH, NEB.—A special election will be held June 10 to vote on the proposal to issue $9,750 in bonds for the installation of an electric lighting system in Oshkosh.

MANHATTAN, KAN.—The plant and holdings of the Marshall County Power & Light Company of Blue Rapids has been purchased by the Rocky Ford Milling & Power Company of Abilene. The latter company operates a hydroelectric plant and supplies service to six towns. Work has been started on the erection of a transmission line connecting the two plants. With the completion of this line the system will supply energy to about 50 towns including Camp Funston. Arthur Groesbeck, manager of the Rocky Ford Company, will manager the Marshall County system from Manhattan.

Southern States

HIGH POINT, N. C.—The High Point Exposition Company is contemplating the construction of a building in High Point for displaying samples of furniture made in the South. The cost is estimated at between $400,000 and $500,000. Charles F. Long is interested.

WILMINGTON, N. C.—The Hamme Marine Railway Company is reported to be contemplating the construction of a plant to build steel and wooden ships. Electrically operated machinery will be installed. R. F. Hamme, Jr., is president.

PORT ORANGE, FLA.—Bonds to the amount of $9,000 have been voted for the installation of a municipal electric light plant.

SAVANNAH, GA.—Interests, headed by Imbris & Company, are planning to establish a meat-packing plant in Savannah, to cost about $1,500,000. An electric light and power plant and refrigerating plant and by-products plant will be installed in connection with the proposed project. James Imbris of New York, N. Y., is president of Imbris & Company.

FRIENDSHIP, TENN.—The Marvel Mill Company is contemplating building an addition to its electric plant and mill.

MONTGOMERY, ALA.—The Montgomery Light & Traction Company has petitioned the City Commissioners for permission to build a 1-mile extension to Wright Field.

UNION SPRINGS, ALA.—Bonds to the amount of $10,000 have been voted for improvements to the electric light and water plants and to purchase a truck for the Fire Department.

ROLLING FORK, MISS.—The City Council has engaged Xavier A. Kramer, consulting engineer, Magnolia, to prepare plans for construction of electric light, plant, waterworks, sewerage system, etc.

OKOLONA, ARK.—R. H. Andrews is planning to erect an electric plant on the Antoine River, 4 miles from Okolona.

BEGGS, OKLA.—The Beggs Power & Ice Company is planning to equip a plant, to cost about $100,000. C. C. Kimble and W. H. Reading are interested in the project.

COMANCHE, OKLA. — Bonds to the amount of $35,000 were recently voted for extensions and improvements to the municipal electric light plant and waterworks system.

NORMAN, OKLA.—The erection of a laundry, to cost about $35,000, at the Oklahoma State Hospital is under consideration; also the completion of the heating, power and ice plant, at a cost of $45,000.

PAWNEE, OKLA. — The local electric light plant recently sold at a foreclosure sale was purchased by H. A. Carmichael, trustee for the bondholders, at $32,000.

Pacific and Mountain States

SEATTLE, WASH.—Acting Mayor Lane has decided to allow the ordinance appropriating $30,000 to finance drilling operations at Diablo Canyon and Ruby Creek to become a law without his signature. Plans will be prepared at once by A. H. Dimock, engineer, for a complete investigation of the Skagit project, the first work to consist of borings at the site of the proposed Ruby Creek dam.

VALLEY, WASH.—Arrangements are being made by the farmers on the west side of the valley to erect an electric transmission line from the local system to that neighborhood.

GLENADA, ORE. — The Glenada Mill, Light & Power Company, recently organized, proposes to operate a mill in Glenada and also to supply electricity for lamps and motors to the city.

CHICO, CAL.—The City Trustees have adopted a resolution asking the Railroad Commission to appraise the electric distributing systems of the Northern California Power Company and the Pacific Gas & Electric Company in Chico. The city is contemplating municipal ownership of the lighting systems.

LOS ANGELES, CAL.—Bids will be received by the Public Service Commission until June 27, for machinery for the municipal power plant No. 2 in the San Francisquito Canyon, including hydraulic equipment, electric generators, transformers, auxiliary electric equipment, etc. The cost is estimated at about $500,000.

LOS ANGELES, CAL.—Specifications for the installation of the ornamental lighting system on Broadway from California Street to Tenth Street have been approved by the Public Service Commission. The system will consist of 134 lamps mounted with two 1600-cp. lamps. A temporary system is now being installed to be used during the change from the old to the new system. The cost is estimated at about $100,000.

ORLAND, CAL.—Owing to the increase in rates the Orland Water Users' Association is contemplating the installation of an independent telephone system, the service te bo provided at cost to the legal water users in the Orland project. There are more than 700 using water supplied by the association.

BOISE, IDAHO.—The Idaho Power Company is planning to erect a transmission line from American Falls to Pocatello, a distance of 25 miles. The company is now installing a 3600-kva. generating unit at its Lower Salmon hydroelectric plant.

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OASIS, UTAH.—The Deseret Irrigation Company and the Melville Irrigation Company have applied to the Public Utilities Commission for permission to supply electricity in several towns in Millard County. The companies contemplate the construction of a second power plant on the Savior River near Delta and propose to furnish electrical serviec in Delta, Oasis, Deseret and Hinckley.

DENVER, COL.—The Colorado Pitchblende Company is reported to have purchased the power plant and water rights in South St. Vrain Canyon, owned by the John L. Neble Company. The property includes 160 acres of timber land and a power and compressor plant, which will be used in connection with the mining and milling operations in the Jimtown district of Boulder County. By impounding the water at the head of the St. Vrain, it estimated that the generating capacity of the power plant can be increased by several thousand horsepower.

MONTROSE, COL.—The installation of a municipal electric light plant in Montrose is under consideration.

Canada

GODERICH, ONT.—The erection of a new transmission line to transmit 25,000 hp. from the system of the Hydro-Electric Power Commission for the proposed plant of the Lake Huron Steel Corporation, recently incorporated with a capital stock of $15,000,000, to manufacture high carbon steel, is under consideration. B. H. McCreath of Toronto, and F. W. Craigie of Goderich are interested in the company.

ST. CATHARINES, ONT.—The Niagara, St. Catharines & Toronto Railway Company, it is reported, contemplates the reconstruction of several miles of track within the city of St. Catharines, the erection of new overhead work on the line between St. Catharines and Thorold, enlarging and transforming of the park at Port Dalhousie into a pleasure ground, etc.

Miscellaneous

KINGSTON, JAMAICA — Arrangements are being made by the government for a survey of the water power of the larger rivers in Jamaica to see if equipping the railways for electrical operation is now feasible.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until June 23, under circular 1282, for copper wire, and cable, condenser tubes and thimbles, copper, watt-hour meters, motor-generator sets, starting compensators, transformers, fans, busbar supports, end bells, connectors, receptacles, reflectors, sockets, studs, switches, fuses, pipe clamps, globes and cypress lumber. For further information address the above office.

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until June 17 for castings, forgings, metal workers' tools and machines, Klaxon horns, copper cable, wire conduit, electric fans, fixtures, fuses, meters, reflectors, sleeves, sockets, switches, transformers, etc., Blanks and information relating to this circular (1281) may be obtained at the above office or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, San Francisco, Cal.

Directory of Electrical Associations

Printed in the First Issue of Each Month

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, C. E. Drayer, 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country. Annual meeting, Lake Placid, N. Y., June 24-27.

AMERICAN PHYSICAL SOCIETY. Secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa. Annual meeting, Atlantic City, N. J., June 24-27.

ARKANSAS UTILITIES ASSOCIATION. Secretary, W. J. Tharp, Little Rock, Ark. Annual convention, June 10, 11 and 12, Little Rock, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF MUNICIPAL ELECTRICAL ENGINEERS OF ONTARIO. Secretary, R. A. Clement, 190 University Ave., Toronto, Ont., Can. Annual convention, Niagara Falls, Ont., June 19-21.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa. Annual convention, St. Louis, Mo., Sept. 22-26.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St., East, Toronto, Ont. Annual meeting, Alexandria Bay, N. Y., June 27-28.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary-treasurer, T. F. Kennedy. 900 15th St., Denver, Col.

CONFERENCE CLUB. Secretary, Sullivan W. Jones, 110 West 40th St., New York City.

COMMERCIAL SECTION, N. E. L. A. Secretary, Henry Harris, Pittsburgh, Pa.

EASTERN NEW YORK SECTION, N. E. L. A. Assistant secretary, J. L. Hemphill, General Electric Co., Schenectady, N. Y.

ELECTRICAL MANUFACTURERS' CLUB. Secretary, Shiras Morris, Hart & Hegerman, Hartford, Conn.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION. General secretary, Franklin Overbagh, 411 South Clinton St., Chicago, Ill. Annual meeting, Hot Springs, Va., June 10, 11 and 12.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, ATLANTIC DIVISION. Secretary, E. Donald Tolles, 52 Broadway, New York City.

ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

ELECTRIC POWER CLUB. Secretary, C. H. Roth, 1410 West Adams St., Chicago, Ill.

ELECTRIC VEHICLE SECTION OF THE N. E. L. A. Secretary, A. Jackson Marshall, 29 West 39th St., New York City.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 29 West 39th St., New York City.

FLORIDA ENGINEERING SOCIETY. Secretary, J. R. Benton, Gainesville, Fla.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary-treasurer, R. V. Prather, Springfield, Ill.

ILLUMINATING ENGINEERING SOCIETY. General secretary, Clarence L. Law. Sections in New York, Philadelphia, Pittsburgh, Cleveland, Chicago and Boston. Annual convention, Chicago, October.

INDIANA ELECTRIC LIGHT ASSOCIATION. Secretary, Thomas Donohue, Lafayette, Ind.

INDUSTRIAL ELECTRIC HEATING ASSOCIATION. Secretary, Homer Kunz, Toledo Railways & Light Co., Toledo, Ohio.

INSTITUTE OF RADIO ENGINEERS. Secretary, Alfred N. Goldsmith, College City of New York, New York.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, C. R. George, Houston, Tex. Annual meeting, Chicago, Sept. 23-26.

INTERNATIONAL ELECTROTECHNICAL COMMISSION (international body representing various national electrical engineering societies contributing to its support). General secretary, C. le Maistre, 28 Victoria St., Westminster, London, S. W., England.

IOWA SECTION, N. E. L. A. Secretary-treasurer, M. G. Linn, Des Moines, Iowa. Annual meeting, Colfax, Iowa, June 18, 19 and 20.

JOVIAN ORDER. Jupiter (president), J. F. Strickland, Dallas, Tex.; Mercury (secretary), E. C. Bennett, Syndicate Trust Building, St. Louis, Mo.

KANSAS PUBLIC SERVICE ASSOCIATION. Secretary-treasurer, W. W. Austin, Cottonwood Falls, Kan.

MICHIGAN SECTION, N. E. L. A. Secretary, Herbert Silvester, Detroit Edison Co., Detroit, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary and treasurer, Meyer Barnest, St. Paul, Minn.

MISSISSIPPI ELECTRIC ASSOCIATION. Affiliated with the N. E. L. A. Secretary, E. S. Meyers, Vicksburg, Miss.

MISSOURI ASSOCIATION OF PUBLIC UTILITIES. Secretary-treasurer, F. D. Beardslee, 721 Locust St., St. Louis, Mo. Annual meeting, June 5-7, Excelsior Springs, Mo.

NATIONAL ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary, W. H. Morton, 110 West 40th St., New York City, N. Y. State associations in Alabama, Arkansas, Connecticut, Georgia, Kansas, Illinois, Indiana, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oregon, Pennsylvania Tennessee and Wisconsin. Annual meeting, Milwaukee, Wis., July 14-18.

NATIONAL ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary-treasurer, William L. Smith, Northeastern College, Boston, Mass. Annual meeting, Springfield, Mass., Oct. 13 and 14.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

NEW ENGLAND SECTION, N. E. L. A. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston, Mass.

NEW MEXICO ELECTRICAL ASSOCIATION. Secretary-treasurer, Charles E. Twogood, Albuquerque, N. M.

NEW YORK ELECTRICAL CREDIT ASSOCIATION. Secretary, Franz Neilson, 120 Broadway, New York City.

NEW YORK ELECTRICAL SOCIETY. Secretary, George H. Guy, 29 West 39th St., New York City.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION. Affiliated with N. E. L. A. Secretary, George L. Myers, Pacific Power & Light Co., Portland, Ore.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual meeting, Cedar Point, Ohio, July 15-17.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

OKLAHOMA UTILITIES ASSOCIATION. Secretary, H. A. Lane, 611 State National Bank Building, Oklahoma City.

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PACIFIC COAST SECTION, N. E. L. A. Secretary, A. H. Halloran, 618 Mission St., San Francisco, Cal.

PENNSYLVANIA ELECTRIC ASSOCIATION. State Section N. E. L. A. Secretary, H. M. Stine, 211 Locust St., Harrisburg, Pa.

PUBLIC SERVICE ASSOCIATION OF VIRGINIA. Secretary, W. J. Kehl, Virginia Railway & Power Co., Richmond, Va.

PUBLIC UTILITIES ASSOCIATION OF WEST VIRGINIA. Secretary, W. C. Davisson, West Virginia Water & Electric Co., Charleston, W. Va.

RADIO CLUB OF AMERICA. Secretary, T. J. Styles, 4171 Beaufort Avenue, Woodlawn, N. Y.

ROCKY MOUNTAIN ASSOCIATION OF MUNICIPAL ELECTRICIANS. President, Lawrence Stone, Denver, Col.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC. General manager, J. M. Wakeman, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Dean F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

SOUTH DAKOTA ELECTRICAL POWER ASSOCIATION. Secretary-treasurer, O. J. Gronsdahl, Hartford, S. D.

SOUTHEASTERN SECTION, N. E. L. A. Secretary-treasurer, T. W. Peters, Columbus, Ga. Annual convention, Asheville, N. C., Sept. 17-19.

SOUTHERN CALIFORNIA ELECTRICAL CONTRACTORS AND DEALERS' ASSOCIATION. Secretary-treasurer, J. E. Wilson, 425 Consolidated Realty Building, Los Angeles, Cal.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, H. S. Cooper, 403-4 Slaughter Building, Dallas, Tex.

SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont.

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., June 17-19.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis.

Record of Electrical Patents

Notes on United States Patents

(Issued May 30, 1919)

1,303,964. ELECTRIC WELDING TRANSFORMER; Adolph F. Rietzel, Charlestown, R. I. App. filed Oct. 3, 1918. Permits free movement of the work platens.

1,303,989. TEMPERATURE INDICATOR; Nathan H. Suren, Needham, Mass. App. filed Feb. 6, 1915. Indicates or records by electrical transmission temperature conditions.

1,304,000. MEANS FOR AUTOMATICALLY CONTROLLING ELECTRIC HEADLIGHTS FOR AUTOMOBILES; Harry E. Wallace, Paducah, Ky. App. filed Sept. 27, 1915.

1,304,008. CONTROLLING DEVICE; Paul H. Zimmer, Milwaukee, Wis. App. filed Feb. 4, 1915. Effects sequential operation of the circuit-controlling parts.

1,304,010. MOVING-PICTURE INDICATOR; Lemoine J. Bechtold, Denver, Col. App. filed Nov. 14, 1917. Time-controlled program.

1,304,022. ELECTRICAL INDICATING DEVICE; Samuel F. Cole, Purcellville, Va. App. filed May 25, 1915. Indicates the quantity of liquids of an explosive nature.

1,304,024. PROTECTOR; Wallace L. Cook, Chicago, Ill. App. filed Feb. 9, 1917. Pencil fuse.

1,304,025. TELEGRAPH SENDING MACHINE; William C. Cozad, Chicago, Ill. App. filed Feb. 12, 1918.

1,304,040. OUTLET BOX; Albert Guth, Perth Amboy, N. J. App. filed May 1, 1916. All fixtures can be adapted to box.

1,304,075. ELECTRICAL CONNECTOR; John Lofgren, Chicago, Ill. App. filed Sept. 29, 1917. For several conductors.

1,304,076. TELEPHONE-EXCHANGE TRUNKING SYSTEM; Fritz Lubberger, Chicago, Ill. App. filed May 6, 1910.

1,304,101. CHOCOLATE-HEATING APPARATUS; John G. Rote, Belmont, Mass. App. filed Aug. 29, 1918. Easily regulated.

1,304,132. SYSTEM OF BOOSTING ELECTRIC LINES; Albert Werner, Berlin-Fiedenau, Germany. App. filed Nov. 25, 1913. Avoids surplus of boosting voltage.

1,304,146. ELECTRICALLY HEATED PUFF IRON; David Bertuleit, Portland, Ore. App. filed June 22, 1918. Head approximately ovoidal.

1,304,169. ARRANGEMENT FOR FORMING ELECTRICAL ARCS; Bertalan Duschnitz, Berlin, Germany. App. filed July 14, 1911. Produces an arc without moving the electrodes.

1,304,172. DIRECTION SIGNAL FOR VEHICLES; Carl Fredriksen, Lackawanna, N. Y. App. filed Aug. 22, 1917.

1,304,178. ELECTRICAL SYSTEM OF POWER TRANSMISSION; William S. H. Hamilton, Schenectady, N. Y. App. filed March 24, 1916. Motor separately excited.

1,304,181. ELECTRIC SHIP PROPULSION; Henry M. Hobart, Schenectady, N. Y. App. filed Sept. 21, 1916. Propellers are driven by polyphase induction motors.

1,304,184. TRANSFORMER; Svend E. Johannesen, Pittsfield, Mass. App. filed Nov. 11, 1915. Relocates leads in transformers of multi-layer coils.

1,304,188. CONTROLLING APPARATUS FOR WIRELESS TELEPHONE SYSTEM; David G. McCaa, Lancaster, Pa. App. filed June 4, 1918.

1,304,192. NEGATIVE PLATE FOR LEAD STORAGE BATTERIES; William Morrison, Chicago, Ill. App. filed Sept. 23, 1918. Possesses a high and uniform electrical conductivity.

1,304,203. LIGHTING SYSTEM; Albert P. Robinson, Kenvil, N. J. App. filed Aug. 9, 1917. Series system which allows lighting although ore burns out.

1,304,210. INDUCTION-MOTOR CONTROL; Newton Shuttleworth and George M. Brown, Rugby, Eng. App. filed March 16, 1916. Speed control for flywheels.

1,304,214. BATTERY ADAPTER; Maxwell H. Smith, Philadelphia, Pa. App. filed April 13, 1918. For flashlight.

1,304,217. PRESSURE-CONTROLLED SWITCH; Edmund E. Taeubert, Los Angeles, Cal. App. filed Oct. 28, 1914. Maintains predetermined pressure in electric railway car.

1,304,222. PROCESS OF EXTRACTING MANGANESE AND MAKING SULPHURIC ACID AND MANGANESE DIOXIDE; George D. Van Arsdale and Charles G. Maier, New York, N. Y. App. filed April 18, 1918.

1,304,226. ELECTRIC BOX; Frederick H. Ward, Brooklyn, N. Y. App. filed May 1, 1913. Outlet box.

1,304,227. WELDING ELECTRODE; James M. Weed, Schenectady, N. Y. App. filed Nov. 4, 1918. Material extremely rigid.

1,304,229. HIGH-SPEED GRINDING MACHINE; John B. Wiard, Lynn, Mass. App. filed July 3, 1915. Electrically driven.

1,304,230. LEAD BUSHING; James Wilkinson, Pittsfield, Mass. App. filed Oct. 7, 1916. Oil-filled.

1,304,236. DISCONNECTING DEVICE FOR ELECTRIC SUPPLY CIRCUITS; Charles H. Wordingham, Redhill, Eng. App. filed Aug. 12, 1918. In case of flooding, fire, etc.

1,304,237. SYSTEM FOR DISTRIBUTING ELECTRIC ENERGY; Charles H. Wordingham, Redhill, Eng. App. filed Aug. 12, 1918.

1,308,239. ELECTRICAL SYSTEM OF POWER TRANSMISSION; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed March 11, 1916. Regenerative control.

1,304,240. ELECTRIC SYSTEM OF SHIP PROPULSION; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed March 22, 1916. Two different speed ranges.

1,304,247. INSULATOR; Omer C. Barger, Indianapolis, Ind. App. filed June 24, 1918. High-tension glass.

1,304,252. ENGINE-STARTING DEVICE; Joseph Bijur, New York, N. Y. App. filed July 7, 1914.

1,304,257. ELECTRICAL APPARATUS; Frederick F. Brand, Pittsfield, Mass. App. filed Feb. 2, 1917. Wall-coiled transformers, reactances, etc.

1,304,269. DISTANT CONTROL OF MECHANISM SUCH AS GUN SIGHTS OR TURRETS; Arthur T. Dawson, and George T. Buckham, Westminster, London, Eng. App. filed April 13, 1915.

1,304,282. MEANS FOR SUPPORTING ELECTRODES IN IONIC TUBES; Oswald Durdle, London, Eng. App. filed Aug. 9, 1918.

1,304,283. INSULATING BUSHING; Eugene D. Eby, Pittsfield, Mass. App. filed May 24, 1918. Resists surges, corona and other transient phenomena.

1,304,288. SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed March 11, 1916. Drives high-speed, high-power vessel at plurality of different speeds.

1,304,289. SYSTEM OF SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed March 15, 1916.

1,304,290. ELECTRIC SYSTEM OF SHIP PROPULSION; William L. R. Emmet, Schenectady, N. Y. App. filed March 1, 1916.

1,304,296. RADIO-SIGNALING SYSTEM; Chas. Le G. Fortescue, Pittsburgh, Pa. App. filed Dec. 2, 1916.

1,304,308. TELEPHONE ATTACHMENT; Eugene Gransault, New York, N. Y. App. filed June 30, 1915.

1,304,324. INDIVIDUAL-SWITCH MECHANISM FOR AUTOMATIC TELEPHONE SYSTEMS; Alexander E. Keith, Chicago, Ill. App. filed April 29, 1905.

1,304,335. AUTOMATIC TELEPHONE-EXCHANGE SYSTEM; Alben E. Lundell, New York, N. Y. App. filed Oct. 26, 1916.

1,304,342. INSULATING COUPLING FOR FENCE WIRES; James L. Martin, Yates Center, Kan. App. filed June 22, 1917. Eliminates live-stock killing.

1,304,350. ELECTRIC FURNACE; William E. Moore, Pittsburgh, Pa. App. filed June 11, 1917. Arc-type electric metallurgical furnaces.

1,304,356. TELEGRAPH SOUNDER; Thomas J. Murphy, Rochester, N. Y. App. filed Nov. 30, 1917.

1,304,365. MOTOR HEATER AND LIKE DEVICE; Walter B. Powell, Quebec, Can. App. filed Jan. 28, 1918. For gas engines.

1,304,369. TELEPHONE SYSTEM; Arthur J. Ray, Liverpool, Eng. App. filed Jan. 26, 1915.

1,304,376. ELECTRIC CURRENT INTERRUPTER; Miguel B. Rodriguez, Madrid, Spain. App. filed Dec. 22, 1917.

1,304,377. ELECTRIC SWITCH; Even J. Rohne, Minneapolis, Minn. App. filed Oct. 1, 1917. Straight-through cut-off type.

1,304,425. ELECTRIC FURNACE; Harold G. Weidenthal, Cleveland, Ohio. App. filed Nov. 16, 1918. Equally applicable to direct-current or alternating-current system.

1,304,444. REINFORCED JOINT FOR CARBON ELECTRODES; William P. Bidelman, Los Angeles, Cal. App. filed Oct. 1, 1918. Prevents breaking.

1,304,451. TRANSFORMER; Locke H. Burnham, Pittsfield, Mass. App. filed Jan. 29, 1917. Increase in capacity secured by better cooling or ventilation.

1,304,453. ELECTROMAGNETIC LOCKING DEVICE; Louis Cadenel, Paris, France. App. filed May 27, 1914. For safes.

1,304,461. TELEPHONE ATTACHMENT; George Dorsey, Seattle, Wash. App. filed April 20, 1918.

1,304,469. OIL-FILLED LEAD BUSHING; John J. Frank, Pittsfield, Mass. App. filed Oct. 30, 1916. Bushing collar makes parts integral.

1,304,491. QUICK-SERVICE ATTACHMENT PLUG; Albert C. Kong and Wah Chong Kam, Honolulu, Hawaii. App. filed Nov. 26, 1918. Can be snapped into Edison base.

1,304,503. CARBON HOLDER FOR ELECTRIC ARC LIGHTS; Ralph C. Miller, Los Angeles, Cal. App. filed Nov. 7, 1917. Extension carbon holder.

1,304,522. ELECTRIC REGULATOR; Joseph Bijur, New York, N. Y. App. filed Aug. 13, 1914.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, June 14, 1919 *Number* 24

Holding the New Electrical Markets

EVEN though the credit policy of some American firms supplying foreign needs has become a little more liberal through the establishment of better American banking facilities in other countries, one of the most vital problems in holding our export trade will not be solved until a satisfactory credit practice is established. Representatives of foreign buyers not infrequently say that a return to the highly competitive conditions that existed in foreign markets before the war would be welcome because it would force those who persist in maintaining "cash against document" systems of payment to be more reasonable in their foreign trading policy—as far-away buyers view it—or be content to see the business gained during the war go to other nations. The demand for American electrical products, the familiarity with them and with American installation methods gained because the war shut off other sources of supply, mean much to the American manufacturers who have devoted special attention to export business. The need for the expanded foreign outlet is real, but it is no more real than will be the return of destructive competition unless a uniform trading policy is established and made known without loss of time throughout all countries, and especially among our Latin-American neighbors.

It is a peculiar mixture of government and company management of telegraph and telephone lines which the Postmaster-General has contrived to inflict for the present exigency. Service is the first principle in utility management, but the post office authorities do not appear to appreciate this important fact.

Everybody Works for the N. E. L. A.

MEMBERS of the National Electric Light Association are undoubtedly looking forward with keen interest to a more active year in committee and section affairs than was possible under the conditions of war. They find that already the president-elect has taken definite steps to restore the pre-war activities and start new lines of action. In last week's issue of the ELECTRICAL WORLD a plan of organization was given under which the vice-presidents will have fixed responsibilities. This will mean that they will supplement the executive usefulness of the president. Mr. Ballard is fortunate in the election of four vice-presidents who will join with him in an effort to make the association of much practical value to its members in the coming year.

As the first president from the Pacific Coast Mr. Ballard has a unique opportunity not only of rendering a personal service to the association but also of bringing together more closely the sympathies of the members who are so widely scattered on the map. That he fully appreciates the opening presented to him in this direction is shown by his views printed in the interview elsewhere in this issue. Naturally he has the viewpoint of the great Pacific Coast Section, which in its way is both north and south. It is different from the busy industrial East, different in character and extent of industries, different in proportion of hydroelectric power and long transmission with interconnection, but basically it has the same problems which the East faces. We do not know of any better method by which the association can get into close contact with its country-wide issues than for it to have as careful geographical distribution as possible in the selection of presidents. This is as true of the South and of the great stretches of Central Western area as it is of the highly developed centers of the East. The East is the financial center, it has a large industrial load, but the other sections of the country are just as vitally concerned, and they have a large influence in the settlement of national issues.

Mr. Ballard lays stress upon the importance of letting the public know that the companies are organized as a part of the nation's industry, not a part of its political life. He sees the economic saving in private ownership and operation and, on the part of the companies, the first obligation to give the service that the public wants. Conservation, utilization of water power, settlement of labor questions within the industry and the provision of the enormous sums of capital which are required to meet the needs for expansion are discussed with a thorough comprehension of the nation-wide importance of these subjects. For the association Mr. Ballard recommends national geographic organization without any abandonment of the many state associations which have proved their worth. He also urges development of the company sections and, in considering the association as a whole, a policy of "Everybody works." We feel that the association is making an excellent beginning for its post-war activities and that its field for indispensable service to the industry is a large and promising one.

July 4, 1919, *will be celebrated by America in peace, victory and prosperity. With the greatest war in history terminated by American arms, the one hundred and forty-third anniversary of the nation's independence is surely an occasion too rich in spiritual meaning to be celebrated by mere noise and fireworks. July Fourth this year will be a day of patriotic meetings, of welcome-home ceremonies to returning troops, and—appropriate to the dignity of the day—there comes the opportunity for the electrical men to provide beautiful and striking electrical illuminations to replace noise and fireworks.*

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From the Old to the New

THE electric equipment of textile mills was one of the early applications of electric power transmission, dating back a quarter of a century, but it made haste rather slowly, since textile mill operators have learned by experience to be cautious and the full advantages of electric drive appeared only after considerable experimentation on the part of the bolder spirits in the business. In fact, it turned out that the application of electricity to textile machinery was most fertile in valuable results, and mill after mill has fallen into line, until at the present time one may speak of electrical driving as the typical modern equipment. One of the striking examples of such progress is described in this issue, the particular mill concerned, at Cohoes, N. Y., being equipped with more than 5000 looms and 200,000 spindles.

This mill started more than eighty years ago, operated by water power, according to the custom of the times. The old motive-power equipment with comparatively small modifications held its place until 1911, when improved waterwheels were added, two of them coupled to electric generators, and a steam electric auxiliary was added to help in times of low water. Another change was impending, for the Cohoes Power Company four years later installed a 30,000-kw. hydroelectric plant and the waterwheels were then abandoned and the whole equipment run from purchased power. At this time the drive was overhauled. Power was cheap, shafting and pulleys dear, so the group drive which had previously been used was retained with slight modification, employing motors around 100 hp. in size, rated for heavy duty so that the power factor might be well maintained. In point of fact it reached 86 per cent, an admirable figure for induction motor drives. The motors were mostly mounted on the ceiling close to posts or walls, where they would be well supported, and the motor starters were mounted on adjacent walls. The principal difficulties were with the starters, but a little instruction of the operators helped to relieve the situation. The motors themselves have given very little trouble. An occasional burned-out bearing and some annoyance from lint and dirt were the chief faults which developed. It is worth noting that while the motors at the start were of the semi-inclosed type, it was found that they caught more lint than when open, and therefore the shields were taken out and kept out. The article referred to contains valuable details as to the maintenance system and equipment which engineers on similar work will appreciate. Many tests of power taken are also recorded. These show an excellent design and good upkeep of the drive. The warp spinning ran a little over fifty spindles per horsepower, the filling spinning in the neighborhood of seventy-five, while the looms averaged about ⅓ hp. apiece, the looms being of two kinds, 32-in. (81.2-cm.) at 180 picks per minute and 40-in. (101.6-cm.) at 160. The data certainly indicate well-planned drives and extremely well-maintained equipment,

It is particularly interesting to see an old waterpower mill passing first to electric drive in part and then taking the long further step of using transmitted power alone. One by one the old groups of mills which used to cluster about water powers have turned away from the older practice until now there is small need for considering anything except an electric drive.

The time has come to install electric wiring and appliances on the basis of quality and not price. With the new level of prices in every other line, the public is to-day ready to command and pay for service, rather than for cheapness. If electrical men will show the public the advantages of oversized wiring, plenty of flush receptacles, switches, lighting outlets and electrical devices for the home, we shall be able to raise the whole standard of electrical wiring and equipment entering into the average dwelling—and incidentally to stabilize the smaller contractor-dealers on a new basis of business prosperity and professional service.

A New Service of the "Electrical World"

DURING the war industrial activities in many lines have undergone a growth which would have taken several times the period under normal conditions. From all indications most such plants will never fall back to a pre-war status because American industrial managements have been awakened to their possibilities. However, many of the industries which made enviable wartime profits were carried along by the tide and will now have to consider improved practices and economies of operation if they expect to survive present high labor costs and the competition of plants operating at high efficiency. Before it was a case of turn away orders; now it is match price against price and quality against quality. While many of the industrial plants depended upon electric motors, electric furnaces, etc., during the war, it is quite likely that many adopted the use of such electrical equipment not only because they considered the economy, flexibility of control and other numerous advantages, but because it was easy to secure electric service and apply the power to industrial processes. Now, careful thought must be given to the other advantages if production problems are to be worked out on a maximum economy basis. This the larger plants can do more easily than the small ones because many of them are equipped with the necessary engineering personnel, whereas the small plants generally have to rely on their electrical superintendents or master mechanics who have many other duties to perform. Of course, such companies can still fall back on consulting engineers when they have any problems which their own organization cannot solve, but for many of the every-day tasks they will have to depend on their own men.

To be of service to these men the ELECTRICAL WORLD has established a new section which will be devoted entirely to industrial electrical problems and will supplement the articles of this nature that have been a regular feature of the paper. In this section will be presented the latest ideas on utilizing, installing, repairing and testing all electrical equipment employed in industrial plants. As before, the leading articles will be devoted to the more technical problems of selecting and laying out the electrical equipment required, methods of operating and controlling it, systems of inspecting and maintaining the apparatus so that maximum reliability, economy and production will be secured with the minimum maintenance expense. Besides, the ELECTRICAL WORLD will aim to serve as a clearing house for the exchange of ideas regarding industrial engineering and operating problems and in a liberal way assist readers to solve their industrial electrical problems.

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What the War Has Taught the Middle West

PERHAPS the great plants of the Middle West have spent less during the war in general extension work than has been necessary in other portions of the country, but they have attended strictly to business when it comes to questions of efficient operation. The coal difficulty was somewhat less strenuous than in the East, but it was quite bad enough. Prices were high in spite of comparatively short hauls, and an even more serious matter was the difficulty of transportation entailed by the great march of material to the seaboard. To meet this difficulty there has been throughout the Middle West a marked tendency to develop coal storage to an extent hitherto unknown. Plant after plant has equipped big coal-storage yards or developed use of natural gas in connection with coal firing, in one case even going to the length of developing gas fields convenient to the plant. Hydroelectric powers too were sought out for additional supply, or developed as auxiliaries, with a noteworthy tendency toward the working up of small hydraulic privileges available but hitherto unused. The Middle West as a whole is not a country of large water powers, but every 100 hp. or 1000 hp. that can be brought into service at a reasonable rate is just so much insurance against the inroads of the coal bill, already formidable and likely to be more so.

Improved methods of handling fuel, including a revival of the interest in powdered coal, have been a feature of the situation, and many a company has developed its plant in the direction of economizers and improved stokers. This, with added attention to boiler capacity and working with the available plant nearer the limit of its capacity, has worked well in many a difficult situation brought about by rapidly increasing load. In the same direction of increased efficiency is the trend of turbine practice toward larger units of materially increased efficiency. In this territory, as in the East, there have been isolated cases of considerably decreased output at the close of hostilities, but on the whole the load holds up much better than a cautious prophet would have admitted. Through the Middle West as elsewhere there is a steady development of transmission service and interconnection of the smaller plants to the great networks, a tendency long dominant in the region around Chicago.

With this tendency has also come increasing use of outdoor substations as an element in plant economy. In fact, the time has come when the engineer who proposes to put up an expensive substation building to house simple transmission apparatus is on the defensive and is liable to be called down as an old fogy. Transmission-line practice has undergone some interesting changes. Many small communities are now being served where cost of construction is of vital importance. In such cases it is notable that the tendency has gone even with wooden-pole lines to spans of 200 ft. (60 m.) or more, a practice often recommended in these columns. It is high time to break away from the old precedents of telephone and telegraph practice, and the change is stimulated by the increasing cost of poles. The mid-voltages, too, are passing out of their one-time popularity, perhaps owing to the sanctifying influence of the suspension insulator, so that the tendency in pressure is toward 50,000 volts to 70,000 volts when anything more than 10,000 to 15,000 would seem to be desirable. There is also a tendency toward the standardization of voltages in order to get rid once and for all of the great variety which have remained as a monument to the cautious and tentative evolution of high-tension transmission.

In distribution matters some growing improvements are worthy of note, in particular the freer banking of transformers and interconnection of secondaries, long known to be advisable and now encouraged by the stress of added needs for output. Another tendency which is worth recording has to do with the periodicity, which shows inclination toward standardization at 60 cycles, in spite of the arguments adduced by the advocates of 25 cycles. This controversy is more or less a relic of old times, when engineers stood in wholesome awe of inductance and capacity difficulties and electrical manufacturers fought shy of induction motors of extreme multipolar design. Finally the farm power business through the great fertile country of the Middle West has come to life again, with a strong probability that the growth of demand after the war is to produce a more complete distribution of energy to the people than has ever yet been approached.

The new activity in state associations of central-station companies is an encouraging sign of the return to normal conditions. There is no longer any desire for the curtailment of such activities and the associations are too valuable to their members to be allowed to lapse into inactivity. The contact with local problems which they afforded in pre-war days will now once more prove its great benefit to the constituent companies.

Electric Brass Melting Is Economical

OFFHAND one would be tempted to say that the complex transformation of energy from fuel to electricity and back again to heat, as required for electric furnace operation, would involve such economic disadvantages that it could not be considered as a commercial proposition. However, brass furnaces, even more than steel furnaces, are showing their economic value in permitting better quality of product, minimizing metal loss and reducing amount of labor.

Furthermore, the temperature is under precise control and the furnace atmosphere is free from contaminating gases and may be made reducing, neutral or oxidizing. These are particularly important points in the melting of non-ferrous alloys because on them depend the metal loss and quality of the product. The gas absorption is materially less than in fuel-fired furnaces, so that more homogeneous metal exceptionally free from blowholes can be obtained. The actual cost of melting brass per ton is considerably less with the electric furnace and energy at 1.5 cents per kilowatt-hour than with gas, coal or coke furnaces at the present prices of fuel.

What is true of brass is to a certain extent true of many other alloys, especially those in which there is considerable difference in the melting and volatilization temperatures of the constituents. In not a few cases the ability to work in neutral or reducing atmosphere is vital to the successful production of alloys. The experience in the metallurgy of brass which has been well recounted by E. J. Collins in the May 24 issue of the ELECTRICAL WORLD may well be taken to heart by all those who have to deal with metallurgical processes.

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East and West Meet in the N. E. L. A.

President-Elect Ballard Discusses Some of the Problems of the Industry and the Pacific Coast Attitude Toward Various Important Issues of a National Character

R. H. BALLARD brings a typical Western point of view to the presidency of the National Electric Light Association. Lest this should be thought alarming by those conservative Easterners who have never traveled beyond the west bank of the Hudson River, it may be said that he sees no reason why the East and West should not coöperate in a big way on matters electrical. He sees every reason why they should do so.

"The Pacific Coast," says Mr. Ballard, "has no desire to secede from either the Union or the N. E. L. A."

Two weeks were spent by the new president in the East after the Atlantic City convention before he went to his home in Los Angeles. Most of this time was passed at association headquarters in New York, where there were meetings with the vice-presidents and conferences with a number of others interested. There were also trips to Washington and Boston, and, on the way West, stops at Cleveland and Chicago. The president-elect left New York feeling that the association work is well organized for the coming year and that good results are to be anticipated from the plans made.

PRESIDENT-ELECT BALLARD

Mr. Ballard, whose title outside of association work is first vice-president and assistant general manager of the Southern California Edison Company, Los Angeles, has as his slogan "Everybody works."

As stated in last week's issue of the ELECTRICAL WORLD, the four vice-presidents of the association—Martin J. Insull, Milan R. Bump, Frank W. Smith and Walter H. Johnson—will take an active part in the work during the coming year.

The new executive of the N. E. L. A. was asked by a representative of the ELECTRICAL WORLD to explain something of the California point of view about which New York has heard so much and to discuss in detail some of his ideas on questions affecting the industry and the association. He replied that he was particularly glad to do so because he regarded his election as a compliment to the Pacific Coast.

"As the Pacific Coast has never before had a president of the N. E. L. A.", he added, "I feel confident in saying that the companies in that section will be pleased and will take hold with new energy of the work that they can do in common with national headquarters. There are national problems which touch the entire industry just as there are localized problems which have to be met locally."

Mr. Ballard feels very strongly that the N. E. L. A. has a great task before it in letting the public know just what it is and just what the companies in its membership are. The companies are public service corporations, that is to say, public servants, and they must give satisfactory service at every point of contact with the public. The companies' greatest asset consists of contented consumers, a satisfied public.

"We are not organized for political purposes," he declared. "We are a part of the nation's industry, not a part of its political life. We want to be known to the public as an industry. We want to have the public understand that we are in business as private companies engaged in furnishing an industrial service. We would like to have the public know the men who are operating the properties, know their methods, appreciate how they are trying to render a service.

"We feel that the advantages of private ownership of these utilities are very clear. They are seen by us and we should try to make them just as plain to the public. We know that private ownership can build these properties and operate them for less than public ownership. We know that private ownership can give better service at lower rates than public ownership. In fact, we know this so well that we are inclined to take it for granted that everybody has just as keen a realization of it as ourselves. It is necessary that we shall relieve ourselves of over-complacency on this subject. We cannot well expect the public to know without being told, and we cannot expect the public to be easily satisfied with a mere statement of the fact. We must be prepared to prove that the statement is true. Prove that it is true by demonstrating our ability to give thoroughly satisfactory service. Works speaks louder than words."

The president-elect was asked about the expression "Service before profit," which has come across the continent from California. He said that the principle which has been developed in California is that the utilities must put the question of service first. Their first obligation is to give the service that the public wants. If service is given, the regulating commission will see that an adequate return on capital is allowed.

On being asked what he regarded as an adequate return, the Californian said that the rate must be such as will attract capital for the development of the business. In order to provide the necessary reserve for safety required by the investor who purchases the securities there should be a reasonable margin over the cost to the company of securing funds. With this policy assured, money will flow to the utilities in the

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needed amounts; without it the money will not be forthcoming. Mr. Ballard also emphasized the announcement of President Wilson last year, together with the similar statements by Secretary of the Treasury McAdoo and Comptroller of the Currency Williams, that it is essential that the utilities be kept in sound financial condition to maintain maximum efficiency.

"We are not yet out of the woods," he continued, "and the conditions which led the President to issue his appeal to the regulating commissions still exist, though modified by reductions of operating cost in some directions."

President-elect Ballard then went into the subject of national organization of the industry. Speaking for himself and the new administration generally, he said that the motto would be "Everybody works."

"We want to make our organization effective in meeting every question that arises during the year touching the national issues," he stated. "There is every reason in the world why the industry of the entire country should pull together for unity of action. It is the best policy. The full effective force of the whole industry can be unified to advance the industry and to study the large questions affecting its welfare."

The discussion then turned to the subject of a more effective organization of geographic and company sections, with the general object of relieving national headquarters and the national annual convention of much detail.

"The purpose would be," Mr. Ballard said, "to keep the discussion of purely local matters in the community or state or states more directly concerned. Thus the national association and the national convention would be left free to handle on a large scale the big questions involving the whole industry. I believe that more of the detail work should be done in the geographic sections. It would be extremely desirable for the whole country to be organized into geographic sections. I should like to say emphatically that the formation of geographic sections would not mean the abandonment of the state organizations wherever those are thought necessary by the companies. It would involve simply the organization of state associations into geographic sections which would be affiliated with the parent body. The importance of state organization cannot be minimized."

Mr. Ballard is anxious that the companies shall develop the activities of the company sections successfully during the coming year. "This is both for the sake of unity in the company and for the development of men," he declared. "There should be a line of progress from company section to state and geographic section and national association."

As may be judged by his slogan "Everybody works," the president-elect is a firm believer in earnest coöperation. He believes that all branches of the industry should be brought together and that there is no room for any serious difference of opinion between manufacturer, jobber, central station and contractor-dealer. The California coöperative campaign, fostered by all the branches, has done notable work.

Some of the problems of the industry were discussed at the request of the ELECTRICAL WORLD representative.

In speaking of state regulation Mr. Ballard called attention to the fact that the various commissions are not uniform in their treatment of various subjects, such as methods of valuation and the principles upon which rate of return is fixed, etc. He is of the opinion that the maintenance of the commissions, with their broad powers of regulation, will promote the needed thorough understanding between the companies and the public.

The question of labor and of the participation of employees in the earnings of the company is also a large subject which should receive attention.

Another matter which Mr. Ballard believes should have the consideration of all companies is that of conservation of resources.

"We can take advantage of what the war has taught us as to the value of power resources," he said. "We can go into the factories and teach people not to waste coal and power. This question receives added importance from the fact that sooner or later we shall face railroad electrification on a nation-wide scale with the immense requirements for power which that will bring. An essential feature in the program of conservation is utilization of our full measure of water power. This is true conservation, and we cannot put the case too strongly in urging a policy that shall utilize our resourses without waste."

The president-elect also indicated the seriousness of the problem of raising capital in the huge amounts needed for development.

"I know that this is a big problem confronting us in the West," he said, "and I assume that it is about the same in the East. But with the companies committed to the policy of giving service first and letting the public know that they are here to serve and with a thorough understanding by the public and the commissions that fair earnings on capital are requisite for development, I feel that the capital requirements will be met."

I HAVE heard men say that America can sell and is selling quantities of goods abroad without the use of the metric system. Certainly she is. She can do that to a certain extent, but compared to what America could do if she would adapt herself to the needs of the people abroad, it is like selling cheap remnants. The day when any nation engaged in industrial production could impose its ideas and views on any nation to which it desired to sell goods has gone by, if it ever existed, and the only way you can sell goods in these days is to sell to the people exactly what they want. A company must sell its mechanical goods of all kinds in the markets of the world, made in the way the people want them, and no amount of explanation on the part of salesmen will make the United States standard wrench go on a hardened nut finished on the metric system, and it is nonsense for any one to suggest anything to the contrary. It won't fit, and you cannot sell any more goods of that kind. For men to go to a French factory and to attempt to sell for use in that factory an engine constructed on the feet and inches basis would be so hopelessly ridiculous that only a man entirely lacking in judgment would ever do it.—*Secretary of Commerce Redfield.*

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Calculating Induction-Motor Magnetizing Current

An Equation Connecting Magnetomotive Force and Effective Magnetizing Current Is First Derived—Magnetizing Currents for Polyphase Induction Motors Are Then Calculated from the Relation Between Counter Emf., Flux and Magnetomotive Force

BY C. M. LAFFOON
Electrical Engineer, Engineering Department Westinghouse Electric & Manufacturing Company

THE no-load or exciting current of a polyphase induction motor can be resolved into two components—an energy component in phase with the voltage and a wattless or magnetizing component at quadrature with the voltage. The energy component supplies the power required for the no-load primary and secondary losses and can be determined from the measured or calculated value of the no-load input to the motor. The magnetizing effect of the energy components of the exciting currents can be neglected, for it is approximately neutralized by the opposing magnetizing action of the no-load secondary currents. The wattless or magnetizing currents flowing through the respective phases of the primary winding produce the rotating magnetic field which induces the counter electromotive force in the primary winding and the secondary electromotive force in the secondary windings.

TABLE I—VALUE OF C_p FOR θ = 30 DEG.

Angle θ	Amperes in Phase A	B	C	Maximum Height of Mmf. Diagram	Area of Mmf. Diagram
0	0	0.866	0.866	13.856	221.696
10	0.1736	0.9369	0.766	15.012	222.508
20	0.342	0.9848	0.6428	15.756	223.86
30	0.5	1.00	0.5	16.00	224.0
40	0.6428	0.9848	0.342	15.756	223.86
50	0.766	0.9369	0.1736	15.012	222.508
60	0.866	0.866	0	13.856	221.696
Average					222.61112

The relation between effective magnetizing current and magnetomotive force for induction-motor windings will first be established. Then, since the numerical value of the counter electromotive force induced in the primary winding can be closely approximated, the actual value of the magnetizing current can be determined from the fundamental relations connecting the counter-electromotive-force, rotating-flux and rotating-magnetomotive-force diagrams.

THREE-PHASE INDUCTION MOTORS

The actual rotating-magnetomotive-force diagram, which is produced by the magnetizing current flowing through the primary winding of a three-phase induction motor, varies in shape, area and maximum height for different angular positions of the rotor of the alternator supplying current to the motor. If the magnetizing current varies according to a sine law with respect to time as shown in Fig. 1, the actual magnetomotive-force diagrams can be determined and plotted. The magnetomotive-force diagrams shown in Figs. 3 to 9 are for a three-phase induction motor having eight slots per phase per pole and a full-pitch winding. These diagrams are plotted for the current relations at regular ten electrical degree intervals over a range of sixty electrical degrees, or one complete diagram cycle. It is obvious from Fig. 2 that in the case of a balanced full-pitch, three-phase winding the maximum height of the magnetomotive-force diagram is proportional to the maximum resultant ampere turns per pole.

The values of the area and the maximum height of the magnetomotive-force diagrams of Fig. 3 to 9 for different angular positions of the current vectors are shown in Table I.

By plotting the values of area and maximum height of the magnetomotive-force diagram against the angular position of the alternator armature, as shown in Fig. 10, it is shown that the maximum area and height of the diagrams occur when ϕ is 30 degrees; that is, when the currents in phase A and C are proportional to $\frac{1}{2}$ and the current in phase B is proportional to 1.

The actual value of the maximum ampere turns can be determined analytically as follows:

Let W = total number of effective wires on the stator; $W/3$ = total number of effective wires on the stator per phase; $W/3p$ = total number of effective wires on the stator per phase per pole, and $A \sin \theta$ = instantaneous current in phase A; $A \sin (\theta + 60)$ = instantaneous current in phase B; $A \sin (\theta + 120)$ = instantaneous current in phase C; where A is the maximum value of the current per phase.

Then,

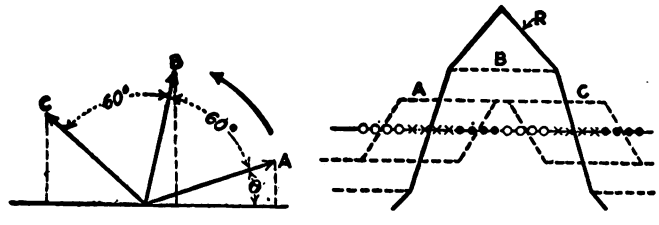
$(\frac{1}{2}AW/3p) \sin \theta$ = maximum instantaneous ampere-*turns* per pole due to phase A.

$(\frac{1}{2}AW/3p) \sin (\theta + 60)$ = maximum instantaneous ampere-turns per pole due to phase B.

$(\frac{1}{2}AW/3p) \sin (\theta + 120)$ = maximum instantaneous ampere-turns per pole due to phase C.

And

$(\frac{1}{2}AW/3p) (\sin \theta + \sin (\theta + 60) + \sin (\theta + 120)) = (AW/3p) \sin (\theta + 60)$, which is the maximum instantaneous resultant ampere-turns per pole due to all phases. (1)



FIGS. 1 AND 2—VECTOR REPRESENTATION OF MAGNETIZING CURRENTS AND MAGNETOMOTIVE-FORCE DIAGRAM

Thus the maximum value of the maximum ampere-turns per pole occurs when $\theta = 30$ degrees and is

$$h_{max} = AW/3p \quad (2)$$

The maximum area of the magnetomotive-force diagram which also occurs when $\theta = 30$ deg. can be determined in terms of the maximum ampere-turns as follows:

Let

H_{max} = area of the magnetomotive-force diagram when $\theta = 30$ deg.

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b = length of the base of the magnetomotive force diagram.

c_p = ratio of the average height of the diagram to the maximum height.

h_{max} = maximum height of the magnetomotive force diagram when $\theta = 30$ degrees $= AW/3p$.

$$H_{max} = h_{max} \times b \times c_p = (AW/3p) \times b \times c_p \quad (3)$$

The value of c_p can be determined from the conditions of the magnetomotive-force diagram shown in Fig. 5, which are given in Table I for $\theta = 30$ deg.

From Fig. 5 and the data in Table I these conditions are found to be,

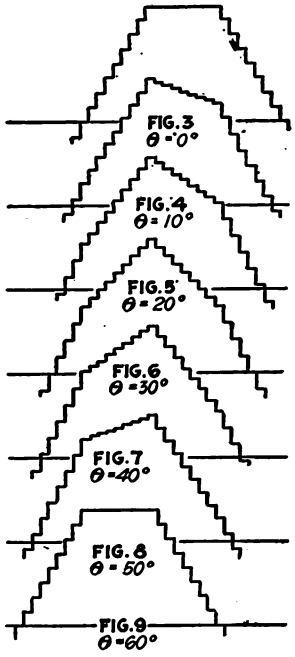
$$H_{max} = 224,\ \tfrac{1}{3}AW/p = 16, \text{ and } b = 24.$$

Substituting these values in equation (3) and solving for c_p gives:

$$c_p = 224 \div (16 \times 24) = 7/12 = 0.583.$$

Hence the general expression for the area of the magnetomotive-force diagram for the current conditions, which give the diagram with maximum area and height, is

$$H_{max} = \tfrac{1}{3} \times 0.583 \times (AW/p) \times b \quad (4)$$



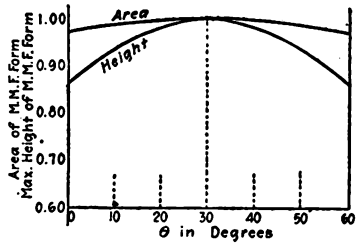


FIG. 10—AREA AND MAXIMUM MMF. FOR THREE-PHASE MOTOR

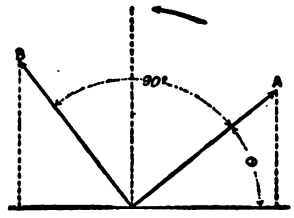


FIG. 11—VECTOR DIAGRAM FOR MAGNETIZING CURRENTS OF TWO-PHASE MOTOR

FIGS. 3 TO 9—MMF. DIAGRAMS FOR A THREE-PHASE INDUCTION MOTOR

From the data in Table I it can be shown that the average area of the magnetomotive-force diagrams for all angular positions of the current vectors is 99.38 per cent of the maximum area, or

$$H_{ave} = 0.9938\ H_{max} = 0.9938 \times \tfrac{1}{3} \times 0.583 \times (AW/p) \times b \quad (5)$$

USE OF EQUIVALENT HARMONIC MMF.

In order to get a more useful diagram from the standpoint of making design calculations, the actual varying magnetomotive-force diagram shown in Figs. 3 to 9 can be replaced approximately by uniform sine-shaped magnetomotive-force diagrams having the same area as the average area of the actual magnetomotive-force diagrams and rotating at uniform speed.

If

h = maximum height of the equivalent sine-shaped magnetomotive-force diagram,

b = width of the base of the equivalent sine-shaped magnetomotive-force diagram;

then the area of the equivalent sine-shaped magnetomotive-force diagram is

$$H'_{ave} = 0.636hb = H_{ave} \quad (6)$$

Substituting this value of H_{ave} in equation (5) and solving for the maximum height—that is, the maximum ampere-turns of the equivalent sine-shaped magnetomotive-force diagram—gives

$$h = 0.9938 \times (0.583/0.636) \times \tfrac{1}{3} \times (AW/p) \quad (7)$$

$$= 0.91 \times \tfrac{1}{3} \times (AW/p) \quad (8)$$

for a three-phase induction motor having a balanced full-pitch winding.

In the case of three-phase induction motors with chorded windings the actual magnetomotive-force diagrams can be determined for different percentages of chording as in the case of the full-pitch winding. The summarized magnetomotive-force diagram data for a three-phase induction motor having a balanced winding, for different percentages of chording, is given in Table II.

It is evident from a comparison of the data in columns (3) and (5) of Table II that the ratio of the average area of the magnetomotive-force diagram for a given per cent chording to the average area for a full-pitch winding is equal to the sine of half of the angle of coil throw. That is,

$$(H''_{ave}/H_{ave}) = \sin(\alpha/2) \quad (9)$$

Substituting the value of H_{ave} 0 per cent chording of equation (5) in equation (9) gives

TABLE II—SUMMARIZES MMF. DIAGRAM DATA FOR THREE-PHASE INDUCTION MOTOR WITH BALANCED WINDING

(1)	(2)	(3)	(4)	(5)
Per Cent Chording	$\frac{\alpha}{2}$ = On half Coil Throw	$\sin\frac{\alpha}{2}$	H″ave	$\frac{H''ave}{Have}$
0	90	1.00	222.61	1.00
16⅔	75	0.966	214.3	0.964
25	67.5	0.924	205.9	0.924
33⅓	60	0.866	193.2	0.866

$$H''_{ave} = 0.9938 \times \frac{1}{3} \times 0.583 \times \frac{AW}{p} \times b \sin \times \frac{\alpha}{2} \quad (10)$$

Substituting this value of H''_{ave} in equation (6) and solving for the value of the maximum ordinate of the equivalent sine-shaped magnetomotive-force diagram gives

$$h = AT_{max} = 0.9938 \times \frac{1}{3} \times \frac{0.583}{0.636} \times \frac{AW}{p} \times \sin\frac{\alpha}{2}$$

$$AT_{max} = 0.91 \times \frac{1}{3} \times \frac{AW}{p} \times \sin\frac{\alpha}{2} \quad (11)$$

But $A = \sqrt{2}\,A_e$, where A_e is the effective current per phase, and substituting this value of A in equation (11) gives

$$AT_{max} = 0.91 \times \frac{1}{3} \times \sqrt{2} \times \frac{A\,W}{p} \sin(\alpha/2) \quad (12)$$

From equation (12) the value of the effective current per phase is

$$A_e = \frac{3\sqrt{2}\,p\,AT_{max}}{0.91 \times 2\,W \sin(\alpha/2)}$$

$$A_e = 2.335 \times p \times \frac{AT_{max}}{W \sin(\alpha/2)} \quad (13)$$

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TWO-PHASE INDUCTION MOTORS

In the case of a two-phase induction motor with a full-pitch winding the variations in shape, area and maximum height of the magnetomotive-force diagram for different current relations are greater than for a three-phase motor. The actual magnetomotive-force diagrams for a two-phase induction motor with six slots per phase per pole and a full-pitch winding are shown in Figs. 12 to 17.

The values of the area and maximum height of the above diagrams are plotted in Fig. 18 over a range of 90 electrical degrees, or one complete diagram cycle.

The maximum height and the minimum area of the magnetomotive-force diagram occur when $\theta = 45$ deg. Using the same notation as in the previous case, the actual value of the maximum instantaneous ampere-turns of the magnetomotive-force diagram can be determined analytically to be

$$h''_{max} = \sqrt{2}AW/4p \qquad (14)$$

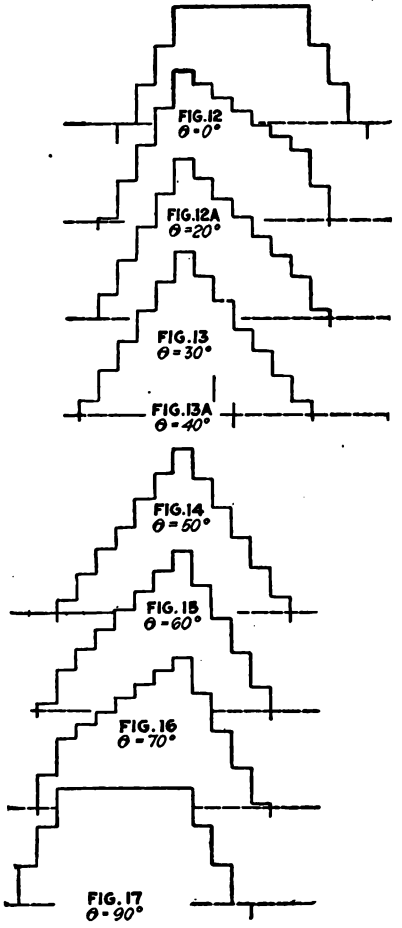
The minimum area of the magnetomotive-force diagrams, which also occurs when $\theta = 45$ deg., can be determined from the conditions in Fig. 17 to be

$$H_{min} = AW\sqrt{2}b/(4 \times 2p) \qquad (15)$$

It can be shown that the average area of the magnetomotive-force diagrams of a two-phase induction motor with a full-pitch winding is 103.36 per cent of the minimum area, or

$$H_{ave} = 1.0336 \times [AW\sqrt{2}b/(4 \times 2p)] \qquad (16)$$

For chorded windings it can also be shown, as in the case of three-phase induction motors, that the average area of the magnetomotive-force diagram is



FIGS. 12 TO 17—MMF. DIAGRAMS FOR A TWO-PHASE INDUCTION MOTOR

$$H''_{ave} = H_{ave} \sin(\alpha/2) = 1.0336 \times \frac{AW\sqrt{2}b}{4 \times 2p} \sin\frac{\alpha}{2} \qquad (17)$$

Substituting the value of H''_{ave} in equation (6) and solving for the maximum ampere turns of the equivalent sine-shaped magnetomotive-force diagram gives

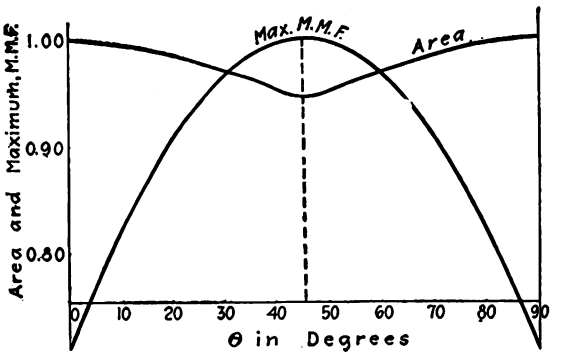


FIG. 18—AREA AND MAXIMUM MMF. DIAGRAMS FOR A TWO-PHASE INDUCTION MOTOR

$$h = AT_{max} = 1.0336 \times \frac{1}{0.636} \times \frac{AW\sqrt{2}}{4 \times 2p} \sin\frac{\alpha}{2} \qquad (18)$$

$$= 1.0336 \times \frac{1}{0.636} \times \frac{A_e W}{4p} \sin\frac{\alpha}{2} \qquad (19)$$

Solving equation (19) for the effective magnetizing current per phase gives.

$$A_e = 2.465 \times \frac{p\,AT_{max}}{W \sin(\alpha/2)} \qquad (20)$$

Hence by means of equations (13) and (20) the effective value of the magnetizing current per phase can be calculated for three-phase and two-phase induction motors, provided that the maximum value of the ampere turns of the equivalent sine-shaped magnetomotive-force diagram can be ascertained.

Since the actual magnetomotive-force diagram has been replaced by an equivalent sine-shaped diagram which rotates at synchronous speed, the induction motor can be treated as an alternator with rotating field poles. It is obvious from the analogy to the alternator that the maximum value of the ampere turns will depend upon the maximum value of the ampere turns required for the air gap, stator and rotor teeth and stator and rotor cores, and also upon the amount of saturation in the stator and rotor teeth, *i.e.*, upon the shape of the rotating field form. Then the value of maximum ampere turns in equations (13) and (20) is

$$AT_{max} = AT_{max\,(g.+t.)} + AT_{max\,(s.c.)} + AT_{max\,(r.c.)} \qquad (21)$$

where

$AT_{max\,(g.+t.)}$ = maximum ampere turns required for air gap, stator and rotor teeth.

$AT_{max\,(s.c.)}$ = maximum ampere turns required for stator core.

$AT_{max\,(r.c.)}$ = maximum ampere turns required for rotor core.

AMPERE TURNS REQUIRED FOR MAGNETIC CIRCUIT

Applying the fundamental voltage formula of an alternator to the induction motor, the counter electromotive force induced in the windings by the rotation of the gap flux at synchronous speed is

$$*E_c = B_{max}SR_s'C_w \sin(\alpha/2)\ 10^{-8} \qquad (22)$$

in which

*Derived by B. G. Lamme, chief engineer Westinghouse company.

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S = circumferential section of the air gap in square inches.

R_s = synchronous speed of the rotating field in revolutions per second.

W' = total number of effective wires in series.

B_{max} = maximum flux density in the air gap.

C_w = root-mean-square electromotive force per conductor, expressed as a percentage of the maximum height of the field form.

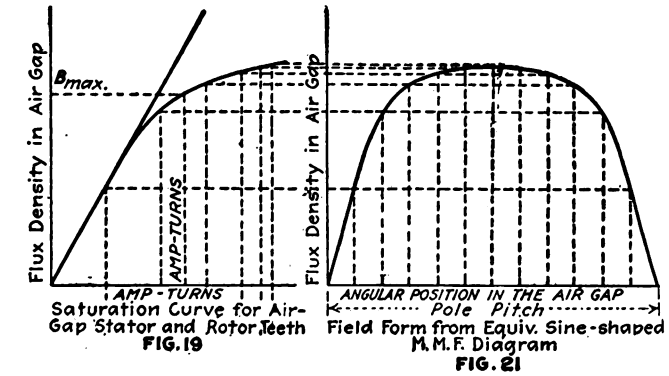
$\sin(\alpha/2)$ = chord factor.

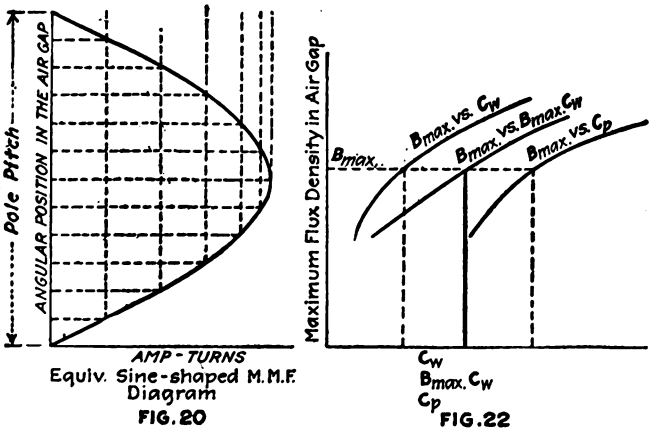
The counter electromotive force induced in the primary is practically constant from no load to full load for a given induction motor. As a first approximation the numerical value of the counter electromotive force can be assumed a given percentage of the impressed electromotive force. The value of $B_{max} \cdot C_w$, which is practically constant for a given motor, can be determined from equation (22).

$$B_{max} \times C_w = \frac{E_c 10^8}{R_s S W' \sin(\alpha/2)} \qquad (23)$$

With the value $B_{max} \cdot C_w$ determined by equation (23), the value of the maximum ampere turns required for the air gap, rotor and stator teeth can be determined as follows:

(a) Calculate and plot a saturation curve for the air gap, rotor and stator teeth, as shown in Fig. 19.





FIGS. 19, 20 AND 21—DERIVATION OF EQUIVALENT HARMONIC MMF. AND FIELD FLUX FORM FROM SATURATION CURVE

FIG. 22—VARIATION OF C_w, B_{max}, C_w AND C_p WITH MAXIMUM AIR-GAP DENSITY

(b) Assume a maximum value of the ampere turns for the equivalent sine-shaped magnetomotive-force diagram and plot as shown in Fig. 20, and

(c) Divide the pole pitch into equal increments and with the corresponding ampere turns determine the actual field form from Fig. 19 and plot as shown in Fig. 21. With the actual field form in Fig. 21, the corresponding values of C_w—*i.e.*, the root mean square per conductor expressed as a percentage of the maximum value of the field form—and C_p—*i.e.*, the ratio of the average height to the maximum height of the field form—can be calculated. Similarly, other values of C_w and C_p can be determined from additional assumed values of

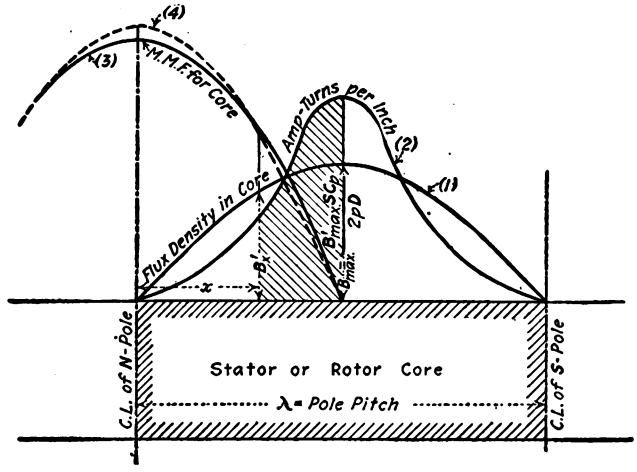


FIG. 23—VARIATION OF EQUIVALENT HARMONIC MMF. FROM ACTUAL VALUES

maximum ampere turns of the equivalent sine-shaped megnetomotive-force diagrams, and curves can be plotted between the maximum flux density in the air gap, B_{max}, and C_w, C_p and $C_w \times B_{max}$, as shown in Fig. 22. With the value of $B_{max}C_w$ obtained from equation (23), the actual value of the maximum flux density in the air gap can be found from curve (1) in Fig. 22. With this value of B_{max} the corresponding value of maximum ampere turns, $AT_{max\ g.+t.}$ of the equivalent sine-shaped magnetomotive-force diagram for the air gap, stator and rotor teeth can be taken directly from the saturation curve in Fig. 19.

AMPERE TURNS REQUIRED FOR THE STATOR AND ROTOR CORES

The total flux per pole is

$$\phi_p = B_{max} S C_p / p \qquad (24)$$

where

C_p = ratio of the average height to the maximum height of the field form and can be found from curve (3) in Fig. 22 for the corresponding value of B_{max};

p = number of poles.

If D is the section of the core behind the teeth, the maximum flux density in the core is

$$B_{max} = \phi_p / 2D = B_{max} S C_p / 2pD \qquad (25)$$

The actual flux distribution in the core can be assumed to vary as the integral of the actual field form, but it is sufficiently close for all practical considerations to assume that it varies according to a sine law as shown by curve (1) in Fig. 23. The density at any point distant x from the center line of the pole is

$$B_x = B_{max} \sin x \qquad (26)$$

The ampere-turns-per-inch curve for the core, which is numbered (2) in Fig. 23, can be determined from curve (1) in Fig. 23 and the magnetization curve of the ma-

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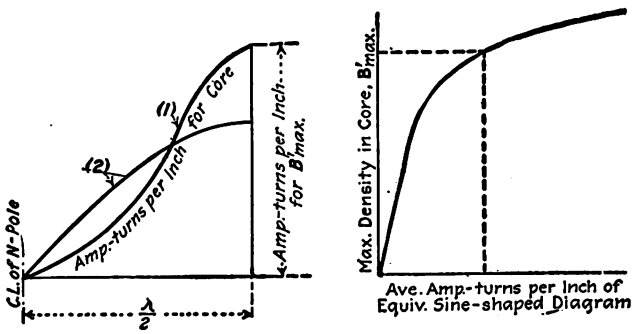
terial used in the core. It is apparent from these curves that the maximum value of ampere turns of the magnetomotive-force diagram is equal to the area under the ampere-turns-per-inch curve between the limits $x = 0$ to $x = \lambda/2$. The value of the ampere turns on the magnetomotive-force diagram at distance x from the center line of the pole is equal to the area under the ampere-turns-per-inch-curve from $x = x$ to $x = \lambda/2$, as shown in curve (3) of Fig. 23. The equivalent sine-shaped magnetomotive-force diagram having the same area as the actual magnetomotive-force diagram (3) is shown in curve (4) of Fig. 23. However, in actual practice it gives close enough results and greatly simplifies the calculations to take the maximum value of the actual magnetomotive-force diagram equal to maximum value of the equivalent sine-shaped magnetomotive-force diagram.

The determination of the maximum ampere turns of the magnetomotive-force diagram of the cores—*i.e.*, the area under the ampere-turns-per-square-inch curve between the limits $x = o$ and $x = \lambda/2$—can be simplified by substituting for this curve an equivalent sine-shaped curve having the same area as is shown by curve (2) in Fig. 24.

For any given material different values for B_{max} can



FIGS. 24 AND 25—SINE CURVE APPROXIMATING MAXIMUM AMPERE TURNS AND MAXIMUM FLUX DENSITY

be assumed and the average value of the equivalent sine-shaped ampere turns per inch curve can be calculated. The B_{max} can be plotted against this average value of ampere turns per inch as in Fig. 25. Then the average value of the ampere turns per inch for the core can be found from this curve for any value of the maximum flux density B_{max} in the core. The maximum value of the equivalent sine-shaped magnetomotive-force diagram for the stator or rotor core is equal to one-half the pole pitch in inches times the average ampere turns per inch, as

$$AT_{max\ (c)} = (\lambda/2) \times AT_{ave/in.}$$

Hence the values of maximum ampere turns of the equivalent sine-shaped magnetomotive-force diagram for the air gap, rotor and stator teeth and rotor and stator cores can be determined. Substituting these values of ampere-turns in equations (13) and (20) gives the effective value of the magnetizing current per phase

$$A_e = \frac{2.335 \times p \times [AT_{max\ (g.+t.)} + AT_{max\ (s.c.)} + AT_{max\ (r.c.)}]}{W \sin (\alpha/2)} \qquad (27)$$

for three-phase induction motors, and

$$A_e = \frac{2.461 \times p \times [AT_{max\ (g.\ \&\ t.)} + AT_{max\ (s.c.)} + AT_{max\ (r.t.)}]}{W \sin (\alpha/2)} \qquad (28)$$

for two-phase induction motors.

MEASURING QUANTITIES OF GAS ELECTRICALLY

Problems in Accurate Metering of 100,000 Cu.Ft. per Hour or More of Gas for City Gas Plants, Industrial Plants and Other Users

Not many electric central-station men look on the competing gas company as a possible prospective customer for electric heating service. Nevertheless, they may well do so now that methods of measuring large quantities of gas electrically have been developed and proved on over 100 practical installations. These points were brought out on May 26 by J. C. Wilson, assistant chief engineer Cutler-Hammer Manufacturing Company, Milwaukee, speaking before a joint meeting of the various electrical engineering societies in Chicago.

The meter which is used in this measuring is built to take advantage of the fact that the heat-absorbing capacity of a standard unit of any industrial gas remains essentially the same throughout all the variations which may occur in practice. In other words, a given quantity of heat applied electrically to gas flowing through a main will always raise the temperature of that gas to the same degree if the quantity of gas flowing is not varied. The meter, however, is worked out on the converse of this principle, so that the temperature rise is always 2 deg., and hence it is only necessary to measure the amount of electric current used to cause this temperature rise to arrive at a quantity which is measurable and proportional to the gas flowing.

The apparatus that has been developed to carry out this method consists of the following essential parts: (*a*) a heater through which electric current flows to warm the gas just 2 deg. as it flows through the meter; (*b*) thermometers on the entrance and exit sides of the heater to indicate the rise in temperature; (*c*) a regulator to vary the heater current in accordance with the variations in the rates of gas flow so that it will always be just enough to warm the gas 2 deg., and (*e*) a meter to measure the electrical energy consumption by the heater in warming the gas 2 deg.

The heater unit consists of spiral coils of nichrome resistance wire. Instead of mercurial thermometers electrical resistance thermometers are used because they are extremely sensitive and accurate. Automatic control of the current which must continually heat the gas 2 deg. as it passes is accomplished through the use of a galvanometer connected in the thermometer circuit. This galvanometer actuates a motor-driven rheostat which controls the current. The electrical energy in the heater is measured continuously by a totalizing meter. This is a watt-hour meter of standard construction having a gear-train and dial so arranged that the readings are direct in standard units of gas.

IT COSTS the government more to do any given thing in a country like ours, where every man is a sovereign, than it costs anybody else to do the same thing. The history of every enterprise of a business character conducted by the government proves all and a great deal more than the statement I have just made. I disparage no one and impugn no man's integrity. What I have said is not only the truth, but it is as natural as life itself.—*Senator Cummins, before Iowa State Legislature.*

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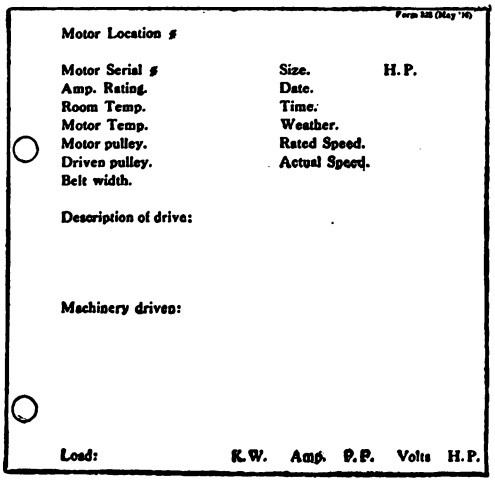
Rehabilitation of New York Cotton Mill

Starting as Water-Power-Driven Mill in 1837, Harmony Mills Have Grown to Have 5000 Looms and More than 200,000 Spindles, All Motor-Driven—Information Concerning Operating Data and Practices

AT COHOES, N. Y., is one of the largest cotton mills, if not the largest, in New York State, it being equipped with more than 5000 looms and 206,000 spindles. It is known as Harmony Mills. Having been started in 1837 with Cohoes Falls as the source of power and now being equipped with motor-driven apparatus, the development of this mill up to the present time should embody some examples that could be followed to advantage by other cotton mills and industrial plants which are still using the primeval power or which are adhering to steam drive and out-of-date transmissions.

In the original installation power was developed by means of lateral or "step" levels affording heads of about 20 ft. (6 m.) each. Part of the laterals were Erie Canal levels abandoned during the early enlargement in 1838. The first really important rehabilitation took place in 1911, when all of the old mill machinery was junked, the mills were overhauled and new up-to-date machinery was installed with new shafting and drives. At this time four new waterwheels were added to supplement eight old units. Two of the wheels were connected to the mill load directly, while the other two were employed to drive 800-kva. generators. Means were provided for coupling the wheels or mill shafts when desired. Since there was not enough water at all times to drive the mills, a 3000-kw., 40-cycle, three-phase, 600-volt steam-generating plant was installed to help out during low water, the waterwheel generators


Motor Location #

Motor Serial # Size. H.P.
Amp. Rating. Date.
Room Temp. Time.
Motor Temp. Weather.
Motor pulley. Rated Speed.
Driven pulley. Actual Speed.
Belt width.

Description of drive:

Machinery driven:

Load: K.W. Amp. P.F. Volts H.P.

FIG. 1—LOOSE-LEAF RECORD OF MOTOR LOAD

being driven as synchronous motors under such conditions. About 2000 kw. in motors was installed at this time, principally on upper floors.

When the Cohoes Power Company installed a 30,000-kw. hydroelectric plant in 1915 to utilize the power in a 100-ft. (30-m.) head, the mill waterwheels were abandoned and power was purchased from a duplicate 12,000-volt transmission line run from the hydroelectric plant. Three 2000-kw. transformers were provided to step the pressure down to 600 volts for use in the mills, where more motors were provided to supplement those already installed.

Before installing the new motors a consulting engineer was called on the job to run tests on existing motor drives and determine what changes were necessary. Some of the results are tabulated on page 1265.

Owing to the high price of shafting and pulleys and the extremely low cost of power, the existing shafting was used and group-drive motors were placed so that they could drive sections of it. Only in one or two cases

NO. 5 SWITCH			
No.	Hp.	Load	
212	100	354 Looms	118
233	150	40 Filling Frames	152
M1	15	Machine Shop	15
HARMONY COHOES			

FIG. 2—SAMPLE MOTOR IDENTIFICATION CARD

The first number at the left indicates that the motor is in Mill No. 2, on the first floor and the second from the north. The figure at the right indicates the input as measured by test outfit when starting up. The names at the bottom indicate source of power available.

was shafting changed, and then only to split up a drive of one class of machinery so that no more than half of it would be stopped by failure of any one motor. In doing this the drawing and railway heads, which require only a small amount of power, were divided into groups and driven by motors operating other kinds of machinery as well. Care was also taken in connecting loads to the feeders not to make any one process dependent on one feeder.

An effort was made to use 100-hp. motors where possible, in no case going above 150 hp. All had a synchronous speed of 800 r.p.m. A heavy class of induction motors was employed, these being laid out so that they would be overloaded about 15 per cent, except where change of load was expected, because of change of style, size or twist of yarn on the spinning frames, to get as high an all-day power factor as possible. The power factor actually obtained was 86 per cent, which is relatively high compared with that in many industrial plants using induction motors. The type of motors employed was determined to a great extent by the installation previously made in 1911.

From the tests which were made after installing the drives it was found that the proper loads were obtained on each motor except in a few cases. These were corrected. It was also found that the overload imposed on the motors was not excessive. The total connected load is about 7500 hp. in ninety units averaging 80 hp.

In nearly all cases the motors were mounted on the ceiling close to posts or walls to give solidity and strength, and care was taken to place each motor in its machine group over unused floor space so that it could be lowered in case of burn-out. Care was also taken to keep the driving belts away from machinery where the dirt and belt dressing thrown off would injure the stock in process. Where very high ceilings existed platforms were swung under the motors to facilitate inspection

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and oiling, but not necessarily to lower motors upon. As few as possible of these were used as they were recognized as dirt catchers and fire hazards.

The starters were mounted on convenient adjacent walls, directly under iron panel boxes in which are fuses, test clips and the circuit switches. To prevent overfusing by inexperienced persons, a list of the proper size of fuses was posted in each box, together with a printed instruction sheet for starting the motor. As the department overseer is responsible for starting and stopping, this was a valuable aid in the early stages of the game. Later the most fertile source of delays in starting proved to be fuse trouble, so a duplicate set of fuses was installed in each panel box, and these were renewed as they were used up.

A simple system of labeling the motors was perfected by using the mill unit number, the floor on which the motor is installed, and numbering the motors from north to south. Above each service switch was placed on the panel a neat index-card frame about 2½ in. by 3½ in. (6.3 cm. by 8.8 cm.), large enough to give the location, number, size, amount and kind of machinery driven and total horsepower input.

Several new sections of switchboard were added to the old installation, the system being laid out on twenty new double-throw feeder switches, with a double bus

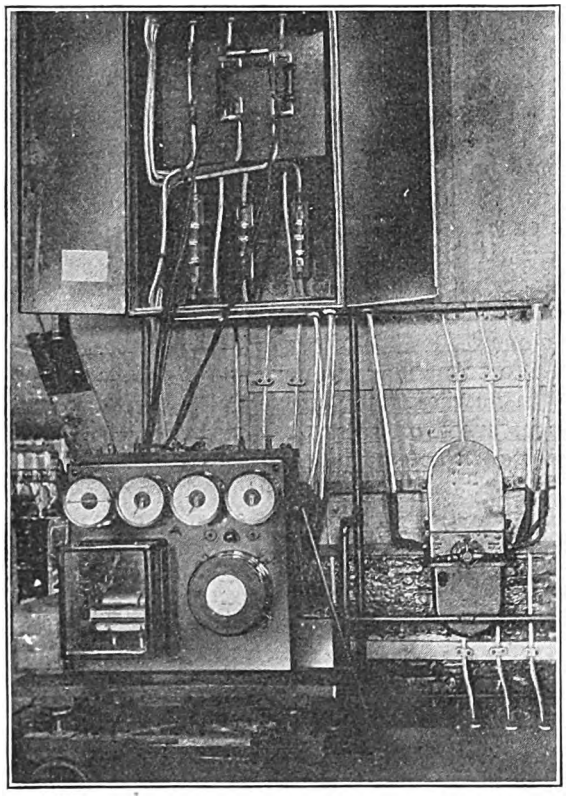

FIG. 3—PORTABLE TEST SET IN USE

Outfit is mounted on truck having rubber-tired wheels and adjusting wheels for leveling. Connections of instruments are shown in Fig. 4.

system that permitted change of motors from purchased power to the Harmony Mills steam power without interruption. The seemingly unnecessary double-bus system was installed because of power contract clauses. Later the abandoned waterwheel generator switches were used as bus ties, and an agreement was drawn up placing the capacity of the steam station at the disposal of the Cohoes company upon reasonable notice. This arrangement has proved its value.

Not having experienced operators, the first trouble developed in starters. It was found that the contact fingers and plates were often burned enough to cause sticking, and sometimes sufficiently to make the motor run single-phase. This resulted because the starting conditions were severe and because the operators were timed. The latter trouble was gradually remedied by

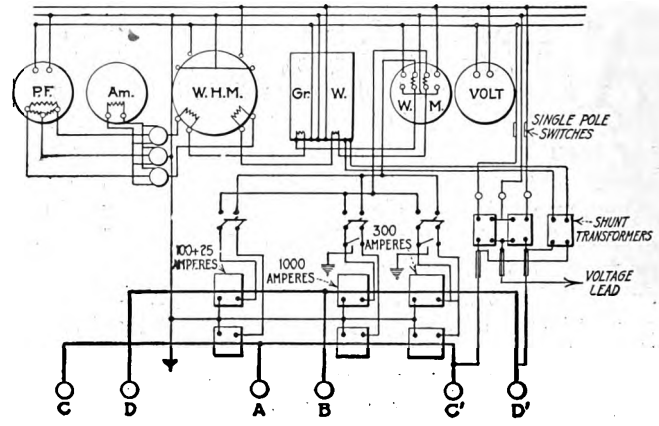

FIG. 4—CONNECTIONS OF INSTRUMENTS ON TEST SET

All of the meters are 5-amp. instruments, three sets of current transformers being provided iwth ratios of 300 to 5, 1000 to 5 and 25, 50 and 100 to 5 for different loads. For a 100-hp. motor the 100-25 to 5-amp. transformers are suitable, while the 300 to 5 is for larger motors. The voltage lead has to be attached to the third leg of the circuit under test. The flexible cables from the test clips are attached to *AB* and *CD* or *C'D'*, depending on load to be measured.

instruction and supervision, but it was found necessary to inspect and renew or clean the contacts about every three months. Records were kept, and where the starters in one department continually became burnt or gave trouble because of the operator's fault another man would be recommended for the starting job. The electrical department of three men found it convenient to repair one starter per day during the noon hour. To do this patterns were made and the castings finished in the mill machine shop, old tips and plates being melted up for stock. A quantity of these contacts are always kept on hand. In the last eight months there has not been any time lost through defective parts or burnt contacts.

So far the motors have given little trouble except what could be prevented or provided against. After the first bearing burnt out one oiler visited all motors every week and reported verbally to his foreman on the condition and cleanliness of each, noting when fuses were blown and that a spare set was left in each panel box. He also made notes of such things as the supporting nuts, a slipping belt or a Pyrene extinguisher partly empty. These small extinguishers are installed at each motor and prove an adequate safeguard against all motor fires. This inspection could be made every two weeks, but daily inspection is preferable to guard against three or more weeks slipping by without its being made. All motors are oiled while running with the exception of three or four where counter-belts are near by, and these are visited during the noon hour shut-down by the oiler.

At the outset part of the motors were of the semi-inclosed type, but the shields seemed to prevent an active circulation of air, hindered cleaning out and served as a "catch-all" for lint and dirt, which finally caught fire due to rubbing of the rotor and overheating. Therefore the end bells were removed and the shields taken out as opportunity afforded until all are now open-type motors.

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An air-pressure system of 35 lb. (2.5 kg.) is available for cleaning, and the motors throughout the mills are blown out semi-weekly by the department in which they are running. This is checked by the oiler.

As the manufacturer of the type of motors used is in the West, a spare motor of each size is kept on hand, unassembled, with parts ready on hand trucks for immediate use, and the largest sizes are changed in five hours. Spare sets of coils of some sizes are stocked, and a few coils of the less important sizes, together with bearings, coil clips, slot sticks, empire cloth, etc. All motor repairs and rewinding are done by the electrical department at the mills.

Occasionally a motor gives trouble at an unsoldered lug or coil-end clip, or sometimes a loose rotor bar throws fire. In many cases time was lost looking for an

TEST OF POWER USED

Figures based on electrical input to motor. This cotton mill has 5000 looms, of which about 300 are on print cloths 60 by 56 and 54 by 60, the remainder are on 80 by 80 four-yard goods and some twills and sateens. In the most part goods are made with 28 warp, the filling running from 36 to 24. A limited amount of goods is made with 24 warp and filling.

Cards.—40-in., 680 lb., per Fifty-four Hours

Motor No.	Rated Hp.	No. of Cards	Kind of Drive*	Total Kw.-hr.	Kw.-Hr. per Card	Kw.-hr. Friction Load	Motor Temp., Deg. Fahr.	Time of Test†	Cylinder Speed	Total Hp.	Hp. per Card	
347	100	105	C	102	0.90	17	112	11.00	163.5	136	1.30	36-in. fan
336	100	90	C	90	1.00	14	108	2.15	164	120	1.33	
132	60	55	C	51	0.93	8.5	140	10.00	164	68	1.24	
131	30	29	C	29	1.00	4	114	8.00	166	38.6	1.33	
123	45	36	C	37.5	1.04	3.5	114	1.10	166	50	1.38	

Binder Frame or Speeders.—3¼-in. by 7-in. Spindles

Motor No.	Rated Hp.	No. of Frames	No. of Spindles	Kind of Drive*	Total Kw.-hr.	Spindles per Kw.-hr.	Kw.-hr. Friction Load	Motor Temp., Deg. Fahr.	Time of Test†	Total Hp.	Spindles per Hp.
344	60	24	4032	C	57	71	7.5	114	2.30	76.0	53
334	100	40	6720	C	89	75	11.0	118	4.30	118.6	57
1-S-21	45	20	3360	Q	46	73	6.0	104	4.30	61.3	55
1-S-11	45	20	3360	Q	47	72	6.5	124	3.30	62.6	54
124	60	20	3360	C	50	67	6.0	112	9.30	66.6	50

Looms.—32-in. Looms, 180 Picks per Minute; 40-in. Looms, 160 Picks per Minute

Motor No. ¶	Rated Hp.	No. of Looms 32-in.	No. of Looms 40-in.	Total Kw.-hr.	Kw.-hr. per Loom	Total Kw.-hr. Friction	Motor Temp., Deg. Fahr.	Time of Test †	Total Hp.	Hp. per Loom
211	150	...	533	127	0.238	32	108	10.30	170	0.320
212	100	...	395	89	0.225	18	136	11.00	118.6	0.301
213	100	...	348	83	0.238	17	108	8.00	111	0.320
214	100	...	276	63	0.228	14	112	9.00	84	0.304
311	100	111	279	95	0.243	20	128	8.00	126	0.324
312	100	111	279	95	0.243	13	118	3.30	126	0.324
313	100	108	273	90	0.235	19	108	8.45	119.6	0.315
314	100	108	273	90	0.235	13	106	4.30	119.6	0.315
316	150	...	616	132	0.214	30	130	9.45	177	0.288
E11‡	30	78	...	22	0.282	4.5	116	11.00	29.4	0.378
E12‡	45	90	60	42	0.280	7	120	2.00	55.7	0.371
411	100	306	...	93	0.304	18	120	4.15	124	0.405
421	30	90	...	27.5	0.305	5	120	.....	36.6	0.407
422	30	102	...	28.5	0.282	5	128	4.00	38.2	0.378

¶ Motors Nos. 411, 421 and 422 are in rooms where countershafts drive looms only on one floor. All other loom motors drive countershafts belted up to second floor and down to first floor. Belts pulling in both directions reduce friction on the bearings.

Filling Spinning.—Ratio of Cylinder to Spindles 7—1

Motor No.	Rated Hp.	No. of Frames	No. of Spindles	Kind of Drive*	Kw.-hr. Total	Spindles per Kw.-hr.	Kw.-hr. Friction Load	Motor Temp., Deg. Fahr.	Time of Test†	Spindle Speed	Total Hp.	Spindles per Hp.	
233	150	40	10,240	B	114	90	24	102	8.00	7,637	152	67	
234	45	11	2,816	M	32.5	86	8.5	120	3.45	7,658	43.5	64	
235	100	32	8,192	B	83	98	15	140	2.15	7,245	110.5	74	
236	75	22	5,632	B	62	91	12	118	11.20	7,310	82.6	68	
237	75	26	6,656	B	69	96	15	124	10.00	7,280	92	72	
241	75	26	6,656	B	65	102	17	104	8.00	6,508	86.6	77	26-in. fan
331	75	24	6,144	C	63	97	10.5	108	9.00	7,581	84	73	
332	150	48	12,288	C	120	102	21	138	3.40	7,567	160	77	
333	150	48	12,288	C	114	107	20	120	11.30	7,301	152	81	
341	150	48	12,288	C	117	105	18	120	10.00	7,280	156	79	
342	150	48	12,288	C	121	101	27	120	10.00	7,573	162	75	
E3‡	45	14	3,584	B	31	115	5.5	116	10.15	6,664	41.3	87	
E4‡	45	14	3,584	B	37	97	7	104	11.20	6,881	49.3	72	

Warp Spinning.—Ratio of Cylinder to Spindle 7—1

Motor No.	Rated Hp.	No. of Frames	No. of Spindles	Kind of Drive*	Total Kw.-hr.	Spindles per Kw.-hr.	Kw.-hr. Friction Load	Motor Temp., Deg. F.	Time of Test†	Spindle Speed	Total Hp.	Spindles per Hp.‡	
E51‡	45	12	3,072	B	49	63	11.5	118	2.45	8,592	65.3	47	
112	60	8	2,048	C.M.	38	54	7.5	106	9.30	8,792	50.6	41	
113	150	32	8,192	C.M.	138	59	28	123	8.00	8,036	184	44	26-in fan
114	150	32	8,192	C.M.	130.5	63	29	124	1.15	8,176	174	47	26-in. fan
141	150	40	9,600	B	132	73	18	170	4.45	8,302	176	55	26-in. fan
142	45	12	2,880	B	43.5	66	7	120	3.45	8,435	57.6	50	E
143	150	40	9,984	B	144	69	25	122	8.00	.....	192	52	
351	100	22	5,632	B	82	69	11	124	9.00	8,652	110	51	
352	100	22	5,632	B	75	75	10	154	4.30	8,470	100	56	
353	100	22	5,632	B	86	66	10	124	8.00	8,428	114	49	
354	100	22	5,632	B	76	74	11	144	9.30	8,449	101	56	E
355	100	22	5,632	B	80	70	10	146	10.30	8,365	106.6	53	
356	100	22	5,632	B	82	69	10	160	11.15	8,400	109	52	
359	100	22	5,632	B	83	68	13	128	3.30	8,365	110.6	51	E
3510	100	22	5,632	B	83	68	10	118	3.00	8,239	110.6	51	
3511	100	22	5,632	B	88	64	16	120	3.50	8,169	117	48	26-in. fan
3512	75	18	4,608	B	73.5	63	11.5	138	4.30	7,875	98	47	26-in. fan

* C denotes countershaft drive, M denotes mule-post drive, Q denotes quarter-turn drvie, B denotes bicycle drive. † Boldface indicates p.m.
‡E denotes elevator on this motor. In 1917 the shafting was changed in room driven by motors Nos. 112, 113 and 114. Instead of two main lines with mule-post drives a line of shafting was placed over each line of frames. The total load was reduced from 408.6 hp. to 352 hp., besides giving very much better frame speed. This room is very low-posted and the only one which required a rearrangement of shafting to get good results.

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extension cord and light or sending back to the shop for a tool. To provide for these trouble calls a metal kit box was made and equipped with small tools, such as prestolyte tank and brazing burner, pliers, screwdrivers, monkeywrench, file, special rotor wrenches, alcohol torch, lead light, solder, paste, tape, coil clips and one of each of the different sizes of fuses. One man can shoulder the box, the outfit in which is sufficient to cope with most shut-downs which do not necessitate replacing the motor. The box is kept in the shop ready for use at any time, and it has certainly proved valuable in shortening the periods of stoppage. The "boys" take great pride in seeing how rapidly they can handle every trouble.

Reference has been made to test clips in the panel boxes. These are attached to the switch jaw and hinge blocks, as shown in Fig. 5, to permit attaching a portable-truck test outfit consisting of a small slate panel carrying a voltmeter and ammeter, a power-factor meter and integrating watt-hour meter, and a graphic and indicating wattmeter. By inserting the dummy fuses with the testing leads attached in these clips and

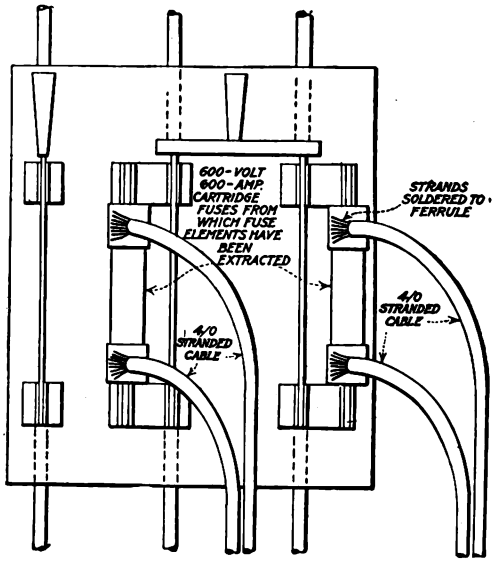

FIG. 5—METHOD OF ATTACHING TEST LEADS

Flexible cables attached to dummy fuses are triple-braided, rubber-covered and are 25 ft. long.

opening the main-line switch, instrument readings can be taken without interrupting service. The results are entered on loose-leaf notebook sheets, together with the date, motor number, pulley sizes, machines driven, speeds and changes in stock or other information that might influence results. This record is kept up to date by the engineer. If changes of stock or speeds are contemplated, the records will indicate how much the motor load can be increased or whether a larger motor will be required. The data also serve as a check on the friction horsepower of each drive, indicating misaligment due to settling timbers in the building, etc. The only condition under which production would have to be temporarily curtailed to permit a test would be when it was desired to obtain data on any particular machines attached to a motor. Friction-load tests can be made during noon hours or at night, while the bearings are still warm, so running conditions are almost duplicated.

The information in this article was contributed by E. B. Tifft, chief engineer of the mill, and by Charles H. Courser, who conducted the investigations made in 1915.

LIGHTING AND CONTROL FOR BRIDGE OVER THE COLUMBIA

Length of Bridge and Limitations Imposed by Lift Span and Series and Multiple Equipment Were Governing Factors

BY T. H. MURPHY
Illumination Engineer, Portland (Ore.) Railway, Light & Power Company.

SINCE it was evident before building the Interstate Bridge which spans the Columbia River between Portland, Ore., and Vancouver, Wash., that it would be required to handle a very large amount of traffic, and since the streets of each city leading to the bridge were fairly well lighted, special attention was given to the illumination of the bridge as well as its approaches. Therefore some of the factors which were taken into consideration and the method of lighting finally adopted may be of interest to lighting engineers.

The bridge with its approaches is approximately 3½ miles (5.3 km.) long. Near the Vancouver end is a 280-ft. (85-m.) vertical lift span. To accommodate foot passengers a sidewalk is carried along the upstream side of the bridge on cantilever supports just outside the main bridge structure. The roadway is well paved and bordered with roses.

Because of the artistic settings of the bridge it was thought best to use a boulevard-type of lighting fixture, so a single-light post with a cast-iron base and a pressed-steel column with a Novalux head was selected for the approaches. On the bridge structure cast-iron brackets are employed to carry the same type of head. The posts were installed on concrete bases along one side of the roadway of the approach about 300 ft. (90 m.) apart, whereas the brackets on the bridge proper are staggered, one being placed about one-quarter span, 67.5 ft. (20 m.), from the end of each span, making two units per span. The light center is about 13 ft. (4 m.) above the roadway all along. At each end of the bridge and approximately 50 ft. (15 m.) from the main structure are two concrete columns, about 25 ft. (7.5 m.) in height, one on each side of the roadway. Each column is surmounted by a large bronze five-light cluster, the lamp for each unit of the cluster being inclosed in a cylindrical opal-glass casing.

Since the need of illumination ceases on the lift span as soon as it is put into operation, there is no occasion for maintaining electric connections to the lights on this span except when it is in normal position. However, the operation of the span should in no way be permitted to affect the balance of the bridge-lighting system, so the lighting of this section had to be considered separately from the rest, as will be explained later.

Owing to the length of roadway to be lighted, a multiple system of distribution could not be used throughout. On the other hand, a series system was a very unsatisfactory one to attempt to handle on the lift span. A low-voltage multiple switch would develop trouble in such a place as this, and one which would properly handle a series circuit would be very difficult to construct and would be, all things considered, prohibitive in cost. If the lighting units on the Vancouver end of the bridge were to be handled on the same series circuit as the rest of the bridge lighting, and accepting the fact that contact switches on the lift span were out of the question, not only because of unsatisfactory operating characteristics and excessive costs but because any such arrangement would of necessity cut off

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all the lights on the Vancouver end of the bridge whenever the lift was out of normal, there remained only two propositions. One was to carry the circuit through the lift span by means of vertical trolleys on either end of the span, running the full height of the lift, and the other was to operate the lighting units on the lift span from the 500-volt circuit used to operate the lift motors, etc., and carry the series circuit underneath the drawbridge span in submarine cable. The first method was expensive, troublesome and dangerous to such an extent that it was not even worthy of further consideration. The second method was expensive and for the relatively small number of lamps to be used could not be justified if any other method was available. Finally, the number of lighting units on the Vancouver end of the bridge was too small to warrant the installation of a separate series system to care for them. Moreover, the distances were easily within the range of a multiple distribution system.

Considering all the factors mentioned, it was decided to use a three-wire multiple distribution, 117-234 volt, alternating-current, for the lighting system on the Vancouver end of the bridge, including the lift span, and to use a series system on the rest of the bridge, including the long approach on the Portland side of the river, a distance of more than 3 miles (4.8 km.). For the posts and brackets on the series system 400 cp., 15-amp. series gas-filled lamps were selected, while for the brackets on the multiple system a 300-watt, 118-volt gas-filled unit was adopted. The lamps used for the towers on the Portland end of the bridge were 250-cp., 6.6-amp. series gas-filled units and those for the towers on the Vancouver end were 200-watt, 115-volt gas-filled lamps.

On this roadway it was desirable that some lighting be maintained throughout the night, but it was unnecessary that the entire system be maintained after midnight. Arrangements were therefore provided for turning on all the lights of both systems early in the evening and leaving them on until midnight, at which time the towers, the brackets on the down-stream side of the bridge and every alternate post on the Portland approach to the bridge, except in two or three instances, where curves in the driveway made it inadvisable to do so, were to have the light turned off. The remainder of the lights were to burn until daylight. The control of these circuits, both multiple and series systems, was made entirely automatic by means of time switches. Automatic control was decided upon because the personal patrol of the system three times a day—evening, midnight and daylight—for that location seemed inadvisable and the cost of providing for control of the systems from substations in either city was prohibitive.

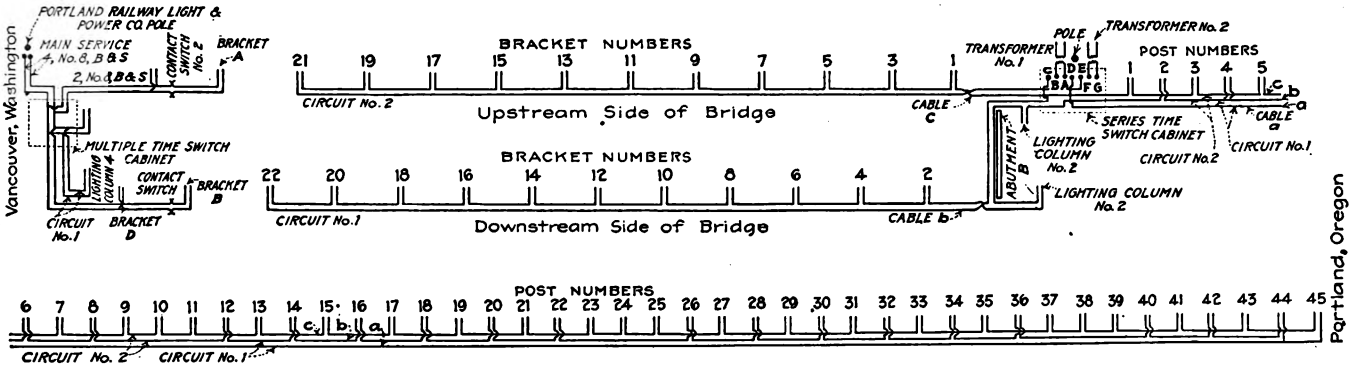

FIG. 1—LIGHTING DISTRIBUTION SYSTEM USED ACROSS COLUMBIA RIVER, WITH PROVISION FOR REDUCED LIGHTING AFTER MIDNIGHT

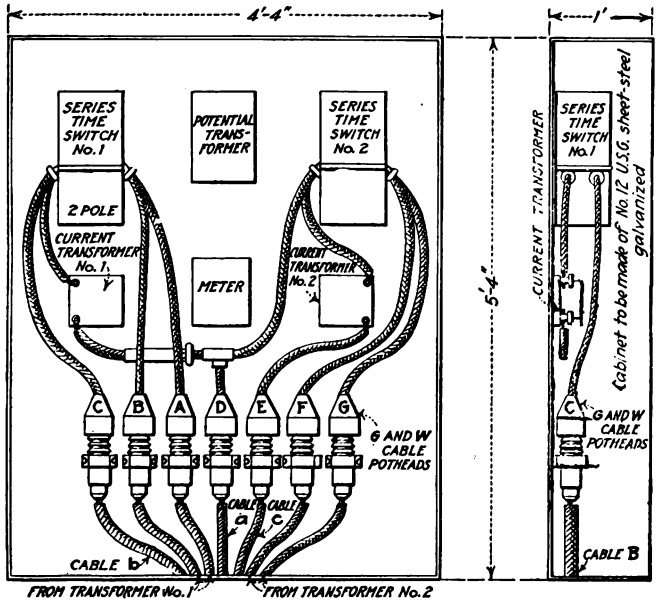

FIG. 2—SERIES TIME SWITCHES ARE EMPLOYED AS MEANS TO CONTROL SERIES LAMPS

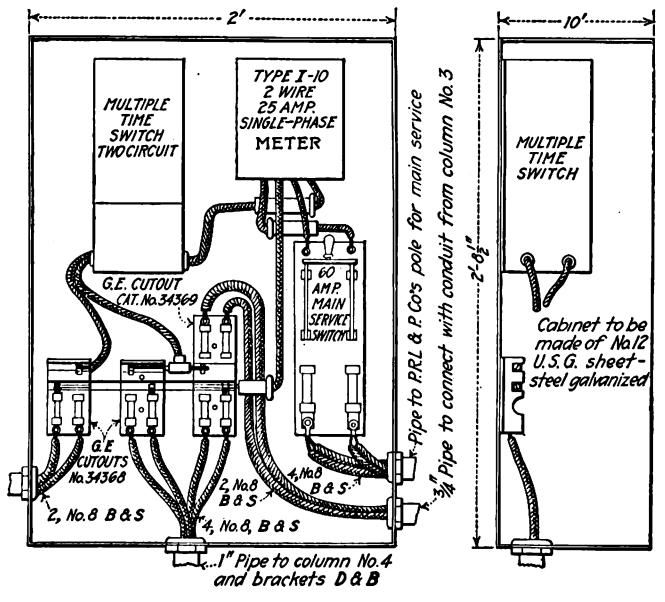

FIG. 3—TIME SWITCH AUTOMATICALLY CONTROLS MULTIPLE BRIDGE LAMPS

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Securing a time switch for control of the multiple system was a simple matter, but for the series system it was a much more difficult problem. Time switches for handling series circuits of the capacity required and of a type that seemed dependable were not available at the time. Furthermore, the only service available where it was desired to feed this system was 11,000-volt.

Since standard constant-current equipment was not available for reducing the 11,000 volts to the standard 2300 volts for the primary service, some other method was sought. The series-multiple system had been used for such purposes on smaller voltage circuits with success, so it was decided to use it in this case also. Such a method would save the purchase of one set of transformers as well as provide a considerable saving in the cost for housing the constant-current transformers. Accordingly two special 10-kw. constant-potential transformers were used, designed for 11,000-volt primary and 6.6 amp. at approximately 1500 volts from the secondary circuit with two 5 per cent taps in the primary windings and four 5 per cent taps in the secondary

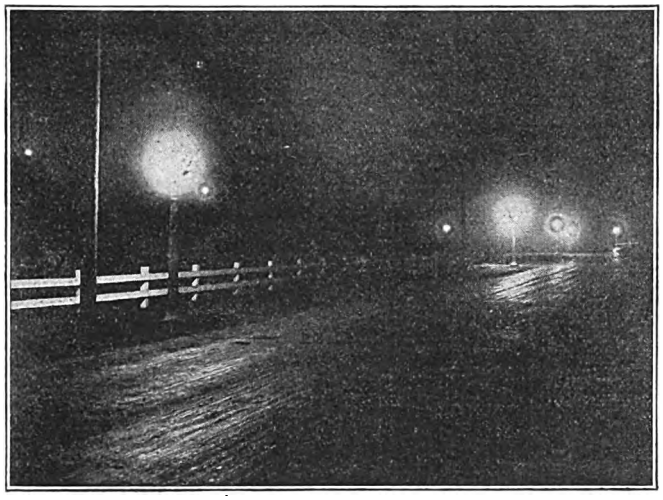

FIG. 4—LIGHTING AT ENTRANCE TO BRIDGE

windings. Auto-transformers were selected for use with each lamp. The 6.6-amp. distribution current was transformed to 15 amp. for the 400-cp. lamps used in all the posts and the series brackets. Auto-transformers were also used in connection with the 250-cp. lamps, although the current taken by the lamps was the same as that on the distribution circuit to avoid any interference with the operation of the circuit by lamp outages. It was specified that these auto-transformers should be so designed that when tested at normal primary current (sine wave), with secondary circuit open, the voltage must not exceed 250 per cent of the rated value. It was further stipulated that these transformers must afford such a degree of protection to the lamps that primary current might be increased to at least 150 per cent of normal value before the secondary current reached the burn-out current value of the lamps.

With the foregoing provision it is assumed that any reasonable number of lamp outages will in no way seriously affect the satisfactory operation of the system. The correctness of this assumption has been amply borne out by the results of a year's operation, during which time, as a result of accidents, several posts have been damaged and it has been necessary not only to remove the lamps but also to shunt the auto-transformers for a time. This seemed in no way to affect the other lamps.

WATER CONSERVATION FOR MASSACHUSETTS

Discussion Before Legislative Committee by Public Officials Emphasizes Importance of Utilizing Water Power Now Wasted

Much hard work is being done at the present session of the Massachusetts Legislature to pass a satisfactory law providing for water conservation both within the state and in coöperation with New Hampshire and Vermont.

The committee on waterways and terminals, to which was referred the recent report of the special commission on water resources, presented a bill near the close of April which was designed to furnish a basis for storage development under state supervision along the lines recommended in the report and previously referred to in the ELECTRICAL WORLD, and endeavoring also to meet objections which led to the failure of a conservation bill at the recent legislative session in Vermont. The bill provides that the courts of the state in which storage facilities are located shall hear appeals from the action of any joint board of supervision or control relative to operation or tolls. Another important feature is that before the cost of a storage development can be assessed upon the owners of water rights upon a stream a majority of such owners both in interest (expressed in gross workable head) and in numbers must consent. Supervision of such projects and their operation would be under the commission on waterways as previously outlined.

At a hearing lately before the ways and means committee the whole question of conservation was thrown open for discussion. A. R. Weed, chairman of the Massachusetts Gas and Electric Light Commission, and John N. Cole, chairman of the Commission on Waterways, defended the bill. Both emphasized the importance of utilizing water power now wasted and contended that the interests of the small power user and water privilege owner are amply safeguarded. Chairman Weed said that with coal at $10 per ton the unutilized and undeveloped hydroelectric power of the principal Massachusetts rivers totals $12,000,000 per year.

To a representative of the ELECTRICAL WORLD and also at the hearing Chairman Weed maintained that agitation in the newspapers and otherwise against the bill on the ground that it seeks to establish control of water-power resources by any so-called trust is entirely aside from the facts. The most vital feature of the bill, he said, is the section providing for interstate coöperation in storage development. He stated that if absolute agreement by every mill owner is to be required to realize a conservation program, no legislation will be needed.

The opposition centered upon the feature of the bill which might require a water privilege owner to pay an assessment for water which it could not utilize in power production and upon the proposal to make assessments a lien upon his property. The Holyoke Water Power Company urged an amendment to the effect that no owner of any improved or operated water mill or dam shall be assessed an amount in excess of the actual benefits derived by such owner from the creation of such water storage. Many mill owners opposed the bill on account of its toll provisions.

It was decided to continue the hearing pending a conference to discuss recommendations by both sides.

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Experiences with Electrolytic Arresters

Tests at 110 Stations of Southern California Edison Company Indicate Need of Giving Particular Attention to Condition of Horn Gaps, Film and Electrolyte, Oil, and Line and Ground Connections

WHILE the electrolytic lightning arrester has been found very effective in protecting station equipment from disturbances due to switching and lightning strokes, it is seriously affected by continued overloads and has the disadvantage of having to be charged, inspected and maintained at frequent intervals. Furthermore, its satisfactory operation depends to a great extent on the setting of the horn gaps, condition of the films and electrolyte, condition and quantity of the oil, and condition of the line and ground connections. The necessity of charging is not such a serious objection except in isolated places, but if this type of arrester is overloaded for any length of time the electrolyte becomes overheated, causing the films to be dissolved with great rapidity, resulting in failure.

In view of these facts, a committee was formed on the Pacific Coast early in 1915 to report on the care and attention to give lightning arresters and methods of testing them. In addition, it was desired to determine whether or not the periodic testing of arresters is a warranted expense. To facilitate this investigation test jacks were installed on the 66,000-volt arresters at three of the Southern California Edison Company's large plants, and a current-testing set was purchased. Periodic tests were made and records kept of all indications of the condition of the arresters, particular attention being given to the current at the time of charging and the color and size of the arc at the horns breaking the current. Other conditions noted were the time of charging, frequency, temperature, any peculiar or unusual sounds coming from within the arrester tanks, the condition of the grounds and the quantity of oil.

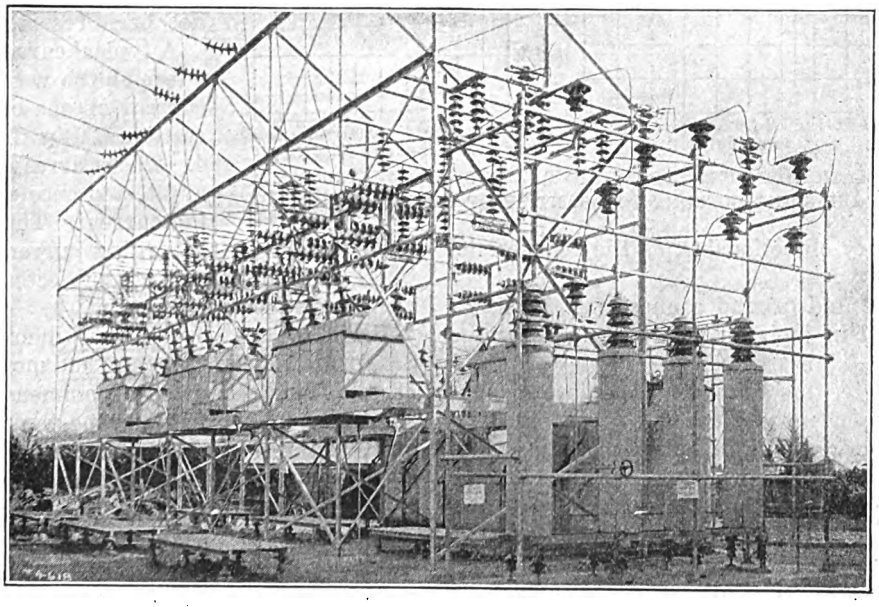

FIG. 1—ONE OF THE STATIONS AT WHICH PERIODIC TESTS OF ARRESTERS ARE MADE

However, it soon became evident that the restriction of the tests and observations to such a limited number of arresters would require an undesirably long time to obtain intelligent results from which conclusions and recommendations could be drawn. Furthermore, the expense of equipping all the arresters with testing jacks had not been warranted yet, so an attachment was devised which could be used in connection with the regular test set to place the ammeter between the horn and short-circuiting strip at the time of charging. In time, all arresters at 110 different stations, ranging in potential from 2200 to 150,000 volts, were tested, and the results showed conclusively the need for periodic testing and inspection.

Some very important things were discovered which showed that it is necessary to pay more attention to electrolytic arresters if they are to be kept in such condition that they will be ready to perform their duty most effectively. Among the things found were leaky oil tanks, defective bushings, loose and too-wide horn-gap settings, loose insulators, defective resistances, deteriorated ground connections, low and deteriorated electrolyte, punctured cones and defective charging apparatus, especially on the 2000-volt and 6600-volt type, which allowed two or three of the stacks to be charged and not the remaining ones.

The leaky oil tanks caused lowering of the oil level, which not only reduced the insulation necessary but exposed the electrolyte to evaporation. As a result of a cracked bushing on a 60,000-volt arrester the compound gradually melted and leaked into the tank. Punctured cones were usually indicated by a cracking or rumbling noise coming from the tanks. When this occurred the tanks were ordered overhauled, invariably revealing one or many punctured cones, which were replaced by new ones. In some cases the whole set of arrester tanks were overhauled at the same time.

Loose horn gaps and too wide settings are particularly objectionable, because the first defect makes it impossible to depend on the gap discharging at the same voltage each time while the second fault eliminates part of the protection which should be afforded. In general, the horn-gap defects are due to the construction employed and aging of the equipment, but they can be reduced by keeping the frames painted, tightening all bolts periodically, and checking the settings regularly, especially on the larger-voltage installations where heavy parts are used on the movable arms.

Damage to the charging resistances was in many cases due to mechanical stresses or excessive heating during sustained discharges which start at the resistance gap, rise on the horn, go out, and repeat again and again. Where a resistance rod had become broken parts fall out quite often, leaving a gap which, if not

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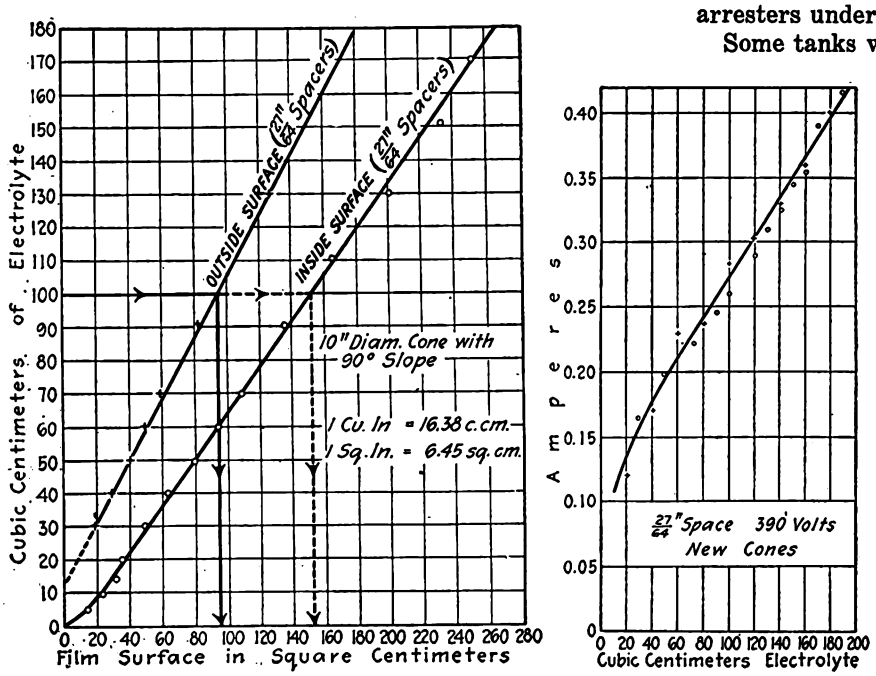
bridged by the charging current, forces the arc over the main gap, subjecting the cells to a charge without any limiting resistance. In some cases this would be so excessive as to cause dissolution rather than formation of the film, leaving it exposed to damage by the dynamic current. The charging resistances, while desirable because of their effect on the charging current, are also desirable in damping surges set up during charging.



FIGS. 2 AND 3—RELATION OF FILM SURFACE TO QUANTITY OF ELECTROLYTE; RELATION OF CHARGING CURRENT TO QUANTITY OF ELECTROLYTE

These surges are very objectionable, as they cause telephone interference.

Without good line and ground connections the lightning arresters failed in their purpose and even became a menace.

As to the electrolyte, this seemed to deteriorate spontaneously quite independently of the natural chemical reaction resulting from passage of current. Cases were observed where fungus, similar to "mother" of vinegar, had formed, causing part of the electrolyte to turn into acetic acid—a rather objectionable constituent because it has a high dissolution effect on the films.

Although the height of the electrolyte could not be determined at first until the cones had been taken apart, it was found later that low electrolyte could be detected by a low charging current, since the decreased electrolyte reduced the effective contact area between cones. This was verified by measuring the quantity of electrolyte in a 30,000-volt arrester which had indicated a very low value of charging current. The cones were in fair condition. The quantities of electrolyte (in cubic centimeters) found in them appear in the table on the op posite page.

Whereas the cones should have contained 178 cu.cm. of electrolyte apiece, it was found that the average quantity was only 100 cu.cm., giving a film surface of 97 sq.cm. on the lower side of the cones and 152 sq.cm. on the upper side with 27/64-in. spacers. The relation between quantity of electrolyte and film surface is given in Fig 2. The decrease in electrolyte, barring incorrect measurement when filled, can only be laid to evaporation.

Since the charging current is proportional to the area of the film in contact with the electrolyte, it is of prime importance that the full quantity be maintained in each cell because the ability of the arrester to absorb high-frequency transients depends upon the electrostatic capacity rather than on the discharge capacity. Also, when the arrester discharges it is of great importance to have the maximum film area in order that the heating shall not be excessive enough to cause dissolution of the film. The correct relation between charging current and quantity of electrolyte is given in Fig. 3 for the arresters under consideration.

Some tanks were found with a charging current of 1 amp., which was three times normal for the type of arrester observed. For such cases charging two or three times a day was recommended to bring the current down to normal. In case this treatment failed the tanks were overhauled and new electrolyte put in after washing the cones.

As far as is known at the present time the local weather conditions, which do not go to extremes of hot and cold, do not greatly affect the operation of the arresters, so that the unsatisfactory and expensive methods of cooling or of heating the arrester tanks to offset these conditions have not been resorted to.

A typical curve showing the possible effect of the weather on the charging current of one of the 150,000-volt arresters at Big Creek is shown in Fig. 4. These arresters are charged daily and tested once each month for charging current. The curve represents the values of highest charging current for any particular tank. This installation is subjected to both hot and cold weather extremes in season.

Prior to the observations mentioned, the Southern California Edison Company had more or less followed the arrester manufacturers' recommendations regarding the frequency of overhauling the tanks. Since then, however, the test department determines this point, the arresters now being tested once every three months for

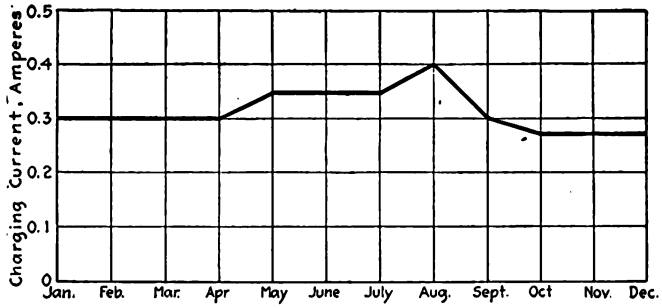


FIG. 4—EFFECT OF WEATHER ON CHARGING CURRENT

this purpose, and a card record of the performance of each arrester tank on the system is kept on file. On the field records (Fig. 5) are recorded such data as location, make, type and serial number, charging current, character of arc and gap setting, resistance, and remarks regarding condition of grounds, resistance rods, framework, etc. These data are turned into the test department by the test man, where they are transferred to permanent file records (Fig. 6), one card being kept in file for each arrester, thus affording a continuous history of each arrester's performance. At the same time the department makes recommendations to the di-

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visional superintendent for overhauling, repairing, etc., on the form shown in Fig. 7, data for which are taken from the file and test record report. On receipt of this form the department superintendent authorizes the work done and on completion notifies the test department through a postal medium. The arresters are again checked and inspected to determine whether they are in first-class condition for service. By this means a great deal of expense can be saved by not overhauling the arresters until their performance indicates that this is necessary, and also by overhauling such arresters as show the need of it before they fail. A failure would cause a much greater expense than simple overhauling, and involve the possible loss of apparatus left unprotected because of a faulty arrester.

To facilitate making these periodic tests, which are now recognized as fully warranted, ammeter test jacks

FORM TEST 24

SOUTHERN CALIFORNIA EDISON COMPANY

LIGHTNING ARRESTER TEST REPORT

STATION Los Angeles #3 DATE 2-13 1919

CIRCUIT West Kern 60 K.V. TYPE I-C-2
MAKE General Electric NO. 7370
VOLTAGE 58500/64250
CONDITION Rumbling in #2 tank
GAP SETTINGS. MAIN 3 3/4" RESISTANCE 3"

RESULTS OF TEST

ARRESTER	No. 1	No. 2	No. 3	No. 4	REMARKS
AMPERES	.20	0 to .2	.20		#2 Cg Annal
ARC	2 B	3 B	2 B		Variable

CIRCUIT East Kern 60 K.V. TYPE I-C-2
MAKE General Electric NO. 7367
VOLTAGE 58500/64250
CONDITION O.K.
GAP SETTINGS. MAIN 3 3/4" RESISTANCE 3"

RESULTS OF TEST

ARRESTER	No. 1	No. 2	No. 3	No. 4	REMARKS
AMPERES	.24	.24	.22		
ARC	2 B	2 B	2 B		

CIRCUIT L.A. #2 North TYPE I-C
MAKE General Electric NO. 6813
VOLTAGE 16100/18700
CONDITION Charging current #3 high Resgap wide
GAP SETTINGS. MAIN 1/2" RESISTANCE 9/16"

RESULTS OF TEST

ARRESTER	No. 1	No. 2	No. 3	No. 4	REMARKS
AMPERES	.24	.26	.70		Tank #3
ARC	1A	1A	3C		Noisy

REMARKS Arresters #7370 and #6813 need attention

TESTED BY A. R. Arnold ENTERED

FIG. 5—FIELD RECORD OF LIGHTNING-ARRESTER CONDITION

have been attached to all the arresters, since they are more convenient to use and safer from the standpoint of the tester and apparatus. Of course, it is possible to make tests without them, and possibly as cheaply. A portable recorder is used, which is moved from station to station as desired. This gives information regarding the time at which discharges occur. If the discharge is frequent, it is the usual indication that the arresters are working properly and that the gaps have the right setting. If, on the other hand, the discharge is infrequent, the gaps should be reduced. On account of the conditions varying in different parts of the system, this recorder has been found to be very helpful in determining the proper settings of gaps and for indicating whether or not the operator has charged at the proper intervals.

In overhauling the arresters, the stacks are dismantled and each cone is carefully cleaned, using cheesecloth and gasoline for the first operation, followed by a bath in denatured alcohol to remove the greasy film left by

ELECTROLYTE FOUND IN LIGHTNING-ARRESTER CONE

Cone No.	Tank 1	Tank 2	Tank 3	Cone No.	Tank 1	Tank 2	Tank 3
1	48	93	102	27	90	109	95
2	65	102	102	29	102	109	102
3	90	95	99	31	85	109	95
4	105	109	89	33	102	89	102
5	65	116	89	35	122	93	102
6	100	109	79	37	100	109	108
7	100	109	79	39	110	113	102
8	110	102	83	41	102	102	106
9	110	102	83	43	102	102	106
10	75	95	89	45	102	109	133
11	75	102	89	47	113	109	114
12	78	109	99	49	110	102	106
13	82	116	102	51	102	109	108
14	88	109	106	53	90	109	106
15	90	99	102	55	110	95	106
17	117	102	102	57	97	102	102
19	110	116	102	59	102	130	108
21	102	93	83	61	102	109	108
23	136	113	95	Average,	97	105	100
25	97	93	95				

the gasoline and also the brown sludge ring left at the edge of the film of the area. Cones that cannot be thoroughly cleaned by this method are replaced by new cones. New cones are used in the same stack as the old cones if the amount does not exceed 10 per cent of the stack. The old cones are returned to the general storeroom to be passed on by the test department, while heavily pitted, punctured or badly dented cones are rejected and sold as junk. Most of the deposits found on the cones can be removed by a bath in a weak solution of hot caustic soda, after which they are thoroughly rinsed in warm water. After drying, the cones are immersed, two at a time, in a small vat of electrolyte and charged thirty seconds by a current of 0.5 amp. It is not expected that the films will be completely re-formed by this method, but, as the cones are always charged up after building the stacks (just before putting them into service), it is believed that the charge is sufficient for the film area. These cleaned cones are stacked on frames in a manner similar to that in which they are received from the manufacturer and placed in the general stores department awaiting call. The cost of cleaning and charging cones averages about 10 cents each. Approximately 99 per cent of the cones received are returned to service after this treatment.

In some places on the system it is impossible to obtain low potential for forming the film on cones, in which cases the whole stack of cones is placed in the arrester tanks complete and charged by the use of a separate line from a generating plant by reduction in voltage, giving a ten-second charge at about one-fourth voltage and then increasing the speed at the plant to one-half, three-fourths and finally full voltage, giving a charge at each voltage. In this way the proper film is formed and the results obtained are satisfactory. Where a separate line and generator cannot be procured, the chance of arrester trouble is increased by energizing the tanks on a high-potential line with full voltage, unless the film has first been formed at a lower voltage.

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The stock of electrolyte kept by the general store department is occasionally tested to determine whether or not it is fit for use or has started the fungus growth, and all the electrolyte before being shipped to any point for use is tested immediately before shipment. This is done for two reasons: To keep the stock up to a certain standard quantity and to prevent any bad electrolyte getting out on the system.

Quite a few isolated stations are equipped with electrolytic lightning arresters which have been charged, inspected and maintained by a patrolman. This practice is not as satisfactory as having a permanent station atttendant because the arresters are more susceptible to trouble where no operators are in attendance, which indicates that they do not receive the proper attention. To avoid this difficulty oxide-film aluminum arresters have been ordered for a number of the isolated stations, in the hope that they will take care of themselves as they seal over after each discharge. If they operate as claim is made for them, the company will undoubtedly replace quite a few of the electrolytic arresters with the oxide-film type.

The best charging practice involves the utilization of a resistance in series with the tanks during the interval of ten seconds that is required each day to re-form the films. This resistance must be high enough to prevent an excessive inrush of current in case the films are in bad condition and at the same time must not be high enough to prevent the cells from getting their normal potential, as the critical voltage of the film depends on the voltage at which it is charged. The value of the resistance selected on this system is such as to limit the current to a maximum of about 10 amp. at the voltage for which the arrester is designed, if the cells were completely short-circuited. This is easily possible, due to the fact that the arrester is typically a condenser bringing the resistance drop in quadrature with the impressed voltage.

During the past two years of investigation one particularly significant point has been brought out, and that is that out of seven arrester failures all occurred in three-tank sets either directly from lightning or owing to insulator failure on the arrester equipment. This seems to indicate that four-tank arrester installations should be used in preference to the three-tank, Y-connected sets. While it is true that three-tank arrester installations may be satisfactory in cases of a grounded neutral system where the stability of the ground is assured, conditions affecting grounding of all kinds in southern California are difficult and erratic, and it is quite possible for a grounded arrester to be so affected by some local condition that it does not get the benefit of the grounding of the neutral of the system. It is also possible that under some conditions of switching the arrester may for a time be on an isolated section of line and therefore should be protected by the fourth tank.

The foregoing information and illustration were kindly contributed by W. R. Frampton, superintendent of the meter test department of the Southern California Edison Company.

FORM TEST 88 800 PAGE 12-17

SOUTHERN CALIFORNIA EDISON COMPANY

STATION OIL AND LIGHTNING ARRESTER REPORT

OIL ARRESTERS

LOCATION Los Angeles #3 DATE 2-13 191 9

APPARATUS	SERIAL NO.	GRADE OIL	TEMP. °C	BREAK DOWN K.V.	SERIAL NO.	TANK NO. 1		TANK NO. 2		TANK NO. 3		TANK NO. 4	
						CHARGING CURRENT	CHARACTER OF ARC	CHARGING CURRENT	CHARACTER OF ARC	CHARGING CURRENT	CHARACTER OF ARC	CHARGING CURRENT	CHARACTER OF ARC
					West Kern #7370	.20	2 B	0 to.2	3 B	.20	2 B		
					East Kern #7369	.24	2 B	.24	2 B	.22	2 B		
					L.A. #2 No. #6813	.24	1 A	.26	1 A	.70	3 C		

Tank #2 in Arrester #7370 rumbles when charged. Indications of punctured cones.

Tank #3 in Arrester #6813 very high in charging current and tank noisy.

Recommend that both these tanks be overhauled at once.

FORM TEST 88 800 11-17

SOUTHERN CALIFORNIA EDISON COMPANY

LIGHTNING ARRESTER TEST RECORD

SER. NO. 13170 TANK NO. 2

MAKE G. E. TYPE L-C-2 VOLTAGE 44500/64250

LOCATION L. A. #3 CIRCUIT West Kern 60 K.V.

DATE OF TEST	CHARGING CURRENT	CHARACTER OF ARC.	GAP SETTING MAIN	GAP SETTING RES.	REMARKS
6/1-16	.25	2 B	3 3/4	3	
9-19-16	.24	2 B	3 3/4	3	
12-6-16	.23	2 B	4	3 1/4	Horn loose, adjusted
2-31-17	.23	2 B	3 3/4	3	
6-11-17	.27	2 B	3 3/4	3	
9-4-17	.30	2 B	3 3/4	3	
12-18-17	.25	2 B	3 3/4	3	Checked gap settings
3-3-18	.25	2 B	3 3/4	3	
6-4-18	.30	2 B	3 3/4	3	
9-18-18	.30	2 B	3 3/4	3	
12-10-18	.31	2 B	3 3/4	3	Checked gap setting
2-13-19	0 to .2	3 B	3 3/4		Rumbles after charge Recommend overhauling
2-31-19	.22	2 B	Data after overhauling		Found 35 cones punctured

NOTE—THE NUMERALS 1 TO 4 INDICATE THE SIZE OF THE ARC FOUND WHEN BREAKING THE CHARGING CURRENT. NO. 1 INDICATING A MINIMUM SIZED ARC AND NO. 4 THE LARGEST SIZED ARC ENCOUNTERED IN PRACTICE. NOS. 2 AND 3 ARE INTERMEDIATE GRADES. THE LETTER A INDICATES A WHITE CRACKLING ARC AND LETTER B RED FLARING ARC. B AND C ARE INTERMEDIATE STAGES.

FIGS. 6 AND 7—PERMANENT CARD RECORD OF ARRESTER HISTORY; FORM SENT TO DIVISIONAL SUPERINTENDENT WHEN RECOMMENDING OVERHAULING OF ARRESTERS

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INDUSTRIAL APPLICATIONS

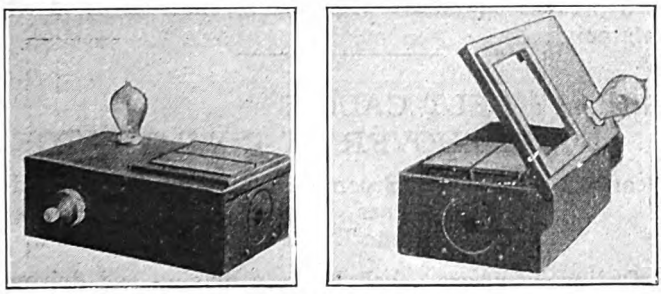
The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

DEMAGNETIZER MADE FROM OLD REGULATING REACTOR

Energized by Alternating Current to Avoid Use of Cumbersome Direct-Current Device—Employed to Treat Steel Products

When magnetic chucks are used for grinding purposes, some method has to be employed for demagnetizing the steel products after they have been ground. Direct-current demagnetizers in which the current is reversed by some rotating device are sometimes used, but one company in the East has found it advantageous to use an alternating-current demagnetizer because it eliminates moving parts. In the plant where this is used 220-volt alternating current was already supplied to a nearby machine motor, so special wiring did not have to be provided.

The demagnetizer employed was made from an old regulating reactor taken from a mercury-vapor lamp by



FACE PLATES SEPARATED BY INSULATION PROJECT THROUGH OPENING IN BOX COVER

sawing the yoke in two and attaching face plates thereto. A space of about 0.12 in. (3 mm.) was provided between the adjacent ends of the yoke and the face plates so that too much flux would not be shunted across the gap. Thus the demagnetizer can be used without making temporary connections, and in order that it might be transferred from one spot to another it was placed inside a box on which were mounted a snap switch and a lamp, connected in the secondary circuit to increase the flux and serve as a current-indicating device.

DEEP-BOWL REFLECTORS FOR CLOSE MACHINE WORK

Equipped with 100-Watt Gas-Filled Lamps and Placed 10 Ft. from Floor, They Form Effective Lighting Scheme with Few Additional Lamps

Obtaining from 3.5 to 4 foot-candles on the working plane, without a particle of glare, at the expense of only 0.64 watt per square foot (0.06 watt per sq.m.) of surface is the record of a large industrial plant in the East. This is accomplished by placing 100-watt gas-filled lamps in Benjamin fluted deep-bowl reflectors on 12.5-ft. (3.8-m.) centers about 10.5 ft. (3.1 m.) from the floor. For finer work, however, 150-watt lamps can be used if necessary because the reflectors are of the 200-watt size. In a few instances individual incandescent lamps are mounted on the machines, but this is only done where an operator has to do internal boring and must look into the bore for the purpose of adjusting his tool.

No covering is used over the top of the reflector in order to procure adequate ventilation. The small amount of light thus escaping is utilized as indirect lighting from the white ceiling.

Plainfield, N. J. IRVING E. SWEAZEY.

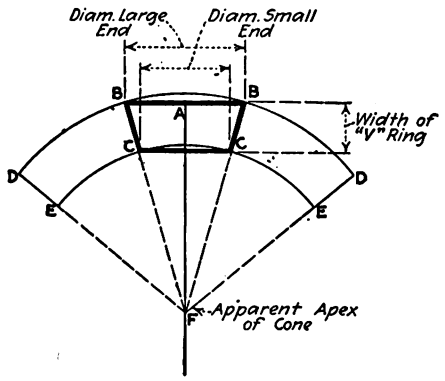
CUTTING RINGS FROM SHEET MICA

Method of Assuring Exact Fit with No Calculations—Tapping Allowed for in Determining Length

An armature winder often experiences much difficulty in cutting a "V" ring from a sheet of mica in such a manner as to obtain a perfect fit. A simple method of getting an exact fit is described in the following paragraphs:

Assume that the beveled surface to be covered with mica is a section of a cone the apex of which would extend to the heart of the shaft at a point which would be the intersection of two lines drawn as the continuation of a "V" ring toward the heart of the shaft.

First, draw a perpendicular line (*AA*) on the mica sheet. Take caliper measurement of the large end of "V" ring and place this measurement (*BB*) at right angles with *AA*, taking care that the latter cuts the former exactly in the center. Measure the diameter of the small end and draw a line (*CC*) parallel to and at a distance from *BB* equal to the width of the "V"



METHOD OF LAYING OUT MICA "V" RING

ring. Connect *B* and *C*, both sides, extending lines to *AA*. Call this intersection point *F*, or the apparent apex of cone. Using *F* as a center and *B* as a radius, describe a large arc. Repeat this operation, using *C* as radius. This gives the proper curve and width of

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the mica "V" ring, but to eliminate waste the length should also be known.

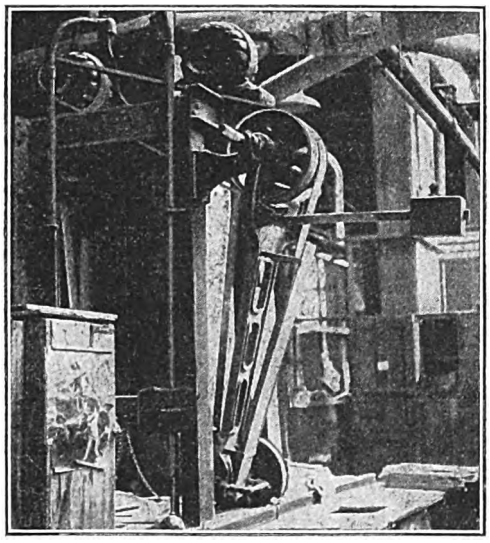
The exact length is not needed, and its attainment would be impracticable for two reasons: First, it would involve too much figuring for the average armature winder; second, because provision must be made for "welding" mica "V" ring ends together. Therefore the exact length would be too short. To get the needed length encircle the large end of the "V" ring with a piece of banding wire, allowing an extra inch for welding. Set this measurement on the larger of the two arcs and mark off points *DD*. After connecting points *DD* with apex *F* the "V" ring is properly laid out and ready to cut.

Youngstown, Ohio. M. S. CLEMENT.

DOUBLE-FRAME MOUNTING FOR SEPARATE CROSS-CUT SAWS

Motors Ordered for Direct Drive Being of Too Large Dimensions, Some Method Had to Be Used to Give Effective Nearby Drive

Ordering motors by rating without specifying outside dimensions sometimes leads to a difficult installation problem when motors are too large. An instance of this kind happened to the Eclipse Box & Lumber Company of Greenpoint, Long Island, some time ago when the 2-hp. motors received measured 10.25 in. (26 cm.), whereas the space allotted for them on the horizontal shaft was only 8.25 in. (21 cm.) in length. As some framework had to be constructed to hold the saws, it was decided to combine the two saws on a square I-beam mounting and thus utilize the framework of one for the motor support of the other. Pulleys were placed on the shafts and the motors were bolted to the top of the iron framework, the belts passing on



FRAMEWORK OF ONE SAW USED AS MOTOR MOUNTING OF OTHER

Motors should have been placed on pulley shaft, but space provided was found to be 2 in. short after motors came.

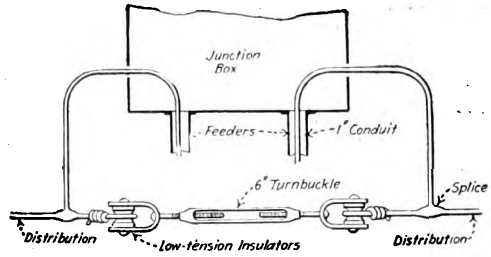
each side of the horizontal top pieces. In this position the motors are easily accessible and do not get so dirty as they would if placed closer to the cutting edge of the saw.

The motors are conveniently controlled by safety switches placed on the framework. The conduit runs directly up the side of the framework, the wires being distributed through a condulet.

SIMPLE FEEDER ARRANGEMENT PREVENTS WIRE SPLICING

A Number of Feeders Coming from One Source Are Effectively Directed at Right Angles by Running Through a Main Junction Box

Where a number of parallel feeders are directed to their respective positions at one diverging point care must be taken to avoid a mix-up of wires and too many



DISTRIBUTION FEEDERS DEAD-ENDED ON EACH OTHER

splices. An arrangement which makes this a simple matter is in use in a rubber mill in New Jersey where the wires from the supply are in a number of conduits arranged in two rows. These conduits terminate in a junction box, and the wires run directly to the distributing feeder without a splice. Here they are attached to the feeder, which is dead-ended to a turnbuckle with another dead-ended wire on the opposite side. Insulators prevent the wires from being short-circuited at this point.

GREASY BELT CAUSES FLASHOVER AT COMMUTATOR

Bearings and Pulley Become Hot and Reduce Speed of Driven Machines—Load Had in Consequence to Be Reduced

Ordinarily where a belt between driving and driven pulleys is horizontal or nearly so, and the pulleys are sufficiently far apart and so turn that the tight side of the belt is under, the additional sag which obtains when load is applied increases the arcs of contact between the belt and pulleys and helps to prevent belt slipping. Where available space requires that the pulley alignment be vertical, however, the sagging effect helps but little, and it then may be necessary to operate with excessive belt tension.

A 550-volt, 45-hp. motor used for driving shop shafting flashed over and blew its breaker; as the flash apparently burned the commutator and brush holders badly, the trouble was hastily attributed to armature defect, but this was not found to be the case. Soon afterward complaint was made of the slowness of the connected machines and an investigation was again made.

The machine was found to be operating in what appeared to be an entirely satisfactory manner, but the connected machines—and there were many of them, including a large air compressor—evidently were operating much below normal speed. A test of the armature speed proved it to be about right, but it was noticed that the bearings and the pulley were very hot. The comparatively short belt was vertical; also it was very greasy. Operating conditions were much improved by cleaning of the pulleys and the belt, but it became evident that the tension required in order to keep the

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belt from slipping was excessive. As changing the location of the motor was impracticable, the only immediate means of relief was to take some of the load off the motor. This was done with entirely satisfactory results.

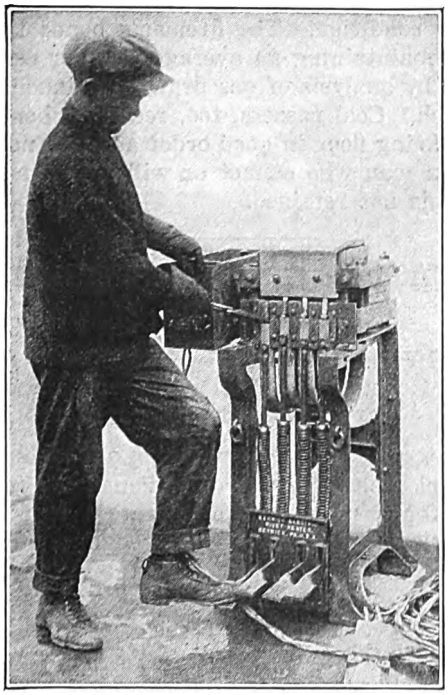
Brooklyn, N. Y. E. C. PARHAM.

RIVETS HEATED BY MEANS OF ELECTRIC CURRENT

Direct and Indirect Heating Have Both Been Found Suitable—Energy Consumption Is About 20 Kw.-hr. per 100 Lb. of Rivets with Either Method

Two methods of heating rivets electrically are used quite extensively, one in which the rivet itself short-circuits the secondary of a transformer, the other in which granulated carbon short-circuits the secondary and radiates heat to the rivets. About forty heaters of the first type are being used by the American Car & Foundry Company, these having been found very satisfactory when an air hammer is used for riveting, and especially where delays are liable to occur in fitting the material to be riveted, since power is required only when the rivets are being heated. These heaters, depending on their size, will turn out 25 lb. to 250 lb. (11 kg. to 110 kg.) of rivets per hour with a power demand of 7.5 kw. to 30 kw. and an energy consumption of 20 kw.-hr. per 100 lb. (45 kg.) of rivets. The rivets can be heated in thirty seconds.

The chief advantages of the second type of heater are that the rivets can be heated uniformly and without oxidation. The latter is important because it avoids



DIRECT TYPE OF RIVET HEATER IN OPERATION

Each rivet is held by its individual spring mechanism between both ends of the transformer secondary. The transformer is directly back of the rivets.

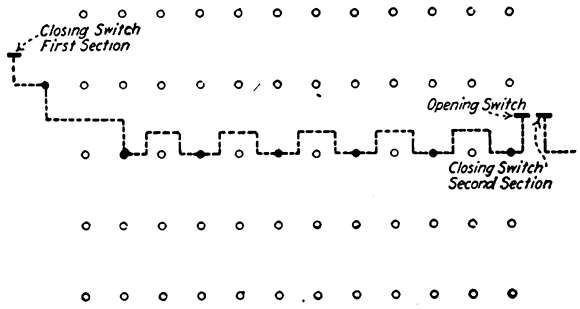
reduction in size of rivets and loose fits and consequently the necessity of removing them. With one of the first heaters of the resistance-furnace type installed at the Ambridge plant of the American Bridge Company, about 200 rivets were turned out per hour at a temperature of 2000 deg. Fahr. (1100 deg. C.) and a power demand of 40 kw No tendency to overheat was noticed and the presence of a reducing atmosphere prevented oxidation and the consequent pitting and wastage of rivets. When this type of furnace is worked to capacity continuously the energy consumption is about 400 kw.-hr. per ton of rivets. Including the furnace and transformer the initial cost is about $100 per kilowatt.

W. S. Johnson of the American Car & Foundry Company developed the direct type of heater and the Electric Furnace Company the indirect type of heater.

WATCHMEN'S PILOT LAMPS SERVE AS ORDINARY UNITS

Alternate Fixtures on Separate Circuit Are Controlled by Two Three-Way Switches—Can Be Used for Emergency Lighting

In order to have light for the watchmen as they go through the factory at night without lighting lamps on the entire floor or installing separate units,



PILOT LAMPS FED FROM INDEPENDENT CIRCUIT DIRECT FROM TRANSFORMER ROOM

the International Motor Company of Plainfield, N. J., has installed in its newest building combined pilot and emergency lamps which serve also for ordinary lighting. This is done by feeding every other lamp, in the center of five rows, from a separate circuit controlled by a three-way switch near the entrance to the floor. The watchmen lights this row of lights on entering and, after walking to the end, lights the next section and turns out the preceding units. The opening switch of the first section and the closing switch of the second are placed side by side.

Inasmuch as these circuits are fed from separate feeders in sets of risers separate from the main lighting circuits, the pilot lamps can be utilized for emergency service. The pilot-lamp circuits also have separate fuse boxes on each floor. On the factory and office floors the main lighting units are fed from circuits in groups of six each. Lockwood, Greene & Company were in charge of the electrical installation.

Hemispherical Distribution Needs Consideration

In determining the proper lamps and reflectors to use and their correct location in industrial plants, it is not nearly so important to know the illumination on the working plane as it is to know the hemispherical distribution, according to Bassett Jones of Myer, Strong & Jones. The value that should usually be known is the intensity of light which comes at an angle of about 45 deg. Therefore units which give a small number of foot-candles illumination on the horizontal plane and a larger number at the 45-deg. angle are usually better than those which have a high intensity vertically under the lamp.

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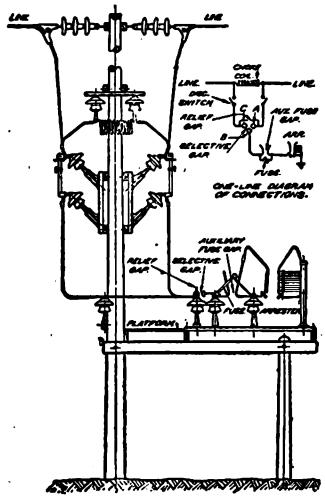
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SURGE ARRESTERS FOR TRANSMISSION LINES

Arrangement of Choke Coil and Lightning Arrester for Protection from Disturbances Coming from Either Direction

Lightning and high-speed power surges are among the most annoying sources of trouble on modern high-tension transmission systems. Small systems with comparatively few miles of metallically interconnected lines do not suffer much from surges, but as the mileage



CIRCUIT AND CONSTRUCTION SCHEME FOR SURGE ARRESTERS

increases the number of outages due to insulation failure increases in faster proportion than the mileage.

Many transmission systems have found it necessary to go to the inconvenience of sectionalizing the high-tension network so as to prevent surges traveling from one point of the system to the other and breaking down insulation at widely separated points. The installation of lightning arresters along the lines will not alleviate the trouble to any marked extent unless choke coils are also installed in the line at the point of lightning-arrester installation. As surges may come from either direction, this necessitates the installation of two arresters at each choke coil to enable draining the line from both sides of the coil.

A method of arranging equipment to drain surges from either direction is illustrated and will be of particular interest to transmission engineers. Line surges from the right-hand side will be reflected to the sphere gap *A*, striking to *B* and thence to the arrester and ground. Surges from the opposite direction will be reflected from sphere gap *C* to *B*, from there to the arrester and ground.

To permit the use of series limit fuses in the arrester circuit and still have protection in case of fuse operation, an auxiliary gap in shunt with the fuse is employed. The connection in the one-line diagram clearly illustrates the various elements of this new protective device.

The above information is contributed by H. W. Young, Delta-Star Electric Company.

BONUSES FOR THE FIREROOM

Standards Set for All Boiler-Room Employees Such that Capable Men Will Earn Bonuses

If a fireman is to become an expert in coal economy, it must be worth his while to learn and worth while for some one higher up to teach him. Rewards for coal saving are paid by the Charles Pfizer Company of Brooklyn, N. Y., according to an ingenious scheme applied by F. S. Jones, works engineer. For the watch engineers a bonus of 10 per cent of their pay is given, conditioned on the maintenance of an evaporation rate of 8.4 lb. of water from and at 212 deg. Fahr. per pound of coal. This requires that their responsibility for the cleanliness of boiler surfaces, inside and out, shall be taken quite seriously, and that each man should see that the fireman on his watch maintains his fires in proper condition. The fireman's bonus in turn depends on maintaining an average CO_2 per cent of 11.6, as shown by analysis of gas drawn continuously during each watch. Coal passers, too, receive a bonus if they keep the firing floor in good order and lose no time. In all cases a man who cannot or will not earn his bonus regularly is not retained.

RELOCATION OF TRANSFORMERS AS MEANS OF SAVING SPACE

Industrial Plant Uses Niche of Building to Advantage of Consumer as Well as Power Company to Permit Plant Expansion

Owing to plans for the expansion of the Dodge works of the Link-Belt Company of Indianapolis, Ind., it was recently found necessary to relocate a bank of transformers supplying energy from the lines of the Merchants' Heat & Light Company to the factory. The old transformer installation was of the usual two-pole type with two short stub poles for supporting the wooden platform for the transformers. As now installed the transformers are more readily accessible, less secondary copper is required to reach the consumer's outlet, and a neater and better installation has been secured. These advantages were gained in addition to that of vacating the valuable space in the yard and driveway. Moreover, in its present location the bank is in a space where there is remote possibility of disturbance due to plant expansion.

In contrast with the old installation only one supporting member of the structure has a ground footing where formerly four poles were set and guyed. The

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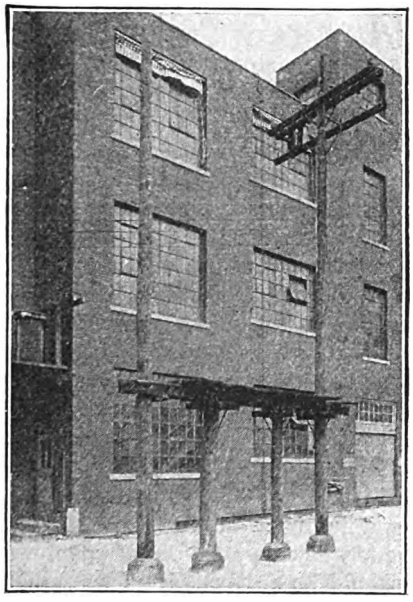
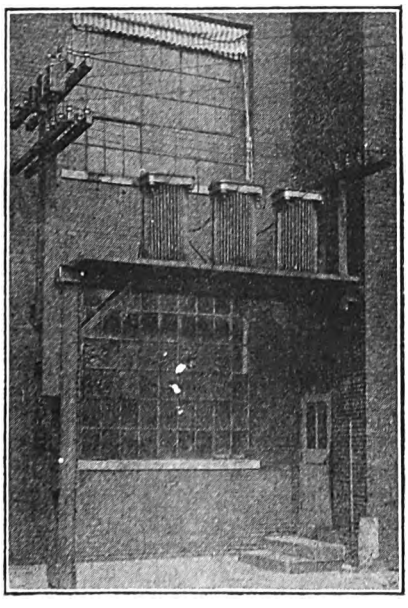
vertical supporting member is made up of two 13.25-lb. (6-kg.), 9-in. (23-cm.) ship channels, spaced 18 in. (46 cm.) apart, set well down in concrete, cross-braced with 0.75-in. (19-mm.) by 12-in. (30-cm.) steel plates and also braced against the building wall by one 4-in. (10-cm.), 7.5-lb. (3.3-kg.) I-beam. The cross members to which the 2-in. (5-cm.) by 12-in. (30-cm.) platform



OLD LOCATION OF TRANSFORMERS

material is bolted are made up of two 8-in. (20-cm.), 25-lb. (11.3-kg.) channels spaced 18 in. (46 cm.) apart, one end of which rests on the vertical member, the other extending 18 in. (46 cm.) into one corner of the building wall, allowing a clearance of 14 ft. (4 m.) from the transformer base to ground. Owing to the method of line entrance, it was found necessary to erect 4-in.



OLD AND NEW INDUSTRIAL TRANSFORMER INSTALLATIONS

by 4-in. (10-cm. by 10-cm.) timbers for dead-ending the primary line. These timbers also support the primary fuses, transformer choke coils and primary bus structure.

At present three 75-kva., 60-cycle, 2200/220/110-volt transformers are installed, connected star-delta. The weight of each transformer with oil is approximately 2200 lb. (997 kg.). Ample safety factors have been allowed to take care of additional power in case larger and heavier transformers are found necessary at a future date.

The steel structure was designed and erected under the supervision of Mr. Praed, works engineer Dodge works of Link Belt Company, and approved by the power company's engineering department.

ACCIDENTAL CROSS BETWEEN TWO INDEPENDENT SYSTEMS

Voltmeter Connected Between Outside Wire and Ground Swings Periodically from Zero to Twice Secondary Voltage Owing to Difference of Frequency

In testing out a new installation recently it was found that the voltage to ground from the two outside legs of a three-wire 120-240-volt secondary circuit varied periodically from zero to 240 volts, while the voltage from the neutral to ground remained constantly at 120 volts. The time required for the voltmeter needle to swing from zero to 240 volts and back to zero again varied from two to five seconds.

By means of an exploring-coil outfit for locating accidental grounds the trouble was soon located and was found to be due to a cross between the neutral of the secondary circuit in question and one outside leg of the secondary circuit of another company having distribution lines in the same locality. Both systems operate at 60 cycles, and the voltmeter was simply acting as a synchronoscope, reading zero when the two systems were in synchronism and 240 volts when they were 180 deg. out of phase.

IRON-WIRE TRANSMISSION LINE PROVES DISASTROUS

Short Circuit at Load End of Iron-Wire Line Fails to Blow Fuses Owing to High Reactance of Wires

BY W. C. HESTON
Line Engineer Portland (Ore.) Railway, Light & Power Company

During the war, when copper was so expensive, an 11-kv. line about 5 miles (8 km.) long, consisting of three wires, each composed of six strands of No. 8 bare hard-drawn copper wire (equivalent to about No. 1/0) was replaced with $\frac{5}{16}$-in. (7.7-mm.) galvanized stranded steel guy wire, as the load on the line was light and the copper was needed for a new transmission line to serve shipbuilding plants.

At the end of this line there were two 50-kw. transformers stepping from 11,000 volts to 2300 volts feeding a small town having a load of about 15 kw. During a heavy windstorm a tree fell on the 2300-volt line fed by the above transformers, short-circuiting all three legs. The two 50-kw. transformers were fused for the customary 150 per cent load, but these fuses did not blow under the short circuit on the secondary side of the transformers, because of the high reactance of the steel wire, which rises very rapidly as the current increases.

The result was that two transformers were burned out. The trouble could obviously have been prevented by fusing the transformers for their rated load, or in this case even less, as the load was very light.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

PUBLIC SERVICE COMPANY MAKES ELECTRIC RANGE RATE

Includes Limiting Clause to the Effect that Range Must Be Rated at Over 3000 Watts to Get Service Under the New Rate

In order to satisfy the demand for service for electric cooking in small towns where gas is not available, the Public Service Company of Northern Illinois has filed a new electric cooking rate which became effective May 1. The new rate schedule is 10 cents net per kilowatt-hour for the first 10 kw.-hr. consumed during the month and 3 cents net per kilowatt-hour for all excess consumption during the month. The minimum charge is $24 per year for installations having a total connected load of 6000 watts or less and $4 for each additional 1000 watts or fraction thereof.

The rate is available only to those customers who will install a range having a capacity of 3000 watts or over. Such provision assures the company that the customer will utilize the service for electric cooking purposes. Electricity under the new rate is available for the operation of cookers, toasters, broilers, ovens, kettles, flatirons, water heaters, luminous radiators and other electrical cooking or heating appliances, in addition to the electric range.

The company has already started demonstrations in those small towns where gas is not available, and from the number of orders secured the electric range business appears to be very promising.

GOOD WILL OF CUSTOMERS COUNTS, SAYS S. M. KENNEDY

Declares in Paper Read at Pacific Coast Meeting that Companies Will Be Repaid for Taking Pains to Please the Man in the Street

Central-station companies should go out of their way to win the confidence and respect of their customers, says S. M. Kennedy, of the Southern California Edison Company, in a paper entitled "The Man in the Street," which he read at the third annual convention of the Pacific Coast Section, National Electric Light Association, at Coronado Beach, Cal. Pursuant to a resolution of the convention, the executive committee of the association has since published the paper in pamphlet form.

The utility company is on trial twenty-four hours a day, declares Mr. Kennedy. Unlike other business enterprises, it must be ready to supply energy at all times, and, as Mr. Kennedy puts it: "The jury is in constant session taking cognizance of the evidence which is being given, and no item is overlooked when the time arrives to review, sum up and render a verdict. Hence heads of public utility organizations should study the jurors, in this case their customers, with a view to making as favorable an impression as possible."

The man in the street, says the paper, is a many-sided individual in some respects, but in the main he will be found reasonable, tractable, and not unfriendly. The man in the street has some advantages not possessed by the men on the inside, and the latter can well afford to give attention to him.

"What kind of an impression does your company make on the man in the street?" Mr. Kennedy inquires. The man in the street is greatly impressed with the appearance of the office and the treatment he receives from employees when he comes to pay a bill. If it is an old forbidding office with small windows, high railings, and with the clerks shut off from the customer, the latter will be repulsed. The atmosphere should be attractive and inviting, so that the man in the street feels that he is welcome. An air of openness and aboveboardness should be cultivated. This will help to give the customer a feeling of genuine confidence in the company.

The central station should make it possible for the man in the street to learn all that is possible concerning the facts of the production and distribution of electricity, so that he may know what he is paying for. The company is selling an intangible commodity, and the man in the street has difficulty in realizing that he pays only for what he gets. The customer will study conditions and reach his own conclusions concerning the business. If the truth is spread before him for thoughtful inspection, his conclusion is likely to be favorable. If, however, he becomes saturated with misinformation concerning the methods and aims of the central station, then his ideas will be perverted and his attitude prejudiced. He must be shown what is the investment and what constitutes a fair return thereon.

Much of the criticism directed against utility companies might be dispelled or relieved by a broad-minded policy in handling complaints, says Mr. Kennedy. Each complaint should be regarded as an opportunity for acquaintance with the consumer and should be given an individuality by impartial and careful investigation. A complaint is an opportunity to make a friend with the individual who makes it. To satisfy means to hold business that probably was difficult and costly to get, and it also means the keeping of old friends and the making of new ones.

New customers are desirable, but, in Mr. Kennedy's opinion, the development of increased business with existing customers is still more desirable. A central-station plant ought to be loaded twenty-four hours a day. The load curve ought to be a straight line before the electrical consumption of any community has reached the saturation point. For greater business from present customers the company must cultivate the man in the street. The most profitable business is produced by inducing customers to increase the number of uses of

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electricity. The time has come when it is "up to" central-station companies to interest themselves more than ever before in the manner and method of using their product on the consumer's premises, so that the greatest possible number of benefits and economies may be secured.

GIVE MORE CAREFUL STUDY TO ELECTROCHEMICAL INDUSTRIES

Closer Relations with American Electrochemical Society Are Fostered by Address of Prof. J. W. Richards Before N. E. L. A. Convention

More careful study of electrochemical industries by central stations and closer relations with the American Electrochemical Society are substantially furthered by the address of Prof. Joseph W. Richards on "The Importance of Electrochemistry" before the recent convention of the National Electric Light Association at Atlantic City. Professor Richards, of Lehigh University and secretary of the American Electrochemical Society, pointed out many opportunities which the electrochemical industries offer to central stations.

E. W. Lloyd, Commonwealth Edison Company of Chicago, who has given close attention to the subject, discussed these opportunities briefly in his remarks at the close of Professor Richards' address. Mr. Lloyd said that in his opinion the association had given too little attention to the subject and that it had not affiliated itself with the American Electrochemical Society to the extent that it should have done. Mr. Lloyd said furthermore that he was sure that it would be very profitable for members of the association to pay more attention to the subject. Mr. Lloyd is convinced that there are a large number of products that can be manufactured by electricity at standard rates now in existence, that there are certain electrochemical products that are marketable at a high price per pound or ton, in the manufacture of which the cost of electricity is not an important factor. For instance, the production of high-grade steels and alloys is accomplished by using so few kilowatts that the cost of electricity is not important.

In the course of his discussion Professor Richards said that he thought that the men in the electrolytic refining industries had not worked out as far as could be done the possibility of running for certain hours by water power. In certain plants it would be possible to operate at less power for, say, four hours daily out of the twenty-four hours.

The case of a very large copper refining plant was cited which, before constructing its own power plant, tried to make arrangements with the local central-station company to secure power on a plan involving reduced consumption at certain times during the day. The arrangement fell through because, said Professor Richards, "they did not quite thoroughly understand each other and did not quite go to the bottom of the proposition, and analyze the problem, and get into their minds exactly the difference which would be caused by the proposed arrangement."

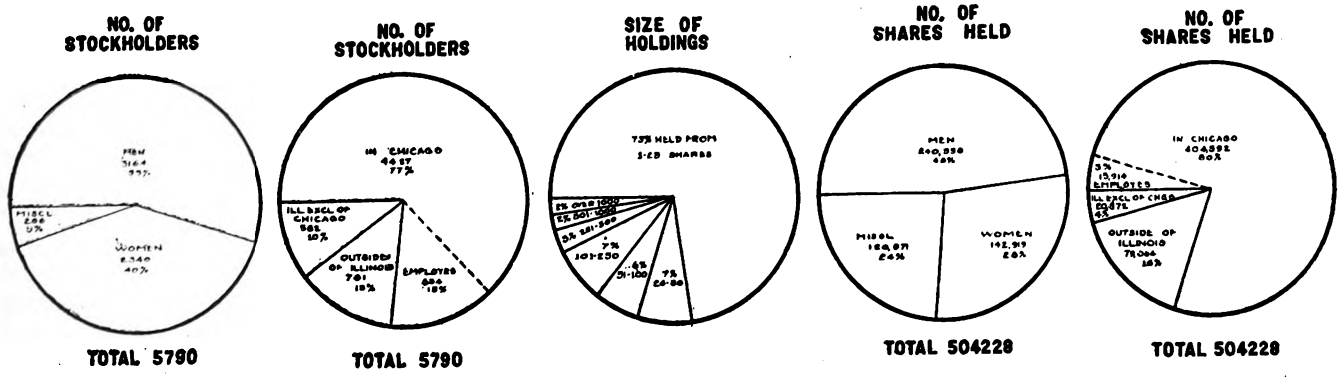
A number of industries were discussed by Professor Richards in which electric power is used and there are large possibilities of development. He described a process for making aluminum which has reduced the cost from about $2.50 a pound to less than 15 cents a pound. "The size of the aluminum industry," he added, "may be indicated by the fact that there is probably 400,000 hp. at work in the United States making aluminum at present, and the chief company which is making aluminum is developing a plant of 400,000 hp. more in eastern Tennessee to double its output."

The most important thing in the metallurgical field now, said Professor Richards, is the invention of the electric heating furnaces. The United States Steel Corporation will be turning out 10,000 to 20,000 tons of electric steel a month in the near future, because it is using the electric furnace to do it. This industry will increase very rapidly. It has increased in the last five years from about thirty concerns in the United States making electric steel to about 250 or more.

"I am forced to admit," said Professor Richards in conclusion," that the electrochemist and the electrometallurgist have not studied out their power problems as they should have done. They have not got together with the central-station men as they should have done. Perhaps there is blame on both sides. I think particularly the electrochemists have not studied out their questions where they could get together with you on the question of intermittent power."

Distribution of Stock of Commonwealth Edison

In a recent address before the new-business and underground-extension groups of the Commonwealth Edison Company Section of the National Electric Light Association Louis A. Ferguson, vice-president of the company, gave some details of the distribution of the capital stock. Chicago people hold 80 per cent of the total shares of the company and constitute 77 per cent of all stockholders. Of the employees 834 are stockholders, and 4254 stockholders own only from one share to twenty-five shares.



COMMONWEALTH EDISON COMPANY STOCK IS OWNED LARGELY BY RESIDENTS IN THE CITY WHERE ITS SERVICE IS RENDERED

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TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Connection of Valves in Polyphase Systems.—In the usual mode of connecting valves for rectifying polyphase currents, the valves are in operation for only a fraction of the total time. For instance, in a six-phase system each anode, and in consequence each secondary transformer winding, is in operation for only one-sixth of each period. In the method shown in French patent No. 487,789 of Brown, Boveri & Company a method of connection is shown by which the valves and windings are maintained in continuous operation.—*Technical Supplement to Review of Foreign Press*, April 19, 1919. (Abstracted from *Revue Générale de l'Electricité*, March 29, 1919.)

Safe Operating Temperatures for Mica Insulation.—H. D. STEPHENS.—Evidence of the ability of mica to withstand high temperatures is shown from the performance of some of the generators installed at Niagara Falls. These were built in 1895, and in 1913 an opportunity was given to install thermocouples in one of these machines. Temperatures of copper were obtained in a mica-insulated generator that had been in operation for about twenty years. Thermocouples were installed in contact with the copper and in various other locations within the slots. Internal temperatures were obtained for the range of loads through which the generator normally operates. From the operating record of this machine and from the measured temperatures the length of time the generator has operated at different temperatures was found to be as follows:

Length of Service in Hours	Range of Operating Temperature (Based on 35-deg. air)
40,000	120 to 145 deg. C.
13,000	145 to 175 deg. C.
8,200	175 to 210 deg. C.
2,600	210 to 245 deg. C.
100	245 to 285 deg. C.

Since 1912 thermocouples have been installed in practically every large generator of new design and readings have been obtained of internal hot-spot temperatures. In many cases generators that were designed in line with past practice to meet a 50-deg. rise by thermometer were found to have hot-spot temperatures 50 deg. higher than the surface temperature. Tests on twelve 60-cycle turbo-generators ranging in size from 5000 kva. to 20,000 kva. gave average results as follows: (1) Surface coil temperature rise, by thermometer, 22 deg. C.; average coil temperature rise, by resistance, 43 deg. C.; hot-spot coil temperature rise, by thermocouple, 85 deg. C. (2) Similar tests on nine large 60-cycle moderate-speed generators (mainly waterwheel-driven) gave the following average temperature rises: Surface coil temperature rise by thermometer, 45 deg. C.: average coil temperature rise by resistance, 54 deg. C.; hot-spot coil temperature rise by thermocouple, 82 deg. C. From the accumulation of evidence gathered, the author concludes: (1) That large generators insulated with the best and latest types of mica insulation not only can but actually do operate with safety with total internal temperatures up to at least 150 deg. C. (2) That the results obtained by the use of embedded temperature detectors vary widely, and that the manufacturer who is carefully and generally testing with such equipment is best fitted to locate and to specify the type of measuring devices to be employed.—*Electric Journal*, April 1919.

Lamps and Lighting

Performance of Argon-Filled Tungsten Lamps.—H. PECHEUX.—In *La Lumière Electrique* for May 16, 1908, June 24, 1911, and March 20, 1912, the author gave the result of his experiments upon metallic-filament lamps of the older varieties, especially as regards the resistance of the filament to heat and cold. He now takes up the study of the new gas-filled lamps, estimating the influence of overvoltage upon luminous intensity and paying special attention to the variations of the characteristic coefficient of the filament, not only in terms of the nature of the filament but also, for any given filament, in terms of the time during which it is subjected to the current.—*Revue Générale de l'Electricité*, May, 10, 1919.

Generation, Transmission and Distribution

Improvements of the Power Factor as a Consequence of the Unification of Frequencies.—A. CUSMANO.—The problem of the unification of the frequencies of the electric installations in Italy was studied by a committee of the Associazione Elettrotecnica Italiana, which proposed to adopt for the new installations the frequencies already existing in the region. The author considers that this proposal is not always rational, as it would not always furnish the greatest sum of advantages. To demonstrate his thesis, the author calculates the costs of a new plant for a concrete case, adopting first the frequency 42 of the region and afterward the frequency 50 and installing a synchronous frequency changer for the energy transmission between the new and the old plant. The increase of the power factor obtained by the choice of a convenient size for the frequency changer allows of obtaining an economy in the costs of the alternators, transformers and electric line, so that, finally, the installation results in being more economical than if the frequency 42 were adopted. Moreover, as the cost of the apparatus for frequency 50 is less than that for frequency 42, a supplementary economy could be realized in the costs of the individual transformers and motors. Consequently the author advocates the adoption of the frequency 50 for the new plants, which solution, in the case of connection with a line at frequency 42, would reconcile the particular interest of securing economy with the general interest of increasing the power factor.—*Science Abstracts, Section B*, March 1919. (Abstracted from *Elettrotecnica*, Feb. 5, 1919.)

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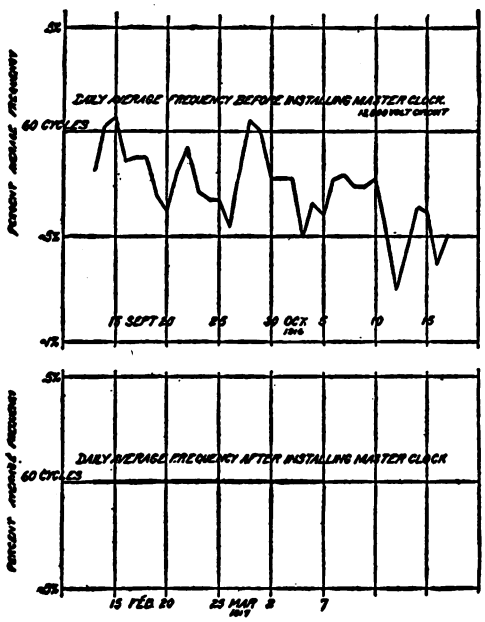
Utilizing the Time Characteristics of Alternating Current.—HENRY E. WARREN.—By the invention of a very small, simple and reliable self-starting synchronous motor, in conjunction with convenient means for regulating the average frequency of an alternating circuit, there has been developed a new field of usefulness for electric power. It is now feasible to drive all kinds of timing devices, such as clocks, graphic-instrument movements, time recorders, etc., directly from the lighting circuits. Remarkable accuracy is obtained, and the amount of care is minimized by the elimination of winding and regulating. The effect of the installation of a master clock is here illustrated. Above is shown variation of frequency to be expected under present conditions; below, that promised by the master-clock scheme.—*Proceedings A. I. E. E.*, May 1, 1919.



HOLDING THE FREQUENCY BY TIME CLOCK

Construction Methods Used at Drummondville.—JAMES DICK.—Problems encountered in the damming of the St. Francis River and building a power house to develop about 19,000 hp. are discussed by the author. It is shown that 2900 ft. (880 m.) of cofferdams were required for the construction of an 1890-ft. (580-m.) dam. It is stated that concrete for the dam was delivered over long distances by means of steel V-shaped cars of 1-cu.yd. capacity. These operated at a capacity of 24-in. (60-cm.) gage and were laid on light trestle built along the upstream side of the dam.—*Canadian Engineer*, April 24, 1919.

Operation at Holtwood.—CHARLES H. BROMLEY.—Some results from the operation of the Holtwood plant of the Pennsylvania Water Power Company are given. Wear and corrosion troubles in the link pins, vane pins, reachrod and wrist pins of the double-runner units have been overcome by the use of monel metal for these pins. Micarta bushings are now being tried, and experience so far indicates good results. The large submerged pins, which originally had no lubrication other than that given during periodic overhauling of the turbines, are now lubricated from the turbine-room floor by means of a grease gun from which a separate pipe runs to each pin. These improvements have increased the interval between general overhauling of the units at least threefold.—*Power*, May 13, 1919.

Traction

Narrow-Gage Electric Railways.—During the war a large quantity of material for railways with a gage of 0.6 m. instead of the standard gage of 1 m. was manufactured in France and now awaits a use. This article suggests that it can be employed in serving agricultural railways, forestry exploitations and, generally, in the furtherance of public work, as advocated by L. Esbran in a paper presented before the French Society of Electricians. Mr. Esbran maintains that while the many narrow-gage steam locomotives built for war purposes can be utilized in the ways just mentioned, they cannot be put to any permanent use. Electric locomotives of 0.6-m. gage, on the other hand, lend themselves to intensive traffic both freight and passenger, and he holds that there is a future for narrow-gage railways thus equipped.—*Revue Générale de l'Electricité*, April 19, 1919.

Installations, Systems and Appliances

Improved Form of Granular Carbon Resistance Furnace.—C. H. LOVEJOY.—A granular carbon resistance furnace of the type described in Bulletin 129, United States Bureau of Mines, for the determination of the fusibility of coal ash and softening temperatures, has recently been built with several improvements to facilitate operation and replacement of worn parts. The furnace was built at slight expense from standard fittings, with very little machine-shop work necessary. A cross-section of this furnace is presented in the article and details are explained.—*Chemical and Metallurgical Engineering*, May 15, 1919.

Review of the Propelling Equipment and Operation of the New Mexico.—ESKIL BERG.—Of particular interest are the statements of the contract weight, steam consumption, penalties and price of the equipment and its performance on the trial run. The table presented here gives the water rates attained on two trials, the second after final adjustment of conditions:

	—Water Rate, Lb. per Shaft Hp.-Hr.—		
	Full Speed	19 Knots	15 Knots	10 Knots
No. 1 trial report	12.29	11.926	11.667	14.223
Results indicated by readings of electrical instruments	12.30	11.55	11.35	14.35
Guarantees reduced to trial conditions	11.67	11.03	11.495	15.28
No. 2 trial report*	12.01	12.196	12.482	14.22
Results indicated by readings of electrical instruments	11.58	11.50	11.60	14.35
Schenectady test reduced to trial conditions	11.00	11.08	11.16	14.25
Guarantees reduced to trial conditions	11.31	11.184	11.45	15.28

* Given unofficially before the preparation of the report.

The fuel economy shown by the New Mexico trials, as reported by Commander S. M. Robinson, is 20 per cent better than the turbine-driven Pennsylvania at high speeds and about 30 per cent better at 15 knots.—*General Electric Review*, April, 1919.

Electrochemistry and Batteries

Electric Furnaces.—W. E. MOORE.—It is said that steel can be made electrically with a more satisfactory chemical analysis than by other methods. Even with the same chemical analysis the electrical field will average 15 per cent greater tensile strength or ductility and is more resistant to shock and better able to receive heat treatment. The reason for this is that the steel is more solid, freer from gases and less prone to inclusions of slag oxides. In open-hearth furnaces it is

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impracticable to melt down fine turnings in quantity for the reason that the oxidizing flames, which furnish the heat to the furnace, will reduce the metal when in an attenuated form to a mass of oxide before it becomes molten, whereas with the electric furnace it is entirely practicable to melt turnings, which under ordinary market conditions are purchasable at about $10 to $15 per ton lower than the heavy melting grade of steel required in open-hearth practice. Comparing the manufacture of electrical steel to that of crucible steel, the writer states the objections to the crucible process as follows: (A) High cost of pure melting stock, as no refining is practicable; (B) very high labor cost on account of the small heats handled; (C) crucible furnaces are notoriously extravagant in fuel consumption, sometimes using three tons of coal per ton melted; (D) high cost of crucible renewals, often averaging two to four crucibles per ton, melted at a cost of $9 to $11 each, or $18 to $44 per ton for crucible alone. For these reasons the crucible melting shop is rapidly going out of use for castings as well as for tool steels. A comparative cost table presented by the author for wartime operation shows the cost of converter steel to be $57.94 per ton, whereas the cost of electric steel in the ladle is $31.63.—*Journal Engineers' Club of St. Louis*, March-April, 1919.

Iron Alloys for Use in Electric Apparatus.—The Société Anonyme de Fourchambault, Commentry et Decazeville, exhibited at the Lyons Fair a number of special alloys manufactured at its works at Imphy. These included: (1) An alloy specially made for electric resistances; (2) an alloy with a thermo-electric power greater than that of iron with respect to lead. This alloy has high mechanical strength, low thermal conductivity and small resistance-temperature coefficient and is particularly suitable for thermo-junctions and industrial pyrometers. (3) An alloy with magnetic permeability that decreases rapidly with increase of temperature, and suitable for use in electric meters with permanent magnets. (4) An alloy that can acquire strong magnetism and retain it when subjected to demagnetizing actions. This is recommended for the construction of permanent magnets. (5) A non-magnetic alloy, non-oxidizable at ordinary temperatures in fresh or sea water. This alloy is subject to very small wear by friction, is remarkably ductile and does not tire under the action of repeated shocks. It is used greatly in artillery, railways and automobile construction and for the manufacture of springs.—*Technical Supplement to Review of Foreign Press*, April 29, 1919. (Abstracted from *Revue Générale de l'Electricité*, March 22, 1919.)

Units, Measurements and Instruments

Helps on Proper Maintenance of Pyrometers.—A. GEMMELL.—The electric pyrometer should be kept in first-class condition to obtain accurate results. The better the care of the leads, fire-ends, etc., the better the results that can be obtained. The proper handling of leads and fire-ends in practical furnace installations is taken up in this article.—London *Electricity*, April 25, 1919.

Telegraphy, Telephony and Signals

The Valve Tube with Three Electrodes.—C. GUTTON.—A review of the work of the French military radiotelegraphic establishment dealing with the performance of vacuum tubes. New models of three-electrode valve tubes were made for the service. As generators of waves these tubes made possible posts with sustained waves capable of sending messages many hundreds of kilometers. They were a great aid in wireless telephony, permitting airplanes to communicate with the earth and with each other.—*Revue Générale de l'Electricité*, April 26, 1919.

The Telephone Repeater.—In this article may be found a simple and extremely clear explanation of the thermionic valve, together with its application as a telephone repeater.—*Post Office Electrical Engineers' Journal*, April, 1919.

Automatic Operation in Long-Distance Telephony.—C. JANCULESCO.—An examination of the subject as exemplified by the automatic telephone systems of Ohio, Michigan and South Dakota. The adoption for long-distance service in Europe of similar methods is favored.—*Revue Générale de l'Electricité*, April 19, 1919.

Nauen Wireless Time Signals.—B. WANACH.—In the device here described the operation is initiated by a single current pulse. This pulse actuates an electromagnet and sets a pendulum free. The pendulum in its swings causes a disk to rotate in jerks, following the swings of the pendulum. On the edge of the disk projections are provided that make a series of contacts by pressing against the tongue of a spring, and these contacts control the signals. After the series of time signals has been given in one revolution of the disk, a cam on the disk closes a second contact, which causes a second electromagnet to be energized. This electromagnet releases an armature that catches the pendulum and arrests it ready for its release for the first electromagnet at the succeeding time signal.—*Technical Supplement to Review of Foreign Press*, April 29, 1919. (Abstracted from *Zeitschrift für Instrumentenkunde*. January, 1919.)

Miscellaneous

Insulating Materials.— DR. BULTEMANN.—The writer discusses the physical, chemical and electrical properties of fiber insulators—slate and marble, mica, wood (variously impregnated), vulcanite, gutta percha, products of cellulose, bakelite and glass.—London *Electrician*. April 25, 1919.

Community of the Trained Engineer.—The writer deals in some detail with the position of engineers at the present time and the desirability of forming unions to protect their interests. The statement is made that it is now next to impossible for an engineer to move from one firm to a better position with another engaged in similar business. This means that once an engineer has entered the services of a particular firm he is virtually tied to that firm for the remainder of his existence, unless he is prepared to risk taking up work in some other direction. The latter course, however, necessarily means that he must accept lower terms, as accumulated experience is largely sacrificed. Such restrictions do harm in two ways: First, they keep down the level of salaries below the standard which they should attain, thus preventing the inflow of good men into the industry, and, second, they produce a discontented frame of mind. The several lines along which a union of engineers might be formed are discussed at considerable length in this article.—London *Electrician*. April 25, 1919.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

FAVORABLE LEGISLATION FOR MISSOURI UTILITIES

Annual Association Meeting Finds Much of Interest in Acts of State Legislature During the Last Year—J. M. Scott Elected President

Nearly every speaker at the thirteenth annual convention of the Missouri Association of Public Utilities at Excelsior Springs, June 5, 6 and 7, mentioned the activity of the Missouri State Legislature during its last session. A law was passed making it a felony to defraud a gas or an electric company. Surveys to locate "jumpers" are in progress in many parts of the state, because under this law electric service thieves can be prosecuted, whereas it was very difficult to secure a conviction under the old law, which made it necessary to show intent to defraud.

Another act passed by the Legislature which was of interest to utilities was the workmen's compensation law. A great variety of House and Senate bills for repeal or restriction of the Public Utilities Commission act were defeated. A full report on this situation was made by J. C. Hall, St. Louis, chairman of the association's legislative committee. President J. H. Van Brunt, St. Joseph, spoke briefly about these bills in his presidential address, but devoted his main attention to municipal ownership and union labor. He cautioned delegates to be on guard against the growth of municipal ownership doctrines, which seem to be spreading quite freely in the near Southwest. He also entreated association members to show the same intense coöperation in utility affairs which unionized labor always exhibits in its efforts to attain its object.

Other speakers at the meetings were: A. V. Wynne, St. Joseph, on "Employees' Morale"; J. B. Hoelz, St. Louis, on "Flow Meters"; L. T. Block, St. Louis, on "Workmen's Compensation and Insurance to Cover Such Risks," and John F. Gilchrist, Chicago, on "Public Utility Securities." F. C. Buffe read a paper by P. J. Kealy, Kansas City, on "One-Man Cars."

Other Branches of Industry Included

One important change was made in the method of operation and scope of the association. Manufacturers, jobbers and dealers now may be active members of the association with all privileges except that of holding elective office. Moreover, one representative of this class of members will sit with the association's executive committee in all its sessions. This change was made to effect close coöperation with manufacturers and to secure the benefit of their experience and opinions in convention discussions.

Officers for the ensuing year were elected as follows: President, J. M. Scott, Kansas City; first vice-president, L. P. Andrews, Sedalia; second vice-president, H. Spoehrer, St. Louis; third vice-president, P. J. Kealy, Kansas City; secretary-treasurer, F. D. Beardslee, St. Louis; committee on public affairs, V. L. Elbert, St. Joseph; executive committee, J. H. Van Brunt, St. Joseph; H. Wurdack, St. Louis; E. H. Algermisson, Montgomery City; W. H. Henby, University City; Mr. McKenzie, Hannibal; E. R. Locke, Mexico, and J. S. Tritle, St. Louis manufacturers' member of executive committee.

LARGER CAPITAL FOR THE KANSAS CITY (MO.) COMPANY

Proposed Increase of $10,000,000 Through Issue of Either Three-Year Notes or Bonds Will Provide for Extensions and Betterments

A reconstruction of finances of the Kansas City (Mo.) Light & Power Company is in progress which will permit an increase in the capitalization of the company by $10,000,000. It is probable that the new money will come either from the issuance of three-year notes or from bonds. In connection with the new financing the name of the company will be changed to the Kansas City Power & Light Company. All of the new capital will be used for extensions and betterments in Kansas City.

INTERCONNECTION OF TWO PENNSYLVANIA COMPANIES

Metropolitan Edison Company of Reading and York Haven Water & Power Company Are to Construct Lines to Exchange Energy

Announcement is made that the Metropolitan Edison Company of Reading, Pa., has signed a contract for an exchange of energy with the York Haven Water & Power Company at York Haven, Pa. The latter company gives service to the town of York and surrounding territory and furnishes wholesale energy to the city of Harrisburg. It also supplies the large steel plant at Steelton.

This new contract of the Metropolitan Edison Company probably will enable the company to dispose of a large amount of energy to the water-power plant as the latter is completely up to its capacity and either must purchase energy from some outside source for all future growth or else develop a new plant. The York Haven company also must have some source of energy for periods when river water is low and the water plant cannot be used to full capacity.

It is estimated that the interconnection of the Metropolitan and York Haven companies involves new construction costing $250,000. In making this connection the Metropolitan company is following its established policy, for it already has connections with several properties, including the Counties Gas & Electric Company at Norristown and the Phoenix Water Power Company at Collegeville.

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TO WIDEN KNOWLEDGE OF AMERICAN TECHNICAL PRACTICE

McGraw-Hill Company Bids Godspeed to F. O. Cooke, Who Returns to England to Extend International Distribution of Company's Publications

Members of the staffs of the ten technical and trade journals of the McGraw-Hill Company, Inc., publisher of the ELECTRICAL WORLD, gathered at a dinner at the Manhattan Club, New York City, on Wednesday night to wish godspeed to F. Ormsby Cooke, managing director of the Hill Publishing Company, Ltd., of London, who is returning shortly to England after a brief visit in the United States. Mr. Cooke has been identified for the last nineteen years in London with McGraw-Hill publications and now returns to his native country as the European representative of these publications to widen and enlarge their international distribution and thereby increase abroad the interest in and knowledge of the best in American technical advancement and engineering practice.

The various speakers at the dinner emphasized the growing ties that bind the United States to England and the continent of Europe. Not the least of these ties is that of American engineering practice, which during the war won such a firm foothold in Europe. McGraw-Hill engineering publications are recognizing this new condition and as pioneers are making greater efforts to serve through a widened distribution this international need for information regarding American practice.

"The engineering journal," said James H. McGraw, president of the McGraw-Hill Company, in a crystallization of the thought of the evening, "is a tool. It is just as much an international tool as it is a domestic tool."

Frequent mention was made during the evening of the necessity for American capital taking up foreign securities if the markets of the world are to continue to absorb American merchandise in large volume.

ANNUAL CONVENTION OF THE JOBBERS AT HOT SPRINGS, VA.

Exceptionally Large Number of Delegates from All Sections of the Country in Attendance at This Week's Meeting—Business Transacted

The eleventh annual convention of the Electrical Supply Jobbers' Association was held at Hot Springs, Va., on Tuesday, Wednesday and Thursday of this week. An exceptionally large number of jobbers from all sections of the country were in attendance, and in addition to the general sessions mornings and evenings there were two meetings of the Atlantic Division and one of the Central Division during the week.

It was suggested by the Atlantic Division that manufacturers allow a differential in favor of goods shipped to jobbers' warehouses as against goods shipped directly from the manufacturer to the consumer, inasmuch as the former shipments involve an element of service by the jobber not rendered when merchandise is shipped directly at the convenience of the manufacturer. It was also suggested that price lists be revised so as to obviate the necessity of quoting list plus, as at present, instead of list.

Two set addresses were made at the general sessions of the association, one by William A. Durgin of the Commonwealth Edison Company of Chicago, who gave an interesting illustrated lecture on industrial lighting, and the other by Dr. Frank Buffington Vrooman, whose topic was "Bolsheviks Big and Little."

The jobbers' association indorsed the work of the Bureau of Research and Education about to be started by the National Association of Electrical Contractors and Dealers and recommended that individual jobbers support the movement. The association also adopted resolutions against the repeal of the present daylight-saving act.

Prof. Irving Fisher's paper on the new price revolution, presented before the conference of governors and mayors in Washington early in March, was read by W. E. Robertson of Buffalo for the information of those in attendance, and the present trend of the markets, particularly in iron, cotton and copper, was discussed.

It was decided to hold the next annual meeting of the association, which will be in the spring of 1920, at Del Monte, Cal. Edward W. Rockefellow of the Western Electric Company, New York, and F. M. Bernardin of Kansas City were reëlected members at large, and the board of directors reappointed the present staff.

ACTION ON WATER-POWER LEGISLATION IS DELAYED

Nothing Done in Either Branch of Congress, and Every Effort Will Have to Be Brought to Bear to Secure Passage of Law

Action on the proposed water-power legislation in both branches of Congress has been delayed during the last week. In the House of Representatives those who are interested in urging the passage of water-power legislation have been waiting for the public lands committee to get through with the work it has been doing. In the Senate the committee of five which, as previously reported in the ELECTRICAL WORLD, is in charge of the proposed legislation has not been able to get together because of the complications with respect to the proposed legislation concerning foreign matters.

The indications are that almost all of the attention of both branches of Congress at the present extraordinary session will be devoted to matters concerning foreign affairs, and it is suggested and advised in Washington that those who are interested in the water-power act shall bring every effort to bear to gain the business legislation which the country requires.

The Illinois Commission in Self-Defence

In answer to the many charges made against it the Illinois Public Utilities Commission says: "From Jan. 1, 1914, to Jan. 1, 1918, as a result of reductions in rates made with the approval of the Public Utilities Commission, the sum of $5,825,000 was saved to the people of the state in decreases of public utility rates. During the year 1918, owing to increases in rates caused by war prices, there was a loss in savings to the people in gas, water and heating rates, but there still continued to be a saving in electric rates. In spite of the increased rates for water, gas and heating during 1918 and the latter part of 1917, there still remains a net saving to the people of the state of $5,871,000 due to decreases approved by the commission since Jan. 1, 1914."

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Resuscitation from Electric Shock

The ELECTRICAL WORLD publishes as a supplement with this issue a chart giving instructions for resuscitation from electric shock by the prone pressure method as recommended by the National Electric Light Association. This chart is an abbreviation of the booklet of rules for resuscitation from electric shock, as revised by the association and presented at the recent Atlantic City convention by the committee on safety rules and accident prevention, of which W. C. L. Eglin is chairman.

Mr. Eglin, reporting as chairman, called attention to the work of the first Commission on Resuscitation from Electric Shock, organized in 1911. His statement continues:

"The 'Rules for Resuscitation from Electric Shock,' which were based on the findings of this commission and were printed and distributed by the National Electric Light Association, have been widely used and have, judging by the evidence presented, adequately fulfilled the purpose for which they were produced.

"Certain questions respecting the method and the use of artificial respiratory and auxiliary apparatus have, however, arisen since the rules were originally issued in 1912, and it was deemed advisable to organize a third resuscitation commission to review the work accomplished and to make such further recommendations as the commission might consider would be helpful. The study of the proceedings and the application of the resolutions [of the commission] by whom and whenever possible are urged in the interest of life conservation.

"Upon receipt of the proceedings and resolutions of the commission, the sub-committee on accident prevention, consisting of Charles B. Scott, chairman, and Magnus Alexander, R. L. Baker, P. H. Bartlett, H. J. Burton, H. B. Harmer, Wills Maclachlan and W. T. Morrison, was requested to undertake the revision of the rules for resuscitation, which has been done with the thoroughness characteristic of the work of this committee.

"The revision of the rules and also the chart, which consists of an abbreviated form of these rules, has been based on field experience covering a number of years; and while no very radical changes have resulted, changes in detail have been made which, it is felt, will make the operation of the method more effective, and to which the careful attention of instructors and those familiar with the method is directed."

Public utility companies are urged to give frequent practical instructions and demonstrations on the use of these rules and to require superintendents, foremen or others having charge of men to be responsible for the regular practice of the method by all employees. It is further recommended that these practice meetings be held monthly and that a record be kept of the attendance.

New French-American Bank to Promote Trade

Among the directors of the French-American Banking Corporation, a combination of French and American banking interests for the purpose of fostering trade between the two countries, are Harry B. Thayer, president Western Electric Company, Inc., and Owen D. Young, vice-president General Electric Company.

The new corporation is expected to prove a great stimulus to Franco-American trade. The merger has the advantage of bringing the American banks taking part in it into closer touch with French finance than would be possible through the establishment of French branches.

MOVING TO REPEAL THE DAYLIGHT-SAVING LAW

Action in Congress Looking Toward the Enactment of Early Legislation to Restore the Clock to Its Old Position

The interstate and foreign commerce committee of the House was expected to report favorably during the present week on Representative Esch's bill to repeal the daylight-saving law.

The House committee on agriculture was prevailed upon, in reporting the agricultural appropriation bill, to add an amendment to the report on the bill repealing Section 3 of the Calder daylight-saving act, approved March 19, 1918. A number of resolutions were introduced in both branches of Congress attempting to repeal the whole Calder act, but more importance was attached to the attempt to fasten a rider on the agricultural appropriation bill, which it is necessary shall become a law by July 1, because that is the measure in which the farmers of the country who are said to oppose "daylight saving" are interested in many ways.

First newspaper reports stated that the proposed rider was intended to repeal the whole Calder act. Instead the language of the proposed rider is as follows:

"Section 3 of the act entitled 'An act to save daylight and to provide standard time for the United States,' approved March 19, 1918, is hereby repealed, effective at 2 o'clock, ante meridian, of the second Sunday after the approval of this act, when by the retarding of one hour the standard time of each zone shall be returned to, and thereafter be, the mean astronomical time of the degree of longitude governing each zone as defined in Section 1 of said act, approved March 19, 1918."

Section 3 of the Calder act is as follows:

"That at 2 o'clock, ante meridian, of the last Sunday in April of each year the standard time of each zone shall be advanced one hour, and at 2 o'clock, ante meridian, of the last Sunday in September in each year the standard time of each zone shall, by the retarding of one hour, be returned to the mean astronomical time of the degree of longitude governing said zone, so that between the last Sunday in April, at 2 o'clock, ante meridian, and the last Sunday in September, at 2 o'clock. ante meridian, in each year, the standard time in each zone shall be one hour in advance of the mean astronomical time of the degree of longitude governing each zone respectively."

Section 1 of the Calder act creates zones; section 2 requires that standard time shall govern the movement of all common carriers, and section 4 names the zones, the first as the Eastern, etc.

When the agricultural appropriation bill was reported to the House a storm of protest arose and champions on both sides came to the front. The rider amendment was ruled out on a point of order, and one of the other twenty-eight bills to repeal the daylight-saving law was considered by the interstate and foreign commerce committee.

Senator Calder is preparing for a great fight, when the agricultural appropriation bill reaches the Senate, to save the legislation of last year which bears his name and which was almost repealed at the last session of Congress, under circumstances similar to the present, when the proposed repeal was attached to the agricultural bill as a rider and when the agricultural bill failed in the filibuster against the President's foreign policies

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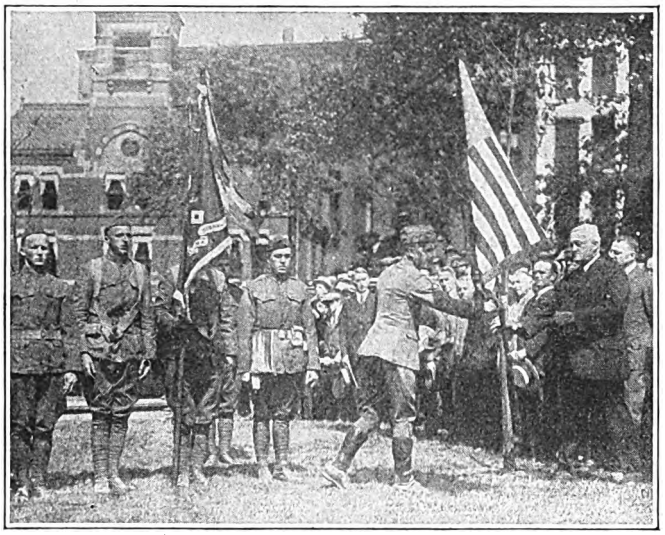
Telegraph Battalion Returns Colors



Major L. W. Abbott of the 401st Telegraph Battalion, A. E. F., is here shown returning the colors to President M. B. Jones of the New England Telephone & Telegraph Company, at the Boston review held on May 28. Standing next to President Jones is W. R. Driver, Jr., who is general manager of the company, and next to him is Vice-president E. W. Lingley.

MUNICIPAL PLANT IS TO EXTEND AT ST. JOSEPH, MO.

Statement of Conditions Under Which Voters Decided to Enlarge Facilities of Competitor Station—Company to Spend $1,000,000

Voters of St. Joseph, Mo., have authorized the issue of $500,000 bonds to finance additions to the municipal electric plant. This plant for years has provided energy for city street lighting, and the plan is to extend it to furnish commercial electric service.

Several matters have a bearing on this situation and they were described to the ELECTRICAL WORLD as follows by an observer of the recent developments in St. Joseph:

The issue of bonds for extension of the municipal plant was approved by voters in connection with issues for several other purposes which made a very popular appeal to voters, such as for a city hospital, new city hall, sewer and park improvements, etc. Five issues of bonds for these purposes were before the voters on the same day and the slogan of their advocates was "Carry all bonds."

Advocates of the issue of $500,000 bonds for the extension of the municipal electric plant promised an amount of service which it is estimated could not be given for an investment at current costs of less than $1,000,000 even if the money should be spent efficiently.

The plant now existing is used to supply energy for the arc-lighting street system, and the proposed enlargement of service will mean an extensive outlay for station and distribution purposes.

The local private company had trouble last winter which arose from failure of the city water supply. In the emergency the company had to get its water from a temporary source. This led to troubles with the boiler-feed pump and boilers. There was curtailment of the power supply for about ten days, but the company gave partial service during most of this period. To increase its facilities the company is spending practically $1,000,000 this year, adding 10,000 kw. to its generating capacity.

HOLYOKE MUNICIPAL PLANT MAY PURCHASE ENERGY

Massachusetts Municipal Plant Considering Contract with Turners Falls Company Which Means Estimated Saving of $1,000,000

The municipal electric plant at Holyoke, Mass., operated by the city since 1902, has reached a point where the purchase of energy from the Turners Falls Power & Electric Company is being seriously considered as the best means of meeting future demands upon the station. In the past sixteen years the number of customers has increased from 273 to 7510 and the energy output has risen from 1,286,790 kw.-hr. to 20,699,000 kw.-hr. The population of the city is now about 75,000.

It appears that if the present policy of producing energy locally is to be continued, a large outlay will be required in the near future for the construction of a new station, owing to limitations of the present site and the inadequacy of the condensing water supply during the period of annual shut-down of the power canals in the city and also at times when the Connecticut River is low. At such times it has become necessary to discontinue service to some of the largest customers

In a letter to the Mayor and Aldermen dated May 26 John J. Kirkpatrick, manager of the gas and electric department, points out that of a total of thirty-nine municipal plants in Massachusetts twenty-nine are purchasing energy and this proportion is steadily increasing. While the output has increased 50.5 per cent since 1915, the cost of coal has risen 232 per cent, or from $62,000 to $206,000.

The Turners Falls company has offered to supply energy at a price which it is estimated will save the city more than $50,000 per year for the first five years and nearly $100,000 per year for ten years. These rates range in base from 1.2 cent to 0.8 cent per kilowatt-hour, with further adjustment varying with the cost of coal at the Hampden steam plant of the Turners Falls company at Chicopee Junction, Mass. The coal differential includes an adjustment providing for increase as the average cost of coal exceeds $5 per gross ton between July 1 and Dec. 31 of any year, with corresponding reductions below $4.

S. H. Mildram, consulting engineer and accountant, Boston, has prepared a report on the cost of manufacture versus purchase, which was to be discussed Wednesday night at a hearing under the auspices of the Holyoke Chamber of Commerce looking toward favorable consideration of the Power & Electric company's proposal.

In his letter of transmittal Manager Kirkpatrick states that the present proposal, in addition to the apparent advantages offered, is in conformity with the policy of consolidation and conservation of the coal supply which is being advocated so strongly by the national government, and that the proposition is transmitted "with an absolute knowledge that there is no central station in Massachusetts purchasing guaranteed power under more favorable terms." It is not intended to abandon the policy of municipal lighting if the proposal of the Turners Falls company is accepted.

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EXTENSION FOR THE NEW ENGLAND POWER SYSTEM

Hydroelectric Station at Vernon, Vt., to Be Enlarged by the Addition of Two 6000-Kva. Generating Units—Other Improvements

The New England Power Company is planning to enlarge its hydroelectric station on the Connecticut River at Vernon, Vt., by the addition of two 6000-kva. generating units with auxiliary equipment. A step-up transformer installation of 12,000 kva. will be required and various outdoor substation material. The new units will operate under a head of from 30 ft. to 35 ft. (9 m. to 10 m.) and will raise the total generating capacity of the plant to about 30,000 kw. The generators will deliver energy at 2300 volts to the transformer banks, whence it will be supplied at about 70,000 volts to the transmission system of the company. The Uxbridge (Mass.) steam plant of the company is also being enlarged at this time by the addition of a 10,000-kva. unit. Within a few weeks it is expected that the interchange of energy with the Eastern Connecticut Power Company's new steam plant near Norwich will be regularly established.

Field work is under way in connection with the 66,000-volt, 15,000-kw. transmission tie line between the New England and Boston Edison systems, final difficulties relative to rights-of-way having been determined by a recent favorable decision of the Massachusetts Gas and Electric Light Commission.

MASSACHUSETTS SUMMER RATE 35 CENTS PER KILOWATT-HOUR

Increased Seasonal Rates for Vineyard Lighting Company Approved by Commission on Showing of Higher Cost of Operation

The Vineyard Lighting Company, Oak Bluffs, Mass., has been authorized by the Gas and Electric Light Commission to increase its summer metered rate for electricity from 25 to 35 cents per kilowatt-hour.

In 1916 the company was before the board on a rate complaint. The questions then at issue related chiefly to the right of its customers to a meter rate in place of a system of rates based upon connected load. An examination by the board disclosed that none of the company's investment could be dispensed with if no electricity was sold during the winter months. The board concluded that under the circumstances this method of charging was justified but recommended certain changes in its application and also, in addition to its other rates, metered service for churches, hotels, stores, shops, saloons, bowling alleys and places of amusement other than motion-picture houses, and to all other customers for heating and cooking devices who have installed a special circuit for such service, at a price of 25 cents per kilowatt-hour with a 5 per cent prompt payment discount during June, July, August and September and a discount of 40 per cent during the rest of the year.

Since that decision the company has voluntarily extended the meter service somewhat and has made some slight modifications in its other rates. During the following season the financial showing of the company improved, but thereafter the increase in expenses due to war conditions rapidly exceeded the increase in revenue. Last year the company was unable to earn its interest charges. The board is satisfied that the proposed increase is justified. The company has also raised the price of 40-cp. street lights 35 cents per month each.

In its brief the company stated that since 1911 its investment has increased 84 per cent; taxes, 680 per cent; output, 170 per cent, and number of customers, 52 per cent. Street-lighting prices for 40-cp. lamps decreased from $1.50 to $1.40 per month until the present advance.

AMERICAN ENGINEERING STANDARDS ASSOCIATION

Correct Statement of Function of the Proposed Organization Shows that It Is to Receive and Pass Upon Recommendations

In last week's issue of the ELECTRICAL WORLD, page 1233, a statement regarding the scope of the proposed American Engineering Standards Association was published. The association reports an error in the statement of the objects of the proposed organization. Section 3 should read:

"To *receive* and pass upon recommendations for standards," etc.,

and not, as given in the original statement:

"To revise and pass upon recommendations for standards," etc.

Rotary Club Inspects Power Plant

When this Rotary Club gathering had lunch at the Miller's Ford power plant of the Dayton (Ohio) Power & Light Company a few weeks ago O. H. Hutchings, associate general manager of the Dayton company, told the guests these facts: "Construction work started Aug. 1, 1916. Placed in regular operation March, 1918. Ultimate capacity, 150,000 hp. Approximately one mile of railroad side tracks. Company owns locomotive for shifting coal cars, etc. Company now serves forty-six cities, towns and villages. Company now serves in excess of 29,000 customers. Coal burned during 1918, 160,600 tons. Cost of coal for year 1918, $725,790.55, or an average cost of $4.52 per ton delivered. Maximum load during 1918, 37,000 hp. Output during 1918, approximately 100,000,000 kw.-hr."

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ENGLAND'S PLANS FOR SUPPLYING ELECTRICITY

Outline of Remaining Provisions of Government Bill to Develop and Unify Sources of Supply in the British Isles

This is the conclusion of the abstract of the government bill now pending in the House of Commons, the preceding provisions of which were described in last week's issue of the ELECTRICAL WORLD.

As the provisions of the bill indicate, it is proposed to insure development and conservation of the sources of electric power supply. American companies will be interested in the program of the English government as it is disclosed in the enabling measures given below:

A district board before incurring any capital expenditure above such amount as the Electricity Commissioners may prescribe shall submit for approval to the commissioners such details with respect to the proposed expenditure as the commissioners may require.

FINANCING BY THE TREASURY

It shall be lawful for the Board of Trade after consultation with the commissioners at any time before the establishment of a district board for any area, and for two years thereafter, to construct any generating station, main transmission line or other works and exercise any other powers which a district board can; but nothing in this provision shall be construed as vesting in the Board of Trade any station or line which under this act becomes vested in the district board. The Treasury may issue to the Board of Trade out of the consolidated fund of the United Kingdom any sums not exceeding £20,000,000 required for the construction of any such works or acquisition of land or for working capital for such works on such terms and conditions as the Treasury may think fit. At the end of two years after establishment of a district board or at any earlier time agreed on between the Board of Trade and the district board any generating station, main transmission lines and other works, and any land acquired for the purpose thereof by the Board of Trade under this section situated within the area of the district board, shall vest in that board subject to payment by the district board to the Board of Trade of such sum as may be certified by the Treasury to be sufficient to repay the advances made to the Board of Trade. The prices fixed by the Board of Trade for electricity supplied by it from generating stations established under this section shall be such that receipts will cover expenditure on income account (including interest and sinking fund charges) with such margin as the board thinks fit.

During the period between the passing of this act and the establishment of a district board in any area any two or more of the authorized undertakers within the locality may with the approval of the commissioners, and if so required by the commissioners shall, enter into arrangements for mutual assistance on all or any of the following: (a) The giving and taking of a supply of electricity and distribution thereof; (b) management and working of the generating stations or any part of the undertakings of the undertakers; (c) the provision of capital for carrying into effect and the appropriation and division of receipts under any such arrangement; (d) any matters connected with any of these purchases. The arrangement shall be on such conditions as may be agreed, or if made in pursuance of a requirement by the commissioners on such terms as in default of agreement may be settled by the commissioners.

There shall be transferred to the commissioners the powers of the Local Government Board, the Secretary for Scotland and the London County Council with respect to the sanctioning of borrowing by local authorities under the electric lighting acts, etc. Where consent of the Board of Trade is obtained to the placing of any electric line above ground consent of the local authority shall not be required.

A district board or any authorized undertakers may place any line below ground across any and above ground across any land other than land laid out as building land or land so situated that this would affect the amenity of any dwelling house in cases where the placing of such lines above ground is otherwise lawful. Provided that before placing any such line across any land the board or undertakers shall serve on the owner and occupier notice of their intention, and if within twenty-one days after service the owner and occupier fail to give their consent or attach to their consent any conditions to which the board or the undertakers object it shall not be lawful to place the line across that land without consent of the Board of Trade.

A district board and any local authority authorized by special act or order to supply electricity may provide, let for hire and in respect thereof may connect, repair, maintain and remove (but shall not, unless expressly authorized by the special act, manufacture or sell) electric lines, fittings, apparatus and appliances for lighting, heating and motive power and for all other purposes for which electricity may be used and may take such remuneration and make such conditions as may be agreed upon.

Prices charged by a district board for electricity shall be fixed by the board subject to the approval of the commissioners, and shall be such that receipts will be sufficient to cover expenditure on income account (including interest and sinking fund), with such margin as the commissioners may allow. In addition to any provisions contained in any special act or order limiting prices to be charged by authorized undertakers the commissioners may regulate such prices so that the benefit of any reduction in the cost of electricity or the capital employed in production attributable to provision of this act shall inure to consumers.

Commissioners may require any authorized undertakers to amend or alter the type of current, frequency or pressure.

Anything which under the electric lighting acts may be effected by a provisional order confirmed by Parliament may be effected by a special order made by the commissioners and confirmed by the Board of Trade under provisions of this act, and any provisional order made under the electric lighting acts and confirmed by Parliament may be amended or revoked by a special order under this act.

It shall be the duty of district boards and authorized undertakers to furnish to the commissioners, at such times and in such forms as the commissioners may direct, accounts, statistics and returns.

Every district board shall establish a fund for receipts and payments, and shall submit annually to the commissioners such statement of income and expenditure on revenue account as the commissioners require. Accounts of every district board and their officers shall be audited by auditors appointed by the commissioners. Every district board shall make annually to the commissioners a report of proceedings during the year.

BORROWING BY DISTRICT BOARD

For payment of the purchase price of any generating station or main transmission lines vested in or acquired by a district board under this act or of any undertaking or part thereof which it is authorized to acquire under this act (except where the purchase price is payable by an annuity), or for any other payment for any permanent work or other thing which the board is authorized to do, the cost of which ought in the opinion of the commissioners to spread over a term of years (including interest on money borrowed for capital expenditure while the expenditure remains unremunerative), and during the first three years after establishment of the board for providing working capital, a district board may with consent of the commissioners borrow money in such manner and subject to such provisions as to repayment as the commissioners may prescribe. Money borrowed under this section and interest thereon may be charged on the undertaking and revenues of the district board or on any specific property forming part of the undertaking and shall be repaid within such period as the commissioners may determine. The commissioners may enable a district board to raise money and authorize it to issue stock. Such stock and interest thereon shall be charged on the undertaking and all revenues of the district board. Subject to this act, any stock created

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by a district board under this act shall be issued, dealt with and redeemed according to regulations made by the commissioners.

Authorized undertakers whose area of supply is wholly or partly within the district of a district board and any authority, company or person receiving electricity from the board and the council of any county or borough or county district wholly or partly within the district of the board shall have power (a) to lend any money to the district board which the board is authorized to borrow, (b) to subscribe for any securities issued by the board for raising such money, (c) to guarantee or join in guaranteeing interest on money borrowed by the board, (d) to give financial assistance in any other form to the board; provided that in the case of the council of a county or borough or county district, whether or not the council is an authorized undertaker or receives electricity from the board, such powers shall not be exercised without consent of the Local Government Board. The raising of money for lending or subscribing for securities shall be a purpose for which the council may borrow, and money so borrowed shall not be reckoned as part of the debt of the council or any limitation on borrowing under enactments relating to borrowing. Any company, association or body of persons may exercise any such power, notwithstanding anything contained in any act, order or instrument by which it is constituted or regulated, and may apply any of its funds for lending such money. Authorized undertakers may exercise such powers notwithstanding anything in Section 3 of the schedule to the electric lighting (clauses) act, 1899.

The commissioners may lend on such terms as subject to approval of the Treasury they think fit to a district board or any authorized undertakers any money not exceeding £25,000,000 which the board or undertakers are authorized to borrow if the commissioners are satisfied that the board or undertakers cannot otherwise raise the money on reasonable terms. Any sums required for such advances shall be taken out of a special fund under charge of the commissioners, to be called the electricity loans fund. For raising money for this fund the commissioners may issue electricity stock bearing interest at such rate as they with consent of the Treasury determine. Interest on electricity stock shall be charged on the electricity loans fund, and the Treasury may guarantee on such terms as it thinks fit payment of such interest.

ANNUAL ESTIMATES

The commissioners at the beginning of each financial year shall prepare an estimate of their receipts and expenditures, other than on account of loans, under the preceding section during the year and submit it for approval by the Board of Trade. The commissioners shall apportion the amount by which the estimated expenses so approved exceed estimated receipts so approved among the several district boards in proportion to their gross receipts in the preceding year, and every such district board shall, on demand from the commissioners, pay to them the sum apportioned. Provided that during the first five years after passage of this act the amount of such excess shall be paid out of money provided by Parliament, but such payments shall be treated as advances and shall be repaid with such rate of interest as the Treasury may fix by the commissioners in equal annual installments in the next three succeeding years. Sums received by the commissioners shall be paid into a separate fund out of which salaries, remuneration, pensions and gratuities of the commissioners shall be paid.

Section 4 of the conspiracy and protection of property act of 1875 (which relates to breaches of contract by persons employed in supply of gas and water) shall extend to persons employed by a district board for any authorized undertakings.

Where under this act a district board is authorized to enter into an agreement with authorized undertakers or any other authority, company or person for any purpose it shall be lawful for those undertakers, authority, company or person to carry into effect such agreement or as the case may be to act on behalf of the board. Where a local authority as authorized undertaker enters into an agreement with a district board or any other authorized undertaker in pursuance of this act, any expenses incurred by the local authority in carrying the agreement into effect shall be deemed to be expenses incurred under the electric lighting acts and the provisions of Sections 7 and 8 of the electric lighting act, 1882, shall apply accordingly. Where by this act an order may be made conferring on a district board or authorized undertakers necessary powers for carrying into effect an agreement entered into by them under this act, and among the powers to be conferred by the order are powers of breaking up streets, railways and tramways other than such as can be broken up under any order or special act relating to the district board or undertakers, the order shall be a special order and shall apply the provisions of the electric lighting acts and the electric lighting (clauses) act, 1899, relating to breaking up of streets, railways and tramways.

The commissioners may hold such inquiries as they consider desirable for purposes of this act.

The Board of Trade and commissioners may respectively make rules in relation to applications and other proceedings before them under this act and to payments made in respect thereof.

A special order made under this act by the commissioners shall not have effect until confirmed by the Board of Trade. Sections 80 and 81 of the factory and workshop act, 1901, relating to the making of regulations under that act as set out in a schedule to this act shall apply to the confirmation of special orders under this act. Before any special order comes into force it shall be laid before each house of Parliament for not less than thirty days during which that house is sitting.

Subject to modifications the act applies to Scotland and Ireland.

MINISTRY OF WAYS AND COMMUNICATIONS

If a ministry of ways and communications is established by an act of the present session of Parliament, all powers and duties of the Board of Trade under this act and the electric lighting acts and any order or special act relating to the supply of electricity shall from such date as His Majesty in Council may fix be transferred to this ministry, and accordingly references to the Board of Trade in such acts and orders shall be construed as references to the ministry.

Take It Back!

"HERE'S YOUR STUFF."

From New York World.

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SCHEDULE OF MEETINGS OF ASSOCIATED MANUFACTURERS

Sessions on June 16 to 18 at New London, Conn., Include Two General Evening Meetings in Addition to the Gatherings of Section Members

A revised schedule of section meetings of the Associated Manufacturers of Electrical Supplies, to be held at the Hotel Griswold, New London, Conn., on June 16 to 18, has been issued by Charles E. Dustin, the general secretary.

In addition to the meetings of sections, two general meetings will be held, on the evenings of June 16 and 17. At the Monday evening meeting the international trade committee will have part of the program, and it is expected that other matters of general interest to the members will also be considered. On Tuesday evening a general history of the development of the submarine both here and abroad will be presented. This was one of the most closely guarded developments of the war, and the large part filled by electrical apparatus and supplies in the submarine make the subject of great interest to the manufacturers.

The schedule of meetings is as follows:

Monday, June 16.—Fuse Section; Outlet-Box Section; Industrial and Street-Lighting Fixture Section; Air-Circuit-Breaker Section; international trade committee; general association meeting in the evening for all members.

Tuesday, June 17.—Signaling Apparatus Section; Heating Appliance Section; Electrical Porcelain Section; Molded or Formed Insulation Section; Rigid-Conduit Section; Non-Metallic-Conduit Section; Armored-Conductor and Metallic Flexible-Conduit Section; Lamp Receptacle and Socket Section; Attachment-Plug Section; Snap-Switch Section; meeting of board of governors; entertainment meeting in the evening for all members.

Wednesday, June 18.—Knife-Switch Section; Panelboard and Switchboard Section; Line-Material Section; Wire and Cable Section.

PROGRAM FOR MEETING OF THE ELECTRIC CREDIT ASSOCIATION

Twentieth Annual Convention at Cincinnati This Week Covers Discussion on Many Questions Important to the Industry

The National Electric Credit Association held its twentieth annual convention at the Hotel Gibson, Cincinnati, Ohio, beginning on Friday, June 13, and extending through Saturday, June 14. The program provided for discussion of a wide variety of topics connected with credit management.

According to the tentative program, Friday morning was given up to registration, greeting by President Hillis, reports of the board of managers, of the secretary-treasurer and of committees. A luncheon followed, at which W. C. Culkins was announced to talk on "Public Utilities."

At the Friday afternoon session it was planned to take up various matters affecting the bylaws and general affairs of the association.

The reading of papers will take up Saturday morning. The program provides for papers and discussion on "Trade Acceptance Experiences—Details of Accounting, etc.," leader C. W. Dupius, Citizens' National Bank, Cincinnati; "Consignment Credits and Lamp Agents," T. K. Quinn, National Lamp Works, Cleveland; "Use of Forms—Experiences, Perplexities, Results," informal discussion from floor; "Moral Risk and Credit Interchange—Luncheon Clubs," by representatives of local associations, leader V. G. Fullman, Pittsburgh; "Handling of an Account—Analysis of Credit Information and Decision," leaders B. S. Berlin, Philadelphia, and J. S. Woodford, Pittsburgh; "Following Accounts—Approved Forms of Correspondence in Connection Therewith," leaders L. M. Creighton, Philadelphia, and C. E. Showalter, Pittsburgh; "Coördination Between Sales and Credit Departments," by representatives of both; "Impressions Gleaned from the Twenty-fourth Convention of the National Association of Credit Men," E. W. Shepard.

A feature of the Saturday afternoon session will be a question box.

COMPLICATIONS IN THE LOS ANGELES ELECTION

Vote Shows Total in Favor of Issue of $13,500,000 Bonds, but Contest in Courts Is Likely Because of Confusion Over Blank Ballots

As stated briefly in last week's issue of the ELECTRICAL WORLD, on June 3 a special election was held in the city of Los Angeles for the purpose of authorizing an issue of $13,500,000 in power bonds. The result of the election was that there was cast a vote of 46,490 for the bonds and 21,143 against. The vote for the bonds obtained the necessary two-thirds of the total, with a margin of 1400 votes to spare

At the same election the city of Los Angeles was authorized by the voters to sell power to other corporations doing business outside of the city.

Of the total amount of the proposed bond issue of $13,500,000, approximately $11,000,000 will be paid for the distributing system of the Southern California Edison Company within the city of Los Angeles and the remaining $2,500,000 will be used in connection with the development of the second unit of hydroelectric power on the Los Angeles aqueduct system.

That the election will be contested there seems to be little doubt, because of confusion resulting from the attempt to hold a special election for voting bonds to purchase the local electric distributing system at the same time and with the same election arrangements as the regular municipal election. This confusion may necessitate the holding of the bond election over again at a later date. Those who opposed the bonds insist that for their ratification two-thirds of the entire number of electors voting in the bond election must have voted for them. Those favoring the bonds hold it was only necessary that twice as many votes should have been cast for them as against them.

The main point is the question of the disposition of the blank ballots voted—that is, whether a blank ballot can be counted as voted. The bonds received a two-thirds majority if only those voters are counted as voting who marked their ballots, but it seems that the bonds did not receive a two-thirds majority of the actual number of ballots deposited in the boxes. The number of blank ballots is estimated at 5000. If there were only half that number and the courts hold they must be counted as "voted," the bonds failed to carry. The proponents of the bond issue have possession of the city administration, so it will be for the taxpayers who were opposing the bonds to contest the election.

Other points are raised by those opposing the bonds, but they appear to be technicalities that the courts would probably brush aside.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

New York Electrical Society Elects Officers.—Edwin B. Katte is the new president of the New York Electrical Society, and George H. Guy is the re-elected secretary.

Electric Club of Chicago.—Major Ainslie A. Gray was the speaker at the club's meeting of May 29, reviewing the work of the Ordnance Department of the United States Army in the war. Major D. J. O'Connor was to speak at the last luncheon of the season at the Hotel Sherman, June 12.

A. S. M. E. to Visit Detroit Edison Plant.—As a part of the program for its spring meeting, which is to be held in Detroit, Mich., from June 16 to 19, a trip to the Connors Creek plant of the Detroit Edison Company is being planned by the American Society of Mechanical Engineers for June 18.

N. E. L. A., Philadelphia Electric Company Section.—Joseph B. McCall, president of the Philadelphia Electric Company, addressed a recent meeting of this section, reveiwing the work of the company and the section. H. Carl Albrecht is the new president of the section and John J. Reily is secretary.

Joint Session N.E.L.A., Iowa Section, and Iowa Electric Railway Association.—The Iowa Section of the National Electric Light Association is to hold a joint session with the Iowa Electric Railway Association on June 18 at Colfax, Iowa. Two addresses are to be made—one by William G. Raymond, dean of the engineering department, State University of Iowa, on "The Iowa State Board of Conciliation, Its Work and Possibilities," and the other by William Chamberlain, general counsel United Light & Railways Company, on "Rate Litigation in Iowa." The program for the Iowa N. E. L. A. Section was published in the ELECTRICAL WORLD of May 24.

Society for the Promotion of Engineering Education.—The annual meeting of this society is to be held on June 25-28 at the Johns Hopkins University, Baltimore, Md. Each half day will be devoted to a special topic, the first session to the Mann report of the joint committee on engineering education, the second to the effect of the war on engineering education, the third to military training in engineering schools, the fourth to the work of the society, and the sixth to a symposium on changes in courses. A number of papers and addresses will be given on the final program, as, for instance, an address by Ira N. Hollis, president of Worcester Polytechnic Institute, on engineering colleges and their administration.

Electrical Men Meet in Portland, Ore.—To stimulate interest in the various branches of the industry a meeting of electrical jobbers, contractors, dealers, central-station men and manufacturers was held on May 21 and 22 in Portland, Ore.

N. E. L. A. Connecticut Get-Together Club Outing.—The Connecticut Get-Together Club of the National Electric Light Association will hold its sixth annual outing at Double Beach, Conn., on June 21. J. T. Hessel, 36 Crown Street, New Haven, is issuing the tickets.

Tri-State Water and Light Association of the Carolinas and Georgia.—Among the addresses to be given at the association convention, which will be held in Greenwood, S. C., from June 17 to 19, are "Algal Growths," by Dr. Francis L. Parker; "Electric Cooking," by George T. Barrett; "Electrical," by W. Rawson Collier, and "A 13,000,000-Gal. Motor-Driven Centrifugal Pumping Plant," by Fred C. Wyse.

Joint Meeting in Chicago.—On May 26 a joint meeting was held by the Chicago Sections of the American Institute of Electrical Engineers and the Association of Iron and Steel Electrical Engineers and the Electrical Engineering and Gas Engineering Sections of the Western Society of Engineers. Two papers were presented. The first, by J. C. Wilson, assistant chief engineer of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., was entitled "Measuring Gas Electrically." The other was by B. E. Fernow, also of the above company, and was called "Lifting-Magnet Operation."

Engineering Education Conference Called by United States Bureau of Education.—At a public conference under the auspices of the United States Bureau of Education to take place in the Willard Hotel, Washington, D. C, these topics will be discussed: Business training for engineers, engineering training for commercial enterprises, significance of the war experience for engineering education, and training of the engineer for overseas engineering projects. A number of business men, public officials and educators have accepted invitations to take part in the proceedings of the conference.

American Institute of Electrical Engineers

St. Louis Chapter.—At the May 28 meeting H. Weichsel, chief designing engineer Wagner Electric Company, gave a short talk on measuring insulation resistance of electrical apparatus, and A. S. Langsdorf, dean of the School of Engineering and Architecture, Washington University, spoke briefly on "Circulating Currents of Direct-Current Armatures," "V-Curves of Synchronous Motors" and "Phase Relation of Interconnected Polyphase Systems."

Lynn Section.—Col. J. M. Andrews, 105th Infantry, 27th Division, A. E. F., gave a talk on experiences with his command in France at a recent meeting.

Denver Section.—The section's annual meeting took place on May 17, and H. S. Evans was elected chairman while R. B. Bonney was chosen secretary-treasurer. Dr. Albert C. Crehore addressed the meeting on "Progress in Atomic Theory."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

San Diego Company's Rates Increased.—Rates of the San Diego Consolidated Gas & Electric Company are increased approximately 10 per cent by a recent decision of the Railroad Commission of California. This amounts to a general revision of the company's rates, effective as of May 1.

Rate Increases in Illinois.—Rate increases have been authorized by the Illinois Public Utilities Commission for the Mount Carmel Public Utility & Service Company and the Canton Gas & Electric Company, and it has entered an order continuing in effect temporarily increased rates previously granted for the Lincoln Water & Light Company.

Service Held Inadequate and Rate Increase Denied.—In a case affecting the Osceola Light & Water Company the Missouri Public Service Commission had before it a complaint as to inadequate service and a demand by the company for an increase in rates in order to enable it to render satisfactory service. The rate increase was denied for the present and the company was ordered to make repairs necessary to put its plant and system in proper operating condition. In part the commission says: "Both the electric and water rates are as a whole as high as are found in most cities of this size in the State of Missouri, and since the plant appears to be operated in an inefficient manner the defendant will be denied any increased rates at the present time, but will be required to make all necessary and needed repairs to its existing water plant, including the installation of some form of reservoir, standpipe or water tower, and to make all necessary and needed repairs to its existing electric system to enable it to give sufficient and satisfactory service."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Northern States Managers Meet.—Managers of the properties of the Northern States Power Company met with the general officers and executives in a two-day business conference at Minneapolis, May 15 and 16. A feature of the program was a paper by H. E. Young, sales manager, on the systematic efforts necessary to build up and maintain public good will.

Middle West Utilities Financing.—The Middle West Utilities Company is offering, through A. B. Leach & Company, $1,500,000 of five-year 7 per cent convertible gold notes, at a price of 97 and interest to yield about 7.75 per cent. The notes are a direct obligation of the company and are further secured by collateral consisting of preferred stock of subsidiary companies and common stock of the Middle West Utilities Company in the proportion of $1,500,000 par value of stock to each $1,000 of notes. The notes are also convertible into the stock of the subsidiary companies and into the common stock of the Middle West Utilities Company in the same proportion.

Electric Trucks in Milk Delivery.—According to A. Jackson Marshall, secretary of the Electric Vehicle Section, National Electric Light Association, one of the electric commercial vehicle manufacturers has developed a very practical light-weight delivery wagon which is being extensively employed by retail milk dealers. This electric truck possesses the feature of external operation by means of a lever which permits the operator to move the "electric" forward and backward under its own power without climbing into the vehicle itself. Thus the electric vehicle competes successfully with the horse trained to move at the command of the driver. The vehicle is also cheaper to operate than a single-horse wagon, besides being much more dependable.

Detroit Strike Ended.—The electrical union, which called a strike May 1 at Detroit to insist on wages of $1 per hour with forty hours' work a week and double time for Saturday and all overtime, has failed to accomplish its purpose. Owing to the conditions in the reconstruction period the contractors thought it impossible to accede to the demands of the union and held out until a settlement was effected. Arbitration was at first refused by the union, but finally the matter was settled by giving the men $7.50 per day, with a week of forty-four hours, with time and a half for overtime, including Saturday afternoons, and double time for holidays. These are virtually the terms on which the contractors were willing to settle before the strike started. This agreement holds until Nov. 1.

Points to Danger of Petroleum Famine.—Congress will be asked to take steps to ward off an alarming shortage of petroleum and its products which seems likely in the near future, according to an emergency report of the Bureau of Mines recently transmitted to the House appropriations committee by Secretary of the Treasury Glass. Mr. Glass has asked that $50,000 be appropriated for an investigation looking to the conservation of petroleum and natural gas. The report discloses that underground reserves are 40 per cent exhausted and that we probably are near the peak of domestic production. The consumption of petroleum is increasing far more rapidly than domestic production. During 1918 there were imported from foreign countries 39,000,000 barrels of oil, while 27,000,000 barrels were withdrawn from stock.

Energy Waste in Living Cost.—Establishment of a nation-wide electric transmission system operated as a common carrier like the railroads is urged in a paper recently issued by the United States National Museum. Such a system is needed to conserve the country's energy resources, which at present are being wastefully utilized, it is declared. The paper attributes the present high cost of living to a great extent to waste of coal, oil and water power. There is too much duplication in the production of energy, in that coal is needlessly transported long distances to regions where water power exists in large quantities. This water power should be developed at once and the system of long-distance transmission installed. America, says the statement, has been able to maintain high wage scales only in so far as machines have replaced hand power and use has been made of natural resources.

Vail Urges Return of Telephones.—Disintegration of the country's telephone systems is threatened unless Congress at once returns them to private control, declared Theodore N. Vail, president of the Bell Telephone Company and President Robinson of the Independent Telephone Association in a joint statement issued at Boston. Expenses of the telephone systems have greatly increased during the past year, for wages alone at the rate of more than $20,000,000 per annum, says the satement. While this was inevitable by reason of larger proportional increases by the railroads and industries of the country, the revenues are inadequate to care for such increases and the deficit to the government to date on that account is large and steadily growing. The Postmaster-General ordered that steps be taken to secure adequate revenues, but contentions with the regulatory authorities of the states, not yet settled, have prevented the satisfactory adjustments. If such conditions continue, necessarily the credit of the companies will be impaired, proper expenses cannot be met, the best operating forces cannot be retained, needed extensions and satisfactory service cannot be provided. This condition will lead to a deterioration which in some localities may threaten a return to public ownership or operation in order to care, even inadequately, for public needs. Such a contingency can be prevented, says the statement, through prompt action by Congress. Just and speedy settlement should be made for all properties taken under existing law, that such balances now in the possession of the government may be restored to assist in the upbuilding and extension of the various systems for better public use. The conditions and regulation of operation should be defined so as to permit the companies to reëstablish and maintain a satisfactory service with reasonable rates without discrimination and to procure the benefits of legitimate competition.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Compensation for Use of Highways by Telephone Companies.—The Court of Appeals of Maryland has pointed out that the provision of the Civil Code giving telegraph and telephone companies the right to construct lines upon highways or across bridges of the state gives the company no right to such use without making compensation therefor (106 A. 260).

"Final Orders" of a Commission.—While in its strict sense a "final order" is the last or concluding order in a case, in the popular sense, and in the sense in which it is most used by the lawmakers, as well as by the legal profession, it is ordinarily considered to be such an order as is subject to review on appeal, writ of error or other appellate process, according to the Supreme Court of Appeals of West Virginia (99 S. E. 63).

Information Needed for Conviction in Meter Tampering.—In a prosecution for tampering with or changing electric meters before they could be tested by assistant state sealer of weights and measures, in violation of statute, evidence of the assistant sealer and superintendent of weights and measures that the meters had been tampered with or changed by defendant before they could be tested, where such facts were not of his own knowledge but merely from information, is insufficient to sustain conviction, according to the Supreme Court of Tennessee (210 S. W. 630).

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Men of the Industry

Changes in Personnel and Position— Biographical Notes

Charles **H. Hubbell** and **Douglas S. Meaden** have joined to form the firm of Hubbell & Meaden, Cleveland, Ohio, and devote attention to consultation on tax and accounting matters and to rate cases and other problems of utility companies.

John G. Learned, the new chairman of the Commercial Section of the National Electric Light Association, is assistant to vice-president in charge of the commercial, advertising and right-of-way departments of the Public Service Company of Northern Illinois. His association with the electrical industry began in 1898, when he was employed for two years in the service department of the Chicago Telephone Company. On leaving that concern he became a salesman for the Commonwealth Edison Company in its Northern division. During this period he completed the course at the Chicago Law School, and in 1902 he was admitted to the bar of Illinois. In 1905 he resigned from the Commonwealth Edison Company to become general contract agent for the North Shore Electric Company, with headquarters at Evanston, Ill., where he remained until 1911, when the North Shore Electric Company became a part of the Public Service Company of Northern Illinois. At that time Mr. Learned was made general contract agent for the Public Service Company's Northern and Western divisions. In August of the following year he was made assistant to the vice-president of the company. Since 1911 he has been particularly active in association work, holding the offices of secretary of the North Shore Electric Company Section in that year, chairman of the Public Service Company of Northern Illinois Section of the National Electric Light Association in 1913-14, and chairman of the committee on electric service in rural districts in 1911 and 1912. He was a member of the executive committee and chairman of the membership committee of the Commercial Section of the National Electric Light Association in 1912 and first chairman of the Lighting Sales Bureau in 1916. Mr. Learned is also a member of the educational committee of the Chicago Central Station Institute and has contributed a number of valuable papers and articles to the commercial literature of the electrical industry.

JOHN G. LEARNED

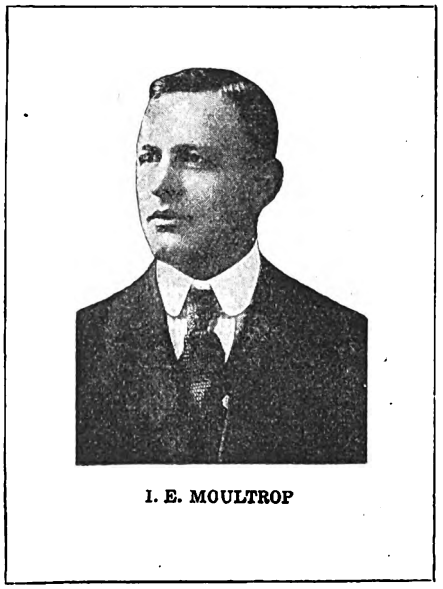
P. M. Parry, formerly manager of the Ogden division of the Utah Power & Light Company, has been made commercial manager of the company to fill the vacancy caused by the resignation of W. R. Putnam. Mr. Parry took up his new duties on June 1, when Mr. Putnam left to become vice-president and general manager of the Idaho Power Company.

Donald C. Barnes, Everett, Wash., heretofore manager of the traction and power properties of that city, has been appointed manager of the Seattle division of the Puget Sound Traction, Light & Power Company, to succeed A. L. Kempster. He will make his headquarters in the Electric Building at Seventh Avenue and Olive Street. Mr. Barnes is well known in utility circles. He has been associated with the management of Stone & Webster companies since 1905.

Major George F. Sever has been honorably discharged from the United States Army after a service of fifteen months and will establish consulting engineering offices in New York City. Major Sever during his service made extensive and detailed investigations of the electric power conditions in New England as well as on the Pacific Coast from Seattle to Los Angeles. His investigation covered careful analyses of the production of power by coal, oil and water and the comparisons of these different methods.

John A. Stevens, a prominent power-plant engineer, on May 17 was the guest of honor at a dinner given by associate engineers and assistants at the Hotel Thorndike in Boston to commemorate his ten years of engineering work. About forty members of the organization were present. Mr. Stevens was born in Galva, Ill., in 1868. Previous to entering the employ of the International Navigation Company in 1893, he served various apprenticeships in marine work. Later he served as an engineer for that company on different steamships and was promoted to first assistant engineer of the U. S. M. S. St. Paul. In 1896 he resigned to take the position of chief engineer with the Merrimack Manufacturing Company of Lowell, Mass., in which position he superintended the power work of the company's Southern mills and made all of the power-plant layouts and estimates. In 1909 Mr. Stevens resigned from the Merrimack Manufacturing Company and spent about three months in Europe collecting engineering information. He then returned to the United States and opened general consulting engineering offices, specializing in power-plant work.

I. E. Moultrop, who has been elected chairman of the Technical and Hydro-electric Section of the National Electric Light Association, is assistant superintendent of the construction bureau of the Edison Electric Illuminating Company of Boston. For a number of years he has been intimately connected with the work of the prime-movers committee of the N. E. L. A. and also with other committees of the A. S. M. E. and A. I. E. E. Mr. Moultrop was born in Marlboro, Mass., in 1865 and started his engineering career in 1882 with the Whittier Machinery Company of Roxbury, Mass. He left that company in 1892 to become engineer on mechanical construction work with the Boston Edison company and has since been connected with that company, advancing to his present position of assistant superintendent of the construction bureau, a department which handles all the construction done by the company. Mr. Moultrop has served on the N. E. L. A. prime-movers committee and the steam-turbine and gas-engineering committee, which preceded the former committee, about twelve years, having been chairman of the prime-movers committee for a considerable portion of that time. He has also served as manager of the American Society of Mechanical Engineers from 1908 to 1911 and as vice-president from 1912 to 1914. He is at present a member of the boiler code committee and power test code subcommittee on turbine testing of that body. He accomplished an important work for the A. S. M. E. in the capacity of chairman of the increase-of-member-



I. E. MOULTROP

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ship committee for a number of years. When this work was started under his direction in 1912 the society had a membership of 4115, and in 1917 the membership was increased to 7704. He then resigned to fill the position of representative of the A. S. M. E. on the board of trustees of the United Engineering Societies, of which he is a member. He is also a member of the Engineering Council, representing the United Engineering Societies in that body. Mr. Moultrop has served as a member of a number of committees of the A. I. E. E. and at present is a member of the power-stations committee of that society. He was recently elected chairman of the Boston Section of the A. I. E. E. for the ensuing year. In Boston Mr. Moultrop has been a member of the board of governors of the Engineers' Club for the past six years and chairman of its membership committee. He is also a member of the board of governors of the Woodland Golf Club.

Dr. F. H. Newell, who has been elected president of the American Association of Engineers, with headquarters in Chicago, is head of the civil engineering department of the University of Illinois and is well known as an engineer. He has been called "father of the United States Reclamation Service," of which he was first chief engineer from 1902 to 1907 and director from 1907 to 1914. Dr. Newell has been active in all of the reform movements in the engineering profession in the last few years. He was one of the founders of the Washington Engineering Society and served as its president. He is a member of the American Society of Civil Engineers, American Society of Mechanical Engineers and Western Society of Engineers and was one of the original members of the Engineering Council.

R. W. Spofford has been made local general manager of the Manila Electric Railroad & Light Company, Manila, Philippine Islands, by the J. G. White Management Corporation, New York, N. Y., the operating manager of that company. Mr. Spofford was graduated from the United States Naval Academy at Annapolis and spent about five years in the navy. He was retired in 1911. Shortly thereafter he was engaged by the J. G. White Management Corporation and was assigned to the engineering staff of the Augusta-Aiken Railway & Electric Corporation, Augusta, Ga. He became general manager of that company in 1914. When the United States entered the world war Mr. Spofford, as a naval reserve officer, was called to the colors for service. With the signing of the armistice he was again placed on the retired list of the navy, with the grade of lieutenant-commander.

Leon C. Smith, Columbus, Ohio, has been provisionally appointed chief inspector by the Public Utilities Commission of Ohio to succeed James B. Dugan, who recently resigned to become superintendent of the Lima division of the Ohio Electric Railway. Mr. Smith has been assistant to Mr. Dugan.

T. C. Miller has been appointed chief engineer of the municipal light plant at Independence, Mo., to succeed A. L. Landsberg, who has resigned after being with the company for several months.

J. M. Walsh has resigned from the commercial department of the Scranton (Pa.) Electric Company to take up the duties of electrical engineer for the Gurney Electric Elevator Company at Honesdale, Pa. During the war Mr. Walsh was commissioned a lieutenant of coast artillery and served in France with a regiment of railway artillery.

R. W. Symes, the new chairman of the Accounting Section of the N. E. L. A., is general accountant of the Detroit Edison Company. He has been

R. W. SYMES

connected with that and subsidiary companies for the past fourteen years and has been an active worker on accounting committees of the N. E. L. A. for the past eight years. He has also been a member of the executive committee of the Accounting Section since that section was organized in 1915.

Prof. A. P. Little of Yale University has been appointed professor of electrical engineering in the Colorado School of Mines. Professor Little is a graduate of the University of Vermont, and for a short time after graduation he was associated with the New England Telephone & Telegraph Company in its electrical department. He left that position to become assistant professor of electrical engineering at the University of Syracuse, N. Y. Later he joined the teaching staff of the Oklahoma Agricultural and Mechanical College, where for five years he was head of the electrical department. From 1913 to 1917 Professor Little was connected with the public utility section of the Bureau of Standards at Washington. Here he was engaged chiefly in investigating standards for electric service, street-lighting service, and central-station heating service.

Obituary

Richard Stevens, son of the founder of the Stevens Institute of Technology, died May 18, at his home in Castle Point, Hoboken, N. J., at the age of fifty-one.

C. P. Larson, for ten years chief engineer of the Hughes Electric Company at Bismarck, N. D., died recently, following a year's illness. Mr. Larson was born in Denmark fifty-seven years ago, but came to this country at an early age.

William S. Liming, superintendent of the Scranton (Pa.) Electric Company, who died on April 19, had been in the employ of that company since May 3, 1902. He was formerly a member of the engineering staff of the Philadelphia Electric Company and had charge of underground construction in Philadelphia when the overhead lines were placed underground. Mr. Liming had been in poor health for the last three years.

Charles Whitman Wetmore, formerly for many years president of the North American Company, New York, N. Y., which controls the Milwaukee (Wis.) Electric Railway & Light Company and the Union Electric Light & Power Company, of St. Louis, Mo., died on June 2 at his summer home. Mr. Wetmore was born in Michigan sixty-five years ago. He was educated there and at Harvard, and was graduated from the law school in 1877. After graduation Mr. Wetmore went to New York and began the practice of law with the firm of Barlow & Olney, which afterward became Barlow & Wetmore. In addition to his connection with the North American Company Mr. Wetmore was one of the organizers of the Montana Power Company and a director of several other public utility companies. About five years ago he retired from active business and lived in Surrey, England, until the war broke out, when he returned to the United States.

Dr. Henry Wilde of Ardsley Edge, Cheshire, England, who recently died at the age of eighty-six, was one of the early investigators in electrical work. He is credited with having discovered in 1868 the synchronizing property of alternating currents to control the rotation of dynamos in generating stations, and he invented a dynamo-electric machine in 1864 for the production of electric light. He applied the dynamo with other inventions to the production of the searchlight for the Royal Navy and to the electrodeposition of metals from their solutions, from 1868 to 1880. He was a frequent contributor of original papers to the *Philosophical Transactions* and *Proceedings* of the Royal Society, the *Philosophical Magazine*, the memoirs of the Manchester Literary and Philosophical Society and the *Comptes Rendus* of the French Academy of Science. Besides devoting his life to science, Dr. Wilde gave substantial aid to English institutions for the promotion of these objects.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

HIGH-TENSION INSULATOR SALES ARE NOT LARGE

Judging from Inquiries and the Amount of Work Projected, the Prospects for the Future Are Brighter than They Were

While there are a number of inquiries out for high-tension insulators, actual sales, manufacturers report, are below those of last year and not very good. Generally speaking, sales are for small quantities. This is to be expected as new long lines have been very scarce. Considerable work is projected, and some new work is under way.

Insulator sales consequently are increasing and, judging from the amount of projected work, the prospects for future business are bright. Many inquiries are coming from without the United States.

One manufacturer not long ago advanced prices on small lots and feels that there is a possibility that prices on carload lots and upward may be advanced.

TRANSFORMER PRICES NOT EXPECTED TO GO LOWER

Owing to Small Increases During War Period Drops in Raw Materials Should Not Necessarily Be Reflected in Finished-Product Prices

Toward the end of March a price reduction of about 11 per cent was established for distribution transformers. In the opinion of those in close touch with the manufacturing of transformers, the bottom has been reached in prices of such equipment. It is pointed out that labor costs show no tendency whatever to decrease. Some material costs are running lower than during the height of the war.

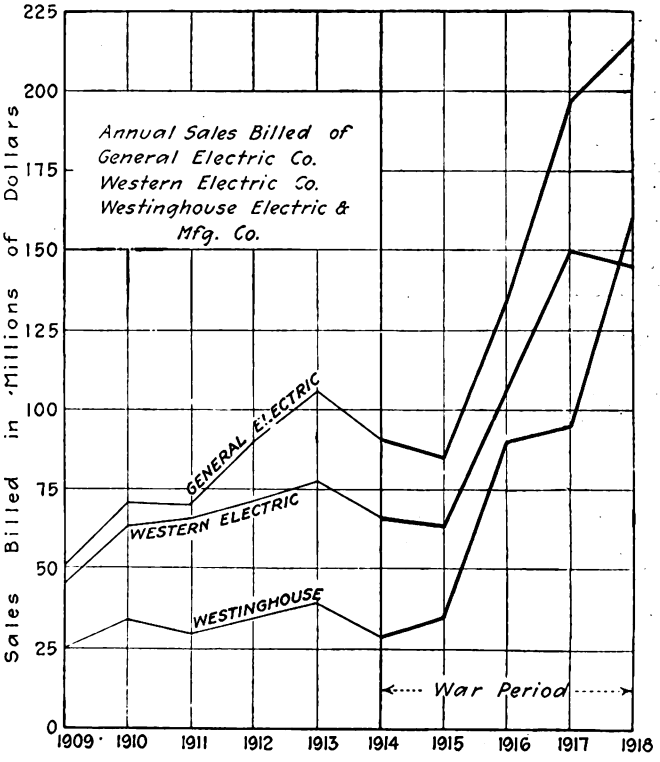
Thus magnetic steel is now costing the transformer manufacturer about 9 cents per pound, compared with 14 cents in the period of maximum demand and allowing for wastage in the fabrication of lamination sheets of the proper shape. The maximum cost of this steel was practically equivalent to the price of copper the year before the war. Considerable stocks of copper and steel which were purchased at prices in excess of ruling quotations are yet to be worked up at the factories. The overhead cost in transformer manufacture and the labor cost are to-day probably not far apart. Insulating materials are a little easier in price than last year, but with present high labor and overhead charges, with existing high costs of maintaining sales work in the field and with outputs far below the capacity of the factories, it is held that no reasonable basis for price reduction exists, bearing in mind always that the price advances of transformer equipment during the war did not exceed about 60 per cent compared with from two to five times that advance in many other manufactured commodities. There is no certainty that the prices of steel and copper will not advance materially during the present year, and neither is it positive that no further increases in the cost of labor will be registered.

Little is being heard of guarantees covering price reductions this year in the transformer quotations now being offered. Since the prices of such equipment did not follow the advances in material cost during the war, it results that very substantial drops can take place in raw-material costs before any sympathetic fall in product prices may be expected. Possibly in the future mass production on the basis of greatly increased labor efficiency may allow a moderate recession to be established, but the prospects are that prices now current will form the basis of quotations for a long time hence.

SALES OF THREE LARGEST ELECTRICAL DISTRIBUTERS

Last Year Brings Total of $522,421,000, While Unfilled Orders Amount to the Sum of $172,513,000

Figures just made available show the business done last year by the three largest distributers of electrical goods—the General Electric Company, the Westinghouse Electric & Manufacturing Company and the Western Electric Company. Both the General Electric and Western Electric



SALES BILLED FOR PAST TEN YEARS OF THREE LARGEST DISTRIBUTERS OF ELECTRICAL GOODS

figures are for the calendar year 1918, while the Westinghouse figures are for the fiscal year ended March 31.

Sales billed last year as shown in the diagram were: General Electric, $216,815,000; Western Electric, $145,226,000, and Westinghouse, $160,380,000, a total of $522,421,000. Both General Electric and Westinghouse showed a gain over the previous year, the former $20,000,000 and the latter $65,000,000. Western Electric sales dropped behind those for 1917 by $5,000,000.

Unfilled orders were as follows: General Electric, Jan. 1, $80,000,0000; Western Electric, Jan. 1, $26,265,000; Westinghouse, April 1, $76,248,000, a total of $172,513,000. This total is less than that unfilled a year previous by about

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$84,000,000. On April 1, 1918, however, Westinghouse unfilled orders totaled $147,858,000.

The above figures, it is well to remember, do not represent altogether the regular products of the three companies. Considerable war work was done which changed the relative importance in the sales ladder of many of the companies' normal products. Moreover, there are included certain munition sales and electrical articles of a war nature never before manufactured.

Furthermore, when making comparisons with previous years care must be taken not to confuse values with volumes. It has been estimated that electrical goods, generally speaking, were about 65 per cent higher in 1918 than before the war. If a comparison of volumes is desired, the figure will be found useful. On this basis the volume of goods billed last year was around 50 per cent more than the volume billed in the record pre-war year of 1913.

BRITISH RESTRICTIONS ON ELECTRICAL IMPORTS

Efforts Being Made to Hold Down Imports Where They Will Compete Too Severely with Domestic Manufacturers

Announcement is made by the War Trade Board of a number of changes in the import restrictions of Great Britain relative to electrical apparatus and equipment. It is well known that British electrical manufacturers are making every effort to keep down the imports of lines that compete with domestic manufacturers. In fact, it is probably true that a committee of electrical manufacturers will determine when licenses will be issued for imports of those items that require them.

Restrictions have been removed from electric vacuum cleaners, small motors up to ¼ hp., rolling-mill motors for auxiliary driving up to 250 hp. and single-phase repulsion induction motors, electrical measuring instruments of all kinds with 4-in. dials and under, and flexible wires for telephone and house wiring.

The importation of the following articles will be licensed only exceptionally, as and when required: Incandescent lamps, meaning complete lamp bulbs with filaments and filament supports, contacts and tubes; electric house-service meters; electrical measuring instruments of all kinds, excepting those with 4-in. dials and under; electrical cooking, heating and domestic laundry appliances, except washing machines and vacuum cleaners; electric cables and wires other than flexible wires for telephone and house wiring; batteries for pocket lamps; electric motors and parts thereof, other than for renewals (except small motors up to ¼-hp., rolling-mill motors for auxiliary driving up to 250 hp., and single-phase repulsion induction motors); electrical accessories and parts thereof, including fan motors.

The following articles are to be rationed for importation: Dry cells and primary batteries, except those for pocket lamps, to be admitted at rate of 20 per cent of 1916 imports; bulbs for electric lamps to be admitted at rate of 50 per cent of 1913 imports.

REGULATIONS AFFECTING ELECTRIC FAN EXCISE TAX

Electrical Goods Primarily Automobile Accessories Subject to Tax Irrespective of Their Ultimate Use

A number of bills have been placed before Congress for the purpose of removing the shackles on business by rescinding excise and luxury taxes. This movement is of particular interest to the electrical trade, owing to the inclusion of electric fans and electrical automobile accessories in the former and portable lamps in the latter.

These excise taxes are on goods sold after Feb. 25, 1919, even though the order was placed prior to that date. Thus, according to the law, fans of last year's model held in manufacturers' stock and sold subsequent to Feb. 25 are subject to the tax of 5 per cent. This, however, does not apply to second-hand fans.

According to a ruling just received by the ELECTRICAL WORLD from Deputy Commissioner John E. Walker, the ordinary portable electric fan, and also fans of a similar type screwed to a wall bracket or other support but capable of being easily moved, are taxable. Ceiling fans, exhaust fans and blowers, permanently attached and requiring separate walls and fixtures, and which necessitate workmen to remove them, are not portable fans within the meaning of the act.

The tax is on the sale price and not the list price of the article. A cash discount or other discount made subsequent to the sale is not deductible in computing the price for the purpose of the tax. Where, however, fans are sold over a period of time under an agreement for a quantity rebate, the tax, considered on the gross price, may be adjusted in the terms for the month in which the price is finally determined. No deductions are allowed for commissions to agents and other expense of the sale.

The tax may be included in the selling price and need not be specifically mentioned to the customer at the time of sale. If the price of the article is increased to cover the tax, the tax is upon such increased price. If the dealer enters on his invoice as a separate item the exact amount of the tax, stated to be the tax, such amount may be excluded in determining the price at which the article is sold.

In respect to electrical articles used as automobile accessories but also having other uses, the commissioner stated that if primarily for use in connection with an automobile they are subject to the tax, no matter what the ultimate use. The commissioner stated that if any doubt, reasonable and bona fide, exists as to the special adaptability of an article, the fact that it is sold by a manufacturer to be used with an automobile or to an automobile accessories dealer will determine its taxability.

The Internal Revenue Commission has just published "Regulations No. 47—Relating to Excise Taxes on Sales by the Manufacturer," in which a large number of technical questions that have arisen since the tax went into effect are answered.

STORAGE-BATTERY MAKERS STILL ON BACK ORDERS

Although Current Sales Are Far Below Production Capacity, It Will Be Early Fall Before Large Stocks Can Be Accumulated

Returning conditions of peace find manufacturers of storage batteries trying to catch up on their back orders. In the case of many manufacturers government requirements for special types of storage batteries kept them behind on both government and commercial orders. The end of the war found some of them, even with enlarged manufacturing space, so far from conditions of immediate delivery that in some cases it has been figured it will be fall before any stocks can be accumulated.

In 1913 and 1914 the market for storage batteries was far below that of to-day, and most manufacturers were on their upward curve of production. One manufacturer's production to date this year is double that of the same period last year, while current production is about ten times as great as in 1913 and 1914.

So far the present demand is below the increased capacities inaugurated during the war, but back orders are keeping the factories going to capacity. One manufacturer figures this present demand as 40 per cent of his capacity.

Sales of batteries for car lighting are practically nil. The industrial and commercial truck and the passenger vehicle battery markets are reported as not up to snuff. On the other hand, the automobile requirements are increasing at a great rate, while unfilled orders of war times are well under way to completion. Another line of increasing activity is the farm-lighting business.

There have been price changes since 1913 all along the line. One manufacturer has increased about 20 per cent

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since 1913, while another has increased prices about 100 per cent since 1915. Others have reported increases but withheld amounts. Since 1913 the relation of labor cost to total cost has been found up 5 per cent and manufacturing and sales cost ratios have also gone up 5 per cent. On the other hand, charge for material is 10 per cent less, a factor in the total cost of manufacturing. This may not be general, but is an instance. Battery costs have been found steady since the first of the present year.

Most manufacturers have sufficient stock of raw materials on hand to continue for several months, the general term being six months. This means considerable material on hand compared to previous years, considering capacity increases since 1913 of from three and one-half to ten times. Stocks of finished batteries could with difficulty be maintained, but manufacturers hope to be able to arrive at the point where by fall they may have started stocks of semi-finished batteries. These must be held till ordered so as correctly to group, arrange and test them. One manufacturer expects to be able to stock 10 per cent of his battery capacity in this way.

In general export sales have been found rather light, although in one instance they are about 25 per cent of domestic sales.

In the commercial type of battery there have been few developments of late. A manufacturer states that slight changes have been made in methods of manufacture and in certain parts. Another reports that on account of a slight change in shape of one part he is able to guarantee 25 per cent more life to his battery.

METAL MARKET SITUATION

Price of Copper Advances 1¼ Cents, and a Fair Amount of Buying Is Reported

Copper is up again. Since the last report electrolytic has advanced from 16.37½ cents a pound to 17.62½ cents for spot, June and July shipments, while August shipment is held at ½ cent higher. Wire base is following right along at 19½ to 20 cents a pound at the mill. The scrap copper and wire market is right in step with another ¼-cent advance.

The copper buying movement is keeping up, although sales at the end of last week fell off somewhat. The market for exports to England, France and Italy is not very strong at present, but considering the way those countries are absorbing their stocks, it cannot be long before their imports will again be in evidence. Their import needs seem to be principally for wire bar.

Spelter continues with an easy upward movement and the market is rather strong. The War Trade Board announced that on June 1 there remained undistributed 1615 tons of allocated tin. This means a reduction in stock of about 50 per cent since May.

NEW YORK METAL MARKET PRICES

	June 3	June 12
Copper:	£ s d	£ s d
London, standard spot	79 5 0	79 10 0
	Cents per Pound	Cents per Pound
Prime Lake	16.75	17.75
Electrolytic	16.37½	17.62½
Casting	16 00	17.25
Wire base	18.00 to 18.50	19.50 to 20.00
Lead, trust price	5.25	5.40
Antimony	8.37½	8.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.50	6.97½
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	32.00 to 33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.50 to 14.75	14.50 to 15.00
Brass, heavy	8.00 to 8.50	8.00 to 8.75
Brass, light	7.25 to 7.75	7.25 to 7.75
Lead, heavy	4.50 to 4.60	4.60 to 4.65
Zinc, old scrap	4.50 to 4.75	4.50 to 4.75

THE WEEK
IN TRADE

FAN season has opened up. The hot weather of last week moved large quantities of fans and in instances cleaned out jobbers' stocks. Other socket devices continue to sell in large quantities.

Wire is slightly higher, but otherwise prices are steady. An upward movement, however, would not be surprising within the next few weeks.

Construction, especially of dwelling houses, is going ahead rapidly and affording a growing market for electrical equipment.

Collections are in good shape and credits show no change.

NEW YORK

June is opening up better than May, according to jobbers' reports. There is nothing startling in the market, however. The fan business, of course, adds considerable activity to the trade.

As to building, there has been reported a general branching out among the silk manufacturers. Additions are being made in the rubber industry, with its resulting demand for larger-size motors.

The assistance of large insurance companies is being sought in the financing of pending building operations. Their heavy participation in Liberty loans may not permit them to place so much money on real estate mortgages as might be expected.

FANS.—The hot spell of last week gave electric fans a push that cleaned some dealers and jobbers out of stocks. One jobber disposed of practically his entire stock of fans, and rather than purchase fans of another make he is waiting for factory deliveries. The same factory has had hurry orders to fill all over the country. Other jobbers have reported sufficient stocks to weather the heat waves that will undoubtedly come. They have ordered reasonable stocks and these are being replenished periodically. In some cases, however, manufacturers figure that only 50 per cent of jobbers' orders have been placed. Deliveries for certain factories have slowed down somewhat.

SCHEDULE MATERIAL.—Jobbers report a slight improvement in the demand for wiring material, with sufficient stocks to handle expected business.

FLEXIBLE ARMORED CONDUCTOR.—No apparent relief in manufacturers' deliveries has been found, and many jobbers report empty stocks. Demand is still heavy.

MOTORS.—Fractional sizes are still finding almost unprecedented demand, and inability to deliver is holding up some motor-driven appliances. Small sizes for industrial use have a fair demand, but not so great as to prevent the gradual building up of stocks. Large-motor business is reported on the increase.

APPLIANCES.—Motor-driven appliances are in exceptionally good demand. One make of vacuum cleaner is reported a month behind on deliveries. Washing machines have an extremely good call, and new companies appear in the field very frequently. Ironing machines for the household are increasing in popularity. Recently inquiries have been received for motor-driven ice-cream freezers.

RIGID CONDUIT.—The market is light. Prices are still on card 41, but when commercial and apartment building sets in in full force it is expected that prices will advance.

LIGHTING EQUIPMENT.—Portables have only a light demand at this time. Illumination for show windows is under way in good shape. Residence lighting is going stronger than a short time ago. Considerable activity is still noticed in commercial lighting for offices on account of the changes in methods of illumination and changes in

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office location. Glassware factories are reported running to capacity. Deliveries are around three to four weeks.

WIRE.—Bare copper wire bases have been reported at 19½ and 20 cents. Weatherproof is found at 20 to 22 cents, annunciator around 27 cents and lamp cord 20-cent and 21-cent base. Two rubber-covered lines advanced slightly this week.

TABLE HEATING APPLIANCES.—Some dealers and dry-goods stores have noticed a slight increase in sales of toasters, percolaters, etc., in the latter part of May and in June, in connection with June weddings. Jobbers are hardly affected at this time.

CHICAGO

The revival of industry is well under way in the Middle West and is most marked in those industries which bore the brunt of war-time privation. Such industries include automobiles, jewelry and some branches of the electrical industry. Industrial expansion, especially in the smaller towns, is being curtailed by the lack of proper housing facilities. Manufacturers are therefore finding it necessary to build homes for their employees.

In the city of Chicago five new apartment houses were projected last week, involving an expenditure of some $3,000,000, besides which a one-and-a-half-million-dollar hotel is announced for the south side. Actual building permits are only averaging about 150 a week for the city of Chicago, or about one-third of the requirements under normal conditions. A firm of engineering contractors in the city has announced that it will proceed to build five grain elevators of 25,000 bushels each and one of 30,000 bushels capacity in the states of Idaho, Kansas and Iowa, in addition to an elevator of 200,000 bushels capacity in Atlanta, Ga. St. Louis appears to be on the threshold of an extensive industrial boom. The Scullin Steel Company is making plans for a two-million-dollar addition to its plant and will probably require some 8000 hp. in 25-cycle motors in addition to transformers and other electrical equipment.

COPPER WIRE.—There is a strong demand for wire, and it is expected that the present base of 21 cents for weatherproof and rubber-covered and 19 cents for bare wire will be increased shortly. The demand is practically all for house wiring, and comparatively little wire above No. 6 is being sold.

SCHEDULE MATERIALS.—Business has been sub-normal, and a price reduction of 10 per cent has been made by some jobbers to stimulate business.

TRANSFORMERS.—Distributing transformers up to 200 kva. are not in great demand. Price reductions have not materially affected business, owing to the lack of building.

WIRING PORCELAIN.—Knobs, tubes and similar material are down about 20 per cent. This drop, it is reported, was made for the sole purpose of stimulating business, and it has generally succeeded. One manufacturer is now sixty days behind as a result of the rush of business which ensued.

MOTORS.—In motors of 1 hp. and above the principal demand is in sizes up to 25 hp. for both direct current and alternating current. These motors are going to many industrial plants which were unable to get motors during the war and are now bringing their maintenance work up to date. The railroads are also buying motors within the limits given. Candy manufacturers are expanding as they expect to increase their business under prohibition. Manufacturers making motors up to 200 hp. are in most instances better able to supply the large motors especially up to 100 hp. and 150 hp. than they are the smaller sizes.

VACUUM CLEANERS.—Some of the manufacturers are behind in their deliveries about sixty days.

FARM-LIGHTING OUTFITS.—One manufacturer reports that he is behind more than sixty days on deliveries, the reason being the combination of large demand and difficulty in obtaining labor.

IRONS.—One maker has reduced his price 50 cents.

BOSTON

An excellent volume of business continues from week to week. Deliveries are so good in most lines that no serious difficulties are experienced in maintaining stocks, though here and there manufacturing facilities appear unequal to the demand. Prices rule firm, with stiffening tendencies on copper wire. Domestic appliances are enjoying a wonderful sale. Labor conditions are unsettled, and strikes are threatened in telegraph and telephone circles. It is also rumored that electric wiremen are getting uneasy. Contractors are not able to pick up building work on a statewide scale as yet, but many small jobs are under construction. The extreme heat of last week boomed fan sales finely. Personal visits to jobbing stock rooms reveal a large amount of diversified material on hand, and little chance of shortages seems likely this season outside a few chronically depleted lines. Collections appear to be running along evenly, with fairly satisfactory underlying conditions.

WIRE.—Weatherproof was quoted at 22 cents base, bare at 19 cents, and rubber-covered at 23 cents. Insulated wire shows a decided advance over last week, and local agencies are enjoying a somewhat increased demand.

FANS.—Record-breaking high temperatures for early June gave a tremendous spurt to the fan market last week. One large jobber is reported to have sold 3000 fans in the first six days of June. Most jobbers did not run out of fans, however. Larger sizes were in heavy demand, and a good grade was handled in smaller outfits. Retail stocks were shot to pieces after the mercury hit 98 deg.

WASHING MACHINES.—The demand increases, and deliveries are still well maintained. A representative retailer sold 200 washers in two recent weeks. At this rate trainload shipments will be wanted before long.

VACUUM CLEANERS.—A heavy trade is being cared for. Manufacturing facilities are hard-pressed to meet the demand, and some shortages are encountered now and then. On the whole, deliveries are not so well maintained as on washers at this time.

LAMPS.—Factory stocks are being rapidly built up to meet the fall demand. All lines are now reported to be in ample supply.

ELECTRIC SIGNS.—A slow revival of sign business is in progress. Materials are so plentiful now that little obstacle can be seen to expansion along broad lines. Keener competition in the retail trade will shortly develop a technique of electric sign practice that will be felt in fields now lying dormant.

MOTORS.—A dull market continues, with fairly good sales in smaller sizes, but sub-normal demand for new installation equipments. Prices show little or no movement.

FIRE-ALARM SIGNAL EQUIPMENT.—Business is quiet, municipal improvements centering on street construction to employ labor more widely. Considerable activity is noted in the sale of police signal apparatus, owing to crime waves. Industrial fire-alarm demand is dull.

METERS.—Trade is improving somewhat, with a decidedly good demand from Connecticut. Building operations in that state are quite active.

ELECTRIC TABLEWARE.—A good retail trade is being looked after, and no difficulty is reported as to supply. Retailers are featuring this apparatus to advantage.

SCHEDULE MATERIAL.—A moderate business is being handled, but stocks will stand a much heavier drain than this without running short.

INDUSTRIAL ELECTRIC TRUCKS.—Business is picking up somewhat, and inquiries are in good volume. A little government buying is to be seen. Bids are reflecting close competition.

ELECTRIC WATER HEATERS.—Great interest has been aroused in water heating for "all electric" kitchen service. An Augusta (Me.) group meeting of central-station men last week brought out much practical information as to requirements and achievements, and an early and rapid development of equipment for the local market would not be surprising.

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ATLANTA

Business in almost all lines continues active and a free movement of material is evident. The first day of the telephone operators' strike at Atlanta created some confusion, but since then all channels of communication have been open with some small delays. The telegraphers' strike in sympathy is being little felt so far. The "Morris plan of banking," which has been established in the East for some time, has been extended to the Southeast, and it is expected that appliance sales will be further stimulated as a result, permitting dealers to discount the paper of customers. The volume of appliance sales is steadily increasing as all interests are widening their scope of activity.

FANS.—Continual rains with an attending coolness considerably below normal has slowed up the movement of fans compared with the flurry of two weeks ago, when seasonal temperatures were expected. Stocks are in good shape, with a possible shortage in the 32-volt product.

WASHING MACHINES.—One manufacturer is falling behind in deliveries, which is being reflected in this section. The jobbers find it a difficult matter to keep the demand supplied. A few jobbers, anticipating the present demand, ordered well in advance and their stocks are in fairly good condition. Prices are steady.

WIRE.—The call for all wires is excellent. Weatherproof base advanced this week from 21 to 22 cents. Requirements for rubber-covered appear to be increasing, but prices are somewhat unsettled, ranging on No. 14 anywhere from 20 to 22 cents.

RANGES.—A slight revival is noted and activity has been stimulated through efforts of specialists and service stations of the large appliance companies. Local stocks are large and factory shipments are good. Prices remain unchanged.

MOTORS.—A quicker movement is observed in fractional-horsepower and capacities up to 25 hp. This is explained by the fact that a number of small manufacturing plants are being started. Then, too, last week's price adjustment may have affected the market to some extent. Shipments are nearing normal.

SCHEDULE MATERIAL.—Prices are firm. The demand has stiffened this week in response to contractor requirements for residence and apartment construction. Local stocks are being well maintained by incoming shipments.

INCUBATORS.—This item is receiving more attention and sales are becoming more active.

SAFETY SWITCHES.—There is big business being transacted, and present indications point to a larger volume of sales. The "safety first" movement, combined with city ordinances and the efforts of city electricians, has tended to extend the demand for apartment and industrial cutins. A 30-amp. size has been put on the market that compares favorably in price with the open-knife type. Factory deliveries are normal.

STORAGE BATTERIES.—Dealers state that factory facilities have improved to such a point that shipments are arriving rapidly and the shortage of a few weeks back is no more in evidence. The demand is steadily increasing, but stocks are ample.

INSULATORS.—The movement on glass has slackened, while shipments are good and prices remain steady. Deliveries on porcelain have reached normal. The call is spotty, and on the whole transactions are at a low level.

POLES.—Independent telephone buying and small municipal plant extensions and maintenance have propped up this item. Florida and South Georgia are leaning toward cypress. The demand for chestnut predominates, but Western cedar is making substantial inroads, even though chestnut poles are being offered at a much lower price. Deliveries from all points are reported as being excellent.

HARDWARE.—Although prices have remained fairly steady of late, the general market is in an expectant attitude and large transactions are scarce. Buying in small lots is frequent, however, and the volume of business at this time is all that can be expected. Stocks are good.

SEATTLE—PORTLAND

The impression prevails that better business is just around the corner and that before midsummer the industrial life of the Northwest will have been resumed on a scale approximating war-time conditions. Jobbers in Seattle during the past week reported sales light, which is true of every large city in the Puget Sound district. Projected industrial enterprises, calling for large electrical installations, are still on paper. The Western Rolling Mills, Hoquiam, Wash., are in the market for a number of large motors.

Dealers, on the other hand, report a comparatively active week. Sales of house-wiring devices, domestic appliances and electric tableware especially show a noticeable increase. Prices, with the exception of certain sizes of copper wire which moved up last week, stand firm. Collections are in excellent shape. No new requests for extension of credit are reported, and no new credits of any consequence have been placed for several weeks.

The volume of building in Seattle in May was more than three times what it was in January of this year and exceeds the volume of May of last year by $500,000.

It is reported that one of the largest wireless stations in the world is to be erected in Seattle by the War Department. The station will connect with another to be installed at Fairbanks, Alaska.

ELECTRIC TABLEWARE.—The two largest dealers in Seattle report increasing sales of percolators, toasters and chafing dishes. Percolators especially are showing increased movement, closely followed by toasters.

FANS.—Seattle and the Puget Sound district have had no weather which could be characterized strictly as fan weather. The actual summer season is short and exceedingly mild, and extremely hot days are the exception. Dealers with but few exceptions carry little if any stocks, while jobbers' stocks are just sufficient to tide over a few days.

SAN FRANCISCO

Orders continue to arrive, and their total is of surprising volume. Credits and collections are in healthy shape. Trade acceptances of ninety-day duration are almost universally used to cover device sales and big jobs. The natural products of California, upon which the state's prosperity chiefly depends, are of encouraging volume. Eastern shipments are a little slower, now running over a month for less than carload lots and about three weeks' time for carload shipments. The only discouraging feature is the inability of many factories to make prompt shipments.

VACUUM CLEANERS.—A few Eastern shipments have been received, but, generally speaking, there has been a temporary stagnation due to poor deliveries. Those who placed advance orders with several factories are receiving small monthly quotas.

IRONING MACHINES.—A more determined effort has been made to impress the public with the idea that ironing machines should accompany the majority of washing-machine sales, but in spite of floods of inquiries sales have been of disappointing volume because of the lack of stock.

WASHING MACHINES.—The market is very brisk, and it is reported that several additional outlets will shortly be obtained for sales efforts, such as a certain large and conservative department store, besides many firms which have recently deserted contracting for device sales.

SMALL MOTORS.—Small-motor applications, such as sewing-machine motors, drink mixers and the like, have been considerablly hurt by a strike in a large factory. Prices remain steady, and there are an increasing number of quantity sales.

FIXTURES.—The local fixture game has greatly changed during the past few years, because of the element of the owners' personality in the choice and the elimination of many of the smaller cumbersome metal fixtures for glassware. Designing and drafting departments are more busy than the sales departments. Good stocks are accumulating.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

Twin-Conductor

	No. 14 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
	No. 12 Solid
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

	No. 14 Solid
Less than coil	List
Coil to 1000 ft.	5%
	No. 12 Solid
Less than coil	List
Coil to 1000 ft.	5%

Twin-Conductor

	No. 14 Solid
Less than coil	$100.00
Coil to 1000 ft.	82.50
	No. 12 Solid
Less than coil	List
Coil to 1000 ft.	5%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to 20%
Std. pkg.	23% to 36%

BATTERIES, DRY
NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	40	40—41
50 to barrel	35—36	36—37
Barrel lots	.32—.329	.33—.339

BATTERIES, DRY—Continued
CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
⅛	250	$5.00
¼	250	7.50
⅜	100	10.00
½	50	13.00
1	50	21.00
1¼	50	26.00
1½	25-50	35.00
2	25-50	45.00
2½	25-50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single trip	$75.00	$63.75— 69.75
⅜-in. double strip	75.00— 82.50	72.00— 75.00
½-in. single strip	100.00	85.00— 93.00
½-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$75.00	$63.25 to $63.75
⅜-in. double strip	78.25	71.25
½-in. single strip	100.00	75.00 to 85.00
½-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.	$25.00	$20.75	$21.50
¼-in.	30.00	21.50	20.50

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
7/32-in.	$33.00	$17.50	$16.25
¼-in.	36.00	19.00	17.25

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3% to 6.1%	+1% to 8.1%
2500 to 5000 lb.	2% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.50
Discount	25%

CHICAGO

List price	$6.35 to $7.50
Discount	30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	30%
1/5 to std. pkg.	40%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$6.00 to $8.75
1/5 to std. pkg.	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$8.00
1/5 to std. pkg.	7.00

Standard packages, 500. List each, $0.07

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LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$35.01–$35.18
Coil to 1000 ft	25.94– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00
Coil to 1000 ft	21.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–40%	10%–32%
$10.00 to $50.00 list	30%–50%	20%–43%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$17.85–$24.15
1/5 to std. pkg	14.70– 21.00

Standard pkg., 2200. List per 1000, $20.00 to 21.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg	11.20– 16.00	22.40– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20 to list
1/5 std. pkg	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	23%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 33%	24% to 25%
$2.00 to $10.00 list	30% to 33%	24% to 25%
$10.00 to $50.00 list	30% to 45%	25% to 30%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.41
No. 18, full spools	.35– .39

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.46
No. 18, full spools	.41

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	18.54	18.54	13.90
10	24.96	24.96	16.64
8	34.02	28.35	22.68
6	53.94	44.95	35.96

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$17.50–$18.50	$10.00	$9.25–$10.00
12	22.05	22.05	18.90
10	29.68	29.08	25.44
8	40.39	34.62	24.62
6	63.84	54.72	54.72

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Ins.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$26.00–$29.25
25 to 50 lb	26.00– 25.25
50 to 100 lb	25.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$25.25 to $25.75
25 to 50 lb	25.25 to 25.75
50 to 100 lb	25.25 to 25.75

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NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Portable Color-Matching Unit for Counter Use

Four portable "Trutint" units for producing an accurate color-matching light with clear gas-filled lamps have

HARMONIZES WITH APPOINTMENTS OF HIGH-CLASS STORES

been standardized by the Nela Specialties Division, National Lamp Works of the General Electric Company, Cleveland, Ohio, and are now being manufactured for use on dry-goods counters or tables. They are more elaborate fixtures than the previous units in the line and are intended to harmonize with the appointments of high-class shops.

Safety-Fused Oil Starters for A. C. Motors

For controlling alternating-current induction motors and not only affording protection against overloads, short circuits and single-phase running, but also preventing the abuse of fuses, "Type I" safety-fused oil-motor starters have been brought out by the Condit Elec-

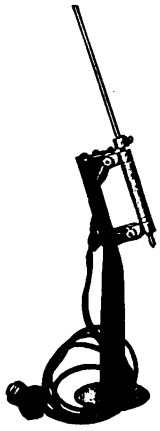
PROTECT AGAINST OVERLOADS, SHORT CIRCUITS AND SINGLE-PHASE RUNNING

trical Manufacturing Company of South Boston, Mass.

These starters are supplied in two, three and four poles for 250-volt and 600-volt service and are arranged with fuse clips to accommodate NEC inclosed fuses. Undervoltage or shunt-trip attachment can be obtained. They conform with the safety code of various states, may be locked in an open position, and are arranged with knock-out holes to take either conduit or open wiring. In their safety, maintenance and installation features these starters resemble the "Type N-1" oil starters with overload coils made by this company and described in the ELECTRICAL WORLD for April 5, 1919.

Soldering Iron for Incandescent Lamp Terminals

For soldering the terminals of incandescent lamps a specially designed electric soldiering iron is being made by the William H. Dalton Company, 4 Charlotte Street, Salem, Mass. The iron contains a copper rod which is capable



SOLDERING ROD IS EASILY RENEWABLE

of being readjusted and pushed downward as it is used. To do the work required this rod must be small in diameter—$\frac{3}{16}$ in. (4.77 mm.)—and must be cleaned frequently. Necessarily the length of the rod is gradually decreased. However, it is possible to renew the rod very conveniently, the maker states. A stand for fastening the soldering iron to bench or work table is supplied, as well as a length of cord and a plug for lamp-socket connection.

Three-Heat Electric Iron

By means of a heat-regulating plug three different heats may be obtained in the "Everhot" electric iron, which the Redtop Electric Company, 8 West Nineteenth Street, New York City, has brought out for domestic and factory use.

The iron is so constructed that when the plug is adjusted for the first or low heat an energy consumption of 125 watts is obtained. The second or medium heat uses 275 watts, while in obtaining the third or high heat 550 watts is used.

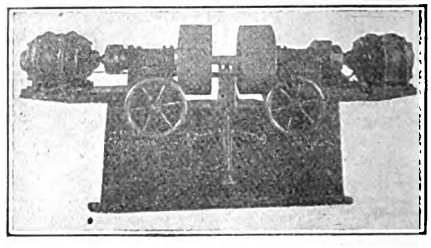
THREE HEATS OBTAINED BY CHANGING POSITION OF PLUG ON TERMINALS

The heating area covers the entire bottom of the iron, which weighs 6½ lb. (3 kg.) and is supplied with a heel stand, 6 ft. (1.8 m.) of cord, and a plug for lamp-socket attachment as well as the heat-regulating plug.

There are three connector terminals on the iron which are connected to the resistor so that changing position of plugs gives the different heats.

Electrically Driven End-Surface Grinding Machine

To finish the end surfaces of various parts an electrically operated grinder has been developed by C. L. Hawes, 12 Adams Street, Ashtabula, Ohio, for use in machine shops and factories. It carries two cup-type emery wheels with 6-in. (15-cm.) faces, diameters of 18 in. (45 cm.) and 3-in. (7.6-cm.) faces on the cap side. Each wheel is directly connected to a 5-hp., 1200-r.p.m., 60-cycle, alternating-current motor. The end surface of the parts can be ground



FOOT PEDAL CONTROLS MACHINE

to any desired length from 3 in. to 12 in. (7.6 cm. to 30 cm.), since adjustable stops are provided.

By pressing down a foot pedal the operator spreads the wheels apart so that the work can be placed in a jig to be ground. When the operator releases the pedal the wheels close automatical-

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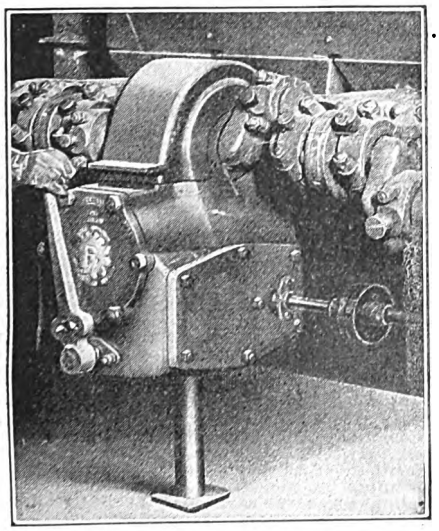
ly, the jig in the center being moved mechanically across the face of the wheels so that they will wear true and the ends of the work will be ground square. Either wheel can be adjusted independently of the other to any distance from the center, this being done by handwheels at the front of the machine.

The grinding machine is equipped with roller bearings. High-speed flexible-type couplings are used to connect the grinding spindles to the motors.

Two-Speed Gear Box for Stokers

The two-speed gear box recently placed on the market by the Sanford Riley Stoker Company of Worcester, Mass., differs from customary stoker gear boxes since it contains, in addition to the worm gearing, a double set of spur gears. These gears are so arranged that by shifting a lever on the box from high-speed to low-speed position or vice versa the coal feed may be retarded or accelerated. On large units the fire can therefore be leveled, thinned or thickened, as required.

When a number of stokers or gear boxes are driven by a single prime mover, any stoker can be operated almost independently of all other stokers or gear boxes through the use of this box. With the stokers driven by an ordinary engine or motor double the usual range of speed is obtained. This is an advantage at high ratings (300 to 350 per cent). The stoker countershaft at these loads usually has a speed of from 400 to 450 r.p.m., and if an engine were used it would be required to operate at from 100 to 150 r.p.m. Such low



SHIFTING THE LEVER ACCELERATES OR RETARDS COAL FEED

speeds are liable to stall the engine and are wasteful of steam; but by shifting the two-speed gear-box lever from high to low speed the engine can operate from 200 to 300 r.p.m., an efficient speed for economical operation.

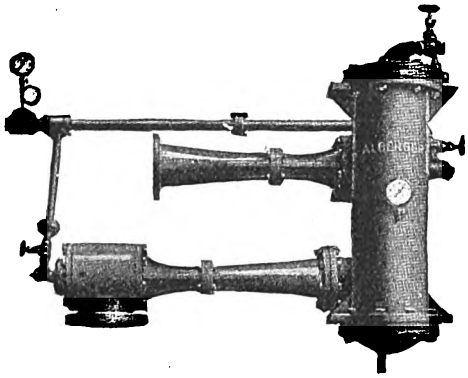
The installation of the two-speed gear box also makes a slip-ring induction motor suitable for stoker drive. A two-to-one reduction in speed is all that can be obtained electrically, but with the two-speed box an over-all range of speed of four to one is obtained.

Since all gear boxes are driven from one through shaft, all sprockets and chain connections, chain guards, countershafts and bearings usually required for each gear box are eliminated. Each stoker with the two-speed gear box has only one chain connection, saving a great deal of mechanism underneath the stoker with large units.

By using the two-speed gear box stokers can be set much lower than usual.

Air Occluders for Surface and Jet Condensers

Operating economy, low cost of upkeep and small space required are advantages which the air occluders made by the Alberger Pump & Condenser



EQUALLY APPLICABLE TO LAND INSTALLATIONS AND MARINE WORK

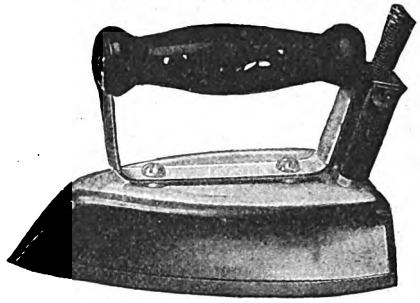
Company, 140 Cedar Street, New York City, for use with surface and jet condensers, are said to possess. Their high efficiency, low cost of attendance and repairs and freedom from breakdown are due to the absence of moving parts. On account of light weight, the small space occupied and simplicity of operation these occluders are particularly suited for marine work, although also applicable to land installations.

The apparatus consists of two stages arranged in series with an intercooler of either the surface or jet type placed between them. The first stage is connected to that part of the equipment from which the air and non-condensible vapors are to be removed and is so constructed that the entering steam entrains the air and non-condensible vapors and compresses them to the pressure existing in the intercooler. The mixture of steam and air and non-condensible vapors is then discharged into the intercooler, which by condensing the steam and cooling the air and non-condensible vapors reduces the volume to be handled by the second stage.

The second stage withdraws the gases from the intercooler and discharges them against atmospheric pressure or against a back pressure not to exceed 1 lb. 70 gm. per sq.cm. above atmospheric, permitting the use of exhaust steam for heating purposes.

Flatiron with Inclosed Heating-Coil Construction

The heating element in the domestic model 6-lb. (2.7-kg.) electric flatiron which has been lately placed on the market by the Simplex Electric Heat-



HEATING ELEMENT HELD WITHIN IRON BOTTOM CLOSE TO IRONING SURFACE

ing Company, 85 Sidney Street, Cambridge, Mass., is the same as those used in this company's ranges and other appliances requiring intense heat. Because of its inclosed coil construction the heating element is twice the length and diameter of the ordinary forms, with a corresponding increase in strength and life. Heavy chromium wire is suspended in grooves in the upper part of the flatiron bottom by small mica blocks. Since nothing but these occasional blocks touches the coil, and as no insulation is needed between the coil and the iron bottom, the chief cause of breakdown in electric irons is removed.

The iron has a highly polished nickel-plated surface, is rated at 570 watts, and is intended for voltages from 100 to 120.

NOTES ON RECENT APPLIANCES

Pliers with Replaceable Cutting Jaws

"Neverslip" pliers with replaceable crucible steel cutting jaws have been developed by the Neverslip Works of New Brunswick, N. J., for use by linemen, electricians, etc.

Mileage Recorder

For recording the mileage of electric and gasoline commercial and pleasure vehicles the H. W. Johns-Manville Company, Madison Avenue and Forty-first Street, New York City, has developed the "Odometer."

Combination Electric and Hand Air Pump

The Visible Measure Gasoline Dispenser Company, 715 West Breckinridge Street, Louisville, Ky., is making a combination electric and hand air pump for garages.

Cut-out Bases

Main-line and branch cut-out bases for NEC and renewable fuses have been brought out by the Economy Fuse & Manufacturing Company, Kinzie and Orleans Streets, Chicago.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

An agency is desired by a man in Belgium (No. 29,479) for the sale of all sorts of electrical goods and machinery.

The purchase of electrical supplies and lighting appliances is required by a firm in Norway (No. 29,494). Payment against documents at destination.

A firm in the Philippines (No. 29,517) having a branch office in this country desires to represent manufacturers for the sale of electrical appliances.

Electrical supplies of all kinds, transmission belting and electrical cables, etc., are desired by a firm in Norway (No. 29,452). Quotations should be given f.o.b. American port of shipment. Terms, cash against documents.

An official of the government of Siberia (No. 29,454) wishes to purchase for the ministry of supplies electrical supplies, a complete list of which together with further information may be had on application to the bureau or its district offices.

A Brazilian engineer (No. 29,478) who will be in the United States shortly desires to purchase materials for the construction of an electric lighting plant and an electric railway, electric railroad supplies, portable electric lighting plants, etc.

A firm in Spain (No. 29,346) desires to secure agencies on a commission basis for the sale of electrical material and apparatus, such as lamps, motors, fans, plates, stoves and water-heating apparatus. Correspondence should be in Spanish.

Resistance wire, covered wire and cables, motors and general electrical material and machinery for developing electric power are required by a firm in Spain (No. 29,453). Quotations should be given f. o. b. New York. Terms, payment in New York. Correspondence may be in English.

BRITISH IMPORT RESTRICTIONS RELIEVED.—The War Trade Board announces that copper wire and copper-clad wire may be imported into Great Britain without individual license.

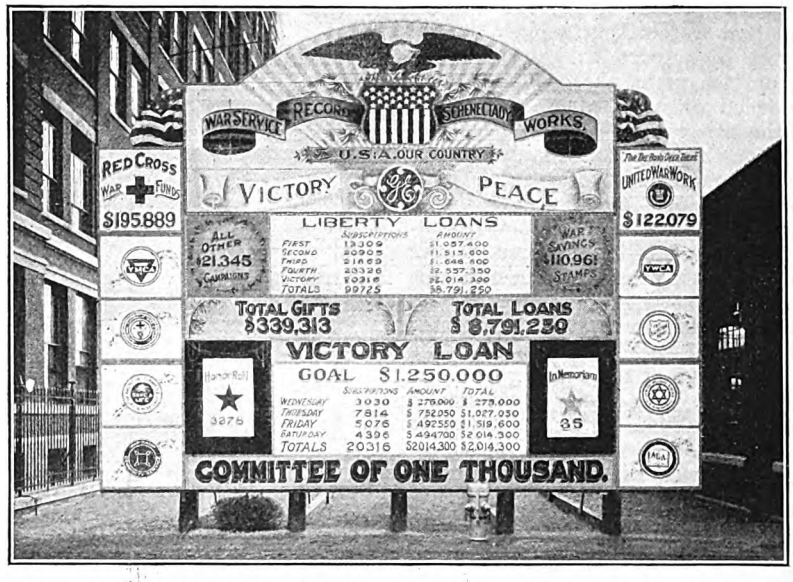
COMMERCE WITH VENEZUELA. — During 1916 imports into Puerto Cabello, Venezuela, of electrical installation materials, amounted to $14,702, while for 1917 the amount increased to $26,154. This material came only from the United States. Considering the whole of Venezuela, the imports were as follows:

	1916	1917
Electrical apparatus	$152,739	$194,252
United States	133,892	188,568
United Kingdom	4,743	4,958
Electric lamps	.....	5,320
United States	.....	4,340
Electric light bulbs	10,601	36,519
United States	9,252	35,594

INDUSTRIAL MAP OF NEW ENGLAND.—The First National Bank of Boston, through its commercial service department, has published a very interesting industrial map of New England; showing by symbols and cuts the leading industries in the cities and towns. A key to the symbols is also included in the map which enables one to locate at a glance the various industries. There is also included a carefully worked-out table of the industrial towns arranged by states, and the leading industries in each city and town are shown. To further the development of foreign trade and to enable the foreign buyer to become familiar with the products which New England manufactures, this map will be published in other languages for distribution in the foreign markets of the world.

ROBBINS & MYERS TO EXPAND.—The Robbins & Myers Company has acquired 5½ acres of ground and all of the factory buildings of the James Leffel Water Wheel Company, adjoining the Robbins & Myers buildings at Springfield, Ohio. As soon as the Leffel company vacates the buildings Robbins & Myers will take possession and increase their force from 3000 to over 5000. Robbins & Myers acquire by purchase 98,000 sq.ft. of factory floor space and all the buildings, including the boiler shop, the erection room, foundry room, woodwork shop and office buildings, thus giving the concern all told approximately 500,000 sq.ft. of floor space over 14 acres of ground. It is reported that the increased factory facilities will mean material growth in the motor-manufacturing department of the company, development of new motors and expansion in the new line of repulsion and induction motors. The Robbins & Myers Company began business in 1878 under the ownership of Chandler Robbins and James A. Myers with a small casting foundry. In 1887 C. F. McGilvray, now president of the company, joined it as superintendent. In 1898 the concern entered the electrical field, producing ceiling fans and later desk and bracket types. Its first power motors followed in 1899. In 1900 Mr. Robbins' interests were purchased by James A. Myers. H. E. Myers resigned in 1915, when Mr. McGilvray became president. Starting in a small way, the firm has grown very rapidly until it now occupies a prominent position in the motor-manufacturing and fan field.

GENERAL ELECTRIC WAR SERVICE RECORD.—The enviable war record of General Electric employees at the Schenectady plant was summarized on a large display board located at the head of Works Avenue, Schenectady, to stimulate interest in the Victory loan. In effect, this display board is a large and handsome poster showing the complete war work of the Schenectady employees in the Liberty loan drives, the various fund campaigns and a record of local G. E. men in the army and navy service. Surmounted by the American eagle and the motto "The U. S. A. Our Country," this board shows the number of bonds sold in all the loan drives, including the record for the Victory loan. It gives the amounts raised for other campaigns, including war savings stamps. The total loans amount to $8,791,250 and the total war gifts to $339,313. The works honor roll contains 3278 names, and there are thirty-five gold stars on the works service flag. This bulletin board is in colors, with the emblem of various war relief organizations on either side, and is really a wonderful piece of work.



WAR WORK OF G. E. SCHENECTADY EMPLOYEES IN LIBERTY LOAN DRIVES

WESTINGHOUSE COMPANY TO BUILD SMALL MOTORS AND AUTOMOBILE EQUIPMENT AT SPRINGFIELD PLANT. —The Westinghouse Electric & Manufacturing Company has taken over the East Springfield (Mass.) plant of the New England Westinghouse Company and will manufacture fractional-horsepower motors and electrical equipment for automobiles at this noted establishment, which was active in rifle production for the Allies during the war. This announcement was made through the Springfield Chamber of Commerce and was followed by a luncheon at the Nyasset Club to A. B. Reynders, works manager, and Frank A. Merrick, manager of the factory during the war period. The ultimate capacity of the plant will be 30,000 automobile type generators and 15,000 small motors per month. It is expected that about 1000 employees will be at work at East Springfield by the end of this year, with an increase of about 2250 next year. The company plans to duplicate its output at Newark and may transfer its small-motor production from Newark during 1920, leaving the New Jersey factory to manufacture meters, as before the war. The estimated cost of machinery and equipment to be provided is $1,000,000. Manager Reynders has been with the Westinghouse company thirty years and was director of production at Pittsburgh until his selection as manager of the East Springfield factory. He is now in Springfield superintending the installation of machinery. The entire plant will be electrically driven. Mr. Merrick will henceforth devote his time to the management of the Canadian Westinghouse Company, Hamilton, Ont., having divided his time between that plant and East Springfield during the war period.

THE BLUEBIRD MANUFACTURING COMPANY is the new name for the National Tool & Manufacturing Company, 2536 University Street, St. Louis, Mo. Heretofore the company was engaged in the manufacture of tools, gages, fixtures, motion-picture machines, typewriting machines, specialties and ordnance material, but since the closing of the war it has deevloped a line of electrical household appliances and from now on intends to devote its efforts exclusively to these electrical products. Its line of goods is being marketed under the name of Bluebird, and the change in the incorporated title has been effected to identify it more closely with its product.

THE O. J. GUDE COMPANY, New York, now comprises the former O. J. Gude Company, the Poster Advertising Company and the Van Beuren Bill Poster Company. The former Gude company has been acquired by the Poster company. The new company occupies one-half the city block on Eleventh Avenue from Fifty-sixth to Fifty-seventh Streets, and the entire organization is under one roof—executive, sales, art, painting studios, electrical laboratories, construction and engineering departments, machine shops and garages. Kerwin Fulton is president of the new company, O. J. Gude is chairman of the board of directors, Irving Bromiley is general manager, Harold J. Mahin is general sales manager, and Clyde S. Thompson is promotion manager.

THE ALPHA ELECTRIC COMPANY, INC., 116-118 West Twenty-ninth Street, New York City, is about to move to 151-155 West Thirtieth Street, where the larger quarters will enable it to handle a rapidly growing jobbing business. Organized five years ago, the company has been consistently growing month after month, and during 1918 it trebled its business for 1917. James H. Hughes, general manager, has just returned from St. Louis, having secured for his company the agency for the Blue Bird electric washer. The territory embraced in the contract covers Greater New York, all of Long Island, the territory from New York City to Poughkeepsie, Port.

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Jervis, N. Y., Trenton, N. J., and Fairfield County, Conn. The company is preparing a plan to market this washer through the contractor-dealer and plans for him to sell machines on time payments.

F. C. ROBERTS is now sales manager of the Great West Electric Company, Winnipeg, Canada.

P. W. SOTHMAN is going to Copenhagen to take charge of the European office of P. W. Sothman & Company, engineers, 30 Church Street, New York City.

THE W. T. McCULLOUGH ELECTRIC COMPANY, electric supply jobber, Pittsburgh, Pa., has recently moved into new and larger quarters at 317-319 First Avenue.

THE WELLMAN-SEAVER-MORGAN COMPANY announces the opening of an Atlanta office at 318 Hurt Building, in charge of E. R. Kenner.

L. W. HENCH, formerly power sales engineer for the Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, is now sales manager of the International Oxygen Company, Newark, N. J.

W. B. WALLIS, vice-president of W. E. Moore & Company, consulting steel engineers, of Pittsburgh, sailed on the Mauretania May 13 for Europe on an extended business trip. His firm has received a demand for electrical furnaces built under the Moore patents at the large industrial centers of the leading western European countries and these require personal attention. Electrical furnaces built under the Moore patent, known as the Pittsburgh furnace, are now in extensive use in the steel-mill districts.

W. B. WALLIS

THE EUREKA VACUUM CLEANER COMPANY of Detroit, Mich., began with May the publication of a monthly bulletin entitled "Volume and Velocity," which will be sent to dealers in vacuum cleaners. It is designed to promote the intelligent merchandising of this company's products.

JOHN F. VAUGHAN, formerly manager of the New England district, United States Shipping Board Emergency Fleet Corporation, has returned to his consulting engineering office at 185 Devonshire Street, Boston, which during the war has been in charge of his principal assistant, E. A. Ekern.

H. H. ASHINGER, formerly chief engineer of the George Cutter Company, has recently been appointed general manager of the Peru Electric Company, Peru, Ind., manufacturer of standard and special porcelain and wiring devices. An extension of factory space is contemplated by the company to take care of the manufacture of new developments.

J. W. McCABE, who until recently has been district manager of sales for the Chicago Pneumatic Tool Company at Buffalo, N. Y., has been appointed special representative for the company's foreign trade department, and will depart shortly for an extended trip throughout the Orient, the Philippine Islands and Australia. W. H. White has been appointed acting district manager of sales at Buffalo to take charge of that territory during Mr. McCabe's absence.

Trade Publications

ELECTRIC RANGES.—An electric range folder for mailing to retail "prospects" has been prepared for the trade by the Simplex Electric Heating Company, 85 Sidney Street, Cambridge, Mass.

ELECTRICALLY HEATED HOUSEHOLD UTENSILS.—The Manning, Bowman Company of Meriden, Conn., has prepared a folder telling about its electrically heated household utensils.

OUTDOOR BUS SUPPORTS.—Hickey & Schneider, Inc., 441 East Jersey Street, Elizabeth, N. J., are distributing bulletin No. 13, of forty-eight pages, which covers H. & S. outdoor-type bus supports.

EXTERNALLY OPERATED ENTRANCE SWITCHES.—The Trumbull Electric Manufacturing Company of Plainville, Conn., tells of one of its externally operated entrance switches in circular No. 44.

WOOD PRESERVATIVE.—The Carbolineum Wood Preserving Company, 518 Prairie Street, Milwaukee, Wis., has prepared circulars No. 29 and 39, telling about the "Arrow" carbolineum wood preservative.

MEASURING INSTRUMENTS. — The Thompson-Levering Company, 325 Arch Street, Philadelphia, has issued a forty-page bulletin, No. 119, to describe and illustrate its electrical measuring instruments.

HIGH-SPEED STEEL.—The properties, manufacture and treatment of "Urite" high-speed steel are set forth in a booklet which the Hercules Electric Steel Corporation, 137 Lafayette Street, New York City, is distributing.

FLOOR MACHINE.—The Kent Vacuum Cleaner Company of Rome, N. Y., has prepared a booklet giving instruction for assembling and also for using the electrically driven "Utility" floor scrubbing and polishing machine.

CONDENSERS AND AUXILIARIES.—An illustrated booklet of 191 pages has been prepared by the C. H. Wheeler Manufacturing Company, Lehigh and Sedgley Avenues, Philadelphia, to describe its condensers and auxiliaries.

METER PROTECTIVE TRIM. — The "Standard" meter protective trim for use with externally operated entrance switches is the subject of circular No. 45 issued by the Trumbull Electric Manufacturing Company, Plainville, Conn.

BLACK ENAMELS AND JAPANS.—A third revised edition of bulletin No. 1 on "Hilo" black enamels and varnishes for air drying and baking has been issued by the Hilo Varnish Corporation, Marcy and Flushing Avenues, Brooklyn, N. Y.

SUPERHEATER.—The Locomotive Superheater Company of 30 Church Street, New York City, and People's Gas Building, Chicago, has prepared an eight-page bulletin T-2, which sets forth the advantages of the Elesco stationary superheater.

DYNAMOMETERS. — Superseding bulletin No. 78,701, bulletin No. 48701-A has been issued by the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York City, and covers Sprague electric dynamometers.

PORTABLE LAMPS, LANTERNS, FIXTURES, ETC.—The Novelty Lamp & Shade Company, 418 West Prospect Street, Cleveland, Ohio, has prepared catalog No. 34, illustrating and describing portable lamps, lanterns, brackets, pendants, porch lights, billiard lights and semi-direct lighting bowls.

OVERHEAD MATERIAL HANDLING. —Bulletin No. 48,713 from the Sprague Electric Works of the General Electric Company, 527 West Thirty-fourth Street, New York City, has for its subject the Sprague adjustable-loop system of overhead material-handling machinery for terminal sheds.

ELECTRICALLY HEATED MELTING POTS.—"Melting Metal with Electrically Heated Pots" is the title of a six-page envelope folder just published by the Cutler-Hammer Manufacturing Company of Milwaukee and New York. This folder calls attention to the advantages of electrically heated melting pots over gas and gasoline.

ELECTRIC SIGNS.—A number of interior-illuminated electric signs are shown in a circular from the Flexlume Sign Company of Buffalo, N. Y.

BORING TOOLS.—Boring machines and bits for electricians are the subject of a folder from the W. A. Ives Manufacturing Company, Wallingford, Conn.

METER BOX.—The Electrical Manufacturing Company, 4149 East Seventy-ninth Street, Cleveland, Ohio, is distributing a folder telling about its safety meter box.

BUCKET ELEVATORS. — Standard bucket elevators are described and illustrated in a seventy-one-page catalog, No. 244, issued by the Jeffrey Manufacturing Company of Columbus, Ohio.

New Incorporations

THE GAINADAY ELECTRIC COMPANY of Dormont, Pa., has been incorporated by Charles B. Barton and associates. The company is capitalized at $50,000 and proposes to manufacture electrical appliances, etc.

THE ADJUSTABLE DROPLIGHT COMPANY of New York, N. Y., has been chartered with a capital stock of $25,000 to manufacture electric devices and supplies. The incorporators are: R. K. Thistle, S. B. Howard and P. L. Nieser, 65 Cedar Street.

THE CUTTING & WASHINGTON RADIO CORPORATION of New York, N. Y., has been incorporated with a capital stock of $36,750 to manufacture radio equipment. The incorporators are W. C. Schmidt, F. and R. F. Cutting, 32 Nassau Street, New York City.

THE WELLAND (ONT.) UTILITY MANUFACTURING COMPANY has been incorporated by George A. Mitchell, Charles B. Wilson, Arthur J. J. Brennan and others. The company is capitalized at $250,000 and proposes to manufacture electrical appliances, tools, machinery, etc.

THE ELECTRIC LOCK CORPORATION of New York, N. Y., has been chartered with a capital stock of $200,000 to manufacture electric motors, dynamos, electric machinery, etc. The incorporators are C. A. Jayne, A. F. Reed and P. M. Freeman, 81 Fulton Street, New York City.

THE CRESCENT ELECTRIC SUPPLY COMPANY of Dubuque, Iowa, has been incorporated by Titus B. Schmid, T. F. Kelley and A. J. Schmid. The company is capitalized at $50,000 and proposes to manufacture and deal in electrical supplies, wiring fixtures, hardware, etc.

THE COMMERCIAL RADIO COMPANY OF AMERICA of Providence, R. I., has been chartered with a capital stock of $100,000 by Frank E. Dyson, 43 Pakis Avenue; Ratcliffe G. E. Hicks and Thomas P. Giblin of Providence. The company proposes to manufacture wireless apparatus.

THE UNIVERSAL X-RAY LABORATORIES of New York, N. Y., has been incorporated by B. H. Bernstein, R. Seixas and L. Robbins, 1476 Broadway, New York City. The company is capitalized at $30,000 and proposes to maintain X-ray laboratory service for physicians.

THE VICTORIA TURBINE MIXER COMPANY of Toronto, Ont., has been incorporated by Walter A. Sadler, 67 Yonge Street; Charles A. Couch, George Stevenson and others. The company is capitalized at $100,000 and proposes to manufacture gasoline-saving devices, electrical and mechanical equipment, etc.

MEYER, STRONG & JONES, INC., of New York, N. Y., have filed articles of incorporation with a capital stock of $50,500 for the purpose of doing a general contracting, mechanical, civil and electrical engineering business. The incorporators are: Schuyler M. Meyer, John L. Dunn and L. H. Hoheim, 20 Exchange Place, New York, N. Y.

THE RAYDEX MANUFACTURING COMPANY of Brackenridge, Pa., has been incorporated by W. F. Detweiler of Trentum, Charles C. Henderson of Aspinwall, Paul A. Stewart of Cheswick, George M. Swan and John R. Rosenbaum of Pittsburgh. The company is capitalized at $150,000 and proposes to manufacture metal furniture, electrical devices, etc.

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New England States

BANGOR, ME.—Improvements are contemplated by the Bangor Railway & Electric Company at both the Ellsworth and Veazie power stations, and also for the reconstruction and reinsulation of the feed wires between the two stations. At the Ellsworth station a 25,000-kw. generating unit is to be installed and at the Veazie station three high-efficiency waterwheels will replace the old wheels now in use.

SWANTON, VT.—At a town meeting held recently the trustees were authorized to enter into a contract with the Wallace Sandstone Company of Phillipsburg, Que., for electric power. The transmission line will be erected as soon as possible via Highgate Springs to the international boundary.

Middle Atlantic States

FORESTPORT, N. Y.—Preparations are being made by the Board of Village Trustees for the construction of a new electric light plant.

GLENS FALLS, N. Y.—The Council is considering a proposal submitted by the Adirondack Electric Power Corporation for the installation of an ornamental lighting system in the business section of the city. The cost is estimated at about $10,000.

GREENWICH, N. Y.—The Consolidated Electric Company is reported to be contemplating an addition to its plant. Harry C. Gray is manager.

HADLEY, N. Y.—The plant of the Hadley Lighting Company was recently sold to John Gatti of New York City for $3,025.

MIDDLETOWN, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until July 1, for construction, including heating, sanitary and electrical work, for new building for chronic patients at the Middletown State Homeopathic Hospital. Drawings and specifications may be seen at the above institution, or at the office of the New York office of the Department of Architecture, Room 618, Hall of Records Buidling, New York City. Copies of plans and specifications may be obtained at the Department of Architecture, Capitol, Albany. L. F. Pilcher is state architect.

NEW YORK, N. Y.—The Wappler Electric Company, 173 East Eighty-seventh Street, New York City, has acquired a site on Harris Avenue, Long Island City, on which it proposes to erect a three-story plant. R. H. Wappler is president.

NEW YORK, N. Y.—A special committee has been appointed by Jefferson De Mont Thompson, president of the Broadway Association, to investigate and make recommendations for improving the lighting system on Broadway. A. F. Berry of the United Electric Light & Power Company and Charles Law of the New York Edison Company are among the members of the committee.

NEW YORK, N. Y.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3933, for the installation of electric traveling cranes at the local navy yard. The cost is estimated at about $200,000. Bids will also be received at the same time and place for elevators for building at the shipbuilding way, No. 1, under Specification 3934. The cost is estimated at $15,000.

SARATOGA SPRINGS, N. Y.—A committee consisting of two representatives of the City Council, Chamber of Commerce, Business Men's Association and the Adirondack Electric Power Corporation has been appointed to make investigations relative to the installation of a new lighting system on Broadway and in the city parks.

NEWARK, N. J.—Contract has been awarded by the American Oil & Supply Company, Lafayette Street, to the K-W Electric Company, 49 Lawrence Street, for electrical work in connection with the construction of the group of manufacturing buildings which are now being built on Wilson Avenue.

BETHLEHEM, PA.—Bids will be received by the Bureau of Water until June 23 for furnishing and installing a 2,000,000-gal. electrically driven centrifugal pump. R. L. Fox is city engineer.

LACKAWANNA, PA.—Bids will be received by the Common Council of the city of Lackawanna until June 16 for material and supplies for equipping the pumping station for electrical operation. Plans and specifications may be obtained on aplication to the Commissioner of Public Works.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

MYERSTOWN, PA.—Preliminary plans are being prepared for the construction of a new power plant in connection with a number of new buildings at the Albright College. The cost of the entire work is estimated at about $200,000.

CREAGERSTOWN, MD.—The citizens of Creagerstown have contracted with the Hagerstown & Frederick Railway Company of Hagerstown for the installation of an electric lighting system. The cable of the company will be tapped at Lewistown and energy will be transmitted over a 4-mile transmission line. Funds to the amount of $4,200 have been subscribed to erect the line. Creagerstown has not a post office.

INDIANHEAD, MD.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning the construction of a power plant, to cost about $200,000, at Indianhead. (Specification 3924.)

WARWOOD, W. VA.—The Highglow District Electric Sign Company is planning to convert an air-craft plant into an electrical sign factory.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 1, for supplying to the various federal buildings, marine hospitals and quarantine stations under the control of the Treasury Department portable desk lamps during the fiscal year ending June 30, 1920. Drawings and specifications may be obtained at the above office.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until June 20, various yards, under Schedule 4102, dry cells. Until June 24, various yards, Schedule 4109, miscellaneous flashlights and batteries. Until June 27, South Charleston, W. Va., Schedule 4098, three electric locomotives, rack drive. Hampton Roads, Va., Schedule 4115, one motor-generator set. Until July 1, Boston, Mass., Schedule 4122, twenty brass-melting furnaces. Applications for proposal blanks should designate the schedule desired by number.

North Central States

CEDAR BANK (Forsyth P. O.), MICH.—The State Board of Control is considering the erection of a State Training School at Cedar Bank, to cost about $500,000. The plans provide for an administration building, three dormitories and central heating plant. B. Wickham is secretary. E. A. Bowd, 127 Allegan Street, West, Lansing, is architect.

DETROIT, MICH.—The National Biscuit Company, Tenth Avenue and Fifteenth Street, New York, N. Y., is planning to erect a power plant in connection with its new buildings in Detroit.

DETROIT, MICH.—The Mutual Electric & Machine Company of Detroit has purchased the building at the corner of Fourth and Porter Streets. Extensions and alterations will be made to provide for a floor space of about 100,000 sq.ft. J. L. Frank is president.

PLAINWELL, MICH.—The local plant of the Consumers' Power Company, it is reported, was recently destroyed by fire, causing a loss of about $25,000.

ST. LOUIS, MICH.—Improvements to the municipal electric light plant, to cost about $40,000, are under consideration by the Electric Light and Water Commissioners.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has petitioned the Public Utilities Commission for permission to issue $6,708,000 in bonds. Part of the proceeds, it is understood, will be used for extensions and improvements.

CINCINNATI, OHIO.—The extension of the ornamental lighting system on Vine Street to cover the entire down-town section of the city and to the suburbs is under consideration by the City Council.

CINCINNATI, OHIO.—Bids will be received at the United States Engineer Office, First District, Cincinnati, until July 8 for furnishing gate-operating machinery for dams Nos. 33 and 39, Ohio River.

CINCINNATI, OHIO.—The City Council has adopted the resolution authorizing the installation of new ornamental lamps on McMillan Street, which is one of the main thoroughfares of the suburban section of the city and the first to be equipped with ornamental lamps.

CINCINNATI, OHIO.—Work will soon be started on the proposed rapid transit loop system, which will consist of a series of rapid-transit lines that will completely encircle the city. The old Miami & Erie Canal bed is to be utilized as a roadway for part of the system. Frank Krug is chief engineer of the commission.

CLEVELAND, OHIO. — The Leonard Electric Company, 433 Champlain Avenue, Cleveland, is planning to erect a new plant, 85 ft. by 115 ft.

CLEVELAND, OHIO. — Contract has been placed by the Ohio Electric & Controller Company, 5800 Maurice Avenue, for the construction of a new plant, two stories, 80 ft. by 100 ft.

LIMA, OHIO.—The Ohio Electric Railway Company is considering improvements to its local plant, involving an expenditure of about $200,000. The company is also planning to build within the next five years either at Indian Lake or Scotts Crossing a power plant to cost about $2,000,000.

MANSFIELD, OHIO.—Contract has been awarded by the Triumph Electric & Ice Machine Company for the erection of a plant, 60 ft. by 80 ft.

SHELBY, OHIO.—The Seamless Tube Company is considering the purchase of new equipment for power plant, including generators, etc., and also equipment for machine shop. G. L. Richert is secretary.

SPRINGFIELD, OHIO.—The Robbins & Myers Company has purchased the manufacturing plant of the James Leffel Company, which will be remodeled for the manufacture of electric fans and motors.

WELLINGTON, OHIO.—An election will soon be called to submit to the voters the proposal to issue $50,000 in bonds for extensions and improvements to the municipal electric light and water plant.

EVANSVILLE, IND. — Extensive improvements are being made by the Louisville & Nashville Railroad Company at its shops in Lowell, a suburb of Evansville, including the installation of an electric turntable and an automatic coaling plant. A new roundhouse will be erected later.

WANATAH, IND.—The caiptal stock of the Wanatah Electric Company has been increased from $5,000 to $10,000.

CHICAGO, ILL.—The Iron Mountain Company, recently organized, has purchased a tract of land in East Ninety-fifth Street, on which it will erect a plant, to cost about $250,000. The first unit will cost about $150,000 and will be equipped with electric cranes. The company will manufacture railroad supplies.

CHICAGO, ILL.—The officials of the Illinois Central Railroad Company have agreed with the Chicago Commission on Railway Terminals and a sub-committee of the City Council to a fifteen-year electrification provision being written into the proposed ordinance for the improvement of the south shore. Under the arrangement the company agrees to have its suburban service equipped for electrical operation within five years after the passage of the proposed ordinance; the next five years to equip the freight service north of Twelfth Street, and in the next five years to equip the balance of the freight service south of Twelfth Street for electrical operation.

DECATUR, ILL.—Contract will soon be awarded by the Comet Automobile Company for the construction of an electric power plant, to cost between $60,000 and $70,000. The proposed plant will have an output of 600 hp. and will supply electricity for the automobile works. George W. Jagers is president.

DELAVAN, ILL.—Preparations are being made by the Royal Light & Power Company to erect a 6600-volt transmission line from the new power house at San José to Delavan. When completed the local power plant of the company will be held for use in emergencies. A twenty-four-hour service will be established by the company when the improvements are completed.

GALESBURG, ILL.—Bids will be received by William L. Boutelle, city clerk, Galesburg, until June 16 for one 30-hp., 220-volt, three-phase, slip-ring-type motor, 1800 r.p.m.; three 40-hp. 220-volt, three-phase, 60-cycle, slip-ring-type motors, 1800 r.p.m.; three 600-gal.-per-minute, motor-driven centrifugal pumps, directly con-

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nected, working under discharge pressure of 60 lb. Specifications may be obtained at the office of F. M. Connolly, city engineer.

PALMYRA, ILL.—The Palmyra Light, Heat & Power Company has applied to the Public Utilities Commission for permission to erect and operate an electric transmission line from Palmyra to Waverly; also to build distribution system in the village of Modesto and to supply electrical service in those villages.

ROCK ISLAND, ILL.—The City Council is considering installing Mazda lamps to take the place of 100 arc lamps. Street-lighting service is furnished by the People's Power Company of Moline.

SPRINGFIELD, ILL. — The amended budget of the city provides $50,000 for the municipal electric light plant. Extensions and improvements will be made to the system.

MANITOWOC, WIS. — The Commissioners of Manitowoc are contemplating the installation of street lamps in conjunction with the street-lighting system on South Eighth Street.

SHEBOYGAN, WIS.—The Honold Electric Company, 819 Pennsylvania Avenue, is planning to erect an addition to its plant, to be used for repair and maintenance of storage batteries and automotive electrical devices.

ELY, MINN.—The Council is considering issuing $66,000 in bonds for improvements to the municipal electric light plant and waterworks system.

MONTEVIDEO, MINN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 9 for furnishing material for construction, including structural steel, plumbing, heating, electrical work, etc., for the United States post office at Montevideo. Specifications may be obtained at the above office or from the custodian of site at Montevideo.

CENTERVILLE, IOWA.—The property of the Iowa Southern Utilities Company has been purchased by David C. Fisher & Company of Davenport. The system is valued at $2,500,000 and operates 33 miles of interurban railway and lighting plants in twenty-five towns.

MONDAMIN, IOWA — Arrangements have been made by local business men for the installation of an electric lighting system. Energy to operate the proposed system will be supplied from the plant at Missouri Valley.

CARTHAGE, MO.—The Council is considering the installation of cluster lamps on all paved streets.

FULTON, MO.—A special election will be held June 17 to submit to the voters the proposal to issue $50,000 in bonds for the installation of a municipal telephone system.

KANSAS CITY, MO.—Morris & Company of Chicago, Ill., are contemplating increasing the output of the power plant at its local works.

ST. JOSEPH, MO.—Improvements will be made to the local packing plant of Morris & Company of Chicago, Ill., including the installation of a 300-ton ice machine and other machinery, rebuilding the water condenser, etc.

ST. LOUIS, MO.—The Weber Implement & Automobile Company is planning to build a garage and rebuidling plant, to cost, including equipment, about $350.000.

SPRINGFIELD, MO.—Plans are being prepared by the Springfield Gas & Electric Company for the construction of a new electric power plant, to cost about $750,000.

NORMAL, NEB.—The power plant at the Green Gables Sanitarium was recently destroyed by fire.

PHILLIPS, NEB.—At an election held recently bonds were authorized for the erection of an electric transmission line from the transmission system of the Grand Island Power Company to Phillips.

EASTON, KAN.—Improvements to the municipal electric light plant are under consideration.

GYPSUM, KAN.—The Central Kansas Power Company is contemplating the construction of a large power plant on the western end of its transmission system. R. O. Keys is president of the company.

HUTCHINSON, KAN. — The Hugoton Elevator & Warehouse Company is planning to erect a terminal elevator, to be operated by electricity supplied by the company's own plant.

HUTCHINSON, KAN. — The United Water, Gas & Electric Company is contemplating the erection of an electric transmission line from Hutchinson to Partridge, Arlington, Langdon and Turon, to supply electrical service in those towns. J. F. Spingfield is general manager.

KANSAS CITY, KAN.—Bids will be received by the city of Kansas City until June 18 for equipment for the Quindaro pumping station, including auto stokers for two 600-hp. boilers, one steam-turbine-driven boiler-feed pump, steam turbo-generator and condensing apparatus, two 600-hp. boilers and steam superheaters, 1,000,000-circ-mil stranded copper cable, 3000 volts pressure; miscellaneous cedar poles, insulators, wire braces, etc., and erection of a brick transformer station. William Barclay is engineer.

Southern States

CORNELIUS, N. C.—The City Council is considering an issue of $6,000 in bonds for the installation of an electric lighting system in Cornelius.

WILMINGTON, N. C.—Plans are under consideration by the Morris Fertilizer Company, Third National Bank Building, Atlanta, Ga., for the construction of a fertilizer plant on the Cape Fear River, near Wilmington. The proposed plant will have a capacity of about 75,000 tons per year. The cost of the plant complete, including an electrically operated industrial railway system, is estimated at about $500,000.

SPRINGFIELD, GA.—The local electric light plant, which was recently destroyed by fire, it is reported, will be rebuilt.

BOWLING GREEN, FLA.—The City Council has called an election to submit to the voters the proposal to issue $20,000 in bonds for the construction of an electric distributing system and waterworks system.

FITZGERALD, FLA.—Improvements to the municipal electric light and power plant are under consideration by the City Council.

COLDWATER, MISS.—The installation of an electric lighting system, to cost about $10,000, is under consideration by the City Council.

HARRISON, ARK.—The electric plant of the Harrison Gas & Electric Company was damaged by the recent flood.

MARIANNA, ARK—Improvements are contemplated by the Arkansas Light & Power Company to its local plant, including the installation of a 250-hp. boiler-feed pump, repairs to switchboard and other equipment.

PARIS, ARK.—The City Commissioners are considering plans to establish a municipal electric light plant in Paris.

GARBER, OKLA.—Plans have been prepared by Black & Veatch, Interstate Bank Building, Kansas City, Mo., for the installation of a municipal electric light plant and waterworks system.

LAWTON, OKLA.—Arrangements have been made whereby the Lawton Railway & Lighting Company will secure power after July 1 for operating its system from the Comanche Light & Power Company of Lawton. The plant of the railway company, it is understood, will be closed down. New equipment, including a 250-kw. synchronous motor-generator set, will be installed by the Comanche company.

PERRY, OKLA.—Plans are being prepared by Black & Veatch, Interstate Building, Kansas City, Mo., for improvements to the municipal electric light and water plant.

SULPHUR, OKLA.—The Citizens' Light Company is planning to erect a new electric light plant and ice factory. Paul G. Liebman is manager.

TAHLEQUAH, OKLA.—Bonds to the amount of $200,000 have been voted to establish a municipal electric light plant and waterworks system.

BLOOMBURG, TEX.—The installation of an electric light plant in Bloomburg is under consideration by the City Commissioners.

BROWNSVILLE, TEX.—Contract, it is understood, will soon be awarded for the installation of new condensing apparatus, to cost about $10,000, for the municipal electric light plant. The Council has recently placed a contract with the Southwestern General Electric Company of Dallas for a 500-kw. turbo-generator.

DALLAS, TEX.—The Dallas Power & Light Company has applied for permission to issue $1,500,000 in capital stock and $6,000,000 in bonds to take up outstanding indebtedness and to provide for improvements and extensions.

DONNA, TEX.—The Donna Light, Ice & Power Company is contemplating making improvements to its system. The capital stock of the company has been increased from $5,000 to $10,000.

FORT WORTH, TEX.—The Fort Worth-Mineral Wells Interurban Association has engaged Fred A. Jones, engineer, Dallas, to make a survey of the proposed interurban railway between Fort Worth and Mineral Wells, a distance of 60 miles.

SHERMAN, TEX.—Plans are being considered to build a power plant to supply electricity to both Sherman and Denison. The proposition, it is expected, will be voted on soon.

WICHITA FALLS, TEX.—The Chamber of Commerce is considering the proposition of constructing an interurban railway between Wichita Falls and Burkbernett. Electricity for operating the proposed railway will be obtained from the Texas Light & Power Company.

Pacific and Mountain States

SEATTLE, WASH.—The City Council has directed the Board of Public Works to prepare plans for the installation of an additional hydroelectric unit of 10,000 hp. at the Cedar Lake municipal power plant.

BEND, ORE.—Owing to the fact that the entire flow of the Deschutes River at Benham Falls has been tied up by the State of Oregon, at the direction of the federal government, for power purposes and irrigation, it will not be possible for the Bend Water, Light & Power Company to carry out its plans for construction of a large plant near Lava Falls, above Bend.

NORTH BEND, ORE.—The Buehner Lumber Company is contemplating the purchase of a 500-kw. to 750-kw., 60-cycle, three-phase, 440-volt generating unit. A low-pressure or high-pressure turbine could be used, but the company prefers a surface condenser.

DEL MONTE, CAL.—The State Railroad Commission has granted the Del Monte Light & Power Company permission to issue $25,000 in stock to acquire the transmission line and distribution system of the Pacific Improvement Company.

LOS ANGELES, CAL.—At an election held June 3 the proposal to purchase the distributing system of the Southern California Edison Company within the city limits, for $11,000,000, was carried.

LOS ANGELES, CAL.—The Southern California Edison Company has completed the purchase of what is known as the Shaver Lake property on the San Joaquin watershed of central California in the Sierra Mountains at an elevation of approximately 6000 ft. above the sea level. It is proposed to construct a dam and the necessary tunnels to connect this reservoir with its existing power plant No. 2 on Big Creek, which will result in a substantial increased output of the plant without any additional generating units. The water supply will also be available for proposed power plants Nos. 3 and 4 on Big Creek, below the two existing plants. Eventually the water will be used by three power plants with a total drop of 4000 ft.

SAN DIEGO, CAL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3921, for construction of distributing system at the local navy yard, to cost about $58,000.

GRACE, IDAHO—Bonds to the amount of $15,000 have been voted for the purchase of the local lighting system.

MESA, ARIZ.—The City Council has decided to call an election to vote on the proposal to issue $100,000 in bonds for municipal improvements, including gas plant, installation of additional equipment in the municipal electric light plant and extensions to power service and improvements to water system, etc.

YUMA, ARIZ.—The Southern Sierras Power Company of Denver, Col., has entererd into a contract with the Sanguinetti & Ewing Company for the extension of its electric transmission system to the irrigated districts in this section to supply energy to operate the pumping plants and for farming operations. About 20,000 acres of land will be added to the irrigation system in addition to the area now being watered from the pumping plants.

PINE BLUFF, WYO.—Bonds to the amount of $40,000 have been voted for extensions to electric light plant, water mains and sewers.

GROVE, COL.—Bonds to the amount of $34,000 have been voted for the installation of an electric light plant and waterworks system.

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SANTA FE, N. M.—A committee has been appointed by the council to negotiate with the Santa Fe Water & Light Company relating to the purchase of its plant and to appoint an engineer to appraise the property.

Canada

VANCOUVER, B. C.—The Lang Electrical Fixture Company of Vancouver has been awarded the contract for electrical work in connection with the new plant under construction by the Morrison Wire & Steel Company on Industrial Island.

ROBERVAL, QUE.—Improvements are contemplated to the municipal hydroelectric plant to cost about $20,000. New equipment includes a 300-hp. horizontal-shaft turbine, 50-ft. head, speed 600 r.p.m.; one 250-kva. alternating-current generator, exciter and switchboard. J. F. Trenton of Chicoutimi is engineer.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing agent, the Panama Canal, Washington, D. C., until June 26 for scrap-cutting machine, copper wire and cable solder, dry batteries, reflectors, sockets, condulet covers, lamp carbons, tape, fuses, etc. Further information relating to this circular (1284) may be obtained at the above office.

Record of Electrical Patents

Notes on United States Patents

(Issued May 27, 1919)

1,304,534. CABLE SPLICE; Newton K. Bowman, Canton, Ohio. App. filed April 6, 1918. Has gripping spurs.

1,304,545. ELECTRIC SOLDERING DEVICE; Frederick A. Costello, Southbridge, Mass. App. filed Oct. 2, 1918. Tubular holder.

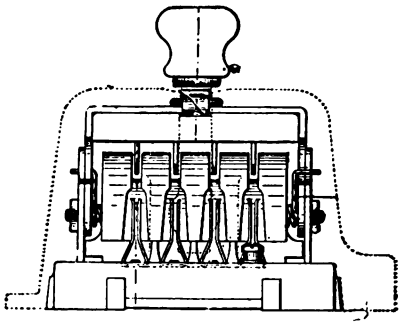
1,304,564. ELECTRIC SWITCH; Ellsworth A. Hawthorne, Bridgeport, Conn. App. filed Sept. 24, 1913. Rotary snap type.

1,304,573. ELECTRICAL DIRECTION INDICATOR; Hosaku Kageyama, Los Angeles, Cal. App. filed Sept. 30, 1914.

1,304,588. TRAY FOR BATTERY CELLS; James F. Monahan, Newark, N. J. App. filed Nov. 30, 1915. Alkaline cells.

1,304,594. ELECTRIC SEAM-WELDING DEVICE; Walter A. Patscheider, Lynn, Mass. App. filed Oct. 29, 1918. Means for clamping seam to work.

1,304,624. ELECTRIC HEATING APPARATUS; John P. Sunderland, Albany, N. Y. App. filed Aug. 1, 1917. Long rivets.



1,304,655—Switch

1,304,625. PROCESS OF RIVETING; John P. Sunderland, Albany, N. Y. App. filed Aug. 1, 1917. Electrical.

1,304,626. ELECTRIC HEATING APPARATUS; John P. Sunderland, Albany, N. Y. App. filed Aug. 1, 1917. Rivets.

1,304,634. ELECTRIC METAL-WORKING MACHINE; Edmund Jannez von Henke, New York, N. Y. App. filed Oct. 28, 1918. Electric welding.

1,304,641. CALL-DISTRIBUTING SYSTEM; Samuel B. Williams, Jr., Brooklyn, N. Y. App. filed July 1, 1916.

1,304,655. SWITCH; Frank Buchanan, Syracuse, N. Y. App. filed June 5, 1915. Means for shielding terminals.

1,304,687. ELECTRIC HEATER; Bertrand B. Kahn, Cincinnati, Ohio. App. filed July 25, 1918. Radiant.

1,304,703. ELECTRIC SEAM-WELDING APPARATUS; Lindley G. Palmer, Cincinnati, Ohio. App. filed Oct. 24, 1918. Maintains a constant difference of potential across the electrodes.

1,304,718. HOLDER FOR TELEPHONE RECEIVERS; Katharine G. Townsend, New York, N. Y. App. filed Aug. 31, 1918.

1,304,782. MAGNETO; Arthur C. Klecker and Walter Brown, Racine, Wis. App. filed Jan. 17, 1919.

1,304,786. APPARATUS FOR SEPARATING LIQUIDS IN EMULSION; Charles W. McKibben, Houston, Tex. App. filed July 26, 1918. Water from crude oil.

1,304,798. SAFETY APPARATUS FOR ELEVATORS; John Mutton, Cleveland, Ohio. App. filed Nov. 22, 1915. Car moved only when gates are closed.

1,304,823. APPARATUS FOR ELECTRICAL FIXATION OF GASES; Bruno Thomas, Seattle, Wash. App. filed April 18, 1917.

1,304,837. CIRCUIT BREAKER; Leo J. Werner, Arlington, N. J. App. filed Nov. 16, 1918. Magneto.

1,304,852. STORAGE-BATTERY PLATE AND PROCESS OF TREATING SAME; Rufus N. Chamberlain, Chicago, Ill. App. filed May 13, 1916. Negative.

1,304,856. COMBINED FLASHLIGHT AND MIRROR; Carl W. Dalberg, Deary, Idaho. App. filed June 10, 1918. Pocket flashlight.

1,304,868. WIRELESS-TELEGRAPH TRANSMITTER; Charles S. Franklin, London, Eng. App. filed Feb. 26, 1919.

1,304,894. AUTOMATIC STORAGE-BATTERY FILLER; Oscar P. Liebreich, Troy, N. Y. App. filed Jan. 17, 1918. Automobile.

1,304,896. GASOLINE HEATER; Harry E. McLaughlin, Lincoln, Neb. App. filed May 3, 1917. For carburetors.

1,304,925. SWITCH CONSTRUCTION FOR LANTERNS; Homer A. Woods, Indianapolis, Ind. App. filed Nov. 29, 1915. Switch always makes positive contact.

1,304,934. LIGHTING SYSTEM; Joseph Bijur, New York, N. Y. App. filed Dec. 21, 1910. Automobiles.

1,304,936. SIGNALING DEVICE; Charles H. Boardman, Vivian, West Va. App. filed April 9, 1915. Ventilating systems of mines.

1,304,957. POLYPHASE MOTOR; Valere A. Fynn, St. Louis, Mo. App. filed Feb. 3, 1917. Part of energy required conveyed by static induction.

1,304,958. DYNAMO-ELECTRIC MACHINE; Valere A. Fynn, St. Louis, Mo. App. filed May 28, 1917. Neutralized series conduction motors.

1,304,968. SIGNALING DEVICE; Clarence B. Harlow, Chicago, Ill. App. filed May 7, 1917. Diaphragm actuated by electromagnet.

1,305,011. REGULATING COMMUTATOR MACHINES; Reinhold Ruedenberg, Berlin-Charlottenburg, Germany. App. filed Jan. 28, 1914. Speed regulation and phase compensation.

1,305,013. AUTOMATIC REVERSING SWITCH; Henry K. Sandell, Chicago, Ill. App. filed Dec. 22, 1917. Music-sheet feeders.

1,305,015. ELECTRIC SYSTEM; Francis H. Shepard, New Rochelle, N. Y. App. filed July 24, 1914. For signaling to operators of electric railway trains.

1,305,031. ELECTRICAL REGULATING SYSTEM; Allen A. Tirrill, Pittsburgh, Pa. App. filed May 6, 1915. Maintains the speed of a motor uniform.

1,305,039. WELDING MACHINE; Robert E. Wagner, Pittsfield, Mass. App. filed Dec. 24, 1917. Electrode feed is effected by inclination of a bar supporting the welding electrode.

1,305,044. SYSTEM OF CONTROL; Charles App. filed April 5, 1917. Regenerative C. Whittaker, Wilkinsburg, Pa. App. filed April 5, 1917. Regenerative control of electric vehicle motors.

1,305,057. ELECTRICAL PROTECTIVE DEVICE; Addison E. Boggs, Pittsburgh, Pa. App. filed Feb. 4, 1916. Multivoltage distribution systems.

1,305,078. ELECTRIC RIVETING; Frank L. Dyer, Montclair, N. J. App. filed Aug. 16, 1918. Riveting operation performed before the blank cools.

1,305,084. SECONDARY OR STORAGE BATTERY; Louis H. Flanders, Jenkintown, Pa. App. filed Sept. 29, 1917. Insures alignment.

1,305,093. DISTRIBUTER; Paul C. Haas, Ann Arbor, Mich. App. filed May 2, 1918. Internal-combustion engines.

1,305,094. CENTRIFUGAL STARTING SWITCH; John B. Hansell, Sutton, Thirsk, Eng. App. filed Sept. 25, 1914. Cuts out the starting winding of single-phase motors.

1,305,104. ANTENNA FOR WIRELESS DISTRIBUTION SYSTEMS; Peter Cooper Hewitt, Ringwood Manor, N. J. App. filed Aug. 12, 1916.

1,305,122. LAMP-SUPPORTING DEVICE; Max Kossmann, Brooklyn, N. Y. App. filed Oct. 30, 1918. Detachably secures lamps to vase.

1,305,126. SWITCHBOARD APPARATUS; Benjamin G. Lamme, Pittsburgh, Pa. App. filed April 29, 1915. Prevents arc from pumping.

1,305,130. GUARD FOR ELECTRIC HEATERS; Richard G. Ledig and Nikolaus Gerson, Philadelphia, Pa. App. filed Jan. 18, 1919. Series of arms.

1,305,136. MOTOR VEHICLE; Allen Loomis, Detroit, Mich. App. filed June 24, 1912.

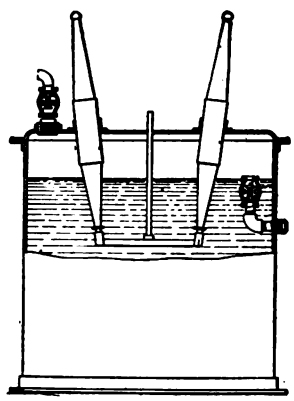
1,305,140. IGNITION SYSTEM; Samuel C. McKeown, East Orange, N. J. App. filed Sept. 9, 1918. Airplanes.

1,305,142. CIRCUIT INTERRUPTER; Joseph N. Mahoney, Wilkinsburg, Pa. App. filed April 5, 1916. Prevents expulsion of insulating oil.

1,305,149. SYSTEM OF CONTROL; Hurd T. Morris, Wilkinsburg, Pa. App. filed Sept. 25, 1914. Automatic for accelerating commutator-type alternating-current motors.

1,305,153. BINDING POST FOR ELECTRIC CABLES; Edward B. Nowosielski, Broomfield, N. J. App. filed Nov. 29, 1918. Igniting apparatus.

1,305,158. SWITCH HANDLE; Clarence D. Platt, Bridgeport, Conn. App. filed April 27, 1918. Can be firmly fixed to the switch blades.



1,305,142—Circuit Interrupter

1,305,165. CIRCUIT BREAKER; William H. Ratcliff, Newark, N. J. App. filed Feb. 24, 1917. Primary circuit of a high-tension magneto.

1,305,167. ELECTRIC FURNACE; Ivar Rennerfelt, Djursholm, Sweden. App. filed Oct. 3, 1918. Centrally located vertical electrodes.

1,305,168. INSULATOR; Omer L. Roberts, Macy, Ind. App. filed July 21, 1916. Telegraph and telephone.

1,305,177. ELECTRIC HEATING AND MELTING FURNACE; Victor Stobie, Dunston-Upon-Tyne, England. App. filed March 28, 1918. Prevents electrode outside of furnace from oxidizing.

1,305,190. ALARM; Charles F. Bobo, Hollis, N. Y. App. filed Oct. 4, 1915. Electrical.

1,305,191. EXPRESSION-DEVICE CONTROL; James W. Bryce, Bloomfield, N. J. App. filed Dec. 22, 1916. Phonographs.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, June 21, 1919 *Number* 25

Honor to the Pioneers

TO THE man who looks around him and sees the giant's part that electricity plays in human affairs its beginnings seem infinitely small. From the Leyden jar to the mammoth generator, from the voltaic pile to the high-tension transmission line, from all the crude adaptations at which men not yet old marveled to the things that are a matter of course to the child of to-day, the distance is as great as that between the primer of infancy and the library of Congress. Yet in the experiments and theories and written records of the early electrical scientists—the men who made possible the inventors and manufacturers of yesterday and to-morrow—lay the intellectual protoplasm from which has evolved the art as the early twentieth century knows it and as in still mightier manifestations the generations to follow will know it. To the memory of these men the profession should pay tribute when the opportunity comes to halt for a moment in the steady march of achievement and look back through the vista of scientific history to the cradles on the horizon and the milestones along the way.

The ELECTRICAL WORLD presents to its readers with this issue a supplement entitled "A Glance at Early Electrical Literature," which aims to afford such a backward look, not in perfect perspective or with all-embracing vision, but, it thinks, with the greatest figures from Gilbert to Kelvin plainly indicated and with enough of the lesser men grouped around them to prevent any unhistorical aspect of isolated grandeur. The sketch makes no pretense to deep research or unfamiliar assertion, any more than to completeness; its object is rather to throw around portraits and book titles which should not be unknown to electrical engineers a touch of that "human interest" sometimes sadly lacking in the unemotional rerords of science.

Never judge a convention by the number of sessions or the array of papers. Human beings severally and collectively thrive least when stuffed most. One good committee report will save a session and two more will make a convention. Attempt little and accomplish much is a good motto for convention committees to follow.

Baiting the Commissions

IN THE legislatures of several states, of which Illinois and Missouri are quite typical, well-organized lobbies have been or are being maintained for the purpose of repealing entirely or placing limiting clauses in the public utility commission laws. Municipalities are the supporters of these lobbies. Superficially one may say that their purpose is to put the utilities back into local politics, for obvious reasons. Viewed from another angle, however, it may appear that they are expressing a sentiment against a new phase of utility regulation and against "war-quality" service.

For instance, one of the main points around which the fight has hinged is the commissions' authority to set aside franchise rates and obligations. This authority was not questioned, of course, until it began to operate in favor of the utilities. That it will withstand all attacks seems fairly certain, for the legislatures are reported in most instances to be treating the attacks on utility commissions quite fairly. In fact, it is from the thoughtful actions of these state bodies that both the municipalities and the utilities may draw a lesson. The municipalities will learn that it is futile, and is not considered entirely patriotic, to bait utilities commissions which are acting in direct line with suggestions of the President of the United States. The utilities will learn that there is a limit beyond which they should not go in insisting that commissions fight their battles, and a limit in quality of service, anything below which the public should not be asked to endure.

Where is the community which has become electrically saturated? The larger the demand for service and electrical conveniences, the greater the market becomes. The time will come when present practice in limiting outlets for home service will look like cheeseparing in comparison with the intensified utilization of electricity lying ahead of the industry and being realized on a larger scale every year.

Army Development of Battery-Charging Sets

IN WARS previous to that which is now being closed the armies in the field had to be supplied with batteries for telegraphic and telephonic service. Those batteries, however, were neither very numerous nor very heavy. In most cases they were primary batteries, and when exhausted they were discarded. In this war, however, radio-communication took a very prominent part. Large numbers of storage batteries had to be provided. These batteries had to be regularly charged from generators. Portable generating sets had to be set up at every headquarters, often down to regimental headquarters. The generating sets were usually gasoline engines, driving direct-current generators, although, among the different armies, various types of engine and generator could be found.

Small battery-charging generator sets were in well-established use before the war all over the world, but they were ordinarily not well adapted to army needs. They were not sufficiently portable or sufficiently rugged. They were designed as inexpensively as possible, and an occasional breakdown was not unexpected. In

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army service the first cost of the generator set became of small importance by comparison with ruggedness, portability and reliability.

It became necessary for the Signal Corps to develop a suitable generating set for army service, in order to meet the needs of the expeditionary force with the least delay and greatest effectiveness. The history of that development is outlined this week in an article by Capt. A. E. Flowers. It would be interesting to learn what will happen to these sets with the full return of peace. It seems likely that they will disappear in favor of less expensive, less portable and more competitive designs. It is earnestly to be hoped, however, that the sets will not become lost altogether.

Without wishing to profit ungenerously by others' misfortunes, it none the less might be said that a recent gas company strike in a New England city did more to advertise the value of electric cooking and heating devices than the contractor-dealers of the community could have compassed in many months of united publicity. Empty mains produced a drive on the appliance shops which practically cleaned out the town in a few hours. The gas returned, but thousands of people who had never before given electric cooking serious thought will henceforth know its benefits.

The Efficiency of the Turbo-Alternator

IT IS customary to call for a certain percentage of efficiency in a turbo-alternator, but it is very difficult to determine by test what the actual efficiency is under load. The ordinary conventional method is to measure the individual stray losses with care at no load, and to compute the copper losses, under load, from the observed resistance of the armature. The efficiency under rated load is then reckoned by dividing the rated ouput by the sum of the rated output plus all the anticipated losses. It is generally admitted that there will be certain additional losses in the machine under actual load, over and above those which can be measured and estimated for no load. Such extra losses are usually referred to as "load losses." It is possible to estimate these load losses from certain tests made with the armature on short circuit. The efficiency arrived at in this way is a perfectly proper conventional efficiency that has been found more or less satisfactory in practical experience. Nevertheless, it is always desirable to be able to test a turbo-alternator for efficiency under actual load conditions, when a steady load can be obtained.

A recent article on this subject in the *Electrician* of London, by S. F. Barclay and S. P. Smith, gives some interesting results based on the measurement of the heat carried away from the alternator by cooling air under measured forced draft. In such tests the alternator has to be completely incased, so that the cooling air can be supplied to it under definitely measurable conditions as to rate of flow and temperature elevation. The principle is identical with that often used in the case of water-cooled transformers, where the power lost in the transformer under steady load is determined from the rate of flow of cooling water and the temperature elevation of the same.

It is doubtful whether the air-heating method can be made available for acceptance tests, owing to the heavy load which large turbo-alternators carry and the practical difficulties in securing this large steady load at the factory for a sufficient length of time. Nevertheless, the method should be capable of being applied to turbo-alternators in service, and at a relatively small expense.

An electrical Fourth of July is a safe and sane Fourth. Invite every householder to help in the celebration by displaying in his front window or on his front porch an American flag, lighted from behind by an electric lamp. Ask that during the hours of the evening celebration every front window and porch light be illuminated. Suggest that every housewife place her handsomest portable lamp in a front window in honor of the "boys from over there."

Grounding the Neutral

EVER since three-wire systems of distribution came into use there has been a difference of opinion as to whether the neutral should be grounded or not. The advantages have naturally not been all on one side of this controversy. Each side of the question has its advantages and disadvantages, but the preponderance of advantage has been on the side of grounding the neutral.

In the days of the low-tension three-wire direct-current system and before the introduction of the polyphase system the question was acute. The disadvantage of grounding was that any ground made on an outside wire became a short circuit and was therefore accompanied by disturbance. The advantage of grounding was that the electrical stresses on the outside conductors were limited to their normal working value. In the long run the policy of grounding the neutral was generally followed.

With the use of three-phase distribution systems the same question has become active under a new form. If the neutral of the system is permanently grounded, the electrical stresses on the three mains cannot ordinarily exceed their normal working values, but an accidental ground coming anywhere on the system becomes at once a short circuit. Under unfavorable conditions the short circuit may attain great violence. Is it better to run without grounded neutral and trust to being able to clear off each ground as it occurs before a short circuit can develop, even if the voltage on the other mains becomes greatly increased, or is it better to run with a permanent ground and take the short-circuits without question and smilingly as part of the day's work?

This question will be dealt with by H. R. Woodrow in a paper before the Lake Placid (N. Y.) convention of the American Institute of Electrical Engineers next week. The paper, which is well worth study by operating engineers, describes four different methods of grounding procedure that have been tried in the New York Edison district. In general, it appears to be indicated that grounding the neutral of such a system is good policy, provided, first, that the ground shall be made through such resistance as will automatically limit the flow of current in case of a short-circuiting ground elsewhere, and, second, that special ground relays are installed, to cut off very quickly and automatically any feeder on which a short-circuiting ground develops.

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Equipment for Industrial Lighting

THE article we publish this week by Ward Harrison and H. H. Magdsick is the beginning of a careful study of equipment suitable for industrial lighting. The present section takes up the preliminary requirements in an extremely comprehensive manner and should prove of very great use in meeting the practical requirements of manufacturing plants. Several of the suggestions are particularly well worth heeding, and in particular we may mention the specification of sufficient light on all working sufaces, however situated. In the codes for factory lighting which have been generally adopted the usual practice has been to specify measurement of the light on the horizontal plane, which is the commonest plane involved. Such specification is probably very sound practice since it is specific and easy to measure, but there are cases where the vertical plane, for instance, is of much importance, and the authors point out that in general terms with any ordinary system this vertical intensity will be about one-half the horizontal intensity and that due allowance must be made for this fact. The question of color of light is, within the range of ordinary illuminants, not commonly a serious one; but for certain purposes an approximation to daylight is highly desirable, while occasionally for critical inspection of product a nearly monochromatic source has distinct advantages. One fact which cannot be too thoroughly impressed is that an object is seen by the light which it reflects, and consequently things like dark fabrics demand an intensity of illumination all out of proportion to average conditions. Again, in certain fine mechanical work the degree of diffusion is a very important matter, limited on the one hand by the danger of reflections and on the other by the lack of contrast due to extreme diffusion.

We wish to point out particularly the treatment here of the general illumination which falls on surfaces surrounding the working plane. The value of light walls and ceilings can hardly be overestimated, both in adding to the general effectiveness of the illuminants and in reducing the contrast between the working light and that which lies about it. All changes from light to darkness or the reverse, whether incurred by passing from one to the other bodily or by merely looking from one to the other, involve adaptive changes of vision which if too severe may be extremely troublesome. The universal use of light paint and whitewash goes far toward ameliorating the visual conditions in any factory. Still another point worth considering is the effect of absolute intensity on the eye, aside from intrinsic brilliancy. One is sometimes tempted to think that glare is dependent on the latter factor alone, which is not at all the case, although it is commonly an important factor. Probably the ultimate measure of glare is the intensity of the light image on the retina taken in absolute measure. This determines the photochemical changes involved in the act of vision, and consequently a very powerful source, even if considerably reduced in intrinsic brilliancy, may deliver as much energy per unit of area in the retina as would a much brighter source of far less total power. The more one studies the question of glare the more complicated it becomes, and the effect of image formation is one of the elements which have been given somewhat insufficient consideration. We shall await with interest the more detailed study of practical lighting units promised by the authors.

Government ownership is a moribund issue at present, but no greater mistake could be made than to assume that opposition to it is unanimous. It behooves public utilities to prove by the best possible service at the most reasonable rates that any further experiments in government operation would be economic and political calamity.

Reinsulation of Large Generators

THERE are two dangers that attend the sustained operation of large central-station generators. One is accidental short circuit, due to some failure of insulation outside of the machine, whereby intensely severe electromechanical stresses may be brought to bear upon the generator. The other is a breakdown in internal insulation, with the probability of an internal short circuit thereby produced. The short circuit is always the accident to be feared. External short circuits can be guarded against, partly by care in external construction and partly by the use of suitable protective reactances. Internal short circuits are often more insidious and more difficult to forefend. They may be due to accidental weak points in construction, to overheating and overloading, or to the puncture of insulation by overvoltage or mechanical injury to coils during operation. Such accidents have been caused by the magnetic indrag of a hoisting chain into a running machine.

An article in this issue deals with the inspection, overhaul and repair of alternator insulation. An alternator armature, in large sizes, is apt to embody a considerable percentage of the capability for output from a central station. In periods of heavy load upon the station the loss of an armature by internal short circuit may not only constitute a serious accident but may also cripple the plant and lead to the overloading of all the remaining units at the very time when these units need to be protected to the utmost. The narrative of events given in the article suggests the advisability of a thorough inspection of the insulation in central-station armatures during the summer months, when the load is likely to be at its lowest for the year. If defects of insulation exist, owing to overheating, such defects are likely to occur in any or all coils, with but little preference for the ends of the winding. In the case, however, of defects due to overvoltage stresses from surges, these defects are more likely to occur in the end coils, or even in the end turns of the end coils, when the dielectric strength is uniformly distributed throughout the winding.

As regards protection from insulation damage due to overheating, probably the best lies in the use of embedded thermocouples, built into the armature and connected permanently to temperature indicators mounted on the switchboard. The switchboard operator can then not only assure himself of the safe temperature of the machine at any moment but he also is able to judge how much load can safely be carried by the machine at any time without exceeding the proper temperature limits. As regards protection from insulation damage due to surge over-voltage, all that can be done is to employ suitable static surge protectors of the lightning arrester types.

After a generator has long been in service, even if it shows no obvious sign of insulation weakness, it may be good policy to overhaul it carefully, at some period when it can safely be spared for a month, if need be. Inspection of one coil may afford a good indication.

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Army Development of Charging Sets

Absolute Reliability, Portability and Ruggedness Were the Chief Requirements of Charging Sets for Army Radio Batteries Developed by Engineers of Signal Corps—Starting with Farm-Lighting Sets in Commercial Use Excellent Results Were Attained

BY CAPT. A. E. FLOWERS
Signal Corps, United States Army

THE experience of the army with radio communication in the field prior to the recent conflict included only the use of fairly powerful sets in small numbers, but with our entrance into the war in Europe an entirely new program was initiated. Instead of a few large radio sets, it was found necessary to use a large number of comparatively low-power and very portable equipments, since they were carried practically to the front-line trenches and the only means of transport was on the backs of soldiers. Previous sets had been supplied with electrical energy from generators driven by gasoline engines or by hand, but the new practice depended almost entirely on the use of portable storage batteries. Providing suitable charging equipment for these batteries was one of the problems presented to the Radio Development Section of the Signal Corps. The progress from a 1¼-kw. set, weighing 393 lb. (178 kg.), to a 1½-kw. set, weighing 150 lb. (68 kg.), is particularly gratifying and proves the value of industrial research even under war-time conditions. It is worth noting that the total cost to the Signal Corps for the engineering development work and making of samples for the development here recorded was 1.7 per cent of the cost of the sets ordered.

GENERAL REQUIREMENTS

The charging sets were generally located at division headquarters and were subject to shell fire and to quick moving of station. Naturally, the only primary source

FIG. 1—A BATTERY-CHARGING POST IN FRANCE

of power to be considered was the gasoline engine, and the "farm-lighting set," well established in commercial production by a number of firms, was the starting point of the development. The service conditions are always extremely severe for military equipment, and this was no exception. It was recognized therefore that the order of importance of the various fundamental requirements for these sets was approximately this: (1) Reliability, (2) ruggedness, (3) portability, (4) simplicity in operation, (5) lightness, (6) economy in fuel and oil consumption.

It is significant of the purely military character of the development that low price is omitted from the list of requirements. The power ratings of the charging sets were determined, of course, by the number of

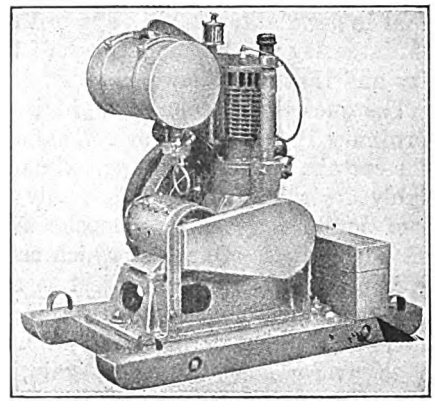

FIG. 2—FIRST CHARGING SET DEVELOPED BY SIGNAL CORPS
Rating, 1¼ kw.; engine speed, 800 r.p.m.; weight, 393 lb.; type, SCR 66. Note high center of gravity.

batteries to be charged on a basis of approximately ten hours per day operation; for the average division it was considered advisable to provide sets of 1½-kw. normal rating. It is interesting to note that this is approximately twice the capacity of the sets in use just prior to our entrance into the war, and the increase is an indication of the increasing part played by radio communication in the front-line operations.

The voltage requirements originally specified were based on the use of two general classes of batteries, one having a very low current and comparatively high voltage, and the other low voltage and high current. The generators were in consequence designed to have double commutators, one to supply current at 115 volts and the other at 25 volts. Later the use of the high-voltage batteries was discontinued and the generator was modified to be a single-commutator machine with output at 50 volts. The demand for sets for immediate use was so great, however, that, pending the production of sets to give these special voltages, standard 32-volt sets were adopted and, after being slightly modified as described later, were shipped overseas in limited numbers as an emergency supply.

The necessary charging panels were desired as separate units rather than permanently attached to the generator so that the panel could be mounted inside the building, leaving the set outside. In use, the set was carried to a new location by motor truck, removed by hand and set down in any available location. It was supposed to run under practically any conditions and received no special care. Fig. 1 shows the interior of a

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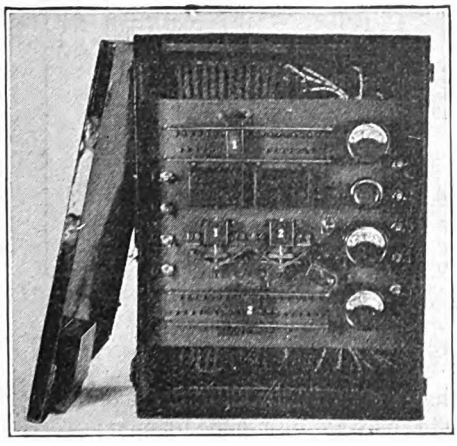
battery-charging station in France, the generator being mounted outside the building.

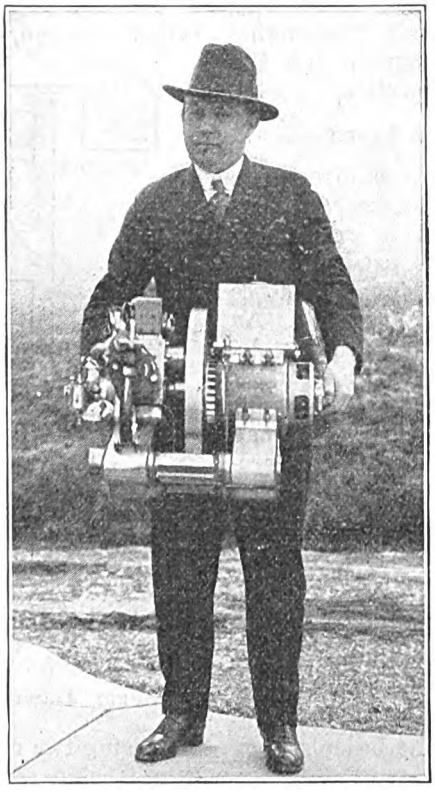
It cannot be too strongly emphasized that for army use certainty of operation is the supreme factor. A machine must work and must work under any and all conditions. No complicated mechanisms are allowable, no matter how beautiful to look at, if they require "nursing" or must be handled gingerly for fear of spoiling a nice adjustment. Consequently, a test for army equipment takes on the characteristics of a "knock-down-and-drag-out fight." "Brute" tests that rack every part in ways no ordinary machine is supposed to undergo must be resorted to. It is essential to secure reliability in operation and ruggedness and then to do as well as possible with the remaining characteristics.

How the Development Was Carried Out

As with all other military developments in war time, speed was of prime importance and pressure of all kinds was brought to complete the development work and get the sets into production. To meet this situation permission was granted to waive some of the detail requirements for the first shipment.

A very large number of battery-charging sets have been manufactured in the United States during the past few years, probably several hundred thousand. These were designed mainly to suit the commercial conditions for farm lighting or other small isolated service. Heavy weight was no particular disadvantage, and low first cost was a prime consideration in order to find a market. Under these circumstances most of these sets had a rating of ¾ kw. at 32 volts and were sold for about $300. Some were fairly reliable and rugged, but instruction to a buyer was easy, and in any case repair parts were readily obtainable and a short shut-down was not a vital matter. These sets weighed 300 lb. to 500 lb. (135 kg. to 225 kg.) each. The first task of the Radio Development Section was naturally the collection of all available information on such sets. It is an interesting commentary on the magnitude of the industry that the preliminary survey considered the products of twenty-nine different companies.





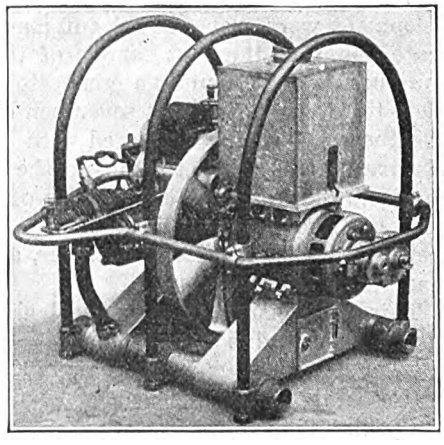


FIG. 3—LATER DESIGNS OF CHARGING SETS AND PANEL

(A) Final model illustrating portability—Type SCR 110-4. (B) Weight of this 1½-kw. set, 150 lb. (C) Door removed from carrying case, showing arrangement for safety of operator and protection of equipment—Type BD-8

It was evident from a preliminary examination that air-cooled engines would be lighter and more compact than those having water cooling and would avoid the necessity for constant attention to the water-cooling system, especially in cold weather. It was also considered that the requirements for reliability demanded the four-stroke-cycle type of engine and magneto ignition. With these points settled the balancing of immediate production against other desirable characteristics was undertaken and the development naturally divided itself into three stages as follows: (1) Production of commercial sets immediately available with such minor modifications as seemed absolutely necessary; (2) development of new sets generally similar to those in commercial use; (3) development of entirely new designs to include all desired characteristics.

The Use of Commercial Sets

The canvass of the available commercial sets already mentioned disclosed, of course, a very considerable number of sets on the market, but when the search was narrowed by the preliminary decision to use only four-stroke-cycle air-cooled engines with high-tension magneto ignition, it was found that only the sets indicated in Table I were available.

It will be seen that only two of these sets have a rating above 1 kw., and the extreme rating is only 1¼ kw., whereas the desired rating was 1½ kw.; but this sacrifice was made for the sake of immediate production. All four of these sets were given very severe tests, including twenty-four-hour non-stop runs, tests on increasing load until the engine stalled, drop tests for ruggedness, etc. Weaknesses developed by these tests such as oil losses at breathers, poor lubrication of main bearings, weakness of base, etc., were corrected, if possible, and a reasonable number of sets were ordered, the final form being that shown in Fig. 2 and designated as type SCR-66.

This slightly modified commercial set consists of a vertical single-cylinder, four-stroke-cycle gasoline engine, connected by an inclosed sprocket chain to a 1¼-kw., 32-volt, shunt-wound generator. The common base of the engine and generator is mounted on a skid for

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easy handling. The engine speed is 800 r.p.m. and the generator speed 1900 r.p.m.

Cooling is by an integrally built fan in the flywheel, this fan being arranged to blow the air over the engine cylinder. A speed-regulating governor of the throttling type is also carried by the flywheel. Lubrication is by the splash system from the crank case, which in turn is supplied from a sight-feed lubricator. Ignition is furnished by a high-tension magneto. A tool box is provided to carry the necessary tools and spare parts for the charging set.

TABLE I—COMMERCIAL AIR-COOLED ENGINES, FOUR-STROKE-CYCLE, IGNITION BY HIGH-TENSION MAGNETO; GENERATOR 32 VOLTS; SHUNT-WOUND

Set No.	1	2	3	4
Number of cylinders	4	1	1	2
Engine speed	1000	800	1000	2000
Type of governor	Mechanical	Mechanical	Electrical	Electrical
Method of driving generator	Gears	Chain	Direct	Direct
Generator speed, r.p.m.	2500	1900	1000	2000
Output of generator, kw.	1½	1½	¾	¾ to 1
Floor space of set, inches	27 by 34	18 by 24	20 by 24½	18 by 44
Height of set, inches	29	29½	30	20
Weight of set without fuel (switchboard not included), lb.	450	275	305	270

The over-all dimensions of the set are 41¾ in. long by 22 in. wide by 29½ in. high (106 cm. by 55.8 cm. by 74.9 cm.) The weight is 393 lb. (178 kg.) The engine is built by the New Way Motor Company and the generator by the Dyneto Electric Corporation.

Development Along Standard Lines

With this set in production attention was directed to obtaining sets having more nearly the desired characteristics. However, it was decided to retain the single-cylinder construction, as it was used in practically all the farm-lighting sets and in consequence could be produced with more assurance of success. An indication of the high pressure under which the development work was carried out may be had from the statement that the first sample of the new gas engine equipped with a suitable generator ready for complete tests was finished in seventeen days after the proposal was informally discussed with the manufacturers. Naturally, this did not complete the development since the tests indicated the desirability of changes in governors and modifications in various other parts. These were made very promptly, however, and the new design was put into production.

This set consists of a vertical single-cylinder four-stroke-cycle engine directly connected to a 2-kw. double-voltage generator operating at 1200 r.p.m. The generator is supported independently of the bed plate, on the engine frame.

A flywheel fan forces the required cooling air into the sheet-metal jacket surrounding the cylinder. Lubrication is by the splash system from the crank case, a gear-driven pump being employed for circulating the oil. Ignition is by a high-tension magneto. In order to facilitate rapid manipulation, a convenient drawer is provided in the wooden-skid base for holding the necessary tools and spare parts of the set.

The generator output is at 25 volts and 115 volts, thus providing for the charging of the two general classes of batteries mentioned above *i.e.*, low-voltage, high-current, and high-voltage, low-current. The over-all dimensions of the set are 44 in. (110 cm.) long, 21 in. (53 cm.) wide and 37 in. (94 cm.) high. The weight is 413 lb. (187 kg.). The engine is manufactured by the H. H. Franklin Manufacturing Company and the generator by the Dyneto Electric Corporation.

Other models of this set were arranged with 32-volt and 50-volt generators instead of the double-voltage machine described above.

The first production order of these sets had not been completed when a radical increase in the army program was made, and in consequence demand for immediate production of charging sets in much larger quantities was received. An examination of the plant capacity in which the sets just described were being made indicated that it could not meet the demand, and another firm was asked to produce sets of practically the same form, with as many of its own standard parts as possible. This design was available for production when the armistice was signed, but was not ordered in quantity.

Development of Entirely New Sets

The sets indicated in the preceding section had ample power output and were in many ways an improvement over the first sets produced, but they still lacked some of the desirable qualities. In particular their weight was excessive and they were too top-heavy for satisfactory handling in transportation. This high center of gravity was a fundamental objection in the single-cylinder design, and the development of entirely new sets using two or more cylinders was undertaken. Certain foreign sets in use by our expeditionary forces showed that much might be done with "two-cylinder opposed" construction, the set in question having an output of ¾ kw. and weighing 207 lb. (94 kg.). By this time the final requirements were well established and were stated as follows:

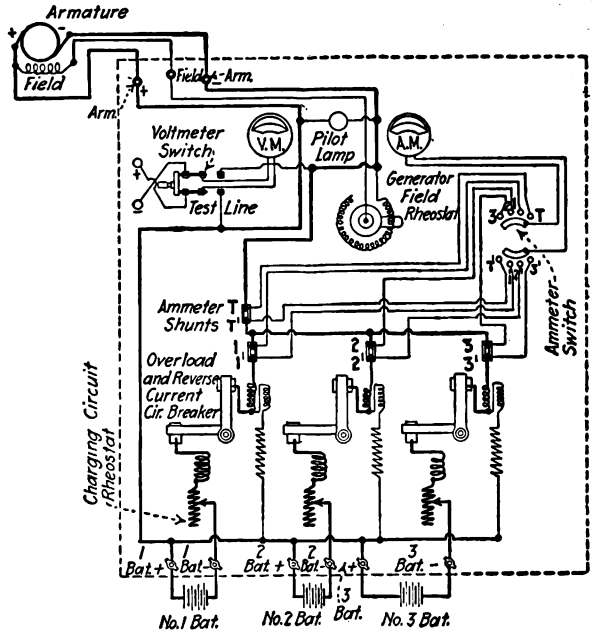

FIG. 4—WIRING DIAGRAM FOR CHARGING PANEL

ASSEMBLY:

(a) *Weight.*—Weight not to exceed 350 lb. (160 kg.), including spare parts, tools, gas and oil.

(b) *Mounting.*—Engine and generator direct-connected and mounted on same base.

(c) *Stability.*—Very stable, broad-skid base, low center of gravity, requiring no concrete foundation.

(d) *Portability.*—Portable, provided with suitable carrying handles.

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(e) *Compactness.*—Compact as possible, other characteristics considered.

(f) *Air-Cooled.*—Cooled by fan mounted between engine and generator; fan may be integral part of the flywheel.

(g) *Weatherproof.*—Must operate satisfactorily when exposed to damp and cold weather.

(h) *Framework Protection.*—Pipe protection required, rugged and light.

(i) *Endurance.*—Every part as durable as possible.

(j) *Reliability.*—Must start easily regardless of weather conditions and must be capable of continuous operation from ten to twenty-four hours per day.

(k) *Simplicity.*—As simple in construction and easy to operate as possible.

(l) *Lubrication.*—Ample, positive, simple, reliable and economical of lubricant.

(m) *Vibration.*—The set must not have excessive vibration but must be smooth-running.

(n) *Speed.*—1800 r.p.m. maximum; 1500 r.p.m. or less preferable. Speed regulation not more than 10 per cent of full load speed.

(o) *Loose Parts.*—Loose parts should be few in number and where required should be secured to set by chains.

(p) *Locks and Keys.*—Two keys required for each lock. Keys for all sets identical.

(q) *Spare Parts and Tools.*—A full set of spare parts to replace parts which are most likely to wear out, together with a complete set of such tools as are necessary, shall be provided, packed in a suitable container. A list of such spare parts and tools shall be attached permanently to the container.

(r) *Instructions.*—Instructions complete and concise for operating the set, and in permanent form, shall be attached to the set in a suitable location.

(s) *Name Plates.*—Name plates shall be provided as prescribed by the Signal Corps.

(t) *Paint.*—Each set shall be given two coats of preservative paint, the top coat of which shall be standard olive-drab color.

(u) *Tests.*—Continuous full load for ten hours, then 25 per cent overload for two hours.

[Note.—This specification of 25 per cent overload rating is made for the following reasons: (a) A. E. F. requirements are for extreme reliability of performance. A set very closely rated has no factor of safety. (b) Standard practice on direct-current generators of this size calls for 25 per cent overload for two hours. (c) An allowance is desirable for decrease in rating due to wear and lack of adjustment on the parts of the engine. Gasoline engines are ordinarily very closely rated, and this overload requirement is considered necessary in order to insure full load rating over the life of the set. (d) Manufacturers have stated they could develop sets to meet this requirement within the weight limits specified by the A. E. F.]

ENGINES:

(a) *Cylinders.*—At least two cylinders. Two horizontally opposed cylinders preferred.

(b) *Capacity.*—The engine capacity should be sufficient for the prescribed capacity of the generator.

(c) *Ignition.*—Magneto ignition required. Must be thoroughly reliable.

(d) *Carburetor.*—Gravity feed preferred. Must be thoroughly reliable.

(e) *Starting.*—Equipped for hand cranking. Must be easy to start in cold or damp weather.

(f) *Fuel Consumption.*—The fuel consumption should not exceed 2 lb. per kilowatt-hour.

(g) *Drain Cocks.*—One-half-inch (1.27-cm.) oil cocks must be provided in bottom of crank case.

(h) *Oil Cocks.*—Two ¼-in. (6.3-mm.) oil cocks must be provided in the crank case to show the required depths of oil.

(i) *Breather.*—A suitable breather must be provided in the crank case. This must not chatter or permit oil to escape.

GENERATOR:

(a) *Capacity.*—1½ kw. with 25 per cent overload capacity for two hours; 50 volts direct current. Tested according to A. I. E. E. Standardization Rules. Shunt-wound, suitable for battery charging.

Four firms undertook to develop sets to meet these requirements, and Table II shows the results, the designers being, respectively, the Copley Manufacturing Company, the Mayhew Company, the Domestic Engineering Company and J. L. Yarian (Figs. 3B and 3C). The characteristics of these sets are shown in Table II.

These sets were completed after the armistice and were not produced in quantity, but if the war had continued one or more of them would undoubtedly have been produced in large numbers.

CHARGING PANELS

In addition to the engine-generator sets, it was of course necessary to provide control equipment. The batteries to be charged were in units of 4, 6, 10 and a few of 40 volts; the normal charging rate varied from 30 amp. to 3 amp., and the design had to be flexible, "foolproof" and of the lightest weight consistent with reliability.

TABLE II—AIR-COOLED ENGINES, FOUR-STROKE-CYCLE, IGNITION BY HIGH-TENSION MAGNETO, GENERATOR 50 VOLTS

Set No.	110-1	110-2	110-3	110-4
Number of cylinders	2	4	2	2
Engine speed	1300	1600	1500	1800
Type of governor	Mechanical	Mechanical	Mechanical	Mechanical
Method of driving generator	Direct	Direct	Direct	Direct
Output of generator, kw	1½	1½	1½	1½
Floor space of set, inches	44 by 29	40½ by 18	26 by 26	27 by 28
Height of set, in	29½	29½	28	21
Weight of set, without fuel, lb.	365	335	291	150

After a considerable discussion it was decided to provide two or three independent charging circuits in parallel and to have each capable of handling anything from one of the smallest batteries to the maximum number of the largest ones. It would thus be impossible to burn out the rheostats and possible to adjust any combination to the right charging current.

The building of light and yet rugged charging rheostats for use on the panels was not so easy as one might think. Thus, the panel supplied with the first 1½-kw., 32-volt set weighed 131 lb. (59 kg.), including rheostats for three charging circuits but not including any carrying case. The latest panel developed for the 1½-kw., 50-volt set weighs but 35 lb. (16 kg.), including control resistors for two charging circuits and a metal carrying case. The circuit diagram of these panels, as shown in Fig. 4, was laid out to provide the essential equipment with as little weight as possible. Circuit breakers were made to serve also as switches and change-over switches were provided for the meters.

The first panels were of open construction for wall mounting. Later ones, indicated in Fig. 3C, were of inclosed construction, the case being something like a sheet-metal suitcase. It can be operated on wall, floor or practically anywhere and is entirely self-housing. The design shown is for 40 amp., weighs 35 lb. (16 kg.) and is used for charging sets SCR 110-1, 110-2. 110-3 and 110-4.

The panels for the double-current generators were of the same general design but of only two circuits, separate panels being provided for the high-voltage and low-voltage sides.

It is worthy of note that within a few months American designers had developed entirely new sets having twice the rating and only 72 per cent of the weight of their nearest foreign competitor with a set much

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more rugged and serviceable. This fact amply justifies the direct engineering attack of the fundamental problem rather than the attempt to copy available material already in service. The essence of military strategy is superiority. Napoleon's dictum that "God fights on the side having the heaviest guns" may or may not be true so far as the Deity is concerned, but it is the soundest of policies in the supply of equipment to an army. It is fatal for a military commander or a country to drift into an attitude demanding and exacting anything other than the superlatively best in every part of its fighting equipment, and this superiority in technical equipment is only a matter of enough brains on the job. The quality of American engineering is easily equal to that of any competitor, but short-sighted management often fails to get the desired result by the use of too few engineers and of those few under conditions making first-quality output impossible.

It is of course understood that the sets resulting from the development here discussed are not perfect. Further service experience and more time spent on detail design will undoubtedly lead to still further improvements. The story is told in the hope that it may contribute to such future progress.

Reinsulation of Large Generators

To Provide Against Interrupted Service on Its Lines During the Period of Heavy Winter Peak Loads, Milwaukee Company Follows This Practice—Engineering Experience Gained in Handling Four Machines Totaling 43,000 Kw.

DURING the load valley of the spring, summer and early fall of 1918 the Milwaukee Electric Railway & Light Company reinsulated the generator windings on four of its main machines as a precautionary measure. While this is not an entirely new practice among the large central-station companies, it is a division of plant operation to which not much attention has been given. The idea has come more to the forefront during the last few years since central-station companies have not been able to maintain their usual percentage of machine reserves. Because the lack of reserve generator capacity may grow worse in some central stations, and because continuity of service during the coming two years should be jealously safeguarded to keep the good will which central-station electric service has gained during the war, the topic merits the closest attention.

The situation surrounding this work at Milwaukee can be better appreciated, perhaps, if some facts are first given concerning the loads the company was carrying and concerning the generator rating that was available. The total rating of the company's generators at its stations both in Milwaukee and in the surrounding territory is 92,000 kw. To this about 12,000 kw. of purchased hydroelectric energy is added at certain times.

The approximate maximum demands which the company was called upon to care for are tabulated here:

February	69,000
March	63,500
April	59,000
May	61,500
June	65,000
July	67,000
August	65,000
September	66,500
October	66,000
November	88,000

Of the 92,000-kw. generator rating possessed by the company, 73,750 kw. is in plants in Milwaukee. Since 43,000 kw. in four machines was reinsulated, it may be seen that 58 per cent of the machine capacity in Milwaukee and 46.5 per cent of the company's total generator capacity was reinsulated. From these data it may also be noted that the failure of any important unit during the period when one of the machines was down for reinsulation would have been serious. It also shows why the company was willing to spend a large sum of money to prevent possible future trouble.

The generators reinsulated included two 7500-kw., 6600-volt, three-phase, 750-r.p.m., 25-cycle generators connected to vertical low-pressure turbines and two 14,000-kw., 4000-volt, 720-r.p.m., three-phase, 60-cycle machines connected to vertical high-pressure turbines. All of the machines were of General Electric manufacture. The two 7500-kw. machines were duplicates and were known by the Milwaukee company as Nos. 9 and 10. The larger machines were also duplicates, and they were known as Nos. 11 and 12. The working period for the four machines began on Feb. 14, just after the No. 10 machine had burned out, and lasted until Sept. 14. The time was divided among the four machines as follows:

Machine	Dates	Time Elapsed
No. 10	Feb. 14 to April 10	55 days
No. 9	April 22 to June 4	45 days
No. 11	July 6 to Aug. 6	30 days
No. 12	Aug. 15 to Sept. 14	29 days

It will be observed that there was a considerable reduction in the length of time required to do this work as more experience was gained. This statement of time required is to some extent misleading, however, because on the machines Nos. 11 and 12 only the fields were reinsulated, while on Nos. 9 and 10 the windings of the entire machines were handled. It is a fact, nevertheless, that it was possible to reduce the time required. The principal factor in effecting this reduction was the employment of a definite schedule of work. A schedule was worked out by the electrical engineer of the Milwaukee company and was agreed to by the foreman who was acting for the General Electric Company. In the work on the last three machines these schedules were adhered to almost to the day. Working to a schedule on the first machine was hardly possible because it was damaged somewhat by the burn-out and material was difficult to obtain. Some of the armature coils were burned so that they had to be ground in order to make them "take" the solder. Moreover, special shop equipment such as horses to support the coils and tanks for boiling the coils had to be constructed. Special tools were also required for handling the coils. These consisted mostly of chisels and wedge drivers and were

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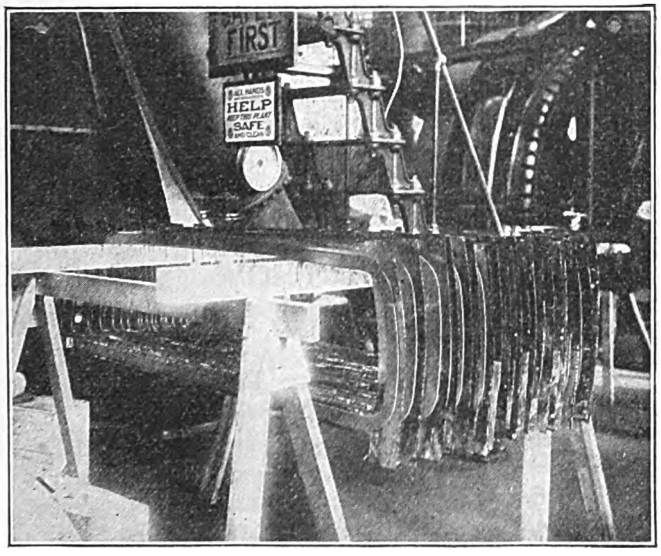
made on the job. Because of the heavy duty to which they were subjected, owing to the character of the work, many were broken before just the correct degree of temper was attained. The forms and clamps for shaping the refinished coils came from the factory. All this work was done in the shops of the company.

Copies of the schedules of work on a 7500-kw. and a 14,000-kw. machine are published here to show how the work was managed and to show what work was done. It should be noted that not as many unskilled workmen as the schedule provided for were available. Nevertheless, the work was handled with the men who could be secured.

Surges Puncture Insulation Between Turns

Both of the 7500-kw. machines had been installed new at Milwaukee in 1911 and had operated continuously without insulation breakdowns since that time. However, when the condition of the insulation of the first machine was seen as it was disassembled it became apparent that it would be wise to consider taking down the other machines before trouble occurred in them. The fish-paper insulation, which was 9 mils or 10 mils thick, had become brittle. Surges had actually caused fine punctures between turns. On opening the second 7500-kw. machine it was found that the fear for its



PREPARING FIELD WINDING FOR NEW INSULATION

condition was well founded. Many bad spots in the insulation of the field winding were uncovered.

With the 14,000-kw. units the situation was somewhat different because the armatures had recently been rewound. Moreover, the insulation appeared to be pliable and withstood the high-potential test. Some doubt was felt as to the condition of the field windings, however, so they were reinsulated. A few bad spots were found in the field windings of each of these machines.

How the Coils Were Handled

Some of the details concerning methods of doing the actual coil repairing are interesting, and there are a few points of experience which might be helpful to other central-station companies undertaking similar work. When the coils had been taken out of the machine the turns were separated by driving blocks of wood between them. Then they were placed in a bath of soda ash to make the old insulation come off readily. The tank used for this purpose measured 8 ft. (2.4 m.) wide by 12 ft. (3.6 m.) long by 2.5 ft. (0.8 m.) high. It was heated by live steam admitted through three taps. About 1200 lb. (544 kg.) of soda ash was used for the coils of each machine. In each case one-half the coils were boiled at a time, so that 600 lb. (272 kg.) of soda ash was used each time a bath was made in the tank. Each batch was boiled for thirty-six hours.

When the insulation had been removed the coils were cleaned with emery paper and sandpaper. Burned spots were filled with silver solder. They were then ready to reinsulate and were hung on racks to facilitate that work. A pasty shellac varnish was applied to the copper and over this a layer of asbestos and mica tape 12 mils thick was laid. When this sort of insulation had been applied the coil was placed on a form, clamped down and baked by sending a heavy current through the copper. For this purpose it was necessary to have a source of direct current available. For such machines a supply capable of maintaining 800 amp. for one hour to two hours, depending on the size of the coil, is necessary. Alternating current cannot be used because the forms on which the coils are placed for shaping are of iron and the high impedance of the resulting circuit prevents enough current from flowing to give the required heating effect. This current causes the coil to "cement," which is the term used in describing the action of the insulating varnishes and the insulating materials.

When the coil has cemented and cooled, the edges are scraped and cleaned with sandpaper and the coil can be tested for insulation between turns with alternating current. The terminals of the coil are then affixed to new connecting strips, and the coil is ready for its over-all insulation. This consists of a layer of linen tape 5 mils thick butted and treated with No. 211 compound, two layers of mica tape 5 mils thick, half lapped, inside the slots, and three outside, one layer of 15-mil asbestos tape half lapped and filled with No. 152 compound inside the slot and two layers outside the slots. Then the slot armor is applied. Especial care is used in handling the coils after they are formed.

Schedule for Repairing 7500-Kw. Generator No. 9

The schedule for repairing the 7500-kw. generator No. 9 at the Commerce Street station was prepared approximately as follows and was adhered to as closely as possible. All of the material required was on hand, and there were, therefore, no delays on this account:

A.	April 22.....	Dismantle machine.
B.	April 23 to 26....	Take off end plates from field, drive out brass wedges, remove laminations and send field coils to the Cold Spring shops. This work will be done on a day-and-night basis with six men in each shift.
C.	April 23 to 26.....	Drive out armature wedges, unsolder and remove coils and send to the Cold Spring shops. This work is to be done on a day basis only and will require at least eight men.
D.	April 27 to May 11.	Clean armature core, reinsulate lacing rings, clean field core, put on plate insulation, tape field bolts with asbestos, clean clips, etc. This work is to be done on a day basis and will require at least eight men.

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E. April 27 to 30.....Block and boil field coils at Cold Spring. This work is to be done on a day basis with overtime if necessary and will require eleven men.

F. April 29 to May 4 Clean field coils and prepare same for turn insulation. This work will be done on a day basis and will require fifty men.

G. May 1 to May 8...Repair defects in field coils, put on turn insulation and trim insulation. This work will be done on a day basis and will require sixteen men.

H. May 6 to 12.....Form work on field coils. This work will be done on a day basis and will require nine men.

I. May 7 to 13.....Sand field coils and attach field leads. This work will be done on a day basis and will require seven men.

J. May 9 to 16.....Tape field leads and field coils. This work will be done on a day basis and will require nine men.

K. May 11 to 17.....Put slot armor on field coils and bake same. This work will be done on a day basis and will require six men.

L. May 16 to June 5..Reassemble field at Commerce Street. This work will be done on a day basis and will require five men. This part of the schedule, however, will be subject to change, as it may prove advantageous to work day and night.

M. April 27 to May 12.Tin ends of armature coils, remove old insulation (outer tape only), reinsulate, apply slot armor and bake coils. This work will be done on a day basis and will require five men.

N. May 3 to June 1..Attach space blocks to armature coils, heat coils and install same. This work will be done on a day basis and will require fourteen men.

O. June 6.....Assemble machine.

P. June 7 and 8.....Run on short circuit to dry out.

The men required for carrying out the above schedule will be divided into two main groups, (a) skilled men, (b) unskilled men.

Date	Skilled Men	Unskilled Men	Date	Skilled Men	Unskilled Men
April 23 and 26...	8	12	May 11 and 12...	24	34
April 27 and 28...	8	17	May 13.....	18	18
April 29 and 30...	8	67	May 14 and 15...	17	12
May 1 and 2...	11	69	May 16.....	19	15
May 3 and 6...	13	81	May 17 to 31....	10	15
May 7 and 8...	14	45	June 1 to 5....	5	0
May 9 and 10...	19	34			

SCHEDULE FOR REPAIRING 14,000-KW. GENERATOR NO. 12

The schedule for repairing the 14,000-kw. generator No. 12 at the Commerce Street station has been prepared and is as follows. It is to be adhered to as closely as possible. All of the material required is on hand and there should therefore be no delay due to shortage of material.

A. Aug. 15.....Dismantle machine.

B. Aug. 16–19 (inclusive)....Take off end plates from field, drive out brass wedges, remove laminations and send field coils to the Cold Spring shops. This work will be done on a day-and-night basis with six men in each shift.

C. Aug. 16–25..... Clean armature, clean field core, put on plate insulation, tape field bolts. This work will be done on a day basis and will require three men.

D. Aug. 19–20.....Block and boil field coils at Cold Spring. This work is to be done on a day basis with overtime if necessary and will require eleven men.

E. Aug. 20–24.....Clean field coils and prepare same for turn insulation. This work will be done on a day basis and will require thirty men.

F. Aug. 21–25.....Repair defects in field coils, put on turn insulation and trim insulation. This work will be done on a day basis and will require nine men.

G. Aug. 24–30.....Do form work on coils. This work will be done on a day basis and will require nine men.

H. Aug. 25–31..... Sand field coils and attach field leads. This work will be done on a day basis and will require seven men.

I. Aug. 26 to Sept. 1.Tape field leads and field coils. This work will be done on a day basis and will require nine men.

J. Aug. 28 to Sept. 3 Put slot armor on field coils. This work will be done on a day basis and will require six men.

K. Sept. 2 to Sept. 11.Reassemble the field at Commerce Street. This work will be done on a day-and-night basis and will require five men in each shift.

L. Sept. 12–13.....Bake and paint field.

M. Sept. 14.....Reassemble machine.

This work was planned and carried out under the supervision of G. G. Post, electrical engineer of the Milwaukee Electric Railway & Light Company.

BENEFITS DERIVED FROM INDUSTRIAL TRAINING

Results Attained from Establishment of Such a Department in War Time Have Led to Its Permanent Institution by Large Plant

The superintendent of one of the country's large manufacturing plants has given emphatic testimony regarding the benefits of industrial training in a recent bulletin issued by the United States Training Service of the Department of Labor. The pamphlet is "A Business Man's Experience with Industrial Training." E. A. Barnes, superintendent of the General Electric Company plant at Fort Wayne, Ind., is the author. Mr. Barnes believes that industrial training as promoted by the training service should be generally adopted in American industries. "In too many cases," he says, "the old system of letting shop foremen hire men without much consideration for the applicant's ability or training is still in effect, with the result that many new employees spoil work, ruin expensive machinery and tools and really produce little work that is perfect enough to be shipped." Mr. Barnes goes on to tell of his conversion to the permanent value of training. He found that his foremen were especially anxious to secure the workers who had been through the training department, which fact of itself was strong indorsement of the idea. Experience with what was first considered a temporary feature led to making it permanent. To this training department all new employees are sent and also old employees who from lack of proper training are not doing as well as they might.

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Selecting Equipment for Industrial Lighting—I

Complete Statement of the Requirements of Good Illumination—Problems of Correct Illumination, Color and Elimination of Objectionable Glare—Technical Data Concerning Lamps Are Also Included

BY WARD HARRISON AND H. H. MAGDSICK
National Lamp Works of the General Electric Company, Cleveland

THE ideal source of illumination for factory use must be low in brilliancy to minimize glare and specular reflection and must distribute the light in a manner to supply satisfactory illumination on the vertical as well as on the horizontal plane. It must be sufficiently large in area to give soft shadows and in most

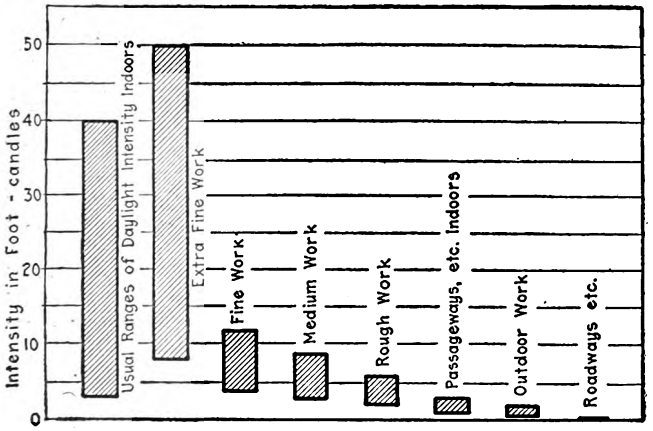

FIG. 1—ARTIFICIAL LIGHTING INTENSITIES COMPARED TO INTERIOR DAYLIGHT VALUES

cases must be small enough to secure a directed light. Reflecting and diffusing equipments of many characteristics for the production, with modern incandescent lamps, of some or all of these qualities in any degree required are available.

REQUIREMENTS OF GOOD ILLUMINATION

The requirements which must be met in the choice of equipment and in the design of a satisfactory lighting installation for industrial plants are:

(1) A steady light of sufficient intensity on all working surfaces, whether in horizontal, vertical or oblique planes.

(2) A comparable intensity of light on ajacent areas and on the walls.

(3) Light of a color and spectral character suited to the purpose for which it is employed.

(4) Freedom from glare and from glaring reflections.

(5) Light so directed and diffused as to avoid objectionable shadows or contrasts of intensity.

(6) A system which is simple, reliable, easy of maintenance and reasonable in initial and operating cost.

To-day work of every kind, including the most intricate operations and those requiring the utmost precision, must be carried on throughout the twenty-four hours. Obviously the minimum intensity to be supplied is that which will permit comfortable vision, conserve eyesight and eliminate accident hazard. Many states, through their industrial commissions, are beginning to require the employer to make such minimum provision. However, the governmental requirements are not such as to assure the most economical production, a factor of vital interest to the manufacturer, and to obtain this considerably higher intensity values are found necessary.

It is difficult to recommend the exact intensity required in a given plant from the economic standpoint. This figure necessarily depends upon numerous factors, such as the cost of producing light, the number and wages of the employees and the value of their output, all of which vary widely in different establishments. For good vision the color and fineness of the materials worked upon are important considerations in determining the amount of light which should be supplied. An object is seen by the light which it reflects rather than by the light falling upon it; hence textile industries manufacturing dark-colored fabrics require higher intensities than those mills which produce light-colored goods. Manufacturing processes involving fine machine work or fine assembling require more light than industries where a comparatively low degree of accuracy suffices. The greater alertness and better morale of the workmen in brightly lighted surroundings is at once reflected in the greater production of the plant.

In consideration of the amount of light necessary for factory illumination the criterion must be the intensity on all working surfaces. Except in especially unfavorable locations, such as near the dark side wall of

FIG. 2—AN INSTALLATION OF MIRRORED-GLASS REFLECTORS IN A FOUNDRY

a room, any of the systems of lighting usually employed can be expected to provide an intensity of illumination on any vertical plane equal to about one-half of that measured on a horizontal plane at the same point. This fact should be kept in mind, particularly in designing a lighting system to comply with the state codes, which usually specify only that value which must be provided on the principal plane of the work. The intensity values used in industrial lighting as compared with the usual range of daylight

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intensities existing in factory interiors are shown graphically in Fig. 1.

Moderate intensities of illumination in aisles and other spaces intermediate between the working surfaces, on the walls, etc., are necessary for safety, good vision and stimulating atmosphere. Light side walls are conducive to a cheerful impression of brightness throughout the room. The eyes of the workmen looking up from his well-illuminated machine or bench

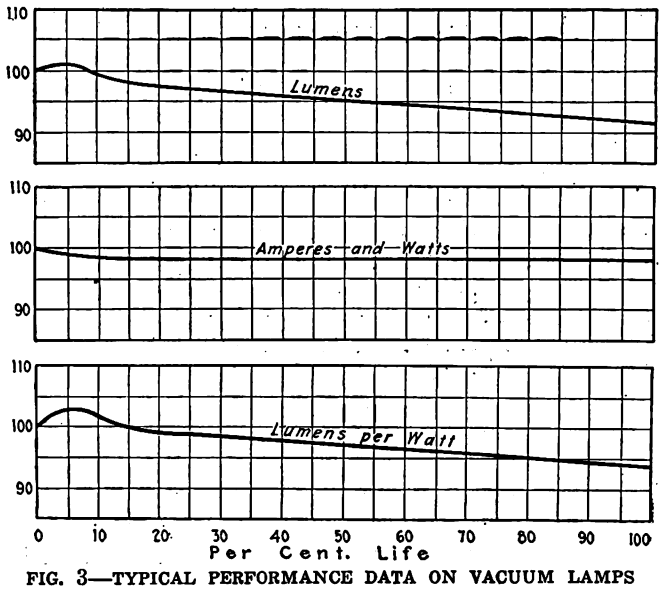

FIG. 3—TYPICAL PERFORMANCE DATA ON VACUUM LAMPS

are not adapted for vision at low intensities. Hence, if ajacent objects and aisles are only dimly lighted, he will be compelled either to grope about, losing time and risking accident, or to wait until his eyes have become adapted to the low intensity. Glancing back at his work, he again loses time while the pupils of his eyes adjust themselves to the increased amount of light which reaches them. If long-continued, this condition leads to fatigue as well as to interference with vision and to accidents. As daylight intensities represent the standards which are to be sought in the artificial lighting of industrial plants, so does the color of daylight constitute the standard which should be approached in artificial illumination. The so-called "daylight" lamp, with its specially selected blue-green glass bulb, gives a light which is a further step toward daylight color and extremely valuable in the manufacturing processes requiring closer color identification or better revelation of detail through color contrasts. For dye making and color matching where extreme accuracy is required, several equipments with special absorbing screens are available which duplicate the standard north sky light with exactness. Under certain conditions, on the other hand, as in a foundry, the criterion for the choice of an illuminant is the penetrating power of the light. The appearance of the sun through smoke, haze or fog evidences the fact that the shorter wave lengths, or the rays near the blue end of the spectrum, are absorbed or dispersed, while the longer wave lengths pass through. Hence, under such conditions, the light in which red and yellow predominate is most effective.

In guarding against the serious effects of glare, six principal factors should be taken into consideration:

(1) Total candlepower from the source directed toward the eye.

(2) Distance from the source to the eye.

(3) Intrinsic brilliancy of the source.

(4) Contrast in brightness between the light source and the working surfaces and surroundings.

(5) Proximity of the light source to the line of vision.

(6) The length of time during which the source of glare is present within the field of vision.

Glare is not entirely a question of the intrinsic brilliancy. Of greater importance than this is the question of the total light flux entering the eye. Tests have shown that a 10-in. (25-cm.) opal globe equipped with a 500-watt gas-filled lamp, hung approximately 10 ft. (3 m.) above the floor and 10 ft. from the observer, will prove fully as glaring as a 75-watt gas-filled lamp in the same location. Although the intrinsic brilliancy of the opal globe unit is only two or three times that of a candle flame, the total candlepower is so excessive that its effect is just as bad as that of the filament of the other gas-filled lamp, which has an intrinsic brilliancy 400 times as great as that of the globe. Glare caused by specular reflection from working surfaces is particularly trying because of the necessity of directing the eyes toward those surfaces, and further because the eyes by nature are especially sensitive to light entering from below. In choosing lighting equipment it must be borne in mind that, although a given reflector may afford adequate protection against direct glare from the lamp filament, it may not protect against glaring reflections unless the lamp is shielded.

Differences in brightness of surfaces, that is, light and shadow, are essential in observing objects in their three dimensions. On the other hand, in the factory it is usually necessary to work on surfaces in many planes; hence, while dense, sharp shadows would define edges and outlines most distinctly, they might be so dark as to interfere with work in the shaded areas.

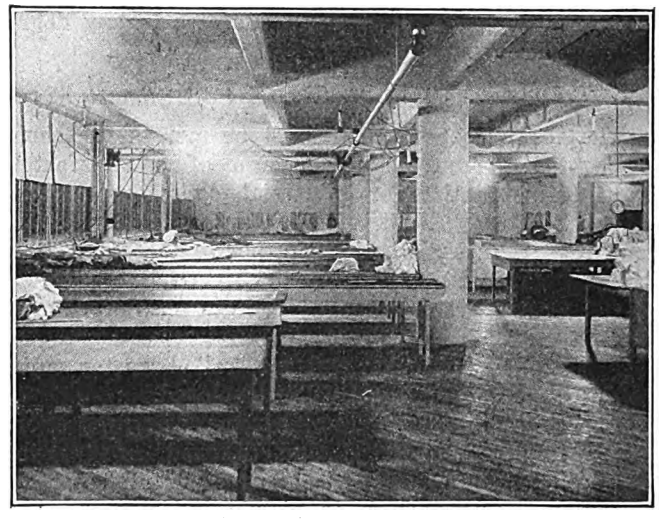

FIG. 4—AN APPLICATION OF SEMI-INCLOSING UNITS IN INDUSTRIAL LIGHTING

Vacuum and gas-filled lamps are available in a wide range of sizes and in several voltage ranges to provide for every application. The curves of Fig. 3 show the changes in light output, energy consumption and efficiency of gas-filled lamps which occur throughout their rated life of 1000 hours. It will be noted from the curves that the current consumption decreases during the first 200 hours of burning. The decrease in lamp efficiency is therefore less throughout life than the de-

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crease in light output. It will be noted that the final lamp efficiency is within 6 per cent of its initial value. The life rating of multiple lamps is determined by the average results of exhaustive tests on many groups of lamps. As an illustration of the results of a typical test on 100 60-watt vacuum lamps, the following table is given. It can be seen that out of the lot of 100 lamps forty lamps failed before burning 1000 hours and sixty lamps burned beyond that period. The average

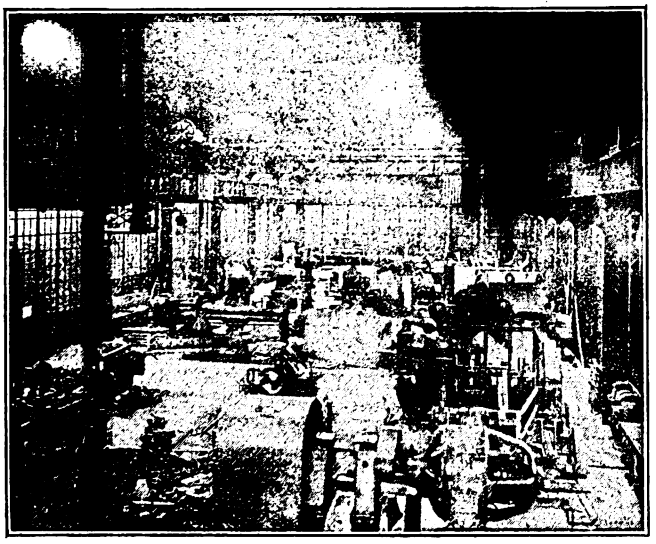


FIG. 5—GENERAL LIGHTING BY ANGLE AND OVERHEAD UNITS

life of all lamps, however, is slightly in excess of 1000 hours:

Hours burned.....	0	200	400	600	800	1000	1200	1400	1600	1800
No. lamps remaining	100	97	94	89	77	60	39	17	3	0

Incandescent lamps of the 110-volt to 125-volt class operate at a higher efficiency than those of the 220-volt to 250-volt class, although the rated life is the same, namely, 1000 hours, and the cost of the lower voltage lamp is materially less. Moreover, the service rendered by these lamps of the high-voltage class is somewhat inferior to that of the lower-voltage class. It is advisable in almost every case to utilize the lamps of the lower voltage range.

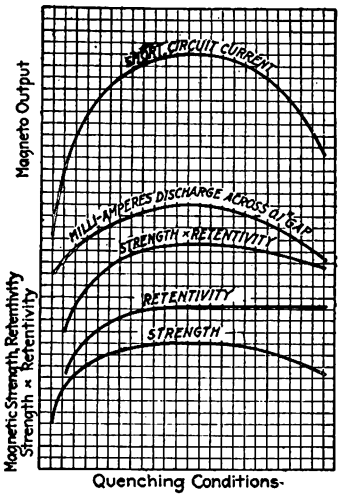
Lighting and power circuits should be separate. Not only are fluctuations and voltage caused by the starting of motors or by the sudden shifting of heavy loads thereby confined mainly to the power circuit but with this arrangement trouble in the power circuit is far less likely to cut off the illumination of the plant at a moment when light is urgently needed.

PERMANENT MAGNETS AND THEIR PROPER TREATMENT

The Two Things Upon Which Their Quality Depends—Nine Considerations in Their Manufacture Are Enumerated

Although a vast amount of scientific investigation has been done and a great deal has been written on the subject of permanent magnets, it remains one upon which very little practical useful information exists. Generally speaking, there are two things which are a measure of the quality of permanent magnets. These are: (1) the residual induction or residual magnetic influx; (2) the retentivity or coercive force. The object of the manufacturer is then to produce a magnet of good quality, of uniformity and permanence. These problems are discussed by John Walter Esterline in a recent booklet, "Permanent Magnets," published by the Esterline Company.

He states that all kinds of steel which can be tempered will retain a portion of the initial magnetism if magnetized. There are, however, very few kinds of steel which make relatively good permanent magnets,



TESTS OF PERMANENT MAGNETS

Curves determined by actual tests showing the relation between the quantities of permanent magnets and the output of magnetos using these magnets. The variation in quality was obtained by varying the quenching conditions, using the same chemical analysis. These curves show clearly the importance of magnets of the proper quality.

and the quality of the magnets made from any kind depends upon a great many different things: (1) Chemical content; (2) conditions under which the billets are made; (3) rolling conditions; (4) annealing; (5) furnace conditions and treatment during the forming or forging of the magnets; (6) conditions under which the final heat treatment is done; (7) the mechanical operations performed after final heat treatment; (8) the process of maturing; (9) method of magnetizing. It is suggested that for the majority of uses to which permanent magnets are applied the product of strength multiplied by retentivity is the best measure of magnetic quality. This has been demonstrated by tests, typical results of which are given in the figure.

The process of aging or maturing the magnets consists in subjecting them to a series of magnetizing and demagnetizing forces after quenching.

IT IS a notorious fact that very few cities and towns have the slightest conception as to what it costs them to build, operate and maintain a municipal utility plant. Possibly in some instances they don't care, but as a plain business proposition they should know whether it is being maintained partly from general revenue of the municipality. It is very natural, however, that city officials want to make as good a showing as possible and are only too willing to allow their successors to assume the burden of renewals to the property. The result is that in a few years not much value is left to the plant, for it is mostly junk.—*S. S. Kendall, Colorado Utilities Commission.*

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The Need of Adequate Rates

Central Stations Must Face the Situation Boldly and Make Plans for Betterments Without Waiting for Decline in Commodity Prices—Their Case Rests on the Economic Changes of the Times

BY L. K. COMSTOCK
L. K. Comstock & Company

This was written by Mr. Comstock in answer to a series of questions sent to him by the ELECTRICAL WORLD. These centered on the need for increased central-station facilities to meet the public demand for power and on the ways and means of raising the great amounts of capital required. Mr. Comstock's view in brief is: (1) Central stations must expand, accepting commodity prices at the present level without waiting for a decline, and (2) they must tell the regulating commissions and the public boldly that the values in which they are paid have been depreciated and higher rates are necessary.

THE central-station industry has been and is confronted with conditions which merit serious consideration not only on the part of central-station owners and managers but also on the part of public service commissioners and consumers.

When central stations are faced on the one hand with increased costs of labor, apparatus, supplies and all things entering into the cost of energy output, and on the other hand with the rate regulations of service commissions, there results an unbalanced condition or lack of equilibrium, producing poor service, general dissatisfaction, small profits or deficits.

Past experience shows that the central-station industry, roughly speaking, has doubled its output and gross revenue every five years. This means large capital expenditures every year in order to provide generating and distribution facilities to meet normal increases. Increased cost of raising capital and higher interest rates must of necessity reflect themselves in the cost of energy output.

No General Downward Trend in Prices

Much has been said and written about an impending fall in prices of metals, building materials and staple supplies to pre-war levels, but the downward trend has been notable in copper alone. Had not the close of the war found the government in possession of huge stocks of copper which have been unloaded upon a weak market, it is doubtful if the price would have sagged much from the price fixed by the War Industries Board last October. It is thought by many good judges that the trend of copper prices will be slowly upward when the buying and selling forces finally reach a post-war equilibrium.

The building construction industry, a good barometer of commercial and industrial prosperity, has about reached the conclusion that prices will not recede much, if any, and as a result building operations will go forward without much further waiting. This conclusion is sound because three powerful factors support it.

The first factor is to be found in inflation. Huge amounts of gold, paper money and credit money have been added to the world's supply, and this relatively depreciates the value of the dollar and inversely causes all prices to rise. The face value of the paper currency put out during the war is greater than the value of all the gold and silver mined in the world since the discovery of America. The legal-tender circulating medium of the world has increased from $15,000,000,000 in 1913 to more than $45,000,000,000 in 1918.

The second factor is to be found in the labor situation. Labor, not alone in America, but everywhere, has set its face against decreases in wages, and rightly so, because the purchasing power of the dollar, if reckoned at par in 1913, is but $0.5102 in 1918. Since all material costs represent nothing but accumulated labor, how can one reasonably expect generally lower material costs?

The third factor is the potential demand for every kind and description of materials.

Central stations must boldly face the situation and make their plans for the necessary and normal betterments and increases without waiting for the fatuous fall in prices. The public must be served and the public is willing to pay reasonably for service. Betterments and increases should be strictly limited to those which will generate and safely distribute the most kilowatts.

It is not possible for central stations to continue their capital expenditures for betterments and increases in a rising market and their operating expenditures at higher costs for labor and supplies and at the same time to be compelled by public service commissions to sell their output at a price fixed quite independently of the conditions brought about by the subtle operations of laws which need no human administrators.

It can be shown to those who are willing to learn that if a central station sold 1000 kw.-hr. in 1913 for $30 and if a public service commission regulation required the same money rate in 1919, the central station would actually receive in 1919, not $30, but about $15.31, if reckoned in purchasing power, because $30 based on a 1913 commodity valuation is equal to $15.31 in 1919 based on a commodity valuation.

If public service commissions could be made to appreciate the argument that all of the commodity expenditures of the central station made for present extensions and operations are on a 1919 commodity base, and the rate at which the central stations are permitted to sell their output are on a 1910 or 1915 or 1916 commodity base, and that it is only necessary to bring the two bases into harmony, much of the central-station manager's worry would be at an end.

It is not possible to suppose that radical alterations in the value of the units in which financial transactions are measured can be lived through without corresponding radical readjustments. These alterations in units of value continue to operate inexorably whether public service commissions recognize them or not, just as the earth continued to be round whether the contemporaries of Columbus believed it or not.

It should be clearly borne in mind that, except as

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to profits paid out in dividends or carried to surplus account, the central-station business is simply one of buying and selling human energy, either physical or mental; and with this in mind it is difficult to escape the conclusion that the business of generating, distributing and selling electrical energy is one of the few industrial activities in which the charge for the unit sold bears little relation to the cost of production.

Central-station owners and managers should lose no time in preparing their cases from the economic point of view, using the index number as a guide to determine the value of the coin in which they are paid for the kilowatt-hour sold, in laying their cases before the commissions and if necessary before the public. Herein lies the true remedy for the distressing ills which have befallen the central-station industry.

A. I. E. E. COMMITTEE PROPOSES STANDARD RELAY NOMENCLATURE

Misunderstandings Among Operating Companies Due to Difference in Names for Protective Relays—Committee Draws Up Definitions

From the answers of thirty-two operating companies to a questionnaire sent out by the protective devices committee of the American Institute of Electrical Engineers it was apparent that much confusion existed in the use of names describing the various protective relays. The committee therefore undertook to select and propose for standard the following nomenclature:

Electric Protective Relay. — An intermediate device by means of which one circuit is indirectly controlled by a change in conditions in the same or other circuits. The relay is ordinarily equipped with contacts to open or close an auxiliary circuit.

Directional Relay. — Any relay which functions in conformance with direction of power or voltage or current or phase rotation, etc.

Power-Directional Relay.—Any relay which functions in conformance with direction of power. (Note: This includes both unidirectional relays with single-throw contacts and duodirectional relays with double-throw contacts. The reason this name is preferred to "reverse power" is that the device is frequently used to function under normal direction of power. Furthermore, in some cases the normal condition of the system may permit power to flow in either direction. Relays for use in either alternating or direct current circuits are to be classed as power-directional relays.)

Polarity-Directional Relay. — Any relay which functions by reason of a reversal of the normal direction of polarity.

Phase-Rotation Relay. — Any relay which functions by reason of a reversal of the normal direction of phase rotation.

Current Relay.—Any relay which functions at a predetermined value of the current. These may be either over-current relays or under-current relays.

Voltage Relay.—Any relay which functions at predetermined value of the voltage. These may be either over-voltage relays or under-voltage relays.

Watt Relay.—Any relay which functions at a predetermined value of the watts. These may be either over-watt relays or under-watt relays.

Frequency Relay.—Any relay which functions at a predetermined value of the frequency. These may be either over-frequency relays or under-frequency relays.

Temperature Relay.—Any relay which functions at a predetermined temperature in the apparatus protected.

Open-Phase Relay.—Any relay which functions by reason of the opening of one phase of a polyphase circuit.

Differential Relay.—Any relay which functions by reason of the difference between two quantities such as current or voltage, etc. (Note: This term includes relays heretofore known as "ratio balance relays," "biased" and "percentage differential relays.")

Locking Relay.—Any relay which renders some other relay or other device inoperative under predetermined values of current or voltage, etc.

Trip-Free Relay.—Any relay which prevents holding in an electrically operated device such as a circuit breaker while an abnormal condition exists on the circuit.

Auxiliary Relay.—Any relay which assists another relay in the performance of its function and which operates in response to the opening or closing of its operating circuit.

Signal Relay.—An auxiliary relay which operates an audible or a visible signal.

QUALIFYING TERMS AS APPLIED TO RELAYS

Notching.—A qualifying term applied to any relay indicating that a number of separate impulses are required to complete operation.

Inverse Time.—A qualifying term applied to any relay indicating that there is purposely introduced a delayed action, which delay decreases as the operating force increases.

Definite Time.—A qualifying term applied to any relay indicating that there is purposely introduced a delayed action, which delay remains substantially constant regardless of the magnitude of the operating force. (For forces slightly above the minimum operating value the delay may be inverse.)

Instantaneous.—A qualifying term applied to any relay indicating that no delayed action is purposely introduced.

Where relays operate in response to changes in more than one condition, all functions should be mentioned.

ELECTRIC STEEL FURNACE RATE SITUATION IS UNCERTAIN

Foundrymen and Steel Manufacturers Claim Lower Rates Are Necessary and Annual Minimum Charge Is Suggested to Cover the Situation

Writing from the Middle West, a central-station power salesman said: "There seems to be a great difference of opinion as to whether or not the electric furnace will survive the high-rate period through which it is now passing. I have had correspondence with several central stations, some of which are about to bring out special rates for this class of service, which in my opinion opens up ground for criticism from the rate-making standpoint.

"Information from the steel manufacturers is to the effect that the steel makers who will use converters and other processes with oil furnaces will find that their manufacturing costs do not vary so greatly with the output as they do with electrical energy. Consequently these manufacturers, so they say, are able to name a lower price for their castings. especially in the dull periods. On the other hand, the electric furnace users are faced with a high energy cost during their periods of low output. This, of course, brings up the rate per kilowatt-hour and apparently increases their manufacturing costs. Consequently they feel they are unable to compete with other processes. This argument holds true in the steel castings industry only and does not apply to the manufacturers of alloy steel."

Another central-station sales manager in the Middle West has expressed his personal opinion that the solution of the problem lies in changing electric furnace rates by inserting an annual minimum charge below which the central-station company cannot go. This annual minimum charge, it is thought, should cover the investment which the central-station company has in electric furnace service.

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FIFTEEN WAYS IN WHICH TO GET BETTER REGULATION

Three-Wire Network, Readjustment of Transformers, Retirement of Old-Type Units, Avoidance of Low-Power Factor, Etc., Recommended

MANY effective ways exist for securing better voltage regulation which can be applied after a voltage survey has determined the particular remedy necessary. A few of them are worthy of mention and are given in the following paragraphs:

It is absolutely necessary that all voltmeters be carefully calibrated, particularly the station meters. If the latter read too high, it may cost the company a considerable sum of money in lost revenue. Among the causes of inaccurate station voltmeter readings is the connection of pilot lamps across the potential transformers or the overloading of these by other switchboard instruments. They should be disconnected and the station voltmeters checked systematically and regularly.

Three-wire, 110-220-volt, single-phase networks with banked transformers are particularly desirable to improve voltage regulation, and if possible the secondary loops should be closed around city blocks. This evens up the voltage over an area by taking full advantage of load diversity with regard to transformers and copper.

Attention should also be given to the general readjustment of transformers as to size and location for carrying the load. The continual adding of lighting business to particular transformers unintentionally overloads them, and the only safeguard lies in checking all transformer loads with a split-coil cable testing ammeter, which every company should own. Transformers should also be readjusted with reference to their characteristics so that load may divide properly between them. Benefit also results from the retirement of transformers which prove unfit for lighting service.

Voltage regulation may also be improved by separating power business from lighting business. The first separation should be in the secondaries, and the second, if needed, in the primaries. Voltage drop is very greatly increased by the effect of low power factor on the regulation of transformers. A drop of from 4 to 5 per cent at full load is caused by an 80 per cent power factor.

The establishment of centers of distribution, as opposed to the common method of connecting business all along the feeders from the plant outward, is generally attended by benefit. In this connection the ends of adjacent feeders should be connected by fuses in order to take advantage of the load diversity offered. Where automatic voltage regulators are not employed it will usually be found convenient and effective to maintain the voltage at any distant point by adjusting the busbar voltage. This can be intelligently done by once calculating or determining the voltage required at the busbars with different loads to maintain a specific voltage at a distant point and then plotting a curve which would give this information readily. By running back light-pressure wires from the center of distribution to the Tirrill regulator at the plant, constant voltage may also be maintained at other than the plant busbar.

Automatic feeder regulators should be considered at the plant or substation if demanded; if required in outlying districts, they may be of the pole-top type. It should be remembered that regulators, generally, do not cut down the distribution losses. Attention should be given to providing additional copper where the drop is considerable, but the amount added should be determined by balancing losses against the price of copper.

As indicating the magnitude of voltage drop from a center of distribution to individual loads, it might be pointed out that the average is usually more than half the drop from a center of distribution to the farthest load, and investigation shows that the former will be approximately 70 per cent of the latter. Taking 70 per cent of the average maximum drop from each feeder and adding this to the desired lamp voltage, the voltage is obtained at which the feeder regulator should be set.

In individual cases of poor voltage regulation due consideration should be given to the customer's wiring, and if it is too light it should be impressed upon him that changes are necessary.

These suggestions have been received from R. L. Baker, electrical engineer of H. L. Doherty & Company.

Book Review

HANDBOOK OF MECHANICAL AND ELECTRICAL COST DATA. By H. P. Gillette and R. T. Dana. New York: McGraw-Hill Book Company. 1740 pages, illustrated. Price, $6.

The old objection to handbooks on cost data is still raised, but it is hardly justified provided that the original contributor of the information, the conditions (including the date) to which the data apply and the itemized labor charges or time spent on different work are given. Since the electrical engineering field has been without any cost-data book until recently, the information which has been compiled by Messrs. Gillette and Dana should be more than welcome. Their professional positions and past contributions in the form of reference data speak for the accuracy and reliability of the data just published. The information has been compiled principally from technical journals, engineering society publications, etc., but the authors have also included some of their personally collected data. If there were more of the latter, it would enhance the value of the handbook considerably. The original source of the information, itemized labor expenses and the date to which the figures apply are given in most cases. The value of this information cannot be too strongly emphasized, for without it assurance cannot be placed on the reliability of the data, nor can they be applied intelligently at a later date when conditions are different. Additional information might be given to advantage in the form of a short summary of conditions which vitally affect construction and labor costs—for example, geographical location, topographical or geological conditions, etc. Since labor expenses differ so in different places, it would seem preferable, where possible, to analyze the man-hours required for different work instead of giving labor expenses, in order that different labor unit costs could be more easily applied. In a handbook that is intended to give only cost data information which is not closely related is out of place. Occasional examples of this kind occur that might better give place to data that are lacking, but this is not a prevailing characteristic. Since designers and constructors represent only a portion of the electrical industry, unit maintenance, operating and repair costs could be included to advantage. Some improvement can also be made in the arrangement of the information and index so that ready reference will be facilitated; but as a whole the Gillette-Dana handbook is very satisfactory.

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INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

GROUPING THE CABLES BEHIND SWITCHBOARDS

Cables Threaded Through Steel Plates Set at Right Angles to Switchboard and Attached to Panel Supports

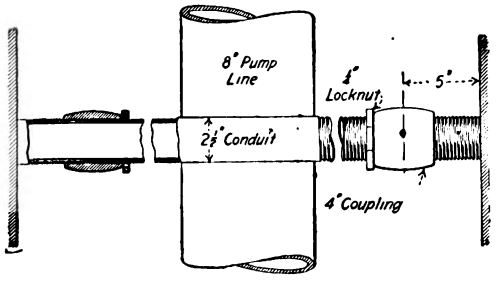
To permit grouping cables neatly above one switchboard which the L. K. Comstock Company installed, it attached $\frac{3}{16}$-in. (4.8-mm.) steel plates to each panel support at right angles to the switchboard and framed these plates with channel irons. Holes were drilled in the plates and nippled so that the cables could be threaded through to their respective switch studs. The top and sides of the framework were inclosed in No. 12 gage steel plates and the bottom closed with $\frac{1}{8}$-in. (3.2-mm.) transite boards in which holes were later drilled for feeder drops to the switch studs. This latter operation was not performed, however, until all the rest of the work was done.

To facilitate handling the switchboard panels, which measured 7 ft. by 24 in. by 2 in. (2.1 m. by 60 cm. by 5 cm.) with switch studs extending about 3 ft. (90 cm.) to the rear, cribs mounted on rollers were employed.

EMERGENCY ARRANGEMENT FOR UNCOUPLING CONDUIT

As Both Ends of a Conduit Crossing a Pipe Line Were Rigid, Quick Removal, in Case Either Line Had to Be Overhauled, Was Necessary

In one industrial plant where a motor feeder crosses a pipe line at right angles some method had to be employed to allow easy and quick removal of the conduit in case of an emergency, since it was rigidly held at



SECTION OF CONDUIT CROSSING PIPE LINE CAN BE REMOVED BY LOOSENING LOCK NUT AND UNSCREWING COUPLING

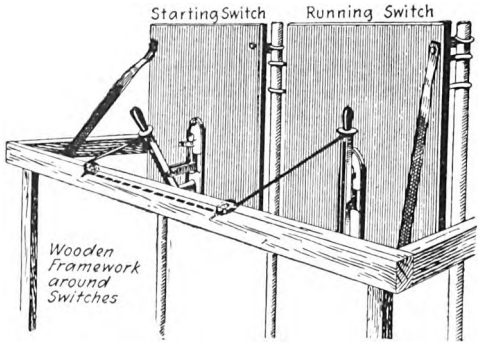
both ends. To do this the conduit was sawed off so that about 5 in. (12.7 cm.) extended into each side of the trough in which the pipe was laid. The ends were threaded so that a 4-in. (10-cm.) coupling would fit tight when screwed on for one-half of its length. The section of conduit sawed out was also threaded on both ends so that a 0.25-in. (6-mm.) lock nut and the coupling would screw on easily. By holding the short section of conduit in position, turning back the couplings and jamming the lock nuts against the couplings the conduit line is made completely rigid.

Plainfield, N. J. IRVING E. SWEAZEY.

SIMPLE SWITCH INTERLOCK FOR TEMPORARY INSTALLATION

Rope and Pulley Arrangement Prevents Starting and Running Switches on 13,000-Volt Motor from Being Closed at Same Time

With the installation of the temporary equipment for a substation in an industrial plant there was some apprehension on the part of the employees that the starting and running switches for a 300-kw., 13,200/220-volt



ROPE BETWEEN SWITCH HANDLES PREVENTS BOTH BEING CLOSED AT SAME TIME

motor-generator set would be closed at the same time with consequent damage to the compensator. It was not considered worth while to purchase mechanically interlocked switches for the service, so a simple arrangement of ropes and pulleys like that shown in the sketch was used. Closing the starting switch automatically opens the running switch and vice versa.

AUTOMATIC "FOOLPROOF" CONTROL FOR LATHES

Permits Unskilled Operators to Handle Equipment at Top Speed Without Danger of Accident or Spoilage

At the Blake & Knowles Company's factory, Cambridge, Mass., special attention has been given to automatic control of lathes, in order that operators without the slightest electrical knowledge may handle the equipment at top speed and without danger of accident or spoilage. The representative installation illustrated shows a 24-in. (60-cm.) Whitcomb-Blaisdell lathe in this plant, driven by a 7½-hp., 220-volt compound motor with shunt-field control, permitting 400 to 1200 r.p.m. The main-line knife switch is mounted against the side of the motor frame in an inclosed cabinet. Directly below this, upon the headstock, is a speed-

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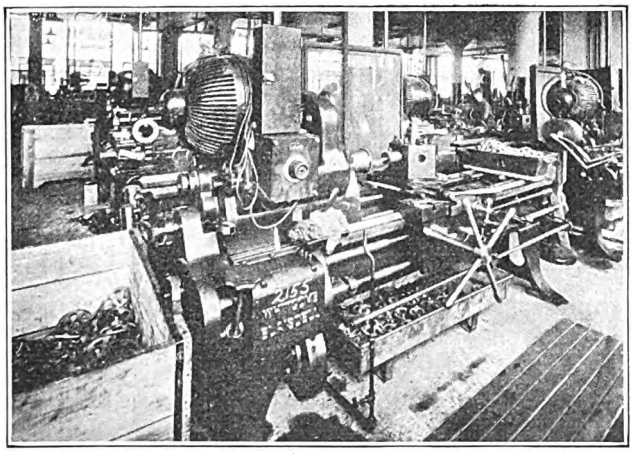
setting device which is used in predetermining the speed at which the motor will run in a given case.

The lathe is fitted with a turret head, the apron being thrown to the right to show this device. The lathe is equipped with a splined shaft, to which is connected by a chain drive, shown at the extreme right, the master switch of the controller. This chain drive and master switch are better shown at the extreme left, mounted upon a duplicate lathe, with back-to-back installation for space conservation. A controller panel, carrying magnetic main switches, accelerating and field commutating switches, is shown at the rear, just above the lathe bed and under the turret head, and upon the splined shaft and attached to the apron is an operating shaft equipped with an electrical control handle. The control equipment is of the Cutler-Hammer type.

As soon as the speed for a given operation has been predetermined, the operator has full control of the equipment from the handle on the apron of the lathe, which permits forward rotation, stopping and reversing at a predetermined speed. In one section of the turret head is mounted a drill, and in the other section is a tap. The lathe shown is used in boring and tapping holes in hand wheels for small valves.

In working, the operator places the blank in the chuck and advances the turret, holding the drill to the piece, then throwing the operating handle upon the apron of the lathe to forward speed. This operation throws the master switch in that direction of rotation, which in turn operates the pilot circuits for the main-control panel, and the motor is automatically accelerated to the predetermined speed. As soon as the drill has performed its work the operator throws the operating handle to full-speed reverse. The control panel automatically decelerates the motor, reverses it and brings it up to the predetermined speed in the reverse direction, thus withdrawing the drill. The operator then throws in the turret so that the tap comes into play and repeats the operation. Should the operator force the feed too fast and tend to overload the motor, an overload movement trips. Under such conditions it is



AUTOMATIC LATHE WITH ADJUSTABLE-SPEED COMPOUND MOTOR

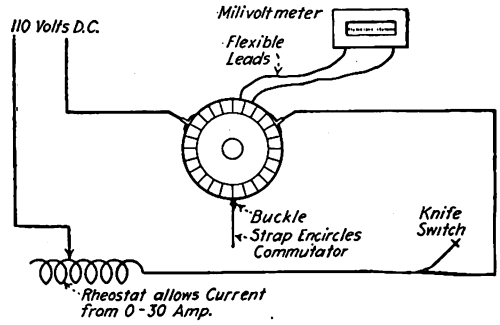
not necessary for the operator to leave her position at the apron of the lathe, the resetting of the trip being done by throwing the master switch to the off position. Dynamic braking is employed in stopping the motor from both forward and reverse positions. This type of equipment has been used to great advantage in piece-work operations.

Boston, Mass. H. S. KNOWLTON.

ARMATURE COIL TESTER FOR PLANT REPAIR SHOP

Shop-Made Arrangement Allows Repair Man to Tell Exactly Where Fault Is Located — Millivoltmeter Indicates Cause of Trouble

When armatures are brought to the electrical shop for repair, determination of the location and extent of the fault must be made in order to remedy it in the quickest and most efficient manner. To do this effectively the E. W. Bliss Company arranged a scheme



THE CONTACTS CONVEYING CURRENT TO ARMATURE CAN BE SLIPPED ALONG BELT PASSING THROUGH THEM

which consists merely of a leather strap holding two sliding contacts the distance between which can be adjusted, a millivoltmeter taken from a Brown pyrometer, an old resistance coil and a rheostat switch. The strap is adjusted on the commutator as shown, and the energizing leads are twisted firmly in place. A current is sent through the armature—the amount depending on the size of armature and being regulated by a rheostat switch. The repair man then places the two wires leading to the millivoltmeter on adjacent commutator bars and notes the reading of the instrument. After marking the starting place, he follows this procedure until he has tested all of the commutator bars. The energizing contacts are preferably shifted so that the meter leads are always within the shortest distance between them, otherwise the meter contacts must be reversed as there is a reversal in current.

If the meter reading is the same for all coils, the repair man will know that everything is all right. However, if no reading is obtained there is a short circuit in one of the coils to which the bars are attached. Or, if there is a low reading, there is either a poor commutator surface or poor insulation on the conductors. High readings indicate an open circuit which may be caused by a wire burn-out or a loose connection.

Brooklyn, N. Y. W. V. BOND.

MOTOR TOO OFTEN BLAMED FOR MACHINE TROUBLES

Possibilities of Mechanical Troubles Should Be Investigated So Breakdown Will Be Less Likely After Replacement of Damaged Equipment

The unfailing regularity with which troubles of motor-driven machines are attributed to the motor or to its starter, without even an inspection of the connected machine, has cost operators many a dollar from the supposed need to send a long distance for an electrician when a competent mechanic available on the job could have located the trouble and removed it. The prevailing feeling appears to be that if a motor heats

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or sparks the trouble is electrical and must be in the motor. The following cases are in point:

An operator telephoned for an inspector to come 75 miles (120 km.) to find out the trouble with a 20-hp., three-phase induction motor used for driving a conveyor in a paper mill. Investigation disclosed that it was due to the bearings. The motor was operated where it was exposed to extreme cold. This would have been a good thing from a purely electrical point of view, because low temperature helps electrical efficiency; but in this case the lubricating oil, thickened by the cold, could not be handled by the oil rings. Smoothing of the bearings and substitution of winter oil restored normal operating conditions.

In another instance the inspector reached the scene of trouble too late to save one rotor from destruction. The disabled rotor had been packed and was on its way to the factory. A spare rotor had been installed and was ready to be started. It was thought advisable to remove the rotor in order to look things over. Inspection of the starter showed that the first rotor had been rubbing because of worn bearings.

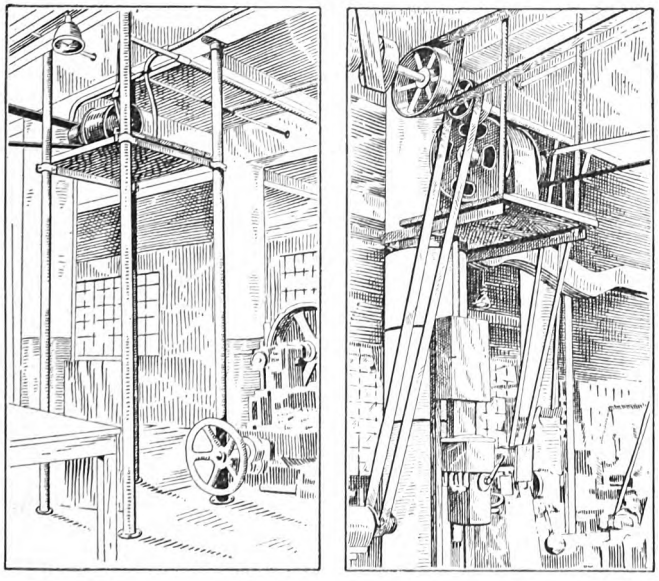
In a third instance a direct-current motor could not be started because the starting box "got too hot." The box did get too hot, but it was on account of a grounded motor field connection, across which and the motor frame lay a wrench used in replacing a grounded coil.

Brooklyn, N. Y. E. C. PARHAM.

SUPPORTING MOTOR ON COLUMN RELEASES SPACE ON THE FLOOR

About 16 Sq. Ft. Is Now Available Under Each Motor Mounting — Also Facilitates Transporting Material to and from Machines by Trucks

Economy of floor space and convenience of control are now being obtained in one industrial plant by attaching the motor stand and control apparatus directly



OLD AND NEW METHOD OF MOUNTING MOTORS

to columns instead of mounting the motors on four iron pipes extending from the floor to the ceiling as was formerly done. As the old supports were about 4 ft. (1.2 m.) apart, some 16 sq.ft. (1.5 sq. m.) of factory space was wasted, and besides the supports usually interfered with the transportation of material.

The improved support is constructed by joining two half-circle iron bands around the column by means of bolts so that they cannot slip and attaching horizontal angle-iron pieces to the joints. The other ends of the angle-iron pieces are held in place by means of vertical ¾-in. (2-cm.) rods attached to the ceiling. The motor is set on a wood platform built on the framework.

The switch box containing fuses and the motor starter can now be mounted on the column directly beneath the motor so that considerable overhead conduit which was formerly used between the starter and motor is avoided. The motor can be easily cleaned, and its location affords convenient inspection.

New York. JOHN SMITH.

FILLERS SUITED TO USE FOR PLUGGING COMMUTATORS

Mixtures of Plaster of Paris, Powdered Mica, Glue or Shellac Can Be Used Instead of Turning Down Commutator

Short circuits which burn themselves clear at the surface of a commutator often burn a hole in the mica and the bars. When the mica is not burned too deep it is often possible to clean out the holes with a thin knife blade and plug them with a suitable filler. When a good job is done and the commutator kept free from oil the plugged section will wear for a year or longer. It is always advisable to save the wearing surface of the commutator in this way whenever possible, for every time a commutator is turned down in a lathe about three years of its useful life is lost.

Fillers which have been successfully used for plugging commuators can be made us as follows: Two parts of plaster of paris, one part of powdered mica and enough glue or shellac to make a thick paste. When this filler is applied it will dry quickly and assume about the same degree of hardness as the mica segments. Another filler can be made up of powdered chalk or plaster of paris and shellac, and still another of water glass and powdered glass. The choice between these fillers largely depends upon the availability of the materials since one works about as well as another. These fillers should only be used for small holes. When the segment is burned deep down the only successful remedy is to remove the bad segment and insert a new one.

St. Louis, Mo. HENRY HAZLETON.

Power Requirements of Stone-Crushing Plant

Records of the energy consumption of a stone-crushing plant in Massachusetts equipped with a 20-hp., 550-volt, three-phase induction motor and operated eight months of the year are given below. The crusher is fed by gravity.

Month	Cost of Service	Kw.-Hr.	Tons Crushed	Demand (Kw.)
May	$50.76	950	1042	17.3
June	35.14	610	701	17.9
July	33.98	590	596	22.4
August	50.22	930	1082	25.4
September	62.10	1150	1240	37.2
October	61.02	1130	1308	22.4
November	69.66	1290	1343	30.9
December	65.88	1220	365	27.6
Total	$428.76	7870	7677	....
Cost per ton for energy				$0.0536
Kw.-hr. per ton				.983
Average kw.-hr. per month				983

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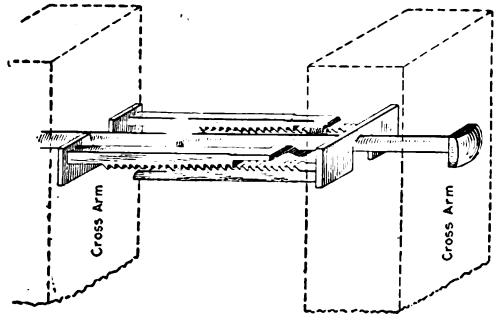
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

METAL CROSS-ARM SPACER FOR POLE-LINE CONSTRUCTION

Adjustable Steel Cross-Arm Spacer Saves Time and Labor in Installation Work—Description of the Apparatus

A so-called "saw-tooth" spacer has been designed by S. B. Hood, superintendent of distribution for the Minneapolis (Minn.) General Electric Company. The use of this device saves labor in sawing up old cross-



ADJUSTABLE SPACER FOR DOUBLE-ARM CONSTRUCTION

arms for space blocks; it saves time in installation since there is only one nut to tighten instead of four, and it also saves cross-arms which would otherwise be sawed up to use as space blocks. It is inserted near the end of double arms to displace bolt-and-block types of spacers and consists of two pieces of malleable iron about 3.5 in. (12 cm.) in length and exactly alike. The saw-like teeth of one piece engage with the teeth of the other piece to make the spacer adjustable to any length.

The through bolt used passes through metal straps on both pieces of the spacer. This holds the teeth engaged so that they cannot slip and also prevents the pieces from falling if the spacer should become loose for any reason. When the nut is tightened both the arms and the spacer are held in place by the one through bolt.

TITRATION TESTS REDUCE BOILER BLOW-DOWN LOSSES

Several Companies Are Adopting Methods for Testing Water in Boilers to See When Boiler Needs Blowing Down

In connection with blowing down boilers the old practice has been to blow down at stated intervals, possibly two or three times in each twenty-four hours. This method has been found in some instances to be wasteful of steam, since it costs from $25 to $50 to blow down an ordinary central-station boiler. Titration tests have been worked out which permit the boiler-room force to test the water in the boiler at stated intervals in order to find out when blowing down is necessary. These titration tests are merely simplified methods of making a chemical analysis of the water to determine what percentage of solids it contains.

The following way of going about such tests is used by the Union Gas & Electric Company of Cincinnati, Ohio.

Chlorinity.—Solutions: Silver nitrate, 1 cc. $AgNO_3$ neutralizes 1 mg. Cl. Potassium bichromate, indicator. Procedure: Add four drops of indicator to 100 cc. of the sample and titrate with silver nitrate. A reddish-brown color indicates the end point.

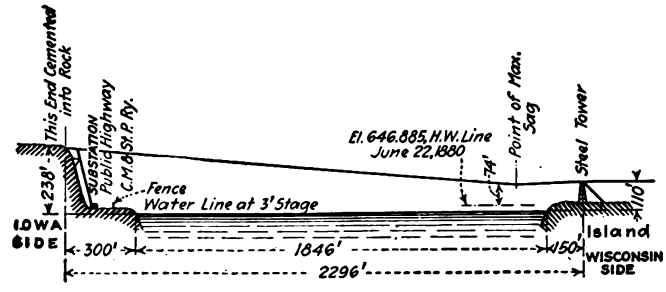
Alkalinity.—Solutions: Hydrochloric acid, 1 cc. HCl neutralizes 14.3 mg. $CaCO_3$. Phenolphthalein, indicator. Methyl orange, indicator. Procedure: Add four drops phenolphthalein to 100 cc. of the sample and titrate with hydrochloric acid until coloration disappears. Then add methyl orange and continue titration until the faintest pink coloration appears. The total titration represents the alkalinity.

Computation: Percentage is calculated as the ratio of the number of cubic centimeters used to the amount of the sample taken. Limits: 10 per cent of chlorine, 20 per cent of alkalinity.

RIVER SPAN CARRIED ON ONE TOWER

Taking Advantage of High Bluff on One Side of River Reduces Cost of Span by $2,500

In stringing a transmission line across the Mississippi River between the cities of Prairie du Chien, Wis., and McGregor, Iowa, the Interstate Power Company found it possible to dispense with one of the towers by anchoring the line into the rock bluff 225 ft. (68 m.) high on the Iowa side of the river. The span consists of three lines of ½-in. (1.25-cm.) seven-strand, extra-



LONG SPAN ACROSS MISSISSIPPI WITH ONLY ONE TOWER

high H. S. steel wires, on which the maximum working stress is 12,000 lb. (5443 kg. per sq.cm.). On the Wisconsin shore there is an 80-ft. (24-cm.) steel tower. A concrete "deadman" was laid in the rock which forms the bluff on the Iowa shore. When the span was completed copper wires were dropped down to the McGregor substation, which is situated near the foot of the bluff.

By taking advantage of the high bluff only a small height of tower was required, whereas had there been

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no bluff high towers would have been required at both ends of the span. The utilization of this bluff also resulted in using the equivalent of a very large sag, accounting for the use of wire of only ½ in. (1.25 cm.) diameter for this long span. It is noteworthy that the lowest point of the span is only a few feet below the top of the tower. It can be readily seen when it is known that the tower as constructed on the Wisconsin side cost $2,500 that a greater amount than this sum was saved by adapting the construction to the natural advantages offered.

WHERE TO DIRECT ATTENTION TO INCREASE ECONOMY

Some Frequent Sources of Losses Pointed Out by Pennsylvania Water Power Company — How to Eliminate Waste

For about four years the Pennsylvania Water Power Company has been trying to utilize water power in its hydroelectric plant at Holtwood, Pa., more economically and in so doing has suggested the following methods to its operators. The results have been very satisfactory and were especially so during the war, when every bit of water power utilized meant just so much more coal saved:

Tailrace Improvements:

(a) Clean out the channel, removing reefs, obstructions or constrictions.

(b) Deepen or widen the channel.

(c) Make the channel more uniform in sectional area.

(d) Make the sides and bottom smoother.

(e) Extend the channel so as to discharge further down the river at a lower elevation.

(f) Improve the seal by lengthening it or making it adjustable, or in some way make it discharge more freely, so as to diminish the backing up of water over the seal when the flow of water in the tailrace is great.

Raising Head Water:

(a) Raise the crest of the dam by installing crest gates.

(b) Use flashboards on the dam crest.

(c) Improve the flow conditions between river and turbine intakes.

Increasing Output Capacity of Generators:

(a) Install new generators of greater output capacity and throw the bulk of low-pressure factor generation on such new units.

(b) Install new windings in existing generators.

(c) Place fan blades on generator rotors.

(d) Provide forced ventilation, thereby (1) obtaining a supply of cooler air; (2) using air washers; (3) using deflectors on the generators to get a better distribution of cooling air through the hotter parts of the generator, or by using deflectors in air passageways to secure a better supply of air to individual generators; (4) providing better air drafts in the station, better air exits, removing hot-air pockets and maintaining a cooler station.

(e) Install temperature coils in the generator windings and operate the generators up to the safe temperature limits possible, being guided by the temperature indicators.

(f) Decrease the iron loss and increase copper loss by operating at a lower voltage in case iron loss is the limiting factor in generator output, or vice versa if copper loss is limiting factor.

Reducing Leakage or Diversion of Water:

(a) Pay more particular attention to leakage through flashboards, or leakage through waste gates, stop logs, etc.

(b) Reduce to a minimum the amount of water diverted through fishways.

(c) Guard against wasting water in auxiliaries or through valves carelessly left open.

(d) Be more careful to manipulate the level of water above the dam to avoid overflow over the dam crest, or splashing of water over the dam because of wind.

Efficient Use of Auxiliaries:

(a) Run the auxiliaries at their most efficient outputs and operate the minimum number required for proper service.

(b) Run the most efficient auxiliary units whenever possible.

(c) Run turbine-driven auxiliary units when there is ample flow, and motor-driven units during low flow.

Increasing Output Capacity of Turbines:

(a) Install new and more efficient runners in existing units.

(b) Keep the trash racks and water passages freer from rubbish by a frequent removal of the latter.

(c) Make the water passages smoother, if they are very rough.

(d) Decrease the turbulence at the draft tube outlets.

(e) Take up the back lash in turbine-gate rigging more frequently, which back lash tends to prevent the turbine gates from opening to their full extent.

(f) Install new and more efficient units with improved gate rigging on foundations which are available and not now in use.

Economy During Low-Flow Periods:

Make studies to determine the best loading points of generators by observing operating results, by making efficiency and power tests of equipment and by obtaining data from the manufacturers.

Load Dispatching:

(a) Strive to improve in predictions of river flow and customers' loads.

(b) Use the power and energy available from the steam plants and water-power plants in such fashion as to obtain the minimum coal consumption consistent with maximum utilization of hydraulic energy and with the peak loads and energy demands at the time; *i. e.*, obtain more fully the benefits to be gained from interconnection of steam and hydraulic electric generating stations.

(c) Make more careful observations of the fluctuations in flow produced by dumping of water from up-river plants under different conditions.

(d) Arrange with up-river water-power plants for modification of their operating methods and for notifications in event of irregular operation.

Baltimore, Md. ALEX BAUHAN.

PORTABLE RIG FOR SETTING HIGH-TRANSMISSION LINE POLES

Gin Pole Is Mounted on Sled and Hauled by Team—This Results in Rapid Erection of Poles Along C., M. & St. P. Electrification

A gin pole hinged to a sled mounting has been successfully used by the Chicago, Milwaukee & St. Paul Railroad for erecting wooden poles up to 85 ft. (26 m.) long on the 100,000-volt transmission line between Spokane and Seattle. The saving in labor effected by the use of this device was considered even more important than the saving in cost. Handling these long poles by hand was very hard on the men, while with the portable rig the work is easy and a smaller crew is required.

The crew operating the portable rig normally consists of five linemen, seven helpers and one teamster. The rate of setting varies widely with the country traversed, of course, the range being from twenty poles per eight hours in very rough country up to thirty-seven in easy country, the average being about twenty-five poles per day. The gin pole with its sled support and guys weighs only 870 lb. (395 kg.) so it is easily moved along the line by the team.

Guy lines, attached to the top of the gin pole, are run out to deadmen as required at each setting. By laying the pole to be erected with the pick-up point immediately

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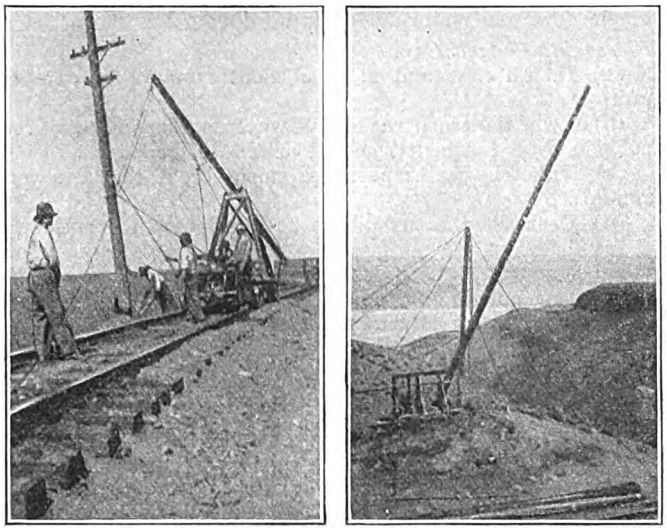
over the hole it was possible to place it with a direct vertical lift, thus avoiding the danger of knocking earth into the hole and decreasing its effective depth. Work on this same line previous to the adoption of the port-



ERECTING POLES FROM TRACK AND AT A DISTANCE FROM THE RAILROAD

able rig showed that poles exceeding 65 ft. (20 m.) in length could not be erected by hand without a special rig.

Seattle, Wash. F. B. WALKER.

CHARACTERISTIC FEATURES OF TRANSFORMER INSTALLATIONS

Automatic Oil Switches with Self-Contained Series Trip Coils for 2300-Volt and 4600-Volt and Insulated High-Tension Wiring for 11,000-Volt Service

In outlining the practice of the Cleveland (Ohio) Electric Illuminating Company in constructing its transformer installations, G. B. Schneeberger, electrical engineer for the company, recently brought out the following points before the transmission and distribution committee of the Ohio Electric Light Association.

The transformer vaults for 2300-volt and 4600-volt work are built of brick or concrete block and are provided with a corrugated iron roof. A separate compartment is provided for the watt-hour meter. An automatic oil switch with self-contained series trip coils is provided on the primary side of the transformers. This switch is mounted so that it may be operated from the outside of the transformer compartment and takes the place of the usual low-tension knife switch, commonly used as a service switch. It also eliminates heavy low-tension fuses. It is troublesome to maintain a heavy-current knife switch under the operating conditions experienced in the average factory. Lightning arresters are installed on all primary cable services at the point where they tie to the overhead lines. Occasional trouble due to lightning has been experienced with oil switches having self-contained series trip coils. These coils should preferably be below the normal oil level in the switch tank. The majority of the transformer installations consist of three-phase units.

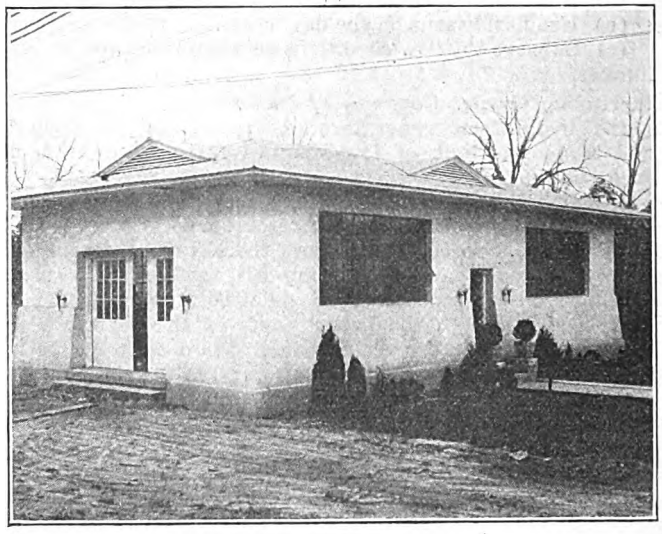
The heavy power consumers, such as electric furnace installations, rolling mills and large manufacturing plants, are supplied direct from the 11,000-volt transmission system, which is entirely underground. The transformer vaults for 11,000-volt installations were formerly built of corrugated iron, but during the past few years brick has been used. In addition to the transformers the transformer vault also houses a high-tension switchboard. This switchboard consists of masonry cells built of brick with sandstone barriers and contains the knife disconnects, automatic oil switches and primary metering equipment. In most cases duplicate service cables are installed which terminate in interlocked hand-operated automatic oil switches. As a safety measure the switch-operating handles are so mounted that in case one cable fails the local electrician can switch to the opposite cable without entering the high-tension transformer vault. All high-tension wiring is insulated with varnished cambric and covered with a flame-proof braid. The use of insulated high-tension wiring and the cell construction make a compact switchboard.

BUILDING SUBSTATIONS IN RESIDENTIAL DISTRICTS

Substation Erected During the War Is Harmonized with High-Class Residential Community in Which It Is Situated

The Piedmont Avenue railway rotary substation of the Georgia Railway & Power Company was built during the war to take care of the enormous passenger traffic between Camp Gordon and Atlanta. It is situated about 7 miles (11 km.) from the the center of the city, taking 22,000-volt, 25-cycle energy from the Morgan Falls plant, 20 miles (32 km.) away.

This substation was built in a restricted building section that is being developed with very fine residences and small villas, and for that reason it was decided to build something in keeping with the future surroundings. The photograph gives a very fair ex-



ORNAMENTAL CONVERTER SUBSTATION AT ATLANTA

ample of what can be done during emergency times and under extreme conditions, showing that a rotary substation can easily be made ornamental as well as useful. This station contains two 500-kw., six-phase rotary converters and is finished inside with black floor and wainscoting, white walls and natural-finished flat ceiling. It has an abundance of light and ventilation and is electrically heated in winter time.

Atlanta, Ga. G. A. ILER.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

SELL HOME SECURITIES NOW, ADVISES JOHN F. GILCHRIST

Tells Missouri Utilities Association of Opportunity Which Private Owners Have to Show Fallacy of Municipal Ownership

Public utility commissions in practically every state have been subjected to attacks during or since the war period, and in all cases the attacks have failed or have fallen far short of their purposes. This evidence of stabilization is important, said John F. Gilchrist of Chicago, speaking before the Missouri Public Utilities Association at Excelsior Springs, Mo., June 7. Its effect on public utility securities will certainly be felt. Evidence of this is available in the experience of independent telephone men in Illinois. These men have for a long time followed a policy of raising their required capital locally. Before the formation of the commission the market for these securities was uncertain to such an extent that local bankers could not be interested in them. Now, however, this has changed so that bankers do buy the telephone securities, thus making a market for the issues.

The application of this experience is particularly interesting to central stations now, for more and more it will be desirable to go to local people for financing, not only because it is a means for raising money, but also because it provides a method of drawing toward the utilities the real interest of the people which they serve. Such action will unite the customers' interest with that of the company and will lay a sound foundation for future financing. Care must be exercised, of course, that such securities as are sold to customers of the company will stand up. However, there is little to fear from this score in any modern conservatively managed company.

The time to start selling these securities is now, said Mr. Gilchrist. Moreover, it is probably a good idea to start in a small way. Investment habits are being formed by many people now, and the investment habits formed early in life are likely to be sustained. For instance, the type of securities in which a man invests between the ages of twenty-one and thirty years are likely to remain his favorite investments throughout life. "In addition to this," the speaker added, "I believe that utility securities have seen the worst and that they will in the future have the solid respect which they earned in the past."

Touching on municipal ownership, Mr. Gilchrist referred to it as a storm center which will have to wear itself out. In this storm center the Kansas City *Star* is an important center of influence. But, instead of worrying about this, the private owners should grasp the opportunity which now confronts them to get busy and show the public what a strong recovery from war conditions has been made and how good privately operated public service can be. In this connection there is an opportunity to accentuate the point that service from governmentally operated utilities is not and has not been up to a standard which its patrons desire and demand.

SAYS UTILITIES MUST DETERMINE OWN FUTURE

President Edgerton of California Commission Thinks Private Ownership Will Be Settled by the Way Companies Meet New Conditions

Survival of the system of private ownership of utilities depends upon the companies themselves and the manner in which they meet the problems of reconstruction, declared E. O. Edgerton, president of the Railroad Commission of California, in an address delivered at the recent convention of the Pacific Coast Section, National Electric Light Association.

The question of municipal ownership, said Mr. Edgerton, will not be decided by any discussion of an academic nature as to whether public ownership is good or bad, but upon the conclusion of the people as to whether or not the private agency now operating is successfully meeting their needs. If the judgment is adverse, there is only one alternative, and that is public ownership. A utility is a monopoly, and there is no place for the people to turn to if they become dissatisfied with its service. Give them bad service, said the speaker, and they will rebel, and if they face a monopoly that will not give adequate service they will do the job themselves.

Commissioner Edgerton said that in his judgment the issue was not, "Shall we have public ownership at this moment?" but "Will the private agency successfully meet the needs of the public?" He thought the answer to this question rested with the public utility men themselves. Their contact with the public would determine it, and if they should fail it would be their own doing.

Upon the ability of utility men to convince the public they are giving real service depends the question of whether or not private ownership is to persist, said Mr. Edgerton. It is not the judgment of the companies themselves as to the kind of service they are rendering, but the judgment of the people, that counts; and no matter how the utility men themselves feel about the quality of their service, if the public does not think it the best that can be supplied, their day is done.

"Are you willing to make sacrifices, to bend every effort to make good?" asked the speaker. "If you are not willing, your case is lost. The public is tired of promises. It is tired of mere pronouncements. It has listened to arguments on public and private ownership until it is utterly confused as to the merits of the two. If the prime purpose of the utilities of California is to give service, that means that every man in the convention must stand up and fight in every sphere he occupies in the public utility camp for the proposition that

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service comes first. If you are not prepared to make that fight, take the easy way. Your day is over."

He said that throughout the great body of the people there had occurred a shifting of doubt, a change in thought, new ideas, and that there was just one way to meet that condition and that was to change ideas and doubts to conform to that condition. If utility men were sincere when they asserted that service is first, they could convince the people. If they were not sincere, the job of convincing the people was utterly hopeless. All the advertising, explanations and excuses in the world would count for nothing if they were not prepared with conviction to go to the people with the proposition that their welfare comes first. If anywhere along the line there was not confidence in this proposition, the whole scheme of private ownership must fail.

There is a new battle ahead, warned President Edgerton, and the utilities are going into that battle, if they are to win, upholding the idea of giving the people service through private ownership to the extent that they practically make that an ideal. They are going to fight, if they hope to win, with new weapons, with the "bunk" cut out, with all the old schemes of fake excuses gone. These new weapons are: Service first, patience, honest explanation. The utilities must hold the determination, first, that their cause is righteous; second, that the people shall understand this cause.

Commissioner Edgerton pointed out that private ownership was going against increased operating expenses, and that unless remedial legislation were adopted which would give it a fair chance, it was hopeless of success. In the telephone situation the public was enraged, and he gave warning that unless care is exercised when the telephones shall go back to private ownership the public may wreak vengeance upon that private ownership.

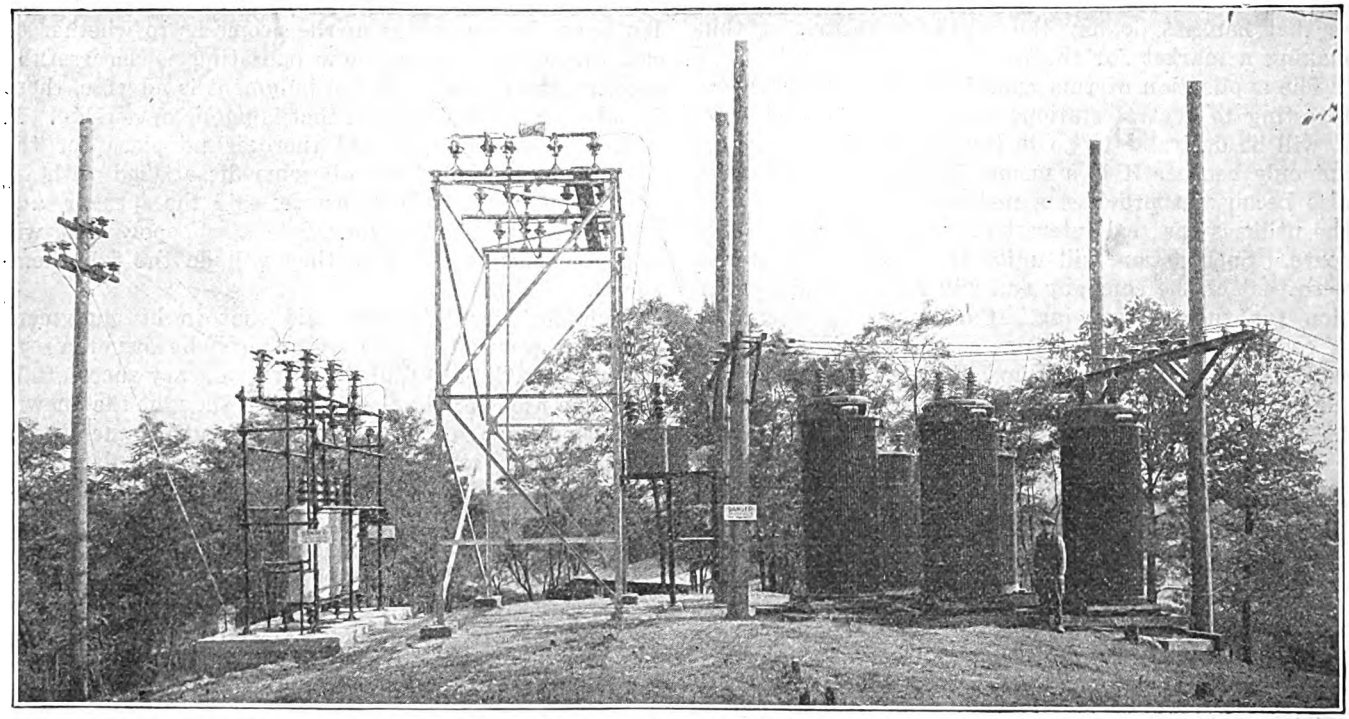
Throughout the ranks of public utilities must go the ideal of serving the people, declared Mr. Edgerton. This ideal must be above profit and loss, for no organization of human beings will work and fight at its best merely for profit. The kind of service that must be given if private ownership is to continue is impossible unless such an ideal prevails.

METERING PRACTICE FOR 33,000-VOLT OUTDOOR STATION

Dayton Company Central Station Incloses Whole Equipment in Iron Case and Does Not Fuse Potential Transformer

Several outdoor substations that are more or less isolated have been erected by the Dayton (Ohio) Power & Light Company to supply energy for the flood-prevention work of the Miami conservancy district. Because these stations are installed in out-of-the-way places, and because they handle relatively large amounts of power, it was necessary to devise accurate and reliable means of measuring the energy.

The equipment consists of a polyphase 33,000/110-volt potential transformer with two double-ratio current transformers, all mounted, oil-immersed, in the same case. The potential transformer is not fused but is protected from lightning by a small choke coil. The current transformers have one side grounded to the outlet cap on the terminal with the right side insulated therefrom. These transformers are arranged with a convenient adjustable disk which acts as a spark gap for any surges that may come over the line. The front of the metering case is arranged as a compartment for the watt-hour meter and testing panel. The meter used in conjunction with this outfit is the Westinghouse type RA combined watt-hour meter and maximum-demand meter equipped with a forty-day clock and self-inking pens. These installations have proved to be quite successful. This information was supplied by Charles P. Garman, superintendent of meter department, Dayton Power & Light Company.



OUTDOOR SUBSTATION OF DAYTON ELECTRIC COMPANY SUPPLYING ENERGY IN WORK OF FLOOD PREVENTION

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DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generation, Transmission and Distribution

Limitation of Earth Currents and Arcing by Earthing Reactance.—W. PETERSEN.—Experiments are described showing results obtained at the Alt-Württemberg supply station. Since the use of earthing reactance the magnitude of the earth currents and the arcing at switch contacts have been greatly reduced. Also, the number of operations of the automatic circuit breakers have decreased from about thirty a month to about one a month.—*Technical Supplement to Review of Foreign Press*, April 29, 1919. (Abstracted from *Elektrot. Zeits.*, Jan. 2 and 9, 1919.)

Plant Extensions at the Kingston-Upon-Thames Electric Power Station.—The Kingston public supply is single-phase, 77 cycles and 105 volts at consumers' terminals, generation being at 2100 volts and consumers being supplied through step-down transformer substations. In recent extensions single-phase generation has been replaced by a three-phase system with its greater flexibility and convenience for future development. This has necessitated a link between the three-phase and single-phase systems. Problems introduced in paralleling these frequency-changing sets are discussed in this paper.—London *Engineering*, April 18, 1919.

A Voltmeter for Synchronizing Purposes.—G. KEINATH.—For synchronizing purposes it is desirable to have definite readings at the bottom of the scale. It is proposed to do away with the usual resistance, which has a negligible temperature coefficient, and to replace it by one that varies considerably with the applied voltage. At low voltage—*i.e.*, with low current—this resistance would have a low value, which would increase with the current. A tungsten lamp provides a suitable resistance of this kind; when hot its resistance is ten or twelve times its cold resistance. The rate at which the resistance varies depends on whether a vacuum of the gas-filled type is used. If a lamp of this kind is put in series with a voltmeter, it is plain that the divisions on the lower part of the scale will be farther apart and therefore more decidedly marked. A voltmeter of the hot-wire type is the most suitable for the purpose. If an instrument with a rotary armature is employed, it will be desirable to give the core a suitable shape if the lamp is to produce the best effect. From curves given it is seen that whereas with a constant resistance the lowest part of the calibration curve is flat, after which point it rises rapidly, with a variable resistance the curve rises rather abruptly at first and more gradually over the rest of the scale.—*Science Abstracts, Section B*, March, 1919. (Abstracted from *Elektrot. Zeits.*, Nov. 14, 1918.)

Notes on Surface Condensing Plants.—R. J. KAULA.—The discussion is particularly devoted to the design of surface condensers and to the general arrangement and layout of condenser plants for large power stations. Equations are developed for the calculation of water required for surface condensers under various conditions. The question of the parallel flow of water and steam versus the counter-current principle in surface condensers is also considered. The author states that of the various air pumps in use the Edwards pump is the only example of reciprocating pumps that can still hold its own in large installations. Regarding rotary air pumps, the characteristics of the earlier designs were such as to show very little difference in capacity between high and low vacua. These disabilities have been overcome in later designs, but the efficiency of such pumps is still low. The steam-ejector type of air pump represents a development of the Parsons vacuum augmenter. In their simplicity they equal the water-jet type, with the advantage of using pipes of small dimensions instead of comparatively heavy water pipes. In power consumption it is claimed that although the quantity of steam consumed is appreciable, practically the whole of the heat value is returned to the feed water. The characteristics of circulating pumps should be adapted to those of the prime mover, and when this latter permits of speed regulation the pump should be able to take full advantage of this feature without loss of efficiency. It is then possible to regulate the water supply according to the head by varying the pump speed, and this method is much to be preferred to throttling. In smaller stations there has been extensive adoption of steam-turbine-driven pumps, but it seems preferable to drive the condensate pump electrically. Apart from the absence of speed regulation, an induction-motor drive from the main supply is not to be recommended, especially on fluctuating loads.—London *Electrician*, April 25, 1919.

Surges in Coils with Alternating Current.—W. ROGOWSKI.—The author examines the problem, taking the case of a coil with two turns only. This case has the advantage that it can be treated mathematically as a coil and need not be replaced by "lumped" capacities and inductances. The treatment is based upon the substitution of a stepped sine wave for the wave of the applied emf. Each step has a time duration corresponding to the time taken by an electromagnetic wave to traverse the coil. The effects can then be studied as the resultant of the summation of the waves corresponding to each step. The author finds that for low and medium frequencies the coil behaves like an inductance shunted by a capacity. As long as the wave length of the impressed voltage is not less than twenty times the length of the wire itself the capacity and inductance may be regarded as independent of frequency. At a frequency corresponding to the resonance frequency of the combination no current flows at the terminals, assuming that the resistance is negligible. There is a current node and a potential loop at the terminals and a current loop at the middle of the coil. This frequency corresponds to Bohm's critical frequency. At a higher frequency n_0, at which the wave length of the impressed

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voltage is equal to the length of the wire, the coil acts like an inductance and capacity in series and displays resonance, with a current loop at the terminals and a possibility of an abnormally high voltage in the middle of the winding. As the frequency of the impressed emf. is increased these two forms of resonance alternate with each other, the current at the terminals being zero for each case of the former type and a maximum for each case of the latter type.—*Science Abstracts, Section B*, March, 1919. (Abstracted from *Archiv. f. Elektrot.*, 7, 1918.)

The Hydroelectric Power House of the Ance.—JACQUES DE SOUCY.—A long, well-illustrated article on this hydroelectric installation of the Compagnie Electrique de la Loire et du Centre, which serves the industrial regions of Saint-Etienne and neighboring places. It began operation in 1916 and is able to produce annually about 30,000,000 kw.-hr., indicating a saving of 45,000 tons of coal. The first part of the article gives a history of the project, executed almost entirely during the war, and a detailed description of the hydraulic and power-house construction. The second part deals with the electric installation, which is of the most modern description. From his platform the operator in charge, by simple maneuvers, can transmit to the network of the company a total load of 14,800 kw., or can divide his power house into two distinct parts and cause each of them to work in unison with other steam or hydroelectric plants, or can put groups of machines automatically in or out of service according to the demand.—*Revue Générale de l'Electricité*, May 3 and 10, 1919.

Traction

Brown-Boveri Locomotives for the Swiss Federal Railways.—J. BUCHLI.—The question of the general adoption of electric traction was considered by the Swiss Federal Railways some years before the outbreak of the war. After careful consideration it had been decided to adopt the single-phase system. A new design of locomotives with individually driven axles is being considered for the extensive electrification plans. Brown, Boveri & Company have been intrusted with making tests in connection with the arrangement of drive, since the results obtained from locomotives having the drive by means of coupling rods has in general not proved entirely satisfactory. Twenty-four heavy freight and express locomotives have already been ordered and work on this equipment is now being pushed.—London *Engineering*, May 2, 1919.

British Railway Electrification.—PHILIP DAWSON.—The problem of the general electrification of British railways and its effect upon the more general use of electrical energy is taken up by the author. The discussion may be summarized by the following thirteen points: (1) In the case of suburban services with short distances between stations and heavy traffic electrification increases the average speed of the trains and the carrying capacity of the line, while giving better conditions of traveling. (2) On congested interurban lines electrification gives greater facility in handling the traffic, increases the traveling facilities and results in better traveling conditions. (3) In the case of underground lines or of lines with many tunnels electrification gets over the difficulties of ventilation. (4) In the ease of railways operating in the neighborhood of highly inflammable materials electrification gives a degree of safety not possible with steam. (5) In the case of lines in mountainous countries electrification increases the capacity of existing lines and enables new lines to be built with heavier gradients and therefore with smaller capital cost than would be possible if steam haulage were adopted. (6) In the case of freight yards where trains are made up, where a great deal of switching takes place, electricity enables the traffic to be handled more economically and more rapidly. (7) In cases where, owing to increase in traffic, existing railway facilities are not sufficient, the capacity of the line can be largely increased by electrification, which may prove less costly than widenings. (8) Electrification enables the capacity of a terminus to be very greatly increased. (9) The war has demonstrated that the railways are the arteries of the nation, which enable it to live, and countries, therefore, possessing no coal of their own but having water power feel it essential to electrify in order to be independent of foreign countries for their transportation. (10) In non-industrial areas where electrification of the railways may, owing to traffic conditions, not prove a very remunerative investment, it may nevertheless be advantageous to electrify, as thereby the country served by the railway will benefit by a cheap electric supply which would otherwise be impossible. (11) In industrial areas where electricity is largely needed for manufacturing purposes the electrification of railways may enable the cost of generation and distribution to be decreased, to the general advantage of the district. (12) Economy may be gained by the decreased cost of maintenance of rolling stock and structures due to the absence of the corroding influences of smoke and steam. (13) Electrification may be resorted to for the conservation of coal, regardless of whether it is in itself financially advantageous or otherwise.—London *Times Engineering Supplement*, May, 1919.

Installations, Systems and Appliances

Electrically Driven Ship Auxiliaries.—Electric drive for deck winches, capstans, anchor windlass equipment and electrically driven steering gear are discussed with special reference to the type of motor best suited to the work and the proper control of such motor.—London, *Engineering*, May 16, 1919.

Controlling the Propulsion of the New Mexico.—H. FRANKLIN HARVEY, JR.—Details of control wiring and apparatus may be found in this article. Because of the fact that every part of the equipment is liable to damage an elaborate scheme of interconnection for obtaining a direct-current supply at the switchboard for turbine generator excitation is in use. The parts of the equipment, their arrangement and the sequence of operations in starting and reversing are fully described in this article.—*General Electric Review*, April, 1919.

Motor Equipment of United States Army Engineer Corps.—Devices exhibited in the Victory loan parade in New York City demonstrated the great flexibility of the motor truck as a tool and suggest similar adaptations in civil pursuits. Such equipment might easily be of service on any widely scattered construction or maintenance operation, where it would be advantageous to make repairs *in situ*, rather than convey the part to and from the machine shops. Portable carpenter, machine, blacksmith and printing shops were exhibited. Portable tool shops and sleeping quarters for small maintenance and construction gangs are also suggested.—*Engineering News-Record*, May 29. 1919.

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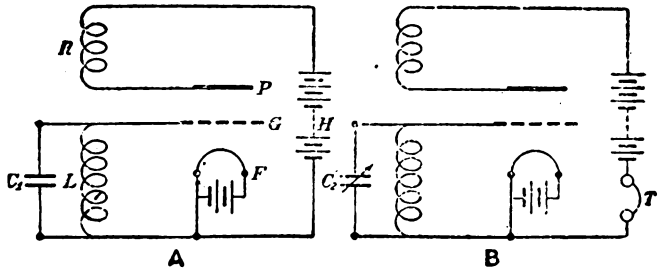
Testing of Permanent Magnets.—J. D. MORGAN.—The writer outlines the tests that should be made of permanent magnets to insure their character and explains the operation of instruments with which the tests may be made.—London *Engineering*, April 25, 1919.

Units, Measurements and Instruments

A New Capacity Meter.—J. SCOTT-TAGGART.—A description of an instrument which is capable of rapid and exceedingly accurate measurement of capacity, suitable for laboratory and commercial use. If an alternating current be superimposed on another one of different frequency, the resultant current will not have a constant amplitude, but will at regular intervals increase and decrease as the two currents come in and out of phase with one another. The frequency of the increases or beats is equal to the difference between the frequencies of the two currents. The same rules apply to continuous oscillations as to alternating current. If the frequencies of the component sets of oscillations were 750,000 and 780,000 respectively, the beat frequency would be 30,000 per second. By keeping the frequency of one set of oscillations constant and varying the other set, beats of any desired frequency may



CONNECTION DIAGRAM FOR NEW CAPACITY METER

be obtained. Let these two individual currents be separately passed through the telephone receiver. They would not affect it on account of the high frequency. If they are passed through the receiver at the same time, the beat will be heard in the telephone receiver when the difference between the two frequencies goes below 14,000. In the apparatus designed by the author provision is made for an oscillating circuit at a frequency which may be altered by means of a variable condenser. Another circuit is arranged which also oscillates continuously at a frequency determined by the capacity of the condenser it is desired to test. Telephone receivers are inserted in the circuit as shown in the figure. There will be two superimposed sets of oscillations in the first circuit, and beats will be produced which when rectified will give a note in the telephone, provided the frequency is within the proper limits. Now let a standard condenser of known capacity be placed in the second circuit, which will then oscillate say at a frequency of 400,000. If the variable condenser which controls the frequency of the oscillations in the first circuit be adjusted gradually, a high note will be heard in the telephone receivers when the frequency of the oscillations is about 410,000. If the condenser be gradually turned round further, the note heard will become lower and lower as the difference between the two separate frequencies becomes less. When the frequency of the first circuit is adjusted to 400,000, no beats are produced, and nothing is therefore heard in the telephone. The capacity of the condenser under a test may thus be compared with the standard condenser.—London *Electrician*, April, 1918.

Telegraphy, Telephony and Signaling

Unidirectional Transmitting System. — The usual rectangular loop antenna radiates electric waves which may be described by the figure 8, giving maximum power in the plane of the loop and in both directions. It is proposed to mount another loop which will make the antenna most effective in one direction only, instead of two.—*Wireless Age*, June 19.

Transmission Maintenance Testing.—It is obvious that if a telephone system is to give the service for which it was designed some means must be taken to determine that it is properly constructed and properly maintained. Apparatus of two types has been standardized by the Pacific Telephone & Telegraph Company for measuring the transmission losses of telephone apparatus and circuits under actual service conditions. These are known as the transmission measuring set, which is portable, and the transmission measuring unit, which is a desk set. These have been installed in the San Francisco office, and it is also planned to put them in Los Angeles, Portland, Seattle and Spokane.—*Pacific Telephone Magazine*, May, 1919.

Wireless Telephone Transmitter for Sea Planes.—The telephone transmitter developed by the American Marconi Company for navy use during the war for flying boats, type SE-1100, is described.—*Wireless Age*, June, 1919.

Vibrations in Buildings Due to Electrical Machinery.—A. B. EASON.—This article describes some of the conditions as regards noise and vibration existing in some post office telephone exchanges and mentions certain reports dealing with similar conditions in other buildings. It may be said that generally trouble is apparent only when the supply is alternating and is always apparent when the supply is single-phase. The vibration is due to poorly balanced machines. The noise is due to (1) windage, or the movement of rotating bodies in air; (2) alternating current, or electrical or molecular hum; (3) brushes. These noises can be examined separately by running the machines with brushes off and on and by cutting off the supply and letting the machine slow down.—*Post Office Electrical Engineers' Journal*, April, 1919.

Miscellaneous

Water-Power Survey of Japanese Government.—The work includes the reconnaissance and investigation of power sites, their available heads and the discharge of rivers throughout the country, to be continued for five years.—*Bureau of Electrical Exploitation*, Tokyo, December, 1918.

Devastated Electric Power Houses in France.—AUGUSTE PAWLOWSKI.—This article on the systematic robbery and destruction of French machinery and power houses by the German invaders is illustrated with many half-page views showing empty interiors and demolished foundations where great machines formerly stood. The destruction of the great iron and steel foundries of Longwy was of a particularly atrocious and systematic kind, little save scrap iron remaining in the five central stations where formerly electrical machines rated at almost 20,000 hp. were installed. The transmission lines leaving the power houses were torn down to add to the ruin, "before which," says the author, "it is right to uncover as before a tomb."—*Revue Générale de l'Electricité*, April 19 and May 17, 1919.

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Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Coöperative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress or Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Technical Theory and Practice" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

ALTERNATING VOLTAGE, WAVE ANALYSIS.

A method has been derived for the determination of the order and percentage of the various components of an alternating wave of emf., using indicating instruments and other inexpensive apparatus. A commercial form of set is being developed in which the order of the harmonic present will be given directly by scale reading, and the percentage of the same from a simple calculation. An analysis of wave form without the use of the oscillograph is a possibility which will be welcomed by many engineers.—*Leslie F. Curtis, University of Washington, Seattle, Wash.*

ARC WELDING, COVERED ELECTRODE.

In the liquid-flux process the covering melts with the electrode, forming a molten flux over the end of the electrode and over the added metal, thus protecting both from oxidation from the air. This flux, by reducing chilling, in a measure serves an annealing function; but its chief value seems to be the protection from oxidation with the accompanying brittleness and porosity caused by the reaction of the oxygen on the carbon and iron of the molten metal. The solidified flux is chipped and brushed off before building up the next layer. There are a large number of different makes of liquid-flux-covered electrodes on the market, and careful experimental work is being carried out with many well-known makes to determine their respective merits or drawbacks. The results will be published in due course.—*Welding Committee of the Emergency Fleet Corporation.*

FREQUENCY METER WITH SYNCHRONOUS MOTOR

A very accurate frequency meter has been developed which consists of a small synchronous motor such as is used in the G. E. oscillograph and of a small fly-ball governor. The motor is started by hand through gears and is run from the power supply; it has no direct-current excitation and operates entirely by armature reaction. The fly-ball assumes a definite position, depending upon the speed of the motor, and the indications are greatly magnified on a long scale. Such a scale 12 in. (30 cm.) long covers a range of only four cycles, and the pointer can be easily read to an accuracy of one-tenth of a cycle from a distance of 20 ft. (6.1 m.). The motor is provided with ball bearings and will run day and night without attention for more than three months. Several of these meters are in successful operation in the power plant with which the writer is connected.—*H. S. Baker, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.*

GALVANOMETER, ALTERNATING-CURRENT.

An alternating-current galvanometer has been developed for use on a 60-cycle, 110-volt circuit, the field being separately excited. The working current for the bridge or other network upon which the test is being made is supplied from taps to a non-inductive resistance in series with the field winding. The current in the working circuit is therefore in phase with the field current, and the moving coil of the galvanometer is connected to the network as the detector.—*Leeds & Northrup Company, Philadelphia, Pa.*

GLASSES, EYE-PROTECTIVE.

Ultra-violet radiant energy of certain wave-lengths, such as occurs in the quartz-mercury arc and in the iron arc, is extremely injurious to the eye. Excessive brightness in the visible spectrum may also cause temporary or permanent injury, while the intense heat or infra-red radiant energy coming from molten glass or metal is also considered by some as being dangerous to the eye. Many glasses have been recommended and extensively advertised to absorb injurious radiant energy and so protect the eyes. Eighty-two samples of eye-protective glasses have been studied and their transmission curves determined (partly in Cornell University). Four different methods were used to obtain the data, viz., Hilger sector apparatus, quartz spectrograph, Lummer-Brodhun spectrophotometer and Koenig-Martens spectrophotometer.—*K. S. Gibson and H. J. McNicholas, Bureau of Standards, Washington, D. C.*

IGNITION DEVICES, OSCILLOGRAPHIC STUDY OF.

Apparatus has been arranged and numerous oscillograms have been taken of the primary and secondary current, voltage, etc., of various commercial types of magnetos, vibrating coils and other ignition devices used with gasoline engines. Tests were made under conditions approximating those in actual engine operation, with the spark plugs partly in a tank at 60 lb. (4.2 kg.) air pressure. During one part of a cycle the secondary current reaches enormous frequencies, and it may be necessary later to use a sensitive high-frequency tungsten oscillograph. It is hoped that from these records it will be possible to estimate the values of secondary inductance, resistance, capacity and energy.—*F. W. Springer, University of Minnesota, Minneapolis, Minn.*

INDUCTIVE INTERFERENCE CAUSED BY DIRECT-CURRENT RAILWAY.

A case of inductive interference with the adjacent telephone circuit has been observed from the 600-volt direct-current feeders of the Saginaw & Flint Railroad; it became aggrevated when the voltage was increased to 1200. Rather extensive tests established the fact that the disturbing element was an alternating current of approximately 1250 cycles, which was caused by the armature teeth of the 1200-volt direct-current generators supplying power to the feeders. This condition was corrected by the installation of resonant shunts across the direct-current generator terminals, which entirely eliminated the noise in the telephone circuits.—*B. E. Morrow in the N. E. L. A. Bulletin.*

INSULATING MATERIALS AT RADIO FREQUENCIES, ELECTRICAL PROPERTIES OF.

In response to numerous requests from Signal Corps officers and others, the Bureau of Standards undertook a general investigation of the suitability of insulating materials for use in radio apparatus. The work has consisted in the measurement of a large number of electrical properties of the materials, and from the comprehensive data thus obtainable in the various laboratories of the Bureau of Standards the materials become known quantities in every respect. The investigation covers mainly bakelite and similar materials of the phenol type. The tests are made on panels or sheets of the material as used in actual construction of apparatus. Special methods and laboratory apparatus, particularly for the effects of high voltages, have been developed by experimental research. The effect of high voltage at radio frequencies on a fairlead insulator and on samples of antenna twine has been determined. The determination of the electrical properties of laminated phenol materials, particularly bakelite-dilecto, bakelite-micarta, formica and condensite-celoron, is to be brought to a conclusion, with a view to a comprehensive report on the subject. The electrical properties measured are volume and surface resistivity, power loss and dielectric constant at radio frequencies, and the effects of high voltage at radio frequencies. These properties are to be measured on a large number of grades and thicknesses of the laminated materials. The effects of coloring material, kind of surface and percentage of resin will be determined. Molded materials of the same kinds are to be investigated later, and also shellac materials, hard rubber, wood, porcelain, fiber and waxes.—*Radio Laboratory, Bureau of Standards, Washington, D. C.*

KVA. METER, RECORDING.

A recording kva. meter has been developed, based upon the principle of a power-factor meter. The stationary three-phase winding with vertical axis carries currents proportional to the line currents. The moving part is provided with a three-phase potential winding. If left to itself, the potential winding turns into a position in which the stator and the rotor mmfs. strengthen each other, thus acting as a well-known power-factor meter. If now the potential winding be placed somewhat above the current winding, an axial thrust is exerted, proportional to the product of the currents in the two windings; in other words, proportional to the kva. in the circuit. This thrust is made to move a pen across a bar in a manner used in Westinghouse graphic recording instruments of the relay type. Laboratory tests have shown the instrument to be independent of the power factor and of the ampere unbalance. The definition of kva. in an unbalanced polyphase circuit that the meter registers is $(\text{kva.})^2 = (\text{kw.})^2 + (\text{reactive kva.})^2$. This meter is radically different from the one in which the kw. and the reactive kva. components are mechanically added at right angles.—*H. S. Baker, Hydro-Electric Power Commission of Ontario, Niagara Falls, Ont.*

Suggestions for Research

INSTRUMENTS, RECORDING BY MEANS OF GAS JET.

The disadvantage of an ordinary recording pen is its considerable and variable friction on paper. A recent proposal, with some successful experiments, is to use a tiny jet of gas (unignited) in place of the pen. The gas must be of such a nature as to react chemically upon the paper. This suggestion opens a fruitful field for research as to the advantages, limitations and new applications possible with this method. For first experiments see *Comptes Rendus*, Dec. 30, 1918; abstracted in *La Revue Générale de l'Electricité*, Vol. 5 (1919), p. 334.—*Editorial Suggestion.*

IRON LAMINATIONS, LOW-LOSS.

In view of the cheapness of silicon, there seems to be no theoretical reason why one should not produce high quality iron-silicon alloy having very low hysteresis and eddy-current loss at a price comparable with ordinary electrical iron. If this were done, and if the permeability at high saturations could be made as good as that of ordinary iron, the iron-silicon alloy would come into general use for large electrical machines and would result in an enormous improvement in the efficiency of electrical machines in general. This problem should be capable of solution in the immediate future if attacked by well-equipped rolling mills.—*Miles Walker, College of Technology, Manchester, England.*

TELEPHONE, AUTOMATIC, STUDY OF STEELS.

A study is desired of steel used for quick-acting electromagnets such as automatic relays and motor magnets. The term "steel" is meant to cover all magnetic irons from Norwegian iron through the various steels which have been found useful for the cores and heel pieces for relays and motor magnets. This study would be chiefly experimental, mechanical and electromechanical.—*A. B. Smith, Chicago, Ill.*

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Arc-Welding Equipment

To the Editor of ELECTRICAL WORLD:

SIR: In your issue of May 31 there appeared an article under the heading "Proper Selection of Arc-Welding Equipment." In the opinion of the writer this article is very misleading on account of the fact that it recognizes only two subdivisions of direct-current arc welding, namely, high-voltage constant potential and so-called "constant energy." Reference to the writer's article of Jan. 25 will show that there are several systems that are not mentioned in this article and that of all the systems these two are of the least importance at the present time. The so-called "constant-energy" system is simply a differential machine such as is made by a half dozen different manufacturers, but in one instance where the differential machine is used as a balancer it has been given the name "constant energy," probably for commercial reasons. However, the writer has tested machines of this type and found that the characteristic is precisely what would be expected from this type of machine, namely, a falling off in voltage with an increase in current in accordance with a practically straight-line characteristic. The energy is only constant when the welder holds a constant length of arc, and under such conditions every system becomes a constant-energy system.

Statements of the kind embodied in this article are very misleading on account of the matter which they omit rather than what they include.

New York. OTIS ALLEN KENYON.

Is Electric Heating of Residences a Dream?

To the Editor of ELECTRICAL WORLD:

SIR: In the March 22 issue of the ELECTRICAL WORLD there appeared an article under the above heading by Prof. Joseph F. Merrill, director of the School of Mines and Engineering of the University of Utah, in which he refers to electric heating of residences as an alchemist's dream. Perhaps it would prove not so much of a dream if one would analyze the proposition from the practical point of view.

It is sometimes of equal importance and many times more illuminating to solve a problem by practical experience than by theoretical computation. I wish to refer to only one part of the above-mentioned article, and that is the last paragraph, in which an efficiency of 60 per cent is assumed for a furnace and upon this assumption the cost of operation for electric power is compared to coal.

In the first place, we know that an efficiency of 60 per cent for a furnace in a home is entirely out of the question and it also might be considered a dream. An efficiency of 10 per cent would be a high average. We also know that coal such as we have been getting for the past three or four years has a B.t.u. value of something less than 10,000 B.t.u. per pound of coal. We also know that the amount of unconsumed coal in the ash is at least 10 per cent of the amount fired.

10,000 × 2000 × 0.90 × 0.10 = 1,800,000 B.t.u. total heat received from one ton of coal burned in the average residence furnace.

1,800,000 ÷ by 3412 = 528 kw.-hr., being the equivalent of one ton of coal.

With coal at $10 per ton as mentioned, the equivalent rate for electricity would be 1.9 cents per kilowatt-hour. However, taking into consideration the handling of coal, ashes and many inconveniences attending the operation of a coal furnace, electric heating for residences would not only be possible but become a necessity at 3 cents per kilowatt-hour in the same manner that running water in the kitchen and bathroom has become a necessity, although we know that we could have a well in the back yard and pull the water up in buckets by means of a rope at much less expense. WIRT S. SCOTT.

Manager Industrial Heating Section, Westinghouse Electric & Manufacturing Company.

Readers' Views and Comments

Efficiencies of Boiler and Stoker

To the Editor of ELECTRICAL WORLD:

SIR: The letter of T. A. Marsh, published on page 1045 of the ELECTRICAL WORLD of May 17, 1919, invites some comment and a considerable amount of criticism. The following statement of the last paragraph, "Engineers are therefore recommended to analyze all results and to reduce efficiencies to a basis of net rather than gross," seems to reflect in an entirely unwarranted manner upon the intelligence, foresight and judgment of the engineers who are designing the big steam-power generating stations of the country to-day. It assumes that properly intelligent study is not being made by designing and consulting engineers of factors which, as a matter of fact, are studied in far greater detail and scope than merely considering the "net" or "gross" efficiencies of boiler and stoker combinations.

A study of the modern stations, for instance, shown on pages 984, 1003, 1015, 1017, 1020, 1021 and 1022 of the issue of the ELECTRICAL WORLD in which Mr. Marsh's letter appears will show that in practically every one of the stations illustrated the type of stoker installed is that which Mr. Marsh refers to as requiring more power for auxiliaries than some other types. The answer is simple—because a careful study of all of the factors entering into the selection of the station equipment has convinced the engineers who designed these stations that with this type of stoker "operating costs" will be lowest and total cost per kilowatt-hour will be cheapest. They find, in studying all of the factors concerned, for instance, that with this type of stoker it will be possible to obtain continuous overload capacities with a given size of boiler, which would be out of the question with stokers of the type which Mr. Marsh describes as "requiring only a small fraction of 1 per cent of the total steam generated for their operation." This, of course, means smaller rated boiler capacity needed to meet the steam requirements of the station—and consequently a smaller building to house the boiler equipment—all at a greatly reduced cost for building and land, and greatly reduced interest on investment. A few per cent more power for operation of auxiliaries may amount to very little compared to the saving thus effected.

Again, engineers operating these stations have found that, in spite of increased power required for operation of auxiliaries, it is entirely possible to obtain net combined efficiencies of boiler and stoker with this type of stoker which are far above those obtainable with stokers requiring a smaller percentage of power to be generated for their operation. Engineers have also found by experience that with the type of stokers which have been installed in practically all large steam generating stations in recent years it is possible to handle load fluctuations, with no appreciable loss in efficiency, which may vary from 100 per cent to 600 per cent of rating for given units with ease and within a few minutes' time, whereas with some types of stokers this would be entirely impossible and would require cutting in boilers operated on banks for the purpose of meeting such load fluctuations.

Regarding the amount of steam used for the purpose of preventing clinker formations on side and bridge walls, Mr. Marsh's statement is quite misleading, as in no case of actual operation would this amount to probably more than one-tenth of 1 per cent of the steam generated. The stoker equipment for most of the modern steam generating stations throughout the country has been selected because a study of all factors entering into the cost of construction, operation and maintenance of the entire plant has proved that the net cost of producing power would be least with the type of stoker selected—the type which admittedly does use a slightly larger percentage of the total steam generated for its operation. The amount required for the operation of stokers and auxiliaries may be an insignificant item as compared to economies made possible in other ways by the use of the type of stoker in question.

E. W. WAGENSEIL.

Stoker Section, Westinghouse Electric & Manufacturing Company.

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

SUMMER MEETING OF THE ASSOCIATED MANUFACTURERS

Gatherings of Sections at New London, Conn., This Week Are Supplemented by Evening Sessions—International Trade Progress

Meetings of the Associated Manufacturers of Electrical Supplies at the Hotel Griswold, Eastern Point, New London, Conn., on Monday, Tuesday and Wednesday of this week, were devoted largely to the sessions of sections. Two general meetings were held, however, on Monday and Tuesday evenings at which all of the members gathered. The first was of a business character and was devoted mainly to the work of the international trade committee. The second was an entertainment session and C. B. Eveleth, General Electric Company, told of the accomplishments in detecting submarines during the war.

Meetings of the sections, which were the principal purpose of the gathering of members, were held according to the schedule printed previously in the ELECTRICAL WORLD. They were well attended. The attendance reached a total of about 175.

President A. W. Berresford opened the Monday evening session with a short discussion of the form of organization which has been effective. He regards the function of the board of governors as supervisory. It is desired to have the action taken represent the average point of view of the men who are doing the everyday work of the industry.

Charles E. Dustin, the general secretary, then arranged the schedule of hours for the various section meetings.

The international trade committee had held a meeting in the afternoon but wanted to present at an evening session for all of the members a number of the matters which it is considering. John J. Gibson, Westinghouse Electric & Manufacturing Company, chairman of the committee, went over in some detail the activities of the committee since its last general report to members. He spoke of the imminence of tariff revision and said that the subject should have the very serious thought of all members. Members should be prepared to appear before the ways and means committee of the House of Representatives in order to present the conditions in the production of their materials upon which they ask for tariff protection.

Reference was also made by Mr. Gibson to the costs of manufacture of electrical materials in foreign countries. He said that the members should prepare to give statistics to Congress on the extent of the industry, and expressed regret that more information has not been made generally available before as to the real size of the large output of electrical manufacturers.

Mr. Gibson showed the importance of statistics to tell the number of employees and the amount of capital used in the industry, not only as totals but also divided according to the various well-defined branches. He also mentioned the question of the development of export trade, another part of the work of the committee.

William Burgess, expert adviser of the committee, outlined the progress made in the compilation of data for the use of the committee. He said that the matter of tariff protection of American industries is of more vital interest than ever before in the history of the country. In referring to the data desired to show the labor content in the cost of electrical supplies he said that it should be borne in mind that the raw materials from which these supplies are made have also a large element of labor cost. Another matter that should be settled definitely, said Mr. Burgess, is that of requesting a separate schedule for electrical machinery and supplies in the tariff act.

In presenting the case of the electrical manufacturers to Congress, said Mr. Burgess, it is desirable to give as full and accurate a statement of facts as is possible to obtain. In addition to the capital actually invested, the annual output in value, the number of persons actually employed and those directly and indirectly dependent on the industry for a living, there should be stated the wide territorial spread of the plants, the great variety of materials used in the process of manufacture, the number of states engaged in furnishing the materials, relation of the industry to the economic and social welfare of all the people, etc.

The Electric Power Club members are coöperating in tariff matters, following the same lines of inquiry as those which are being developed for members of the Associated Manufacturers of Electrical Supplies.

Mr. Burgess gave some statistics of the extent of the industry in 1914, based on the manufacturers' census. The classification does not include those parts of the industry included under the classification "iron and steel and products" and "metals and metal products" or under "gas and electric fixtures, lamps and reflectors." According to the statistics given the number of establishments engaged in the manufacture of electrical machinery, apparatus and supplies ranked as follows in comparison with other industries with gross products in excess of $100,000,000 but less than $500,000,000:

Average number of wage-earners	14
Value added by manufacture	16
Value of products	19
Cost of materials	23

Mr. Burgess made an appeal to the members to furnish accurate statistics up to date. He feels that the 1914 statistics, which as shown are incomplete, are an inaccurate presentation of the scope of the industry. These statistics indicated 1030 establishments, with 144,712 individuals engaged, $355,724,756 capitalization, $109,097,610 salaries and wages, $154,728,076 cost of materials and $180,442,118 value added by manufacture. Based on such incomplete statistics as have been obtained, the industry has increased several fold in the last five years.

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Figures were given by Mr. Burgess to show the number of raw materials entering into products of the industry. There were 58 different kinds of minerals and chemicals, 8 of water, 5 of oil, 34 of metals, 18 of rubber and composition, 9 of paper, 13 of cotton, wool or silk, 11 of paint and varnish, 4 of wood and 21 of miscellaneous, a total of 181.

Considerable discussion then followed on the subjects brought up by the committee. Mr. Berresford spoke of the mine cost and mill cost back of raw materials as large elements in the total cost before they reached the electrical manufacturers. The discussion was directed toward the necessity of awakening the manufacturers individually to the importance of giving close attention to tariff matters.

E. F. Wickwire, Ohio Brass Company, chairman of the export sub-committee of the international trade committee, spoke on the work done to develop export trade. He said that the difficulty with manufacturers in the past had been that when times were good they were too busy to give attention to export trade and when times were hard they were too poor. They are now getting interested, however. Mr. Wickwire then spoke of the reasons for the proposal to form an organization or association to undertake investigations into export trade possibilities, working along research lines. This plan is mentioned in an article printed in this issue of the ELECTRICAL WORLD.

Thomas M. Debevoise, general counsel of the association, then discussed briefly the recent decision of the United States Supreme Court in the Colgate case and spoke generally of the aims of the manufacturers in the Associated Manufacturers' organization.

On Tuesday evening no business was transacted. President Berresford introduced Mr. Eveleth, who gave an illustrated talk on the development of submarine detection during the war. He told of the detail of engineers of the company, including himself, who conducted experimental work at Nahant, Mass., and then of the more dangerous work in the North Sea.

PLAN OF THE MANUFACTURERS FOR EXPORT RESEARCH WORK

Organization or Association Is Proposed to Make Studies of Foreign Trade Possibilities and Matters of Credit, etc.

A plan for the organization of an export research organization or association to represent electrical manufacturers is under consideration. A brief announcement in regard to it was made at the meeting of the Associated Manufacturers of Electrical Supplies at New London, Conn., this week. John J. Gibson, chairman of the international trade committee, and E. F. Wickwire, chairman of the export sub-committee of that committee, have been appointed by the committee to take up the matter with the manufacturers of electrical apparatus. Mr. Wickwire, in referring to the subject at one of the sessions at New London, said that the purpose is to see if the manufacturers of electrical supplies can be brought together with the manufacturers of electrical apparatus in a movement to develop the export trade markets in both classes of materials.

Under the proposed arrangement an organization or association would be formed which would conduct what might be termed research work of a commercial and financial character. It would not be a buying and selling agency. It would not be organized under the Webb-Pomerene act. It would conduct investigations into the possibilities of markets for manufacturers and into matters of credit.

THEODORE N. VAIL TO BE CHAIRMAN OF THE BOARD

H. B. Thayer Will Become President of the American Telephone & Telegraph Company—John J. Carty to be Vice-president

Theodore N. Vail, president of the American Telephone & Telegraph Company, announced on Wednesday a reorganization of the corporation and important changes in personnel preparatory to the return of the wires to private control. The changes, he said, would enable the company more effectively to meet the problems of the reconstruction period. Under the new system Mr. Vail will become chairman of the board of directors and will thus be able to devote his attention to the larger problems of the business. He will continue to be in active direction of the policy and problems of the company.

H. B. Thayer, who has been identified with the system for forty years in both manufacturing and administrative capacities, has been made president. N. C. Kingsbury, who has been concerned with both operation and public relations, has been designated first vice-president. N. T. Guernsey, the general counsel, has been named vice-president in charge of the legal department. John J. Carty, who has long been head of the research, experiment and development work, is to be vice-president in charge of development and research. W. S. Gifford, also long connected with the company, and who since resigning as director of the Council of National Defense has been comptroller of the company, has been made vice-president in charge of accounting and finance. Bancroft Gherardi, for many years Mr. Carty's chief aid and who has been acting chief and engineer during the period of Mr. Carty's war service, has been appointed chief engineer.

Vice-president Bethell, who has been in charge of the federal operating board, was invited to rejoin the organization, but as he wished to take a long rest he declined.

Mr. Vail's statement pointed out that these changes were in titles rather than function. The statement said that the readjustments were necessary in view of the great development in the art of transmission of intelligence by electricity, particularly the great development in multiplex telephony, machine operation of both telephone and telegraph and wireless telephony.

Effect of Daylight Saving on White Mountain Central Station

The Bethlehem (N. H.) Electric Company supplied 33,798 kw.-hr. in the season of 1916 to sixteen of the larger hotels in the upper White Mountain district, this being a normal year with no price changes or other disturbing features. In 1918 these same hotels, under the same management, and with daylight saving in effect, purchased 21,948 kw.-hr. from the Bethlehem company.

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A. W. BERRESFORD ON EUROPEAN CONDITIONS

Much Misunderstanding in This Country and England as to International Trade, and British Attitude Should Have Due Consideration

A. W. Berresford, vice-president and general manager of the Cutler-Hammer Manufacturing Company, Milwaukee, and president of the Associated Manufacturers of Electrical Supplies, returned to this country recently from a short trip to England. It was taken in reference to matters concerning the Igranic Electric Company, Ltd., which is controlled by the Cutler-Hammer Manufacturing Company.

Mr. Berresford did not cross from England to the continent, but his visit gave him an insight into conditions of Europe as a whole which will be of interest to manufacturers in this country. He was asked to give his views on these conditions to the ELECTRICAL WORLD. He believes that there is much misunderstanding in both this country and England as to the factors which affect international trade and competition between the two countries. As an example of this, Mr. Berresford called attention to a recent advertisement of an English manufacturer in the London *Electrician;* part of this is reproduced here. He further stated that he had naturally expected to find in England a more exaggerated situation than that prevailing here. The relief from the strain under which England has labored during the past four years must, in his opinion, be evidenced in some form, and the expression might easily involve the elements of hysteria. This seemed somewhat in evidence in labor conditions.

The workers of the country, at the request of the government, had abandoned for the period of the war their policy of restrictions on output, with the understanding that they were to be reëstablished at its termination. The entire productive facilities of the country had been employed on war work, and the results of the cessation of this demand were consequently by far more serious than in this country and the difficulty of return to normal lines of output by far greater, with a consequent increase in the duration of the period required.

"Rather naturally, from the standpoint of human nature, the men have seen little reason for an apparent delay in readjustment and have become impatient, and all manner of doctrine is receiving ready acceptance, although most of it is at distinct variance with economic considerations," said Mr. Berresford. "The trained and experienced leaders of the workers realize conditions and urge patience and conservatism, but the demagogue is for the moment more influential, and demand after demand appears embodying every variety of claim, from simple requests for wage increase to equal participation in management and nationalization of entire industries.

"Furthermore, the government is paying 'out-of-work benefits' to nearly a million workers, and this does not appear to be productive of good, as it is claimed

MADE IN ENGLAND, OR MADE IN U.S.A.?

To make it in England would necessitate our laying out about £10,000 in press tools and equipment to manufacture.

Would you lay out even £10 of your money on a proposition which under present free trade conditions would work out as follows :—

1ST YEAR. We lay out £10,000 of hard-earned money. Start factory, employ British labour, turn our articles equal in every respect and at same prices as American product.

2ND YEAR. Americans will undoubtedly cut their prices. We do ditto.

3RD YEAR. Americans cut under us again.
We cannot reduce price without loss. (Americans can *always continue to cut lower than we can*, as they are making double or treble the quantity, having their own tariff-walled market *and* our free trade market to sell in.)

4TH YEAR. We are compelled to shut down factory, discharge British workers, and lose our £10,000.

5TH YEAR. Americans having killed competition (by aid of the advantage they have working under tariff conditions), up go their prices far above even their first year's price.

RESULT. We loose our £10,000.
British workmen unemployed.
Consumer is paying more for the article.
Profits are taken by foreigners.
Factories are enlarged in foreign countries.

REMEDY. Tariff Reform. That is, reciprocal tariffs, further adjusted to compensate for different rates of labour in the different countries.

A good deal of publicity has at one time and another been given in our English Electrical papers to American-made goods, and whilst the American product was no doubt worthy of praise, an article as good or better can be made here, and will be, as soon as the conditions of manufacture are made fair to the British makers.

The above are *our* views, and the reason why we don't care to put money into the scheme.

We want to make this apparatus. We could be selling it in three months from starting.

Can you prove to us where our argument is wrong? If so, will you immediately write us?

So many of our friends have suggested we make these articles, that this statement is chiefly to show why we are absolutel prevented from starting.

It's not for want of pluck on our part; we'll compete with anybody under fair trade conditions.

We think, however, it would be sheer madness for us to put our money in it under free trade conditions

There are 500,000 unemployed in this country at the present moment (*Sir Eric Geddes*)

GIVE THEM A JOB.

THIS IS FROM AN ADVERTISEMENT OF AN ENGLISH MANUFACTURER IN A LONDON ELECTRICAL PAPER

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that the recipients would rather idle on the amount so received than work for a somewhat greater return.

"Under these conditions, the factor in the situation which occasioned real surprise does not seem so unreasonable. Reference is made to the fear on the part of the British manufacturer that America will not merely be a competitor for world trade but will invade England and actually absorb the Englishman's home market. This belief finds expression in the insistence that the government at least limit imports and even forbid them in certain lines of product, notably those involving metal trades.

"To offset the demands for increased compensation so as to provide a better living standard, employers are pointing out that this is possible only if justified by production; otherwise compliance means the death of British industry and the delivering of British markets to competitive nations.

"The immediate effect of this is to place a premium on British manufactured goods, and for the immediate future at least import into Great Britain will be accomplished with increasing difficulty. No attempt is made to pass on the economics of the situation, but the attitude of the British manufacturer is at least a human one, and while a solution will be found ultimately, it would seem that the finding of it will be hastened if this attitude is appreciated and given due consideration.

"The United States is undoubtedly more fortunately placed at the moment, owing to its lateness in entering the war, and there is at least a doubt if the ultimate good of all will be served by too great insistence on this advantage at this time.

"The policy of France at the time appeared to be definite in the decision to permit no preventable importation and in effect to carry on her own reconstruction work. Lately this appears to have been modified to some extent, provided that exceedingly long credits are granted, say two or three years, and at least a possibility of importation is thus provided; but it should be remembered that the transportation facilities of northern France have been practically destroyed and economical rehabilitation must be to a large extent contingent on their restoration.

"Spain is becoming active in the improvement of her copper and iron resources, and England is naturally pushing her trade there."

Asked as to readjustment conditions in this country, Mr. Berresford expressed himself as in agreement with the large majority of American manufacturers in favoring the minimum of government connection with the country's activities. He believed that the return toward stable conditions would be delayed by any interference with the natural trend of events. He felt that but little reduction in prices of finished products would come in the near future from the operation of natural laws, pointing out that inflation and the consequent reduced purchasing power of the dollar rendered present and pre-war prices practically equivalent.

Mr. Berresford did not believe that for the average concern the moment was opportune for extended planning for the extension of European trade, especially so far as the warring nations were concerned, but felt that the situation should be carefully and competently studied and plans evolved which a year or two from now would come to fruition and form the foundation for a continuing relation helpful to both parties to the bargain.

EQUIPMENT MANUFACTURERS DISCUSS WORKING PLANS

Makers of Material Handling Apparatus Hold Semi-Annual Meeting—To Educate Public as to Need for More Labor-Saving Devices

The Material Handling Machinery Manufacturers' Association meeting at the Hotel Astor, New York City, on June 10 and 11 laid plans for a nation-wide educational campaign to bring home to manufacturers and the public at large the need for further development in the use of labor-saving devices.

Coöperative advertising through the medium of motion pictures will be a feature of the campaign as outlined at the preliminary meeting on June 10 of the advertising managers of the concerns represented. An advertising council was also formed to join with Zenas W. Carter, the association's secretary-manager, in this work. The object will be to stimulate interest in mechanical handling devices generally rather than in any one appliance in particular. E. B. Hill, McGraw-Hill Company, briefly outlined a tentative advertising campaign and suggested that the association adopt a trademark. Others who spoke advocating coöperation among manufacturers were Burdette Phillips, Burdette Phillips Company, and G. M. Van Harlingen, Republic Motor Truck Company.

At the morning session on June 11 President Calvin Tomkins outlined the association's program, declaring that it faced an unequaled opportunity to demonstrate the effectiveness of coöperative publicity. The association must prove to labor as well as capital that more extensive use of mechanical appliances would increase productivity and be a benefit to all concerned, he said.

Among those who spoke at the afternoon session were James H. Collins, writer on industrial subjects; Francis Holly, director of commercial economics, Washington, D. C., and David B. Rushmore, General Electric Company, who declared "that the association's plans were of special interest to the electrical industry." Since most mechanical handling appliances are electrically driven, adoption of such equipment at terminals and in factories would, he thought, materially increase the central stations' load.

At the evening session ex-Senator Theodore N. Burton spoke on "Extension in Port and Terminal Facilities as the Determining Factor in the Success of the American Merchant Marine."

ASSOCIATION OF EDISON COMPANIES WILL MEET

Convention to Be Held at New London, Conn., Sept. 15 to 18 Will Renew Activities Suspended for Period of the War

The Association of Edison Illuminating Companies will hold a meeting at the Hotel Griswold, Eastern Point, New London, Conn., on Sept. 15 to 18. This meeting will mark the renewal of the important activities of the association after suspension of the work during the war.

Notice of this meeting follows the announcement of resumption of activities of other associations in the industry, as printed in recent issues of the ELECTRICAL WORLD.

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ARKANSAS INTERESTED IN INTERCONNECTION PLANS

Electric Power to Be Large Factor in Developing Resources Under Commission Regulation—Economics Are Also Discussed

While the papers and discussions at the annual convention of the Arkansas Utilities Association at Fort Smith, Ark., June 10, 11 and 12, contained few direct references to utility conditions in Arkansas, there was apparent an undertone of optimism that was unmistakable. All four of the principal groups of properties in the state were represented at the meeting, and a few men were there from other plants. It was among the men from the companies that aspire to become more than "single-town outfits" that it was easiest to detect this confidence in bright prospects. Interconnection, extension, electrification of heretofore virgin territory and kindred subjects are the topics of hotel lobby conversation at gatherings of Arkansas public utility men now; and these are the topics which represent the real interest of the industry in that state more than do the convention papers of the twelfth annual meeting.

The prearranged convention program consisted of six papers as follows: "Transmission-Line Construction," by William Crooks, engineer for the Arkansas Light & Power Company, Pine Bluff; "Incandescent Lamps," by George B. Walker, St. Louis; "Application and Operation of Light-Weight Safety Cars," by A. L. Faber, St. Louis; "Elements of Rate Making," by F. A. Whitlaw, manager the Pine Bluff Company; "Advertising and Publicity," by T. A. Wright, Little Rock, and "Insulation of Distribution Transformers," by A. C. Farmer, East Pittsburgh, Pa. Mr. Crooks in his paper discussed the standards of construction which his company uses in building 33,000-volt lines. Mr. Whitlaw explained methods of making equitable rates and methods of explaining these rates to the public so that they might be understood. Mr. Wright told how the proper and continuous use of publicity in Little Rock had retained the good will of the community at a time when war's demands on the company's service might otherwise have made the public antagonistic.

New Arkansas Commission

In the open discussions other subjects were broached. All utilities expressed interest in seeing that the new Arkansas Corporation Commission, which has just begun to regulate utilities, should secure whatever coöperation from the companies it might desire. To assist in this committees from the association were appointed to work with the commission. L. W. Helmreich, Little Rock, chief engineer of the commission, who attended the meeting, voiced the intention of the commission to do justice to both the utilities and the public. As another matter of legislative interest President D. C. Green, Fort Smith, stated that the legislature which had just ended had not enacted a single law antagonistic to capital. He advised utilities to adopt a platform of asking a fair replacement value for their business in cases before the commission but spoke strongly against abusing the rights which the new commission law gives. At the suggestion of J. S. M. Wharton of Helena, a committee was formed to see if some uniform and fair plan of taxing could not be discussed with the state tax commission.

Officers elected for the ensuing year are: President, J. S. M. Wharton, Helena; first vice-president, J. L. Longino, Pine Bluff; second vice-president, P. T. Phillips, Little Rock; secretary-treasurer, W. J. Tharp, Little Rock. Class B members, the salesmen, elected officers as follows: President, H. J. Bonenkamp, St. Louis; vice-president and chairman entertainment committee, Walter Springe, St. Louis; secretary-treasurer, L. E. Fuller, St. Louis.

JOHN I. BEGGS OF MILWAUKEE BUYS ARKANSAS UTILITIES

Milwaukee Utility Man Secures Control of Transmission Company Serving Coal-Producing Regions in Southwest

John I. Beggs, Milwaukee, has purchased control of the Commonwealth Public Service Company, which has headquarters at Fort Smith, Ark., from a firm of Chicago bankers. This company, operating gas and electric properties in eastern Oklahoma and western Arkansas, has as its principal property a transmission company that buys power from the Fort Smith (Ark.) Light & Traction Company to distribute to ten towns and to a group of thirty-four coal mines and eight cotton gins. These towns are Alma, Dyer, Mulberry, Ozark, Altus, Alix, Denning and Hartman, where energy is sold at retail, and Clarksville and Coal Hill, where wholesale power contracts exist. The total population of the group is 15,000, and districts are known as the Denning, the Spadra and the Jamestown fields. In addition to this, the company owns gas plants at Prior, Wagner, Choteau, Vian and Salina, Okla., and Alma, Ark., and ice and electric plants at Mena, Duqueen, Ashtown and Vian, Okla., and an ice plant at Salisaw.

The company will continue to operate under the name of the Commonwealth Public Service Company. Its officers are: President, John I. Beggs, Milwaukee; first vice-president, Dick R. Lane, Davenport; vice-president and general manager, G. W. Fry, Fort Smith, and secretary-treasurer, C. O. Reynolds, Chicago.

OMISSION IN 1918 EDITION OF NATIONAL ELECTRICAL CODE

Second Paragraph of Rule 23a, Appearing in 1915 Edition, Inadvertently Omitted but Still Applicable

In the 1915 edition of the National Electrical Code the second paragraph of Rule 23, Section a, read as follows:

"Where the switch required by No. 24a is inside the building, the cut-out required by this section must be placed so as to protect it, unless the switch is of the knife-blade type and is inclosed in an approved box or cabinet, under which conditions the switch may be placed between the source of the supply and the cut-out."

Through an error this section was omitted when the 1918 edition was printed.

The electrical committee of the National Fire Protection Association has voted that the matter be given the widest publicity in order that all interested parties may be advised that this section was inadvertently omitted and is still applicable.

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ILLUMINATING ENGINEERING SOCIETY ELECTS OFFICERS

S. E. Doane Will Be President in 1919-1920—Officers for the Four Geographical Sections Are Also Chosen at June Meeting

The election of the following officers of the Illuminating Engineering Society for the fiscal year 1919-1920 was confirmed by the council on June 12, 1919. They were elected to fill the offices made vacant by expiration of terms:

President—S. E. Doane.
Vice-president—William J. Clark.
General secretary—Clarence L. Law.
Treasurer—L. B. Marks.
Directors—E. C. Crittenden, F. E. Cady and R. B. Ely.

S. E. DOANE

The membership of the council for 1919-1920 will therefore be as follows: S. E. Doane, president; G. H. Stickney, junior past-president; George A. Hoadley, junior past-president; William J. Clark, vice-president; H. A. Hornor, vice-president; Otis L. Johnson, vice-president; H. K. Morrison, vice-president; Clarence L. Law, general secretary; L. B. Marks, treasurer; Adolph Hertz, S. C. Roger, P. S. Young, John C. D. Clark, Evan J. Edwards, James J. Kirk, E. C. Crittenden, F. E. Cady and R. B. Ely, directors.

The election of the following section officers was also confirmed:

New York Section—Chairman, F. M. Feiker; secretary, R. E. Harrington; managers, W. T. Blackwell, W. J. Clark, L. J. Lewinson, J. P. Ladcliffe, Jr., and G. A. Sawin.

Philadelphia Section—Chairman, G. Bertram Regar; secretary, H. B. Anderson; managers, H. Calvert, C. E. Clewell, R. B. Duncan, Howard Lyon and W. L. Nodell.

New England Section—Chairman, H. F. Wallace; secretary, H. W. Jordan; managers, G. N. Chamberlain, John C. D. Clark, J. W. Cowles, Raymond A. Fancy and F. A. Gallagher, Jr.

Chicago Section—Chairman, F. H. Bernhard; secretary, E. D. Tillson; managers, A. L. Arenberg, F. F. Fowle, E. H. Freeman, James J. Kirk and J. L. Stair.

Samuel E. Doane, the new president of the Illuminating Engineering Society, is chief engineer of the National Lamp Works of the General Electric Company. Mr. Doane was born at Swampscott, Mass., on Feb. 28, 1870. He was associated with the Thomson-Houston Company, Lynn, Mass., from 1886 to 1892, working four nights each week on the testing force and in the laboratory and rising from office boy to acting engineer and assistant foreman of the incandescent lamp department. When the lamp department at Lynn was shut down in 1892 because of the financial panic in that year all the employees were released with exception of Mr. Doane, who was transferred to the plant at Harrison, N. J. He served with the General Electric Company from 1892 to 1897 as assistant engineer, superintendent of the Harrison Lamp Works and later as acting engineer of the foreign department at Schenectady. From 1897 to 1900 he was superintendent of the Bryan-Marsh Company at Marlboro, Mass.

ILLUMINATING ENGINEERING SOCIETY TO MEET IN CHICAGO

Annual Convention Will Be Held in That City on Oct. 20 to 23 Inclusive, and an Excellent Meeting Is Anticipated

The 1919 convention of the Illuminating Engineering Society will be held at the Hotel Sherman, Chicago, on Oct. 20 to 23 inclusive. The chairman of the 1919 convention committee is Homer E. Niesz. William A. Durgin is the vice-chairman and Edwin D. Tillson the secretary.

No definite program plans have been formulated as yet, but it is expected that the joint work of the program and convention committees will result in an excellent meeting.

A CHICAGO MAN HEADS ELECTRICAL CREDIT MEN

National Association Protects Members from Poor Credit Risks—Bad Accounts Decreased in Number and Amount Compared with 1918

Members of the National Credit Association have shown their appreciation of the benefits they are deriving from the organization by increasing the per capita dues levied upon the five local associations for the support of the national body. This action was taken at the twentieth annual meeting of the association at Cincinnati last week. During the past year the total number of names of slow or otherwise unsatisfactory customers reported to the local associations of Boston, New York, Philadelphia, Chicago and San Francisco was 167,758. Both in number and in amount involved there was an average decrease of 30 per cent in bad accounts compared with the preceding year and a decrease of more than 50 per cent compared with the totals of 1915.

The election of officers for the ensuing year resulted as follows: President, Benjamin P. George, Beardslee Chandelier Manufacturing Company, Chicago; vice-president, George J. Murphy, Pettingell-Andrews Company, Boston; general secretary-treasurer, Frederic P. Vose, Chicago; assistant secretary-treasurer, Walter S. Vose, Chicago.

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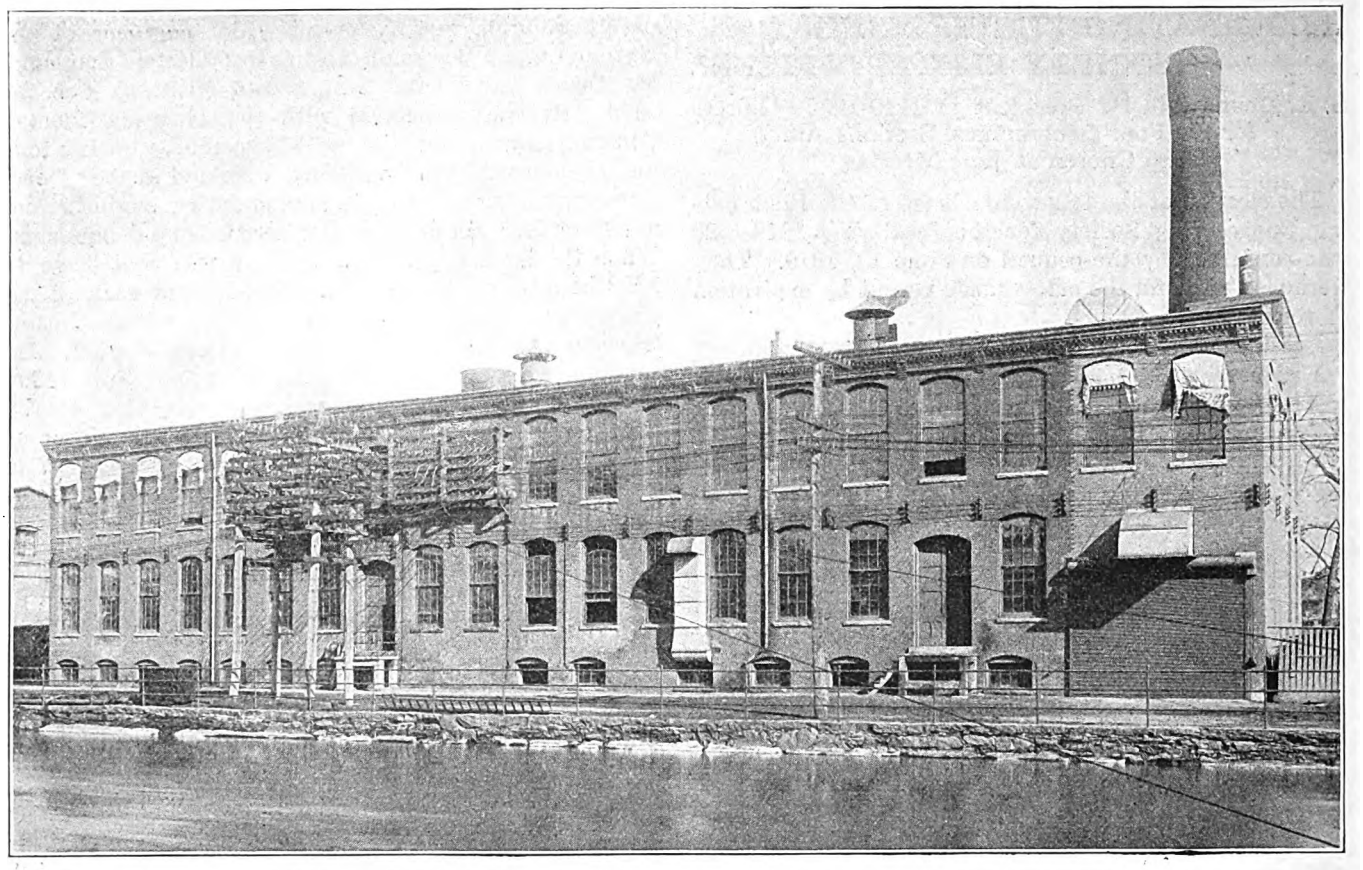

IMPORTANCE OF CHEAP POWER IS DISCUSSED AT HOLYOKE

Proposition of Hydroelectric Company Considered at Hearing Upon Future Policy of Municipal Plant in That City

Leading manufacturers and business men of Holyoke, Mass., manifested a great interest in the proposed contract of the municipal lighting plant with the Turners Falls Power & Electric Company at a public hearing June 11 called by the Chamber of Commerce to discuss the future policy of the city's station. An outline of the situation confronting the plant was published in the ELECTRICAL WORLD for June 14, page 1286. President J. H. Potts of the Chamber of Commerce occupied the chair and stated to the 200 citizens present that the proposition was the most important question that had arisen in municipal affairs in the past twenty years. He urged that hasty action be avoided by a careful and thorough consideration of the situation.

John J. Kirkpatrick, manager of the city lighting department, stated that the Holyoke plant contains about 13,000 hp. in steam-driven and 1000 hp. in water-driven generators. The proposition is the result of a suggestion of the Fuel Administration made in the fall of 1918, calling attention to the advisability of utilizing water power to save coal and intimating that a tie-in between the Holyoke municipal plant and the Turners Falls system might be mutually advantageous. Within a few miles of Holyoke are the municipal plants of South Hadley, Chicopee and Westfield, which purchase all their electrical energy. Mr. Kirkpatrick said that he submitted the company's proposal to the city authorities as a matter of duty and that he made no apologies for his letter of transmittal, in which he emphasized the general advantages of the terms offered the city. He stated that in his opinion the contract might be amended in some particulars.

W. T. Sawin of the Holyoke Water Power Company said that his plants had about 1000 hp. in reserve at present which is available for the city's use, and that the company had furnished the city with water power to save coal or to maintain the full volume of service at times in the past. It was brought out by Mr. Kirkpatrick that about 55 or 60 per cent of the municipal plant's output is utilized in power service. The minimum price for energy is about 1.3 cents per kilowatt-hour; the maximum price for power is 4 cents, and the average price about 2.58 cents. The retail lighting rate is 6 cents per kilowatt-hour. If the power load of the plant were cut off, it would be necessary to charge 14 cents per kilowatt-hour for lighting service.

C. L. Newcomb, manager of the Deane works of the Worthington Pump & Machinery Company, pointed out that the Turners Falls company's proposal deserved serious consideration. In five years the present plant of the city will be hardly worth its scrap value. C. A. Crocker of the Crocker-McElwain Company pointed out that industrial New England is built up on water power and that in a manufacturing sense the whole United States is "out in competition with New England." The speaker maintained that the local generation of energy in the municipal plant can scarcely compete with a large modern station.

Other speakers emphasized the possibilities of transmission system interruptions and maintained that the city should develop its own plant regardless of outside offers to supply energy in bulk. It was finally voted to recommend to the Mayor and Board of Aldermen that a joint committee of the chamber and of the board select an independent engineer to report upon the proposition and advise the city as to the most desirable course to pursue.

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PACIFIC GAS & ELECTRIC COMPANY GROWS IN SIZE

Purchases Northern California Power Company and Because of This Expansion Operates Largest Transmission System in the World

The board of directors of the Pacific Gas & Electric Company has ratified an agreement whereby that company takes over the ownership and the indebtedness of the Northern California Power Company properties. Final confirmation of the sale by stockholders of both companies is expected soon.

The purchasing company is to receive a deed to the properties, subject to the bonded indebtedness, in re-

turn for $3,400,000, which is at the rate of $34 per share of the Northern California stock. The total assets of the Northern California Power Company are rated at about $18,000,000.

This addition to the Pacific Gas & Electric Company's system will extend its transmission network to the Oregon line, links in the chain having been completed by the two companies during the past year.

The Pacific Gas & Electric Company serves an area of approximately 40,000 sq. miles, equivalent to a territory one-half the size of the New England States or three-fifths the size of the State of New York. Its circuits extend into thirty of the fifty-eight counties of the State of California. Electricity is supplied directly or indirectly through other companies to 214 cities and towns. The company operates at present thirteen hydroelectric stations and three steam stations. The generating capacity of the hydroelectric plants is over 160,000 hp., and the capacity of the steam plants is approximately 120,000 hp., or a total of approximately 283,000 hp. There are more than 6500 miles of high-tension and low-tension distribution circuits. The substations, of which there are 156, connect to the system with a total installed capacity of 321,000 kw. in transformers.

The hydroelectric developments of the Northern California Power Company are situated on Battle Creek and Old Cow Creek. The principal source of water supply is the western slope of Mount Lassen.

The company operates seven hydroelectric plants with a combined rating of 50,000 hp., waterworks at Redding and Willows, gas works at Redding, Red Bluff and Willows, and about forty-six substations. It supplies light to all important towns in Shasta, Tehama and Glenn Counties, Cal., and has a contract expiring December, 1925, to deliver 10,667 hp. to the Pacific Gas & Electric Company at Chico, Cal., where connection is made with that company's lines. Gas is manufactured and distributed in Redding, Red Bluff and Willows, and water is distributed for municipal and domestic uses in Redding and Willows. Franchises are without limitation in point of time in the cities; county franchises for the use of public highways for transmission lines expire from 1952 to 1956. There are more than 400 miles of 22,000-volt and 60,000-volt lines in the system.

SOUTHERN ILLINOIS COMPANY BOUGHT BY CHICAGO INTERESTS

Through Purchase of Common Stock, William A. Baehr and Associates Obtain Control of Property Supplying Fifty-five Communities

J. J. Frey of St. Louis and associates have sold the common stock of the Southern Illinois Light & Power Company to William A. Baehr, consulting engineer, Clement Studebaker, George Studebaker and associates of Chicago. This gives the Chicago interests control of the company without any change in its capitalization. The company has nine main and four reserve steam generating stations and 267 miles (430 km.) of high-tension transmission lines, from which it supplies fifty-five communities in fourteen counties in the State of Illinois. The maximum demand on the lines of the company is about 8000 kw. The principal towns on the system are Collinsville, Litchfield, Hillsboro, Mount Vernon, Duquoin, Chester, Nashville, Greenville, O'Fallon, Sparta and Eldorado.

William A. Baehr, consulting engineer of Chicago, supersedes J. J. Frey of St. Louis as president of the company. Mr. Frey retains an executive post with the company as vice-president and a member of the board of directors. Guy C. Lane of Hillsboro, Ill., is second vice-president. He was formerly the vice-president of the company. H. L. Hanley and Scott Brown, both of Chicago, are secretary and treasurer respectively. Mr. Baehr, the new president of the company, is interested in electric, gas and ice plants in Montana, Idaho, Oklahoma, Missouri, Ohio, Wisconsin and Illinois, and most of the companies are controlled by the North American Light & Power Company.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Toledo Joint Company Section Elects Officers.—M. H. Somerville and W. M. Berger were elected chairman and secretary respectively of this section on June 6.

A. I. & S. E. E., Birmingham Section.—This section of the Association of Iron and Steel Electrical Engineers is to hold an outing on July 4 at the hydroelectric plant of the Alabama Power Company, on the Coosa River.

A. A. E., Dallas Chapter Formed.—The Dallas Chapter of the American Association of Engineers was installed at a meeting on May 23, which resulted in the organization of a Dallas Engineers' Club to include all engineers of the city.

Engineers' Society of Milwaukee.—"The Motion Pictures' Secret Part in Winning the War" was the subject of G. G. Curtis, who spoke at the June 11 meeting. Films showing gasoline vapor, sound waves, electric energy and other unseen forces were displayed.

N. E. L. A., New England Section Convention.—The annual convention of the New England Section, National Electric Light Association, is to be held from Sept. 16 to Sept. 18 in the Hotel Griswold, New London, Conn. O. A. Bursiel, 1149 Tremont Street, Boston, is the section's secretary.

A. I. & S. E. E.—"Central-Station Power Rates" will be discussed by George M. Gadsby, vice-president of the West Penn Power Company, and E. C. Stone, system manager of the Duquesne Light Company, at the meeting of the Association of Iron and Steel Electrical Engineers to be held on June 21 at the Chatham Hotel, Pittsburgh, Pa.

Convention Held by Vancouver (B. C.) Contractor-Dealer Association.—At an electrical convention held by the association in Vancouver, B. C., on May 26 and 27, Samuel Adams Chase, special representative Westinghouse Electric & Manufacturing Company, spoke optimistically on the future of the electrical industry, and W. L. Goodwin gave a talk on "The Ills of the Industry."

Special Libraries Association Convention.—The Special Libraries Association, an organization to promote the interests of libraries devoted to particular professional and business subjects, will hold its tenth annual meeting at Asbury Park, N. J., June 24-26. Among the papers to be presented is one on "How the Special Library Can Help Build Industry," by F. M. Feiker, editorial director McGraw-Hill Company, publisher of the ELECTRICAL WORLD.

American Institute of Electrical Engineers

Fort Wayne Section.—C. I. Hall and O. B. Rinehart have been elected chairman and secretary-treasurer respectively of the Fort Wayne Section.

Pacific Coast Convention.—The Institute's Pacific Coast convention will be held in Los Angeles under the auspices of the Los Angeles Section from Sept. 18 to Sept. 20.

Atlanta Section.—Major Edward B. Craft, assistant engineer of the Western Electric Company, gave a talk on "Electrical Communication in War Times" at the May 30 meeting.

San Francisco Section.—"Recent Development in Long-Distance Radio-Telegraphy" was the subject of a talk by L. F. Fuller at a recent meeting. W. G. Vincent has been elected chairman of the section and A. G. Jones secretary.

Boston Section.—At the annual meeting of the section Irving E. Moultrop, Edison Electric Illuminating Company, Boston, was elected chairman for the ensuing year, and Ira Cushing, General Electric Company, Boston, was elected secretary-treasurer.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Facilities for Service.—The New York Public Service Commission, First District, in a decision affecting the Edison Electric Illuminating Company of Brooklyn, sustained a complaint alleging unlawful refusal to furnish electrical energy for power purposes. In part the decision, written by Commissioner Ordway, says: "In my opinion it was the intention of the Legislature to compel electrical corporations to supply adequate service to any and every consumer within 100 ft. of its consumers' wires. This section does not cover new extensions beyond the limits of existing service, but it does require that within the limits of existing domestic and commercial service the company shall not refuse adequate service to any consumer who desires it; otherwise the company might 'pick and choose' among its existing customers and give all of its energy to one on the ground that that one needed it all, and cut off entirely its other customers on the ground that its existing wires were only sufficient to serve the one. . . . As the commission is obliged, from the evidence comprising the record in this case, to find that the defendant is not rendering adequate service to a consumer it is already serving and does not have adequate facilities (*i. e.*, cables and wires running from its substation under these various streets) to render such service, and refuses to provide the same, the remedial power of the commission, which has been invoked by the complainant, must here be exercised. . . . The defendant's legal duty is to give reasonable, adequate and just service and to provide the necessary facilities and instrumentalities therefor. It cannot, under the definition of reasonable service to those already sustaining to it the relationship of customers, impose a charge (as the prepayment of $25,000 with the loss of interest thereon and possibly a part of the principal in fact would be) in addition to the rate for service demanded in accordance with its tariff schedules of all its other customers receiving the same kind of service under similar conditions. Nor can it be said that there is a difference in 'conditions' of service, for the difference cannot be founded upon the adequacy of the facilities of the defendant to serve one or more customers and the inadequacy of its facilities to serve another customer. . . . It is contended by the defendant that without a reasonable assurance that the additional facilities will be utilized by the complainant the expenditure to provide them may be an idle one, increasing carrying charges and expenses of service generally. The defendant should not be compelled to provide a plant unjustifiably excessive over the fairly anticipated requirements for rendering adequate service to the public. On the other hand, the defendant may not impose upon the complainant any other conditions or regulations for assuring a minimum quantity of consumption to justify the readiness to serve than it imposes upon other wholesale power consumers. The commission is impelled to the conclusion that the existing facilities of the defendant are inadequate for rendering adequate service to the complainant, and that the defendant should be ordered to provide such facilities and equipment and so increase and improve its present facilities and equipment, and particularly the feeders between its substation and the point in the street, opposite the premises of the complainant, from which the company's wires now enter the plant, as may be necessary to render adequate service to the complainant in the furnishing of electrical energy in the quantity and at the rate for which the complainant shall offer to enter into an agreement with the defendant in accordance with the forms of agreement provided by the rate schedules of the defendant on file with the commission, but without, however, the inclusion therein of 'rider No. 4.'"

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Stockton (Cal.) Has Most Electric Signs.—According to a survey of the electric sign situation in the United States recently completed by the Electrical Products Corporation, Stockton, Cal., has more electric signs per capita than any other city in the United States.

Electric Trucks Used by Leading Stores.—A. Jackson Marshall, secretary of the Electric Vehicle Section, National Electric Light Association, points out the fact that the electric commercial vehicle is employed extensively by many of the great department stores in this country and abroad. For example, Marshall Field & Company, Chicago, use 264 electric trucks, while Harrods, Ltd., London, England, employs 72. The "electric" has proved by long experience, Mr. Marshall adds, that it is the ideal truck for such frequent-stop transportation service.

Prize - Winning Central - Station Paper.—The papers committee of the Public Service Company of Northern Illinois Section of the National Electric Light Association has announced the winners of the 1919 papers contest. F. E. Andrews won first prize for a paper entitled "Our Job, Service"; J. S. Sproull won second prize for a paper entitled "The Soul of Utility," and the third prize was awarded to George E. Dunn for a paper entitled "If I Were —." The latter paper is particularly well adapted for distribution among employees of central-station companies.

Electrical Jobs for Men with Various Disabilities.—A returned soldier, whatever his disability and whether or not he has had previous experience, will, if he is at all interested in electricity, find some job that will be suitable for him, says the federal board in charge of this matter, so great is the present demand for electrical men. It is not surprising that courses in electricity, either in construction, maintenance or repair, are popular with disabled soldiers who go to the federal board for training. There are at present 178 men taking courses in the general subject of electricity. Thirteen are studying bench work and sixty-one are preparing to be electrical engineers. Disabled men can fill many positions in power plants, such as switchboard operators, substation operators, combustion experts and attendants of auxiliary machinery. Clerks whose duty it is to analyze and record the daily operating charts and compile them into cost records are being used more and more in electrical plants.

Louisville Company Provides Life Insurance for Employees.—Employees of the Louisville Gas & Electric Company received a surprise at a recent meeting of the employees' association in the form of an announcement that the company has provided life insurance amounting to $1,000 for each of its 500 employees.

New Cable Service to South America.—The Western Union Telegraph Company and the Western Telegraph Company of Great Britain have completed arrangements for direct cable service to Brazil and the eastern coast of South America. The new line will extend from Miami, Fla., via Barbados to Belem, Brazil, thence connecting with Rio Janeiro, Buenos Aires and the principal cities of the eastern seaboard. The project involves the laying of 3200 miles of cable, the work being equally divided between the two companies, and will probably be completed within six months.

Turning a River Into Power.—Lee, Higginson & Company, bankers of Boston and New York, in offering bonds of the Great Western Power Company, San Francisco, say: "We on the Atlantic Coast, living close to the best anthracite and bituminous coal in the world, hardly appreciate the value of water powers on the Pacific Coast, where there is no coal and where oil is becoming an increasingly costly fuel. The demand for power in California has doubled in the past eight years; it is expected to double again in the next six years. On the Feather River, the flow of which is always protected by a vast storage reservoir, the Great Western Power Company's principal plant, with 87,000 hp., is operated by half a dozen men. This means practical freedom from labor troubles."

Lynn Medical Director Indorses Anti-Tuberculosis Efforts.—The industrial importance of the war against tuberculosis was emphasized recently in a New England sanitarium campaign by Dr. F. E. Schubmehl, for the past six years medical director of the Lynn (Mass.) works of the General Electric Company. During this period from 14,000 to 16,000 persons were employed, and about every year 16,000 applicants for work received physical examinations. About 1 per cent were found to be tubercular to some degree. Some of the applicants were too ill to be employed, while others were hired and helped in working out their own cure. About forty employees have been sent to sanitariums at the company's expense. For some time the company has been keenly interested in combating this trouble, and it is considering plans for an institution for employees who are considered supicious cases. The importance of follow-up work and supervision among patients in whom the disease has been arrested or partially cured cannot be overemphasized, and the company is making every feasible effort to prevent the loss of employees through a relapse into unsatisfactory conditions of living and working.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Contract of Public Service Corporation.—A contract of a public service corporation that conflicts with public duties imposed upon it by law is not within the protection of the constitutional provision inhibiting impairment of the obligations of contracts, according to the Supreme Court of Appeals of West Virginia (9 S.E. 208).

State Regulation of Interstate Commerce.—When, in the absence of federal regulations, state supervision of matters that incidentally affect interstate or foreign commerce is permissible the state authority is dominant, but upon the assertion of paramount federal authority state regulations in the premises are thereby excluded, according to the Supreme Court of Florida (81 S. 498).

Temporary Injunction.—According to the Supreme Court of Minnesota, a municipal corporation is entitled to a temporary injunction restraining an electric light company operating under a contract fixing rates from refusing to furnish service at the contract rates when it is protected by a bond securing it against loss in case it is finally decided that it should have been permitted to put into effect increased service rates (172 N. W. 217).

Reasonable Rates.—According to the Supreme Court of Minnesota, it will be presumed that rates specified in a contract between a municipal corporation and the grantee of a franchise to operate an electric light plant are reasonable, and the electric light company has the burden of proving that they are so low that a refusal to sanction an increase would result in depriving it of its property without due process of law, even though the ordinance granting the franchise and the contract itself do not unqualifiedly prohibit the company from increasing its rates (172 N. W. 217).

State Regulation in Local Matters.—The Supreme Court of Appeals of West Virginia has held that as to those forms of interstate commerce which are of national importance and require a general system and uniformity of regulation the federal power is exclusive, and the state may not act, even if Congress has not exerted its paramount legislative authority as to them. But where the subject is of local rather than national importance, admitting of diversity of treatment according to the special requirements of local conditions, the state may exercise its regulatory authority within reasonable limits till Congress does act (99 S.E. 207).

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Men of the Industry

Changes in Personnel and Position—Biographical Notes

George B. Foster, who has been elected chairman of the Electric Vehicle Section of the National Electric Light Association, has been connected with the electrical industry for thirty-two years. In 1887 Mr. Foster entered the laboratory of the Chicago Edison Company. Between the time he left that company and 1908, when he joined the organization of the Commonwealth Edison Company, the successor of the Chicago Edison Company, he was engaged in several other branches of the industry. This experience included construction work with Leonard & Izard, supervision of electric lighting for the Chicago & Northwestern Railroad, direction of the arc lighting on grounds and buildings at the World's Columbian Exposition under Frederic Sargent and R. H. Pierce, Chicago district representation for the Wagner Electric & Manufacturing Company, the Bullock

GEORGE B. FOSTER

Electric Company and the Allis-Chalmers Company at Milwaukee, and manufacturers' agency at Chicago. When Mr. Foster opened an office to act as a manufacturers' agent he at the same time directed the operation of the Gunther Electric Company, which served a section of downtown Chicago. When the Gunther company was absorbed by the Commonwealth Edison Company, Mr. Foster became a member of the latter organization. He has now been eleven years in the employ of the Commonwealth Edison Company. His present position is that of assistant to Vice-president John F. Gilchrist, in charge of purchasing stores, transportation and statistical departments. During his work with the Commonwealth Edison Company his interest in the electric vehicle has done much to accelerate the growth of that business both locally and nationally. He has served three years as chairman of the Chicago Electric Vehicle Section of the National Electric Light Association and was for one year president of the Commonwealth Edison Section of the National Electric Light Association.

Philip H. Gadsden of Charleston, S. C., formerly president of the Charleston Consolidated Railway & Lighting Company and now vice-president of the United Gas Improvement Company of Philadelphia, has been elected a member of the executive committee of the Chamber of Commerce of the United States. Mr. Gadsden during the war was chairman of the American Electric Railway War Board and later chairman of its successor, the committee on national relations of the association, and also chairman of its committee on readjustment. His keen insight into public utility affairs and his unceasing efforts in presenting to government officials problems in financing and operating have won for him a prominent place as a public utility official.

H. H. Crowell, a vice-president of the Michigan Railway Company and the Consumers' Power Company, Jackson, Mich., who has represented the Commonwealth Power, Railway & Light Company interests for the last eight years, has been elected a vice-president of the Electric Bond & Share Company to fill the vacancy recently created by the death of George E. Claflin. Mr. Crowell has been identified with the electrical industry since 1889, when he entered the service of the Thomson-Houston Electric Company. Later he was New York State agent of the Thomson-Houston Motor Company and assistant New York State manager of the Thomson-Houston Electric Company until the organization of the General Electric Company, in 1893. He was manager of the Syracuse and Buffalo offices of the General Electric Company until 1906, when he became chief engineer of the Commission of Gas and Electricity of New York State, and later of the Public Service Commission, Second District. Since 1911 he has been with the Commonwealth Power Railway & Light Company properties in Michigan. He is a member of the National Committee on Public Utility Conditions, which has represented the public utilities in Washington during the war.

E. B. Katte, for many years chief engineer of electric traction of the New York Central Railroad, has been elected president of the New York Electrical Society. Mr. Katte is well known for the work he has done in connection with the electrification of the various lines of the New York Central in New York City and vicinity. This undertaking included the construction of two 20,000-kw. central power stations, nine substations, batteries and electric locomotives, car equipment and the third-rail and transmission systems required. He was born in St. Louis on Oct. 16, 1871, and in 1881 entered the Cutler School in New York City. Eight years later he went to Sibley College, Cornell University, and was graduated in 1893 with the degree of mechanical engineer. His thesis consisted of a commercial test of one of the first interurban electric railroads. After graduation Mr. Katte traveled through Switzerland and Germany, studying electro-hydraulic plants. He then returned to Cornell and took up special work in the design of vertical marine-type engines and in mechanical and electrical testing. Upon the completion of this course in 1894 he received the post-graduate degree of master of mechanical engineering. After a short term of service with Henry R. Worthington, he became assistant engineer in

E. B. KATTE

charge of the direction of the superstructure of the Park Avenue viaduct of the New York Central Railroad in New York City. In 1898 he was appointed mechanical engineer in the engineering department of the company. In addition to much general work for the company his duties as mechanical engineer embraced the design and installation of mechanical and electrical appliances for numerous coaling stations, water-supply stations, electric light and power plants for small passenger and freight stations, offices, yards, shops, transfer tables, cranes, drawbridges, etc. His appointment as chief engineer of electric traction dates from November, 1906. Mr. Katte served as vice-president of the Mechanical Society of Mechanical Engineers in 1913-1914. He is a fellow of the American Institute of Electrical Engineers and has served on the railroad committee of that body. He is a member of the American Electric Railway Association, the American Railway Engineering Association, the New York Railroad Club and the American Railway Association.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

WIRE AND CABLE SALES PICKING UP RAPIDLY

Indications Now Point to Full Capacity Production of Mills During the Coming Fall Months— Prices Advancing

Wire and cable manufacturers report a steady increase in orders booked. For a while incoming business was rather slow, particularly in the East. The Middle West and the South have been purchasing more steadily. Last week some very nice cable orders were placed in the East, and the manufacturers are of the opinion that better business is on the way.

Rubber-covered wire demand began to pick up perceptibly about five or six weeks ago and has gathered momentum ever since. Each time the price advanced the buying appeared to go ahead faster.

Steel-taped cable for street-lighting purposes is now moving faster. In fact, all kinds of cable are finding a better market to-day than they did a month ago.

Flexible armored conductor is in such demand that stocks are low almost everywhere. This condition has existed for some time.

With advancing copper prices and assurances of 10 to 15 per cent higher prices by the early fall the wire market should rapidly become better. In addition, construction work is getting larger every day.

There is every reason to believe that by September the copper wire mills of the country will again be running at full capacity.

RADIO VACUUM-TUBE LITIGATION IS SETTLED

Excellent Market for Thousands of Bulbs a Month in Prospect Now that the Three Rival Manufacturing Concerns Have Come to Arrangement

During the war litigation over rights for the manufacture and sale of vacuum-tube detectors for radio work was suspended by common consent, and tubes or "bulbs" for government use were made at various plants. As the situation stood at the close of hostilities an attractive market for bulbs was in prospect but patent rights prevented any one manufacturer from entering the field independently. The Marconi company held rights covering the use of a two-element bulb, Dr. De Forest's patents protected the use of the third element, and the Moorhead Laboratories in San Francisco had patented still other features also essential to the commercial production of the best tubes, among these being the use of a chemical process for exhausting air. During the war the Moorhead company had developed manufacturing facilities rapidly and bulbs were being turned out for the Allied governments at the rate of 30,000 per month.

Early in May representatives of the Marconi, De Forest and Moorhead companies held a conference in San Francisco and agreed that patent rights of all three should be extended to the Moorhead company, for which the latter should make payment to the other two on a royalty basis. In this connection it should be noted that this company is only permitted to make receiving and amplifying tubes, the Western Electric Company having the rights to manufacture the transmitting tubes. It was also agreed that the Marconi company would become the sole sales and distribution agent for the Moorhead output. The tube produced under this agreement is to be known as the Moorhead audion. Government contracts still operative will call for 15,000 bulbs per month, and within sixty days after the date of the contract the Marconi company, in the capacity of main distributing agent, is to receive bulbs at the rate of 50,000 per month.

THE ELECTRICAL BUSINESS OUTLOOK NOW MUCH BETTER

Indications During Past Month Are that Bottom in All Lines at Pittsfield General Electric Plant Has Been Reached

The Pittsfield (Mass.) Works of the General Electric Company, the largest industry in the city, are now employing between 5000 and 6000 hands, but not all on full time. Regarding present business conditions in the electrical industry and outlook, the general manager, C. C. Chesney, stated to a representative of the ELECTRICAL WORLD:

"Business as a whole in this plant has not shown any appreciable increase since the first of the year. Some lines have increased and others have decreased. During the past thirty days, however, there were indications that the bottom in all lines had been finally reached, and the outlook is now much better than it was three or four months ago. We are not contemplating entering upon any new manufacturing lines this year, but will confine our extensions to such lines as may be supplementary to the old ones, and in consequence we do not expect to build any additions to the plant this year as we have buildings sufficient now for a force of 8000 people. In the transformer department (transformers are our principal business) there has been increased activity during the past few weeks. The hot weather has also brought large sales of fan motors, and our sales in these this year will at least equal our last year's sales. By the beginning of next year I feel sure that the electrical industry in Pittsfield will be on its feet again."

LINE MATERIALS ARE TO GO TO HIGHER LEVELS

Advancing Prices of Copper and Lumber and Anticipated Strengthening of Steel Prices Make It Advisable to Place Orders Now

Prices of distribution and transmission-line material are lower at this writing than they probably will be at any time later in the year. Utilities that are contemplating the extension or rehabilitation of lines or the building of new ones would not be making a mistake if they placed their orders for the required material prior to July 1.

Wire is advancing steadily. At this writing weatherproof is on a 20-cent to 22-cent base and bare wire on a 19½-cent to 20-cent base. These prices are 2 cents to 3 cents higher than the prices of the spring.

Copper is being quoted at 17¾ cents for early delivery and more for August delivery. In fact, there is every indication now that copper will go as high as, if not higher than, 20 cents a pound during the early fall months.

Wire, in other words, can be expected during the next quarter to advance further from 10 to 15 per cent or even more.

Poles and cross-arms are due to advance from 10 to 15

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per cent by the first of July, and in some instances cedar poles are advancing this week.

Pole-line hardware is undoubtedly as low as it is going. As soon as steel begins to stiffen in price, and that will probably happen in the next thirty to fifty days, hardware will go higher.

Insulators show no tendency downward. In fact, it would not be surprising if, in view of possible higher transportation and labor charges, the price of insulators advanced before the fall months.

Guy lines, anchors and transmission towers will probably be guided largly by the price of steel. Inasmuch as steel is expected in some quarters to go slightly higher in July or early August, there seems to be no good reason for believing that these products will go lower.

Transformers, it is learned on good authority, will go no lower this year. In fact, it is not improbable that costs may mount so rapidly that higher charge must be made.

Lightning arrester prices appear to be very steady. Cement for tower and pole ground work is also very steady.

CONTROL OF THE RESALE PRICE BY MANUFACTURER

Supreme Court Rules in Colgate Case that Seller Has Right to Choose Customer, Thereby Protecting Rights as Trade-Mark Owner

Of particular interest to electrical manufacturers of trade-mark goods is the recent decision of the United States Supreme Court upholding the decision of the federal district court in the action of the Federal Trade Commission against Colgate & Company, in which it was declared that the soap company in refusing to sell its product to certain objectionable distributers had not broken any of the provisions of the Sherman anti-trust law.

Action was brought by the commission against the soap company on the ground of unfair trade practices because the soap company refused to sell to certain distributers who would not resell the company's product at the price set by the company. The soap company took the stand that it had a right as a seller to choose its own customers and in so doing was merely protecting its own rights as an owner of a trade-marked article.

This decision, while at variance with some earlier decisions interpreting the anti-trust laws, will, it is understood, act as a most weighty precedent in future cases.

RELIABILITY IMPORTANT FACTOR IN BUILDING UP LAMP TRADE

Outline of Causes of Early Burn-outs Prepared by Leading Lamp Maker for Benefit of Factory Personnel

In the manufacture of incandescent lamps to meet modern specifications extraordinary care must be taken to avoid defective work and to maintain a high average of quality over a long period of production. It is remarkable how much abuse lamps will stand when properly made, and progressive manufacturers are constantly studying the processes of production to strengthen weak spots in their work and thus add to the good will which is so important a factor in their success. Responsibility for failures in service or for short life under normal operating conditions is easily brought home to the manufacturer, and the enormous number of units which he supplies to his trade in comparison with the number of units of large equipment marketed, combined with the delicate character of the operations and material involved in lamp making, justify extreme care in the factory.

An outline of some of the causes of early burn-outs recently prepared by a leading lamp maker for the benefit of his factory personnel suggests the importance set upon reliability as a factor in trade expansion. It would be difficult to cite another branch of the electrical industry where the quality of the product depends more upon the coöperation of the entire manufacturing organization. A few early burn-outs pull down the average life of the product; but, worse than this, they create an impression in the mind of the buyer out of all proportion to the loss of service resulting. Some of the practices avoided in high-quality production are as follows: Use of wrong size or cut of wire in mounting, error in marking stems, mixing lamps in process, mislabeling and oversight in inspection, improper amount of spraying in mounting, use of too small tubulating contractions, improper heating before exhausting bulbs, defective exhaust equipment, careless flashing and testing, poor sealing-in, careless tip-making and chipping of tips. and the premature removal of lamps from flashing machines. Adherence to good practice results in a product which will meet severe service tests, lighten the labors of the sales organization and establish a basis for trade expansion.

THE ITALIAN ELECTRICAL MARKET IS INCREASING

Local Production Not on Scale Large Enough to Take Care of Rapidly Growing Demand in the Kingdom

Owing to the lack of coal, Italy is preparing plans to utilize, as far as possible, the hydroelectric energy of the country. Several important plants are now in the course of construction, and it is estimated that in the near future these, together with the plants already in operation, will use up more than 1,000,000 hp. of the 3,000,000 hp. to 4,000,000 hp. remaining.

While there are in Italy some large manufacturers of electrical machinery, equipment and supplies—and a fair number of smaller manufacturers—still Italian production is not on a scale large enough to take care of the ever-increasing demand; furthermore, many types of electrical machinery are either not manufactured at all or their manufacture has just started. Before the war much of this equipment was made in Italy. Some of it came from Germany, and a small portion was purchased through the Italian agents of American companies.

American exporters, according to a statement put out by the Italian Discount & Trust Company, New York City, may be interested in knowing that the following products are not manufactured in Italy and that therefore a market in that country exists for them: Single-phase motors or three-phase motors with collectors, induction motors with auto-exciters, phase converters contained in a single machine, synchroscopes, phasometers and indicators. In the matter of electrical equipment for ship propulsion there exists an excellent market at this time, due to the activity of Italy's shipbuilding plants. Credit terms, quick shipments, and quality of the Italian standard are the main factors in this trade.

TO INCREASE POPULARITY OF ELECTRIC FLASHLAMP

Manufacturers Realize that More Work Must Be Done with the Dealer to Help Him to Sell This Product Better

Manufacturers of flashlight batteries are coming more and more to realize that the average person does not know fully the utility of the flashlight and that too many dealers are not able to educate the public in its use. Besides this, the confidence of the public must be obtained in a greater degree that prevails at present, and this confidence will be more largely enjoyed when the public knows for what purposes the flashlight can be used and how to use and not to use it.

The manufacturers propose to assist the dealers in every way possible to show the purchaser how to use the light and how it may be misused. For every flashlight sold there

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is a potential market for a certain number of batteries a year, and after all it is the sale of battery refills that is the big market. Consequently users of flashlights must not be allowed to become dissatisfied.

Just as an example, flashlamps too frequently are carried about on the person or in a bag or trunk, or put away in such a way that contact is made and the battery discharged. When the owner goes to use the lamp he is disgusted to find it dead, and the case and lamp are relegated to the junk drawer, with much of the previous confidence in flashlights gone.

To prevent such occurrences and to increase the new uses of flashlights manufacturers feel it is necessary to impart some information to the many classes of dealers. This will probably be in the form of printed circulars inserted in packages of batteries as they are sent out. It would be practically impossible, it seems, to get in touch personally with sellers of lamps because of the diversity of retail distribution.

METAL MARKET SITUATION

Copper Market Rules Strong at 17.75 Cents—Tin Outlook Regarded as Satisfactory

Copper continues upward, although not in so big a step as last week. The general quotation for June and July is 17.75 cents and for August 18 cents. There is some hesitation about setting a price for September. Some smaller interests, however, are shading their prices about ⅛ cent. An authority in the copper world sets 20 cents as the price in the early fall.

The heavy buying has eased off a bit, but there has been no decline in price to tempt it back. Present requirements again seem to be met. Judging from recent past performances, buying will probably be light for a short time until manufacturers' stocks begin to drop a bit. Prices may recede a fraction, then, as restocking becomes necessary, buying will increase and prices jump up to a new level just above the present level.

Purchasing of copper is a little better than production at this time, and production is about the same as before the war and 60 to 80 per cent of November production. May sales approximate 200,000,000 lb., an extremely encouraging come-back.

The War Trade Board announces that applications will now be considered for licenses to import pig tin and tin alloys on condition that shipments will not be made from point of origin until June 30, and that these imports will not be permitted to enter till Aug. 1. Last week's sales of tin, it is stated, were nearly 500 tons, so that there are less than 600 tons of allocated tin left for disposal before restrictions on sales will be lifted. The zinc market is quiet.

NEW YORK METAL MARKET PRICES

	June 12	June 19
Copper:	£ s d	£ s d
London, standard spot	79 10 0	82 5 0
	Cents per Pound	Cents per Pound
Prime Lake	17.75	18.00
Electrolytic	17.62½	17.75
Casting	17 25	17 37½
Wire base	19.50 to 20.00	20.00 to 20.50
Lead, trust price	5.40	5.40
Antimony	8.37½	8.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.97½	6.90
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.50 to 15.00	15.00 to 15.50
Brass, heavy	8.00 to 8.75	8.50 to 9.25
Brass, light	7.25 to 7.75	7.50 to 8.00
Lead, heavy	4.60 to 4.65	4.75 to 4.87½
Zinc, old scrap	4.50 to 4.75	4.75 to 5.00

THE WEEK
IN TRADE

AN INCREASING volume of business is reported from almost every section of the country. The Northwest, owing to the condition in the shipyards, is showing the least improvement.

For one reason and another wire sales are getting better rapidly. Appliance business shows no tendency to fall off except for fans. This was to be expected at the close of the hot spell.

Labor is somewhat unsteady this week, and unless the prices of foodstuffs show a more marked tendency downward higher wages may be demanded before the summer is over.

Few new credits are being placed at this time and collections keep up in good shape.

New construction is going ahead, and at the present rate the work under way in September should be enormous. Investment building is now coming in.

All prices, while steady, show a tendency upward rather than downward. Wire continues to advance.

NEW YORK

The month of June seems to be holding up well in sales of jobbers' materials. The quiet, steady growth in the business is satisfactory and shows the stability of the market. Prices show practically no fluctuations, and evidences of price cutting to stimulate trade are rare. Copper wire prices are tending upward, and so are lumber products. Otherwise general steadiness prevails.

Large contracting jobs are few and far between owing to lack of large residence, industrial, hotel and apartment-house building. But there is a large volume of small-residence building and small remodeling jobs, both residential and commercial. A large hotel is projected for Park Avenue, New York City, and another factory for Long Island City.

Collections are holding up in good shape and new extensions of credit are rarely sought.

INSULATORS.—Inquiries on high-tension insulators seem to be opening up in better volume, although little increase in ordering has been noticed. Manufacturers' agents report no change in price.

SCHEDULE MATERIAL.—Jobbers report orders running in better volume in this district. Open-wiring porcelain has little call in and around New York, but in regions a considerable distance from the large cities some jobbers have reported better sales. Porcelain prices are unchanged. Flexible non-metallic conduit is having little sale at present locally.

FLATIRONS.—Electric flatirons are enjoying just a fair summer sale. Where central-station campaigns are under way satisfactory results appear. One large department store in New York City is advertising a prominent make of electric iron complete for $2.50.

TRANSMISSION-LINE MATERIAL. — Orders for wooden poles are reported in better volume. Pick-ups from stocks at local points are satisfactory. Chestnut is having a better call. Buying of cross-arms continues in good shape. Stocks are reported in satisfactory condition to make quick shipments. The accompanying line material and hardware orders are growing larger in volume. With the announcement of an advance in lumber prices of 10 to 15 per cent to be effective July 1, prices on poles, cross-arms and wooden pins will be advanced, probably that amount, according to a prominent distributer. Another distributer it was learned on Tuesday, anticipated a sub-

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stantial increase in Northern and Western cedar poles on Thursday or Friday of this week.

WIRELESS.—There is an increasing interest found in wireless work, particularly radio-telegraphy. Inquiries are coming for export.

WELDERS.—There has been a better buying movement in spot and butt welders in the last two weeks. The lighter volume of metal-working business in this district, however, does not bring as large a sale as will be found in the Middle West. The smaller sizes from 30-gage to ⅛-in. sheets seem to have considerable call for spot work, while butt work runs in sizes up to ½-in. and ¾-in. sheets.

FANS.—The cool weather of last week put a damper on fan sales, and up to early this week there has not been sufficient hot weather to cause another heavy buying spurt. Jobbers and dealers as a whole are in good shape to take care of another jump in sales, although some sizes, notably 16-in. oscillating direct-current fans, are low in stock with some concerns. Factories are replenishing jobbers' stocks in good shape. One large department store in New York City advertises certain 6-in. and 8-in. fans at about $1 less than regular price.

WIRE.—Rubber-covered base is quoted at 22 cents this week by seven manufacturers, at 20 cents by two, 25 cents by one, and one manufacturer quotes on cost.

CHICAGO

The popular expectation of lower commodity prices is at last being succeeded by the belief that a new level of value has been established, considerably higher than in pre-war times. Some commodities have declined toward this new level, and others have advanced by way of adjustment. Building materials are among those which show a tendency to advance. The building movement is gaining momentum after the prolonged wait on the part of builders for a lower range of costs which has failed to materialize. The construction of a two-million-dollar hotel near the Chicago Beach Hotel has been decided upon. This brings the hotels which have been projected during the past three or four months in this city up to a total of about $15,000,000.

Jobbers are experiencing an increased business due to the growing activity in buildings. The government business of last year in fans seems to be going into industries this year to increase the comfort of the workers. Sixteen-inch oscillators are being extensively used for this purpose. Utilities in Illinois, Indiana, Michigan and Iowa are building new lines.

WIRE.—The base on weatherproof wire is from 20 to 22 cents. Considerable quantities of No. 6 and No. 8 and some No. 4 are being sold for transmission-line work. The base on rubber-covered is from 19 cents to 23 cents. The demand is good, principally in house-wiring sizes. The price tendency is upward, but copper prices have changed so rapidly that the selling price depends largely on the price at which the jobber's stock was bought.

CONDUIT.—Conduit is in good demand with no change in price.

POLES.—The price of Northern white-cedar poles is expected to advance 10 to 15 per cent on July 1.

TIME SWITCHES.—One manufacturer's stock is almost depleted, and he is unable to get clock movements for ninety days.

CROSS-ARMS.—The increase in price of lumber is expected to cause an increase of 10 to 15 per cent in cross-arms by the first of next month.

CONTROLLERS.—One manufacturer reports a growing demand for equipment to control and regulate building equipment, such as fans, pumps, elevators, etc. Deliveries are being made in from two to three weeks.

FIXTURES.—There is a good demand for fixtures and reflectors for store illumination. Many of these are going into converted saloons.

REFRIGERATING MACHINES.—Manufacturers cannot supply the demand for electric domestic refrigerating machines.

CHURNS.—This is a new device on the market. One company is turning out seventy-five per week.

LINE HARDWARE.—The demand is strong and the price is firm.

FRACTIONAL-HORSEPOWER MOTORS.—The demand for repulsion motors is increasing more rapidly than the demand for slip-phase motors. Buyers are placing orders for their requirements up to a year ahead and having the motors shipped according to schedule in order to insure delivery. The business attracted a new manufacturer to the field.

FANS.—The demand for the smaller fans which was expected by many because of high prices has not materialized. There has been comparatively small call for sizes below 12 in. There has been an exceptionally large demand for 16-in. fans, especially oscillators. Ceiling fans are also selling well. One jobber reports having sold twice as many this year to date as were sold during the same period in 1918.

BOSTON

Trade is fairly good, considering the small amount of industrial construction under way for new developments. In some jobbing houses the sales are as good as or better than in May to the corresponding date, both in revenue and volume of commodities handled. New building work is gradually coming into its own. In Boston some large office building construction is well started, at Worcester comprehensive housing plans, starting with the immediate building of 100 three-family homes, are being tried out and the contractors are very busy in house-wiring work; in the Connecticut valley conditions continue excellent. Collections are good and deliveries satisfactory in most lines except armored flexible conduit. Wire stiffened about a cent in price last week, but other prices remain about the same. Seasonal appliances are moving well. There is a feeling that if the government establishes and maintains a constructive policy in dealing with business interests a long period of prosperity will be enjoyed. Labor exhibits much unrest, but the amount of non-employment is decreasing, especially in Connecticut, and on the whole New England is meeting the problems of readjustment well.

WIRE.—Weatherproof wire is steady at 22 cents base and bare wire has moved up a cent to 20 cents. A fair demand is noted, but in most cases it is not difficult to fill orders promptly. Flexible armored conductor is still far below normal in supply.

MOTORS.—The demand is confined chiefly to motors of 10 hp. and under. Manufacturers are stocking up so fast now that little trouble is experienced on deliveries. The total motor sales are naturally running considerably below those of last year, but in some cases half to two-thirds the turnover is being handled, which is good considering present conditions. Business is spotty and scattered very unevenly among motor sales organizations. Recently second-hand motor dealers have begun to buy new motors. So far the motor installations in former munitions plants have been closely held in place. After peace is signed some motors may be released, but no immediate prospect of price tobogganing can be seen.

FIXTURES.—The demand from residences and banking establishments is the feature of this business at this time. Some manufacturers are unable to fill orders at the desired rate, stocks having been left unreplenished during the war period. The larger houses distributing in New England are fairly well stocked. Prices are steady.

ELECTRIC TABLEWARE.—A short-lived gas company strike at Worcester last week threw the local appliance market into a ferment. Local dealers and jobbers were practically cleaned out of grills, hot plates and irons in a few hours. Had the strike lasted another day the demand upon Boston jobbers would have increased heavily; as it was, a lot of material was rushed to Worcester by twentieth-

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century Paul Reveres, who made the most of their unusal opportunity.

STORAGE BATTERIES.—Automobile battery stocks are hard to maintain in face of the present demands. Trade is brisk in batteries for lighter service, such as telephone and signaling work. A big business in railroad-car lighting batteries is due soon, for little money has been spent in this way since the United States entered the war. Prices hold firm.

IRONS.—Sales are being well maintained, and the pushing of irons of lighter size for vacation use is coming to the front. In the Worcester gas strike last week many large electric irons were sold to accommodate tailors whose gas outfits were piped to temporarily dead mains.

VACUUM CLEANERS.—The market continues good, and the demand shows little sign of slacking off. Central Maine is absorbing this equipment at a striking rate this summer, but other parts of New England are buying their share too.

WASHERS.—A standing paragraph might be run as to the continuous heavy demand in all parts of New England. Deliveries are still pretty well kept up. Price seems to have little relation to the customer's desire to own apparatus of this class.

RADIO-TELEGRAPH APPARATUS.—Renewed interest in radio equipment is noted as a result of the relaxation of regulations relative to the erection of receiving stations.

ELECTRIC PASSENGER CARS.—The demand for some cars cannot be supplied at present. A steady growth of business is rewarding persistent workers in the sales field.

FANS.—A brisk demand continues for all standard types and sizes. Jobbers' stocks are being refilled.

ELECTRIC COAL LOADERS.—Stocks have been practically sold out in a representative manufacturing plant. Inquiries and orders are very brisk, with firm prices.

SEATTLE—PORTLAND

The volume of jobbers' business over the past two or three weeks shows little if any improvement. Sales are still light. Large purchasers of electrical equipment are persisting in hand-to-mouth buying. Prospective purchasers of electrical machinery which is to be used in electrifying plants and in making additions and betterments to existing plants are holding off until conditions settle down. Inquiries regarding equipment totaling in the aggregate thousands of dollars continue to come in, but orders are not following.

In Seattle last week, as far as can be learned, no large sales of consequence were made. However, the past month's volume was maintained. Seattle jobbers, as a whole, continue to predict heavy sales volume for the summer, stating indications were never brighter. Seattle retailers, on the other hand, report business during week showed a noticeable increase over last week, this being true particularly of dealers who are pushing sales of domestic appliances of all kinds.

The help problem in Seattle is hopeless. Unheard-of wages are offered, but still help cannot be obtained. With the exception of wire, which recently increased in price, prices remain comparatively firm. All stocks, generally speaking, are in good shape. Collections are good. No new credits are being placed.

The Portland territory reports an active trade in both jobbing and retail lines, with both jobbers and retailers looking forward to an unusually active summer season. Apparently, from reports, Portland men of the trade are not wasting time with gloomy predictions, nor are they waiting for a boom. The annual Rose Festival with its usual host of visitors from all over the Pacific slope, just concluded, did much to boost retail electrical sales during the past week. Jobbers report an exceptionally active market for washing machines and other household appliances, this being occasioned undoubtedly by the domestic employment situation, which is pressing, and to the unusually large number of June weddings. Collections are good and stocks in all lines are in good shape. There is a marked upward tendency in the price of wire, all kinds and sizes. Prices of other electrical appliances, including machinery and accessories, show but little variation. Manufacturers report that the sale of government motors at Vancouver, Wash., by the spruce production division recently has very materially affected the motor market in the Portland district. Many of these motors are new, having never been uncrated. Great activity continues in the construction of small business buildings, including public garages. Residence construction also continues unabated. Retail electrical trade has been exceptionally active during the past three weeks. May, 1919, exceeded the same month last year by a considerable margin, and June to date shows still further increases.

The Spokane district reports wholesale trade as very good and retail sales volumes as excellent. In the latter heaviest movement appears to be in washing machines and electric irons. Fan sales in Spokane increased noticeably last week. Collections are in good condition. There is considerable residence building, but big business construction is holding back. The labor situation in the Inland Empire is good and wages are from 65 to 70 per cent higher than before the war.

The return of the two-hundred-million-dollar French government order for steel ships to the Northwest is believed to be a certainty. The Foundation Company, operating plants in Portland and Tacoma, has an order from the French government for 104 steel ships. The beginning of construction awaits authorization from the Shipping Board, it is stated.

SAN FRANCISCO

Building permits for May, 1919, figured as follows: Los Angeles, $2,000,000; San Francisco, $1,250,000; Oakland, $550,000. This is a big increase in the aggregate over private building figures for several years past. Labor conditions are tightening again, with telephone operators' and wiremen's strikes scheduled. On the other hand, the telegraph strike seems fruitless, and the proposed Mooney sympathetic strike is condemned by conservative labor leaders as a Bolshevik movement.

The past week has witnessed a decisive drop in prices both for roughing-in and finishing material. Wire, however, remained steady. After several years special prices for some wiring staples in large quantities have been reinstated. It is too early, however, to state their effect.

CONDUIT AND FITTINGS.—Pacific Coast stocks of conduit are good and could be bettered were there the demand. Prices for all sizes and quantities have decreased 10 per cent. Special prices on boxes and covers in 1000-piece lots in full standard packages have been instituted, marking a 15 per cent decrease over former package prices, and lock nuts and bushings in 5000 lots of assorted packages made a 20 per cent drop. Flexible conduit has dropped 10 per cent, with a further decrease of 15 per cent in 5000-ft. lots. The demand on all these staples is far less than that of last year because of the absence of large special orders, but the orders are better distributed.

SCHEDULE MATERIAL.—Important changes have occurred in schedule price. Special quantity prices, such as those for push switches in 500 lots, standard sockets in 1000 lots, plug cut-outs and panel switches in 500 lots, are being quoted to stimulate business and decrease the present hand-to-mouth system of buying as well as to enable dealers to prepare for the expected fall business. All these prices give an extra profit of 15 per cent, but full standard packages must make up the quantities. Fuse plugs, too, carry an extra 10 per cent in 5000 assorted lots; in fact, prices and order quantities seem to be resuming their pre-war status.

RANGES.—Several San Francisco power companies are staging determined campaigns to increase their range load. A 3-cent rate in the Bay sector and a 4-cent sliding scale in the outer districts, coupled with credit and installation inducements, are proving popular factors. These efforts are not spectacular but steady and conservative and planned with the district dealers and contractors.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

Armored Conductor, Flexible Steel

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315 00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft.	List to 25%

Twin-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	5%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Twin-Conductor

No. 14 Solid	
Less than coil	$100.00
Coil to 1000 ft	82.50
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Attachment Plugs

List ranges from $0 22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 20%
Std. pkg	23% to 36%

Batteries, Dry

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— 37
Barrel lots	.32— .329	.33— .339

Batteries, Dry—*Continued*

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

Conduit, Metallic Flexible

Size, In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
3/8	250	7.50
1/2	100	10.00
3/4	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

Conduit, Non-Metallic Flexible

Size, In.	List per Foot	Size, In.	List per Foot
7/32	$0.05 1/2	1	$0.25
1/4	.06	1 1/4	.33
5/16	.09	1 1/2	.40
3/8	.12	1 3/4	.47
1/2	.15	2	.55
3/4	.18	2 1/4	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00	$20.75	$21.50
1/4-in.—	30 00	21 50	20 50

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
7/32-in.—	$33 00	$17 50	$16 25
1/4-in.	36 00	19 00	17 25

Conduit, Couplings and Elbows, Rigid Iron

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08 1/2
3/8	.08 1/2
1/2	.08 1/2
3/4	.11 1/2
1	.17
1 1/4	.23
1 1/2	.27 1/2
2	.37 1/2
2 1/2	.58 1/2
3	.76 1/2

Conduit, Couplings and Elbows, Rigid Iron—*Continued*

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 to 1/2 In.	3/4 to 3 In.
Less than 2500 lb.	+3% to 6.1%	2% to 8.1%
2500 to 5000 lb.	+1% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

Flatirons

NEW YORK

List price	$6 50 to $7.50
Discount	25%

CHICAGO

List price	$6.50 to $7.50
Discount	25% to 30%

Fuses, Inclosed

250-Volt	Std. Pkg.	List
3-amp. to 30-amp	100	$0.25
35-amp. to 60-amp	100	.35
65-amp. to 100-amp	50	.90
110-amp. to 200-amp	25	2.00
225-amp. to 400-amp	25	3.60
450-amp. to 600-amp	10	5.50
600-Volt		
3-amp. to 30-amp	100	$0.40
35-amp. to 60-amp	100	.60
65-amp. to 100-amp	50	1.50
110-amp. to 200-amp	25	2.50
225-amp. to 400-amp	25	5.50
450-amp. to 600-amp	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

Fuse Plugs

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8 75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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Lamps, Mazda or Tungsten

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

Lamp Cord

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$26.47–$35.01
Coil to 1000 ft	23.82– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00
Coil to 1000 ft	21.00

Lamp Guards, Wire

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

Outlet Boxes

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	33%–40%	24%–32%
$10.00 to $50.00 list	45%–50%	32%–43%

Pipe Fittings

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

Porcelain Cleats—Unglazed

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$15.00 to $22.40
1/5 to std. pkg.	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$17.85–$24.15
1/5 to std. pkg.	14.70– 21.00

Standard pkg., 2200. List per 1000, $20.00 to 21.00

Porcelain Knobs

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg.	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid Nail-it—N.C.	Std. Pkg. 4000 N.C.
Less than 1/5 std. pkg.	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg.	11.20– 16.00	22.40– 32.00

Sockets and Receptacles

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20 to list
1/5 std. pkg.	List to 10%

Switches, Knife

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

Switches, Snap and Flush

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

Switches, Snap and Flush—*Continued*

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	23%

Switch Boxes, Sectional Conduit

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 33%	24% to 25%
$2.00 to $10.00 list	30% to 33%	24% to 25%
$10.00 to $50.00 list	30% to 45%	25% to 36%

Toasters, Upright

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	25% to 30%

Wire, Annunciator

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.42
No. 18, full spools	.35– .40

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.46 to $0.56
No. 18, full spools	.41 to .51

Wire, Rubber-Covered, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	18.90	18.90	14.18
10	25.50	25.50	17.00
8	34.94	29.10	23.28
6	55.38	46.15	36.92

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.50	$10.00–$11.00	$9.50–$10.00
12	22.05	22.05	18.90
10	29.68	29.08	25.44
8	40.39	34.62	24.62
6	63.84	54.72	54.72

Wire, Weatherproof

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Ine.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$27.00–$29.25
25 to 50 lb	27.00– 25.25
50 to 100 lb	26.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$25.75 to $26.50
25 to 50 lb	25.75 to 26.50
50 to 100 lb	25.75 to 26.50

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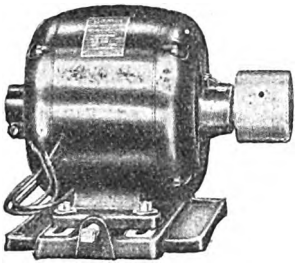
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Interchangeable-Type Electric Motors

Physically interchangeable motors—that is, motors having their important dimensions the same—are especially advantageous to the manufacturer of

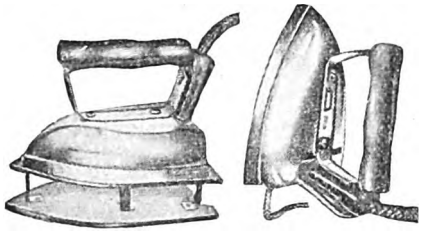


INTERCHANGEABLE-TYPE 2-HP. THREE-PHASE MOTOR

motor-equipped machines who may furnish equipment for use on various kinds of circuits. The Emerson Electric Manufacturing Company, 2024 Washington Avenue, St. Louis, Mo., is marketing a line of motors, including stock types of single-phase, multiphase and direct-current motors of corresponding rating operating at identical speeds. They range in size from 1/30 hp. to 2 hp.

Flatiron with a Cement-Embedded Heating Element

Among the features of the "Guaranteed" electric iron pointed out by Manning, Bowman & Company, Meriden, Conn., who now manufacture it, are the blue steel sole plate highly finished in nickel plate to make it glide smoothly, the cord protected against wear by a coiled guard, the contact plug held securely by a locking device



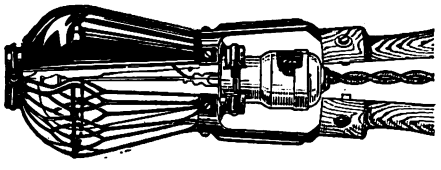
FURNISHED WITH EITHER REVERSIBLE OR HEEL STAND

which insures perfect electrical connection, and the solid-steel heating core which prevents cooling in heavy work.

The heating element used in the iron is made of Nichrome wire embedded in cement, making the unit practically indestructible. To prevent heat from traveling up the upper part of the iron and to drive it downward, where it is needed, an asbestos pad is inserted between the bottom of the pressure plate and the top of the heating unit. There are also asbestos washers between the bottom of the handle strap and the top cover stamping to prevent heat conduction into the handle. The wooden handle of the iron is strongly constructed, having a bolt through its entire length. Two types of stands may be had—a reversible style or a heel stand. Each iron is furnished with 6½ ft. (2 m.) of cord and lamp socket connections.

Split-Handle Portable Reflector Lamp Guard

With the "Flexco" split-handle portable reflector lamp guard, which is now marketed by the Flexible Steel Lacing Company of Chicago, rays of light can be reflected away from the eyes of the user and concentrated on the work. In



OPENS IN HALF TO RECEIVE EXTENSION OR DROP CORD, SOCKET AND BULB

shops, garages, plants and in other places where ordinary fixture lighting is insufficient, such as engine pits and under machines, this reflector lamp guard may be used safely and conveniently.

Unlike the ordinary type of guard this split-handle type does not have to be wired. It opens in half to receive the lamp bulb, socket and cord without rewiring. The guard proper, made of expanded steel, coated with tin, clamps over the bulb, while the cord runs through a groove in the split handle, the latter being adjustable by means of screws.

Aluminum Vacuum Cleaner with Adjustable Nozzle

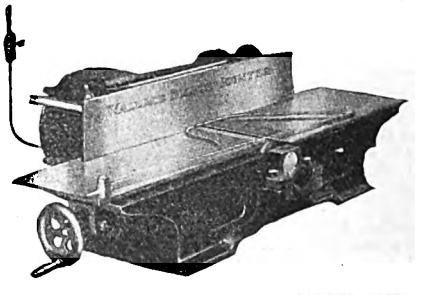
An electrically operated vacuum cleaner having a cast-aluminum body and a high-speed General Electric air-cooled universal-type motor has been announced by the Hotpoint division of the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, and is known as "Hotpoint" model V2.

A stationary-type, adjustable-bristle brush is employed and is said to brush the dirt out of the carpets without injuring them. A powerful suction is created by the motor, which has a removable dome. The 13½-in. (34-cm.) nozzle of the cleaner is adjustable, the height being changed for various lengths of nap by a conveniently placed thumb screw. The dust bag is lined and, while it has tight connections, is easily removed for emptying. A light hard-wood handle is furnished and is fitted with a pistol-grip control. When not in use it remains in the vertical position. Rubber-tired wheels insure smooth and quiet running. Eight easily connected attachments for cleaning draperies, furniture and so forth are supplied with the machine, which has standard separable plug motor connections and 20 ft. (6 m.) of cord.

Electrically Operated Portable Wood Jointer

In order to save the time usually spent by workmen in woodworking shops walking back and forth from their benches carrying small work to the large stationary jointer the J. D. Wallace Company, Station C, Chicago, has developed a portable bench-type electrically operated 6-in. (15-cm.) jointer. By its use the workman is enabled to do the bulk of his small planing without moving from his bench, thus saving considerable time and releasing the large stationary jointer for major operations.

An especially interesting feature of the machine is the fence which is mounted on the motor and slides backward or forward on rods, rendering



SIDE VIEW OF ADJUSTABLE FRONT AND REAR TABLES AND SAFETY GUARDS

it quickly and accurately adjustable. Another point of interest is the manner in which the motor, which is operated from an ordinary light socket, is applied. The cutter head can be easily taken out and other heads inserted in only a few seconds. Tables are ar-

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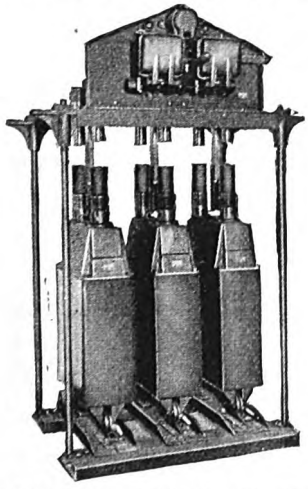
ranged to slide backward to permit the use of these special heads, or forward so as to work with the narrowest possible throat opening, a feature that will prove especially desirable when the machine is doing small or very close work.

Removable-Unit Oil Switches and Circuit Breakers

Switching equipment capable not only of interrupting large quantities of energy but also able to withstand the thermal effect and mechanical strains incident to such current rushes is necessitated by the increase in capacity of generating and transforming apparatus, the interconnection of feeders and the interlinking of distribution systems. The Condit Electrical Manufacturing Company of South Boston, Mass., has lately brought out type F-6 oil switches and circuit breakers, three-pole type, cell mounting, in 500-amp. and 800-amp. capacities, where the pressure is not in excess of 15,000 volts. They may be arranged for either hand remote control or electrical operation.

The removable-unit constructional feature of these oil circuit breakers renders possible quick replacement, repair or inspection. The operating mechanism is entirely inclosed in the expansion chamber, which is fastened to a steel tank supported on a three-point truck to facilitate handling. The electrically operated mechanism, of simple and compact design, is mounted above the switch units. The conductors may be brought to the circuit breaker through the top or the rear of the cell.

Other features of these oil switches and circuit breakers are the laminated brush, reversible and easily replaceable arcing tips, self-aligning, sure-seating action between the movable contact members and the stationary contact



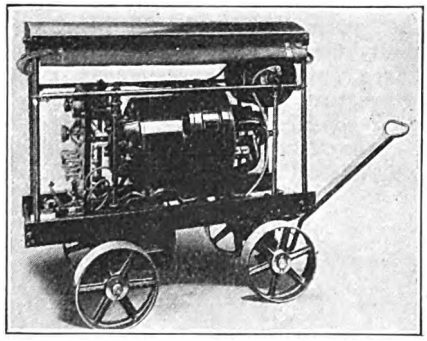
EASY INSPECTION, REPAIR AND REPLACEMENT MADE POSSIBLE

members, the rugged tank-per-pole construction, high head of oil over break, arge expansion chamber, and the strong spring action of the brushes, which facilitates rapid acceleration of the movable ccntacts upon the initial opening of the circuit.

Arc Welders for Portable and Stationary Use

A line of electric arc-welding machinery has been developed by the U. S. Light & Heat Corporation of Niagara Falls, N. Y. For shops where it is practicable to bring the parts to be welded near to the welding apparatus a stationary type is provided; otherwise a light-weight portable truck-mounted machine can be used.

With rated capacity of 4 kw. these arc welders give 200 amp. direct current or less, with an arc voltage of 17 volts to 22 volts and open-circuit voltage of 35 volts to 65 volts. They are made in the form of a converter for use on 100-volt to 125-volt circuits only and in the form of a motor-generator for all other alternating-current and direct-current circuits. Weighing 665 lb. (301 kg.) the converter delivers



TRUCK AND EQUIPMENT CAN BE EASILY PULLED AROUND THE SHOP

current at the arc through the arc-stabilizing reactor with an efficiency of 65 to 70 per cent, it is said.

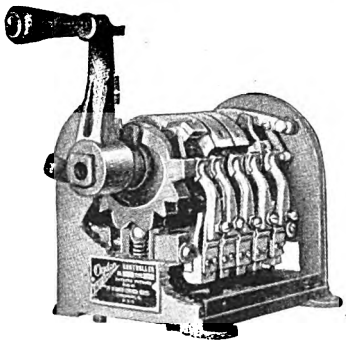
The motor-generator type consists of a 7½-hp. alternating-current or direct-current motor on the same shaft with a 4-kw. "USL" welding generator. Inherently regulated, compound-wound, self-excited and with drooping voltage characteristic, it is claimed that the generator, as well as the converter, produces an arc peculiarly suited to arc welding.

Controller for Storage-Battery Industrial Trucks

Designed for use on storage-battery industrial trucks and tractors, the "Ogden" type NS automatic controller with self-contained safety switch, made by the Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, is said to be particularly suited for this low-voltage, heavy-current work because of its indestructible metallic drum, which provides an excess of current-carrying capacity. The controller drum moves from speed to speed in a quick and positive manner, assuming a definite position each time.

The heavy, renewable copper segments and oversize fingers reduce burning to a minimum, and the voltage drop is practically nil, permitting the use of a minimum of battery cells. As the segments are mounted on a metal base, they may be replaced indefinitely without causing any injury to the drum proper.

The quick-break safety switch is self-contained within the controller housing and mechanically connected to the



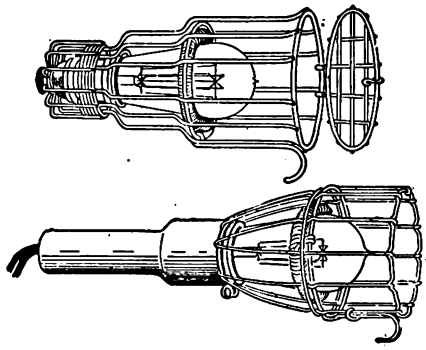
PHANTOM VIEW, SHOWING QUICK-MOVEMENT, POSITIVE-STOP MECHANISM

motor brake so that when the brake is applied the switch opens instantly, disconnecting the motor. Being mechanically interlocked with the main drum, the switch cannot again be reclosed and the truck started until the controller handle has been brought to neutral position.

Portable Lamp Guards with Safety Cushion Ring

The portable hand-lamp guards manufactured by Frank W. Morse, 289 Congress Street, Boston, have been improved by the addition of a cushion ring which keeps the lamp bulb in the center and prevents it from touching the outside guard. The bulb is therefore prevented from breaking at the neck should the guard be dropped on the floor or struck.

These guards, which have an electroplated finish and are thus not likely to rust, are made in a number of styles and sizes. The "Heavy" guard can be placed on end and has a hook which allows it to be hung perpendicularly. The



NO HANDLE WITH TOP STYLE; LOWER GUARD CAN BE STOOD ON END

"Ryerson," in addition to these features, protects a weatherproof socket as well as the bulb and requires no wooden handle. The "Handy" is stronger than the first guard and the "Eureka" has an extra strengthening ring and an opening for a key socket.

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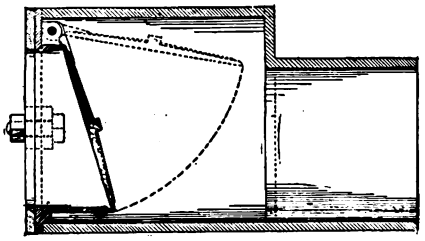
Back-Pressure Valve for Manholes

For preventing sewer water from backing up into manholes and flooding the underground conduit system the "Maco" back-pressure valve is being



STOPS SEWER WATER FROM BACKING INTO MANHOLES AND FLOODING CONDUIT

marketed by W. F. Cummings, Inc., 330 South Paulina Street, Chicago. Manholes are kept free from water and dirt to the height at which the valve is placed in the wall. The depth of the sewer regulates the height in the wall where the valve must be installed. It is, of course, placed as near the floor as possible. The valve is simply constructed, and should the sewer tile become clogged the valve grate may be readily removed.

Circuit Breaker with 635,000 Kva. Rupturing Capacity

One feature of the 15,000-volt type CO-2 oil circuit breakers which the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has recently developed is that they have a rupturing capacity of 635,000 arc kva. at 12,000 volts and are capable of opening such a short circuit twice in succession at least two minutes apart and still be immediately reoperative for non-automatic service without any necessity for immediate inspection or cleaning of contact parts or renewal of oil.

Furthermore, the manufacturer declares that it is possible to perform this operation without throwing an excessive quantity of oil or damaging any part of the breaker beyond the burning or pitting of arcing contacts. The breakers are designed to withstand the mechanical stresses that may be imposed upon them during the first few cycles of the short circuit when unsymmetrical currents of high value may exist.

These breakers are for indoor mounting in brick, concrete or steel structure compartments apart from the switchboard—that is, for remote control—and are adapted for electrical operation only. The two outstanding features of the "CO-2" breakers are their compactness and ease of installation. No intermediate structural walls are required for the individual poles, all of them being supported from a common steel top. The breaker is supported in the structure compartment by means of anchor plates set in and projecting from the cell walls. The steel top of the circuit breaker rests on these anchor plates and bolts hold it securely in place.

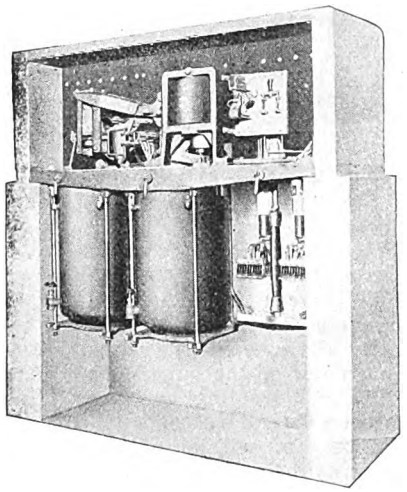
The breaker tanks are round and seamless, being die-pressed from heavy sheet steel. To avoid arcing between contacts and tanks two sets of removable micarta insulating linings are used in each tank which are 20 in. (50 cm.) in diameter. The tanks are dead and may be grounded.

Among other features of this breaker are the form of tank, use of steel supporting flanges, steel tie rods (four per pole) and cradles, steel tops, large volume and head of oil, liberal air chamber over oil, together with the high-speed arcing tips and rapid acceleration of moving contacts when opening.

The tanks are deep, providing ample space above the oil level as an expansion chamber for the arc gases and also to reduce slopping of the oil from internal disturbances.

The gases are vented through a specially designed check valve providing free venting of gases under ordinary pressure but at the same time preventing passage of oil.

The operating mechanism is mounted above the steel bedplate from the under



BREAKER IS SUPPORTED IN STRUCTURE COMPARTMENT BY MEANS OF ANCHOR PLATES

side of which the tanks are supported. The lift rods attached to the moving contacts of each pole unit are connected to a common operating mechanism actuated through a toggle lever by the solenoid operating mechanism.

A powerful accelerating spring is provided as an integral part of the operating mechanism to assist gravity in forcing the breaker to the open position. An air-cylinder dash pot in conjunction with the leather bumpers on each pole brings the moving parts to rest without shock.

The standard breakers are supplied with vertically arranged leads brought out at the rear of the cell. These leads are insulated for full line potential. In the vertical arrangement the leads are brought out one above the other on the center line of each cell space.

Electric Fireplace Log

An electric "log" for fireplace use has been recently developed by Strait & Richards, Fabyan Place and Selvage Street, Newark, N. J. The log illustrated is a 20-in. (51-cm.) style, which can

HEATING ELEMENTS EASILY REPLACED

be wired for operation on any current above 2000 watts. It is regularly equipped for 110 volts and is supplied fully wired and with a stand, but without a switch, since the varying conditions of installations make a standard impracticable.

The heating elements of this contrivance are arranged in such a manner that they can easily be replaced. The life of each element, the makers say, is upward of 2000 hours, continuous running.

NOTES ON RECENT APPLIANCES

Farm-Lighting Plant

The Gray Motor Company of Detroit, Mich., is marketing a farm-lighting plant with a 1-kw. capacity.

Bell-Ringing Transformers

Single-circuit and three-circuit type bell-ringing transformers have been developed by the Empire Transformer Company, Chicago.

Hospital Lighting Fixtures

Inclosed indirect lighting fixtures for installation in hospitals are now made by the M. J. Grady Fixture Manufacturing Company, Minneapolis, Minn.

Electric Dryer for Shoe Soles

For use in shoe factories to dry shoe soles the Millner Electric & Manufacturing Company, 1706 North Twelfth Street, St. Louis, Mo., has developed an electrically heated dryer.

Heavy-Duty Circuit Breaker

A circuit breaker of 3000-amp. and 4000-amp. capacity, known as "type LRL," for heavy-duty work such as is met with in steel mills and street-railway service, has been recently put on the market by the Automatic Reclosing Circuit Breaker Company of Columbus, Ohio.

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Trade Notes

Foreign Trade Opportunities

The Netherlands Legation at Washington has just opened a commercial department for the purpose of fostering trade between the United States and Holland and is in a position to give commercial information about trade between the two countries to American merchants.

Harrods, Ltd., London, England, which is one of the largest department stores in the British Empire, is in the market for electrical goods of American manufacture, both for London and for Belgian wholesale department. Representatives will be seen by appointment at Harrods, 225 Fifth Avenue, New York City.

The Aktiebolaget Elektrisk Materiel, Radmansgatan 73, Stockholm, Sweden, wholesale dealer in electrical machinery and materials, desires to get in touch with American manufacturers who want an agent in Scandinavia, Finland and Russia. Information may be obtained from the National Export Advertising Service, New York City.

COMMERCE WITH SPAIN.—Imports into Spain of copper wire in 1916 were $79,200 from the United States, $3,957 from France, and $20,822 from Great Britain. Of electric motors and generators, imports in 1916 were $579,179 from the States, $17 from Argentina, $170,694 from France, $342,421 from Great Britain, and $34,622 from the Netherlands. In 1916 and 1917 imports of copper wire were respectively $825,104 and $970,720; electric lamps and bulbs, $403,479 and $307,254; electric insulated wire, $43,815 and $57,342; electric motors and generators, $1,652,769 and $1,452,565; telegraph and telephone materials, $843,842 and $602,313. Many other imports also decreased during 1917.

ELECTRICAL STOCKS IN SOUTH AFRICA LOW.—Reports from English correspondents in South Africa are to the effect that stocks of electrical supplies are very low, except lamps, which seem to be in exceedingly plentiful supply. Conduit is reported as especially scarce and expensive. Local consulting engineers, it is reported, have standards for motors, transformers and general mining electrical supplies, and on these standards all mining supplies will be ordered. Good prospects for equipment for electrical business for industrial plants are reported, and better orders are also expected from the smaller lighting plants. Japan appears to be making a formidable attempt to corral this market and has placed large stocks, particularly wiring.

BUILDING PLAN FOR EMPLOYEES OF AMERICAN BLOWER COMPANY.—To aid its employees in acquiring their own homes the American Blower Company, Detroit, Mich., has organized an advisory and financial service in its welfare department. Officials of this concern occasionally talk to employees on the economy and value of acquiring homes, giving practical suggestions as to how to go about purchasing a lot and building a house. This is an outgrowth of the savings and investment movement resulting from war finance experiences, and thrift and war savings stamp investments are increasing generally. It is laid down as a general proposition that any married employee earning $25 a week is in a position to invest $3,300 in a cottage and lot, and that this will be cheaper than the average Detroit rentals, as well as give better living quarters and independence. Speaking recently to employees of that plant, the secretary of the company explained that if an employee owns an eight-hundred-dollar lot or has that sum in savings with which to buy one, it is possible to build a cottage costing $2,500 on it. The first step is to select the lot, and as location is important in determining mortgage value, the company advises that employees confer with the secretary of the Society for Savings, a Detroit thrift institution. Through experience in real estate this official is able to suggest locations and very often save money on the price. The next step is securing a loan for building. The Society for Savings will lend 60 per cent of the total value of house and lot. The lot being $800 and the house $2,500, this yields $1,980 on a mortgage. Before building can start it is necessary to borrow $520 additional, and this is loaned by the American Blower Company. One mortgage covers the whole transaction, as the Society for Savings issues the mortgage for $2,500 and the company pays the additional $525 into that institution. Care is taken to make clear to employees that this is not benevolence on the company's part, because the Society for Savings issues certificates of deposit to the company for its money and these certificates pay 5 per cent interest.

PROSPEROUS ELECTRICAL YEAR IN SWEDEN.—Reports from larger electrical manufacturers of Sweden indicate that 1918 was a very prosperous year in that country. Sales of transformers and transmission-line material were especially good. The three largest electrical manufacturers increased their capital stock by 50 per cent, and many additions were made to manufacturing facilities. Developments are now under way to increase the production of transformers, motors and generators and other electrical products. Electrification of the rural districts is occupying the attention of the trade at the present time, and according to authentic reports from Sweden it seems probable that this development will be undertaken quite extensively, with the backing of the government, in the near future.

KRANTZ COMPANY GROWING.—The Krantz Manufacturing Company, Inc., of Brooklyn, is now a subsidiary of the Westinghouse Electric & Manufacturing Company and in the past year has been remade and enlarged considerably. For about twenty years the Krantz company has been actively engaged in the manufacture of switches, switchboards and panelboards. In the last few years a complete line of safety switches, safety switchboards and safety panelboards has been developed. On account of the small representation, however, the greater part of the output was sold for local installations in two or three central localities, but with the sales forces of the Westinghouse Electric & Manufacturing Company, the Westinghouse Export Company and the Canadian Krantz Electric & Manufacturing Company it is expected that the output of the Krantz factory will be made more widely known. During the past year several very important contracts have been completed, headed by the Pennsylvania Hotel, which covered the switchboards and panelboards for the entire building. Contracts were secured also for installations at the new army base at Brooklyn, N. Y., and for the Elks' Home in New Orleans.

THE RISDON TOOL & MACHINE COMPANY, Naugatuck, Conn., reports the establishment of a number of selling agencies throughout the county and in several of the foreign countries. The company has recently added some new socket shells to its line.

THE WHITE LILY MANUFACTURING COMPANY of Davenport, Iowa, manufacturer of electric washing machines, it is reported, will erect a 20-ft. by 225-ft. addition to its factory, a 25-ft. by 30-ft. warehouse and seven auxiliary buildings, each 25 ft. by 30 ft. The contract for the improvements planned has been let.

THE ROLLER-SMITH COMPANY, New York City, announces that it is now represented in St. Paul, Minn., by A. H. Savage, Pioneer Building. Mr. Savage will handle the company's various lines of instruments, meters and circuit breakers in Minnesota and North Dakota and part of Wisconsin and South Dakota. Mr. Savage prior to 1914 represented the Fort Wayne Electric Works in St. Paul, and in 1914 he became a representative of the Wagner Electric Manufacturing Company of St. Louis, he being now in charge of the St. Paul office of that concern. At the present time Mr. Savage is treasurer of the Dakota Light & Power Company of Flandreau, S. D., and is also president of the South Dakota Power Association. He has been in the Northwest for over eighteen years.

THE PLATT IRON WORKS, Dayton, Ohio, which last year was engaged 100 per cent in direct war work, reports that a great maority of this work has been discontinued and that the company is now returning to its regular line of products of pumps, water heaters and oil-mill machinery. A number of new agents in the field have been appointed, as follows: The Charles F. Ames Company, 90 West Street, New York City, covering the entire territory of New York State and partof New Jersey and Connecticut; the W. P. MacKenzie Company, Pennsylvania Building, Philadelphia, covering the Philadelphia territory, and the Texas Manufacturing Company of Fort Worth, Tex., covering that part of the country. The factory [illegible] of the company was enlarged during the war, but at the present time the new building is not being used for its regular products.

THE DETROIT INSULATED WIRE COMPANY announces that R. S. Wakefield has recently been appointed representative for Texas with offices at 13,123 Great Southern Life Building, Dallas.

THE TOLEDO SCREW PRODUCTS COMPANY, Toledo, Ohio, will shortly begin the manufacture of vacuum cleaners. These will be put on the market by the Air-Way Company, 1229 Ohio Building, T. H. Tracy, president.

THE CROUSE-HINDS COMPANY of Syracuse, N. Y., announces that P. A. Fuss has joined its staff in an advertising capacity after a number of years of service for the Thomas Edison Company and the T. G. Plant Company.

F. W. MARSHNER has been appointed as manager of the Detroit branch of the New Departure Manufacturing Company, succeeding the late Samuel B. Dusinberre. Mr. Marshner has been with the company at its Detroit office for something like seven years, having been an engineer salesman.

THE AMERICAN APPLIANCE COMPANY, manufacturer and distributer of incandescent lamps and specialties, states that it has recently opened an additional branch in Dallas, Tex., at 1812-1814 Live Oak Street. This makes seven branches, at every one of which is a warehouse and complete stock of all different kinds of incandescent lamps.

W. H. HUSTON, production manager of the Robbins & Myers Company, Springfield, Ohio, is to take charge of production, purchasing and material at the plant of the Dayton Fan & Motor Company, effective June 1. W. A. Lubbers will succeed Mr. Huston as production manager, and William Winters will succeed Mr. Lubbers as assistant production manager.

THE ECLIPSE FOLDING MACHINE COMPANY, Sidney, Ohio, manufacturer of portable electric cleaners, has within the past two years tripled the factory space devoted to the manufacture of cleaners. The distribution of these products is now largely through territorial agencies or distributers. Sales for 1919 are approximately 300 per cent greater than any former year, while the factory is working about thirty days behind orders. E. C. Brown is now sales manager of the company.

THE BROOKINGS COMPANY, Cleveland, reports that during the past year it has built up a large export business in lighting fixtures. I. I. Hance, manager of the commercial lighting department of the company, states that agencies have been established in China, Japan and Australia. The company has shipped many thousands of dollars' worth of fixtures to these countries during the past six months and has in its factory nearing completion a large order destined for Shanghai, China.

C. J. COOPER, JR., who has recently resigned as general manager of the Mineral Point Public Service Company, has joined the forces of J. H. Jones, Northwestern manager of the Hoover Suction Sweeper Company, where he will be engaged in promotion work. Mr. Cooper, before he became general manager of the Mineral Point property, was superintendent of heating and assistant general manager of the Merchants' Heat & Light Company of Indianapolis, Ind., and earlier still was sales engineer for the Laclede Christy Company, St. Louis.

MERLE R. GRIFFETH, publicity manager of the Boston office, General Electric Company, at a recent meeting of the Boston Chamber of Commerce was the recipient of an honor cup fabricated from a 77-mm. shell for winning a drive for new members during the first twenty days of this month. Mr. Griffeth obtained sixty-six members and the next in the contest obtained twenty. A total of 152 new members was added, increasing the total chamber membership to more than 4100. The cup was bestowed by President Harriman, who is also president of the New England Power Company.

CHARLES B. BURLEIGH of the Boston office, General Electric Company, has been devoting considerable time since the signing of the armistice to the employment of returned service men, and as chairman of the employment committee of the Boston Chamber of Commerce has personally placed 2000 men in new positions among 300 firms. At the close of hostilities 190,000 Massachusetts men were in the service. Eighty-two per cent of these are returning to their former posts in civil life; 5 per cent place themselves, and 3 per cent are returning to educational institutions to complete interrupted courses.

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THE ADVANCE ELECTRIC COMPANY of St. Louis expected to move into its new plant about June 10.

THE WORCESTER STAMPED METAL COMPANY, Worcester, Mass., has established a new sales office at 305 Merchants' Bank Bulding, Indianapolis, Ind., with Frank J. Coffey as manager.

THE TOOL EQUIPMENT COMPANY of San Francisco, Cal., has recently been authorized Western sales agent for the Geometric Tool Company. Offices are at 735 Folsom Street, San Francisco, Cal.

THE HARTFORD BATTERY MANUFACTURING COMPANY, 51 Elm Street, Hartford, Conn., is at present being equipped for an output of about $20,000 per month of automobile batteries and reports that it will soon begin shipments.

THE BRUNSWICK (GA.) CROSS-ARM COMPANY reports that it is placing orders for two additional fast-feeding machines and intends to build an addition to its plant 50 ft. by 100 ft., about doubling the present size, for the purpose of operating a complete planning mill and catering to export business.

THE MASSACHUSETTS MACHINE SHOP, INC., announces that it is moving its plant to its new factory at 817 Albany Street, Boston, where enlarged quarters and equipment will greatly increase its facilities. There was of necessity a short suspension of production on new work. Shipments of stock goods were not interrupted, however.

THE APPLETON ELECTRIC COMPANY, manufacturer of conduit fittings, Chicago, writes that it has opened up with several new distributers and hopes to do an increased business from now on. The company is adding to its sales force. H. F. Bloom, who has just returned from service, will travel the Chicago territory, and R. H. Robinson, formerly with the electrical department of the city of St. Louis, will travel throughout the South and Southeast, with headquarters in Atlanta or Birmingham.

THE FAULTLESS ANCHOR & MANUFACTURING COMPANY, formerly in Findlay, Ohio, is now at Centerburg, Ohio. The company has a new building with plenty of floor space, and it reports keeping a small force busy taking care of the anchor situation, which is very good considering conditions. At a recent meeting of the stockholders and directors quite a few changes were made in the personnel of the company. The present officers are: C. Bowen, president; H. T. Blosser, vice-president and general manager, and F. C. Bishop, secretary and treasurer.

THE NATIONAL CONDUIT & CABLE COMPANY, according to the *Wall Street Journal*, showed a deficit of $219,694 in the first quarter this year, compared with a deficit of $292,413 in the corresponding quarter of 1918. The stagnant condition which prevailed throughout the brass industry over the first three months of this year, it was stated, resulted in few companies earning sufficient to cover overhead, depreciation, etc. Companies which manufacture brass and copper products are not working at more than 50 per cent of capacity. Some of them are only handling one-third the business transacted in normal times. However, it is expected that June will witness a good buying movement on the part of wire, telephone, cable and telegraph companies, public utilities and the building trade.

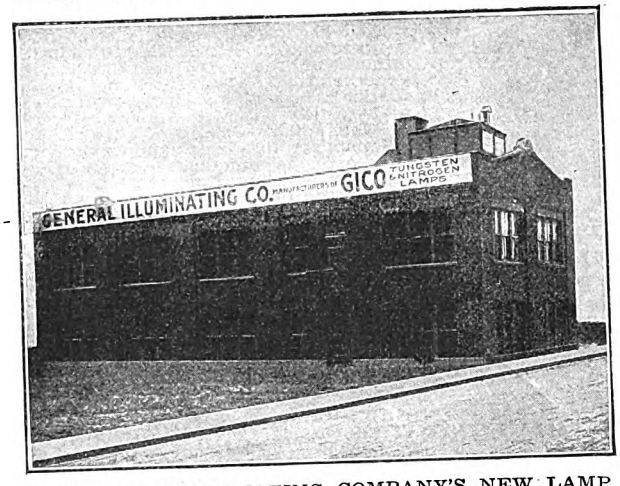
THE ALLIED MACHINERY COMPANY OF AMERICA has increased its capital stock to $5,000,000. This was made necessary by the decision of the American International Corporation to group all of its machinery export selling subsidiaries under one head. This move contemplates the complete absorption of the Allied Construction Machinery Corporation by the Allied Machinery Company of America. The Allied Machinery Company of France and the Allied Machinery Company of Italy will retain their corporate entities, but their parent corporation will be the Allied Machinery Company of America rather than the American International Corporation, as before. This is also true of the Horne Company, Ltd., of Japan, which was purchased early in the year by the American International Corporation. It is announced that J. W. Hook will continue as president of the Allied Machinery Company of America, in general charge of the business. F. A. Monroe, S. T. Henry and T. G. Nee have been elected vice-presidents. Mr. Monroe is in charge of the administrative affairs of the company. Mr. Henry is in charge of sales and advertising, and Mr. Nee is at present in Japan devoting his attention to the affairs of the Horne Company, Ltd. R. P. Redier is general sales manager of the company, with headquarters at Paris.

THE NITRO-TUNGSTEN LAMP COMPANY of Providence, R. I., has appointed the Ullman Electric Compaany of Boston, Mass., general sales agent for the Comet brand nitrogen lamp.

THE INTERNATIONAL INSULATING CORPORATION, Springfield, Mass., has increased its factory floor space by 15,000 sq.ft. and has recently completed tools and is now placing on the market a new switch.

SMITH & HEMENWAY, INC., Irvington, N. J., report that the demand for Red Devil tools, both for domestic and export consumption, is very good and increasing. The company has recently added some new tools to its line. Within the past year the company has enlarged its factory space considerably, adding a building of two stories, 110 ft. long by 50 ft. wide, besides considerable machinery and equipment.

THE GENERAL ILLUMINATING COMPANY announces that it has recently purchased its own factory at 5317-5321 Twenty-first Avenue, Brooklyn, N. Y., where it has greatly enlarged facilities for manufacturing standard tungsten lamps and nitrogen lamps under a patent license granted by the General Electric Company. The company formerly renewed tungsten lamps only, but now this policy has been entirely abandoned.



GENERAL ILLUMINATING COMPANY'S NEW LAMP FACTORY IN BROOKLYN, N. Y.

THE UNITED ELECTRIC COMPANY, Canton, Ohio, manufacturer of vacuum cleaners, has opened an office in the Builders' Exchange, Chicago, with Donn Mitchell and Leon C. Zimmerman in charge, the former handling the stationary line and the latter the portable line. The company has also opened a new office in Cleveland in the Builders' Exchange, with Jerry Snyder in charge, and an office at 321 Madison Avenue, New York City, with F. H. Schaefer in charge. A new storehouse is being built by the company this summer which will give it about one-third more space.

THE AUTOMATIC TRANSPORTATION COMPANY of Buffalo, N. Y., announces that since the first of the year its sales department has been under the direct charge of its vice-president, E. L. Kleindinist. Several new sales offices have been established and the company now has thorough representation in every part of the United States and Canada. A large addition to the company's plant has recently been built, affording additional facilities for the production of storage-battery trucks and tractors. In the last few months many improvements on various models of these machines have been made.

THE R. H. BEAUMONT COMPANY, 315 Arch Street, Philadelphia, manufacturer of conveying and hoisting systems, is expanding its business to take in complete boiler houses under one contract covering the entire job. R. H. Frost, formerly with John W. Cowper, Buffalo, N. Y., has been engaged to take charge of all matters pertaining to this branch of the business. He will cooperate with the company's engineering department in the design of a standard boiler-house structure. The company has opened an office in Cleveland, Ohio, with H. B. Mosley, formerly with the home office as manager. The Canadian Fairbanks-Morse Company, of Montreal, is representing the Beaumont company.

A. P. SAAS has resigned his position of treasurer and sales manager of the Independent Lamp & Wire Company, Inc., and of secretary and treasurer of the Rochester Bulb Company, effective June 15.

EDGAR M. MOORE & CO., 708 Farmers' Bank Building, Pittsburgh, Pa., has recently taken the representation of the Watson Wagon Company of Canastota, N. Y., for the sale of Watson tractor, trucks and trailers.

THE RICHARDSON SCALE COMPANY of Passaic, N. J., reports that it proposes to go more extensively into the export business, particularly in South America. W. R. Kent, sales manager, has been assigned to take charge of the export work.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY has added to its sales force A. J. McWilliams, who will make his headquarters in Pittsburgh and push the safety switch line for the company in the Pittsburgh district.

THE MURRAY IRON WORKS COMPANY, Burlington, Iowa, announces that S. C. Orrell, recently manager of the Minneapolis office of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., has resigned to assume charge of the Chicago office of the Murray Iron Works Company.

THE CARBOLINEUM WOOD PRESERVING COMPANY, Milwaukee, Wis., announces that it has lately centralized its business, doing away with all former branches, distributers and agents, except only the Pacific Coast branch. All distributing will be done from stocks carried at different points with headquarters at the Carbolineum Building, Milwaukee, Wis.

THE SIMPLEX ELECTRIC HEATING COMPANY, Cambridge, Mass., announces that R. C. W. Libbey is now visiting the Pacific Coast States with a view to securing new outlets for its smaller appliances and its new ranges. It has concluded arrangements with Holbrook, Merrill & Stetson of San Francisco and Los Angeles, Cal., to act as wholesale distributers for California, Arizona and Nevada.

THE REDTOP ELECTRIC COMPANY, INC., New York City, has established a new sales office in San Francisco, where sales are being handled by the Globe Commercial Company, of 618 Mission Street. The company has enlarged its factory twice during the last few months because it has increased its sales about 200 per cent. It reports that it is shipping all over the world, and its trade with China has developed of late considerably.

THE ELECTRIC SPECIALTY COMPANY, Stamford, Conn., manufacturer of motor generators, reports that it is erecting an addition to its factory which will double its present floor space. The addition is 100 ft. by 40 ft., two stories high. The company expects to have the addition ready for occupancy in about six weeks or two months. The addition is made with a view of doing a much greater export business than heretofore.

THE MACOMBER & WHYTE ROPE COMPANY, Kenosha, Wis., manufacturers of wire rope and wire, announces the opening of two new branches, one at New York City, at 30 Church Street, under the management of E. E. Robirds, who has been with the company for ten years, having previously been successively manager of the Pittsburgh and Chicago offices. Another office has been opened at Birmingham at 805 American Trust Bank Building, under the direction of James A. Boope. Complete stocks will be carried at both places.

THE DAYTON INSULATING DIE COMPANY, manufacturer of molded insulation products and dies for same, has just purchased the Edgemont Die Casting Company of Dayton, Ohio, manufacturer of white-metal castings, and will consolidate and operate both lines under a new name. C. A. Kurz will be president, and I. W. Detamore is also connected with the new organization. Ground was broken during the third week in May for a new plant, about 60 ft. by 120 ft., two stories, steel and concrete, situated at Edgemont, a suburb of Dayton, Ohio.

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THE JAMES LEFFEL WATER WHEEL COMPANY has sold its plant in the Lagonda district, Springfield, Ohio, to the Robbins & Myers Company, and has acquired more extensive property in Springfield. Engineers and architects are at work on plans for a large, modern and fully equipped plant and construction work will be rushed so that the new plant will be ready for occupancy by Dec. 1. The company found itself cramped for factory space in its old quarters. The company has grown very rapidly since it started in 1862 with the inventions of James Leffel. In 1890 the business was incorporated under the name of James Leffel & Company and since then has expanded considerably. George R. Prout, president of the company, and other officers of the company have been identified with the business for many years.

Trade Publications

INSULATORS.—J-D insulators are the subject of a leaflet from the Jeffrey-Dewitt Insulator Company, Huntington, W. Va.

ELECTRIC TRUCKS. — A number of types of industrial electric trucks and tractors are shown and described in a pamphlet prepared by the Baker R. & L. Company of Cleveland.

WASHING MACHINE.—To tell about the "Mola" home laundry machine, the Modern Laundry Machine Company of Kansas City, Mo., has issued an illustrated folder.

ELECTRIC RANGE.—The new "Jewel" electric range manufactured by the Detroit Stove Works, Detroit and Chicago, is illustrated and described in a recently distributed circular.

MOLDINGS AND FITTINGS—The National Metal Molding Company, of Pittsburgh, Pa., is distributing an illustrated broadside on its interconnecting metal moldings and fittings.

ELECTRIC TRUCKS AND TRACTORS. —A mailing folder on electric trucks and tractors is being circulated by the Automatic Transportation Company, 2933 Main Street, Buffalo, N. Y.

VENTILATING FLOORING.—The Irving Iron Works Company, Long Island City, N. Y., has issued a thirty-six-page catalog, 2A, covering "Irving subway" fireproof ventilating flooring.

CENTRIFUGAL SEPARATORS.—The International Equipment Company, Boston, Mass., is distributing catalog C on centrifugal separators and other electrical apparatus for laboratories.

STOKER.—The Jones automatic cleaning underfeed stoker is described in an illustrated pamphlet published by the Under-Feed Stoker Company of America, Harris Trust Building, Chicago.

LIGHTING FIXTURES.—Two styles of lighting fixtures suitable for store lighting are illustrated in a recently issued leaflet of J. Livingston & Company, Grand Central Terminal, New York City.

ELECTRIC IRON.—The new domestic electric flatiron which the Simplex Electric Heating Company of 85 Sidney Street, Cambridge, Mass., is marketing is described in a folder recently issued.

LAMP AND SCALE REFLECTION INDICATOR.—The Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J., has prepared a leaflet about its new lamp and scale reflection indicator.

CENTRIFUGAL PUMPS. — The Allis-Chalmers Manufacturing Company of Milwaukee is publishing a monthly bulletin containing a list of the centrifugal pumping units it has available for shipment.

ELECTRIC APPLIANCES.—A novel mailing folder is being circulated by the General Electric Division of the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, containing reproductions in colors of its advertisements.

PORCELAIN PUSH-BUTTON SOCKETS.—"Sockets to Harmonize" is the title of an envelope stuffer which emphasizes the harmony to be secured through the use of C-H push-button porcelain sockets with white enamel fixtures as manufactured by the Cutler-Hammer Manufacturing Company of Milwaukee.

ELECTRIC SIGNS. — Interchangeable day and night electric signs are spoken of in an illustrated mailing folder being distributed by the Flexlume Sign Company, Buffalo, N. Y.

ELECTRIC ELEVATORS.—The Warner Elevator Manufacturing Company of Cincinnati, Ohio, is circulating a mailing folder showing views in its factory and some of its products.

ELECTRICAL TOYS.—The Knapp Electric & Novelty Company, 511 West Fifty-first Street, New York City, has prepared catalog No. 27, covering its toy electrical motors, transformers, telegraph sets, etc.

FANS, BLOWERS, HEATERS, AIR WASHERS.—The Massachusetts Blower Company, Watertown, Mass., has issued condensed bulletin No. 51, giving general data on its fans, blowers, heaters and air washers.

PLATE BATTERIES.—For its distributers and agents the Luthy Storage Battery Company of Newark, N. J., has prepared catalog No. 1 on replacements and parts for "Dependable" plate storage batteries.

OIL CIRCUIT BREAKERS.—The General Electric Company, Schenectady, N. Y., has prepared bulletins Nos. 47,417, 47,443 and 67,482, describing respectively type FP-7, type FK-13 and type FK-52B oil circuit breakers.

ELECTRICAL APPLIANCE SELLING HELPS.—"Helps in Merchandising Electrical Appliances" is the title given a sixteen-page two-colored bulletin issued by the Cutler-Hammer Manufacturing Company of Milwaukee.

SHOW-WINDOW ADVERTISING DEVICE.—The "Symmetriscope", a motor-driven advertising device for show-window use, is described in a circular being distributed by J. B. Beans, 1216 Land Title Building, Philadelphia.

SWITCHES, SWITCHBOARDS, CABINETS, ETC.—The Electrical Manufacturing Company of Cleveland has prepared a sixty-eight-page catalog, D, covering knife switches, panelboards, iron cabinets and switchboards.

CAPACITY BRIDGE. — The Leeds & Northrup Company, 4901 Stenton Avenue, Philadelphia, has issued bulletin No. 120 on capacity bridge and accessories. An odd stock list of the instruments sold by this company is also available.

COLOR MATCH UNITS.—"Chameleons Change Color" is the title of a booklet from the Nela Specialties Division, National Lamp Works of the General Electric Company, Nela Park, Cleveland, telling about its "Trutint" lighting units for color matching.

ELECTRIC APPLIANCES.—A novel mailing folder is being circulated by the General Electric Division of the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, containing reproductions in colors of its advertisements in nationally circulated magaines.

LIGHTING FIXTURES.—Lighting fixtures for residences and public buildings, electrical conduit fittings and boxes and marine electrical appliances are the devices covered in a booklet issued by the Trans-Com. Lighting Products Corporation, 508 Broome Street, New York City.

STEAM POWER PLANTS.—The Murray Iron Works Company, Burlington, Iowa, is distributing catalog No. 85 of ninety-five pages, to describe and illustrate its Corliss marine, pumping and vertical engines, air compressors, tubular, marine, portable and water-tube boilers, and rocking grates.

SOLDERING IRONS. — "C-H Electric Soldering Irons and Hand Tools" is the title of a folder which illustrates and describes standard sizes of electric hand soldering irons, automatic soldering iron rack and a soldering fixture manufactured by the Cutler-Hammer Manufacturing Company of Milwaukee and New York.

BOILER FEED REGULATION.—An eight-page bulletin embodying specifications for the Copes system of boiler-feed regulation has just been published by the Northern Equipment Company, Erie, Pa. The bulletn discusses the following points: Principle of operation, heat storage, reduction of furnace temperature fluctuations and sudden load change, service performance, constant characteristic, thermostat, control valve, standard dimensions and drilling, and the Copes steam-pump governor.

ELECTRIC TOASTERS.—Circular No. 189 from Manning, Bowman & Company, Meriden, Conn., covers four styles of electric toasters.

ELECTRIC BLOWER.—In a recently issued leaflet the Rosewater Electric Company, Cleveland, Ohio, tells about its "Roto" electric blower.

FLATIRON.—The Simplex Electric Heating Company, 85 Sidney Street, Cambridge, Mass., has printed an electric flatiron folder to be used by the trade for retail circularization.

ROOT CUTTERS.—The Superior Churn & Manufacturing Company of Northville, Mich., illustrates and describes an electrically driven root cutter in a recently issued circular.

New Incorporations

THE MALONE (WIS.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $25,000 by John L. Beau, Frank Clark and Christ Pickart.

A. S. ELLIOTT & COMPANY of New York, N. Y., has been incorporated by A. S. Elliott, A G. and S. Lichtenstein, 138 East 117th Street, New York City. The company is capitalized at $40,000 and proposes to manufacture electric and gas fixtures.

THE MARTALEX MANUFACTURING COMPANY of New York, N. Y., has been incorporated by A. Ascher, M. Fogel and A. Kutz, 320 Broadway, New York City. The company is capitalized at $10,000 and proposes to manufacture electrical devices.

THE AMERICAN SAFETY GAS BURNER COMPANY of Bridgeport, Conn., has been chartered with a capital stock of $25,000 by Samuel Rosenburg, Daniel J. Trivres and Bernard W. Ring. The company proposes to manufacture electric and gas fixtures.

THE ELECTRIC TWIN WATER PURIFICATION of Buffalo, N. Y., has been incorporated by J. Roche, R. J. Parker and H. W. Smead, 11 Tremont Avenue, Buffalo, N. Y. The company is capitalized at $100,000 and proposes to manufacture water filters.

THE WOLCOTT MANUFACTURING COMPANY of Hartford, Conn., has been incorporated by Frank E. Wolcott, H. C. Bailey and R. L. Gideon. The company is capitalized at $100,000 and proposes to manufatcure electrical tools and other specialties.

THE ALADDIN LAMP WORKS, INC., of New York, N. Y., has been chartered with a capital stock of $15,000 to manufacture electric lamps and equipment. The incorporators are R. S. and J. G. Turnbull and I. Castelli, 334 East Seventy-eighth Street, New York City.

THE F. B. ELECTRIC & MANUFACTURING COMPANY of Detroit, Mich., has been organized by John W. Fitzgerald of Detroit, Mich.; D. J. Buns of Bronxville, N. Y., and Albert J. Fisk. The company proposes to manufacture electrical and mechanical apparatus.

THE WEBB ELECTRIC FURNACE COMPANY of New York, N. Y., has been incorporated with a capital stock of $20,000 to manufacture electric furnaces and equipment. The incorporators are J. G. Webb, H. T. and E. C. Gerdes, 30 Church Street, New York City.

THE HAMILTON LAMP COMPANY of Hamilton, Ont., Can., has been incorporated with a capital stock of $300,000 by Lyman Lee, Thomas H. Simpson, R. Meyers and others. The company proposes to manufacture electric lamps, electrical equipment and fixtures, machinery, etc.

THE P. PHELPS LIGHT & POWER COMPANY of Rock Island, Ill., has been incorporated with a capital stock of $800,000 to construct and operate an electric light and power plant. The incorporators are: R. W. Phelps of Rock Island, Ill.; H. C. Thompson and A. G. Bush of Davenport, Iowa.

THE INCANDESCENT LIGHT & STOVE COMPANY of Cincinnati, Ohio, has been incorporated with a capital stock of $50,000 by Paul J. Connolly and others. The company, it is reported, will take over the plant of a company in Oakley, having the same name, which has not been in operation for some time.

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New England States

BRANDON, VT.—The Hortonia Power Company Brandon, it is reported, is contemplating the construction of two dams and a hydroelectric power plant at Weybridge.

BOSTON, MASS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3946, for cranes for shipfitters' shop at Boston, Mass., to cost about $65,000. A deposit of $10 is required for plans.

HOLYOKE, MASS. — The Board of Aldermen is considering a proposal submitted by the Turners Falls (Mass.) Power & Electric Company to furnish electricity to operate the municipal electric light and power company. John J. Kirkpatrick is manager of the municipal plant.

MARION, MASS.—The Gas and Electric Light Commission has approved of an issue of $900,000 in capital stock by the Southeastern Massachusetts Power & Electric Company of Marion and Wareham.

NEWPORT, R. I.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3951, for a fire-alarm system at Newport, to cost about $15,000. A deposit of $10 is required for plans.

PROVIDENCE, R. I.—A permit has been granted to the Atlantic Mills for the erection of a new power house, 46 ft. by 98 ft., in the rear of Manto Avenue.

DANBURY, CONN.—The installation of an ornamental lighting system in the business section is under consideration by the City Council.

SOUTH NORWALK, CONN.—Plans are under consideration by the commissioners of the municipal electric light plant of the Second Taxing District of the city of Norwalk for enlarging the municipal electric plant to meet the increasing demand for electrical service. Frederick Hunkemeier is president.

Middle Atlantic States

AMSTERDAM, N. Y.—The J. W. Bishop Company of Boston, Mass., has been awarded the contract for the erection of a large woolen mill and power house at the plant of the Amsterdam Manufacturing Company.

BALDWINSVILLE, N. Y.—Franchises have been granted to the Seneca River Power Company in the villages of Cato and Meridian to furnish electrical service. Bonds to the amount of $15,000 have been sold to pay for the extension of the transmission line. Both villages will enter into contract with the company for street-lighting service.

BROOKLYN, N. Y.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 8 for furnishing, at South Brooklyn, under Schedule 4147, 175 portable electric drills.

CENTRAL ISLIP, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until July 1, for new boiler, stokers, etc., and coal and ash-handling equipment for the new central heating and lighting plant at the Central Islip (N. Y.) State Hospital. Drawings and specifications may be consulted at the above institution, at the New York office of the Department of Architecture, Room 618 Hall of Records Building, and at the Department of Architecture, Albany. L. F. Pilcher, Capitol, Albany, is state architect.

GLENS FALLS, N. Y.—Application has been filed by the Adirondack Electric Power Corporation for permission to make extensions to its systems in Vernon, Westmoreland, Verona and Kirkland.

NEW YORK, N. Y.—Bids will be received by E. S. Walsh, Superintendent of Public Works, Capitol, Albany, until July 15 for furnishing and installing industrial freight-handling trailers and stevedore freight-handling trucks for barge canal terminals in New York City, under terminal contract No. 112. Plans and specifications may be seen at the office of the Superintendent of Public Works, Albany, at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, at the canal office, Spaulding's Exchange, Buffalo, and at the office of the State Engineer, Hall of Records, New York City.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—Ophuls, Hill & McCreery, Inc., have been retained as architects and engineers to design and supervise the construction of a fish-freezing plant for the French government on the Isle of St. Pierre, off the coast of Newfoundland. Specifications for the mechanical, electrical and refrigerating apparatus will be ready to be issued on June 21. The proposed equipment will include 400 hp. in water-tube boilers, four 50-hp. uniflow engines directly connected to 75-ton refrigerating machines, two uniflow engines directly connected to 150-kva. generators, concrete or brick stack, 125 ft. by 5 ft.; brine pumps, water pumps, circulating pumps, together with two 25-ton ice-making tanks, switchboards, wiring, etc., for electrical installation. The cost of the entire project is estimated at between $600,000 and $700,000. The offices of the engineers are at 112 West Forty-second Street, New York.

OSSINING, N. Y.—Bids will be received by C. F. Rattigan, superintendent of state prisons, Hall of Records Building, New York City, until June 24 (extension of date from June 17) for construction of mess hall and kitchen No. 4, detention building No. 5, outside cell building No. 7, clinic building No. 8, pump house and reservoir, and also for sanitary heating and electric work on same. L. F. Pilcher, Capitol, Albany, is state architect.

SARATOGA, N. Y.—The City Council has decided to install a new lighting system on Broadway and in the parks. It will be installed by the Adirondack Electric Power Corporation, which will maintain it, and the city will pay $13,300 per year.

SCHENEVUS, N. Y.—The Board of Village Trustees has applied to the Public Service Commission for permission to construct and operate an electric light plant and transmission system through the towns of Maryland and Milford. Bonds to the amount of $22,000 have been voted to cover the cost of the project.

BORDENTOWN, N. J.—Arrangements are being made by the Public Service Electric Company for the erection of an electric transmission line to the municipal waterworks to supply electricity for operating the pumping units. The cost of the entire work is estimated at about $15,000.

CAPE MAY, N. J.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3963, for floodlighting system at Cape May, to cost about $4,000. A deposit of $10 is required for plans.

ORANGE, N. J.—Plans have been filed by the Hart Roller Bearing Company, 25 Main Street, for a power plant to be erected in connection with its new roller bearing works now under construction.

BETHLEHEM, PA.—Bids will be received until July 14 by H. J. Judd, superintendent, for construction of high school building, to cost about $800,000. V. T. Ritter, North American Building, Philadelphia, is architect.

GROVE CITY, PA.—Plans have been prepared by Sidney B. Martin, engineer, Penn Building, Pittsburgh, for additional units for the municipal electric light plant.

HONESDALE, PA.—Contract has been awarded to Kreitner Brothers for the construction of the new electric light plant for the Honesdale Consolidated Light, Heat & Power Company.

McKEESPORT, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 25 for installation complete of an electric mail elevator, etc., in the United States post office at McKeesport. For details see Searchlight Section.

PHILADELPHIA, PA.—Bids will be received by the Department of City Transit, 1211 Chestnut Street, until June 24 for the following work on the Frankford Elevated Railway: Contract No. 567, installation of electric conduits for lighting system in the stations to be built at the corner of Kensington and Allegheny Avenues and the corner of Kensington Avenue and Somerset Street; contract No. 568, installation of water and drainage lines in the above stations. Plans and specifications may be obtained at the above office upon deposit of $10. William S. Twining is director.

SHENANDOAH, PA.—Plans are being prepared by Gannett, Seelye & Fleming, engineers, 204 Locust Street, Harrisburg, for improvements to the waterworks system, including pumping station, pumps, motors, etc. D. T. Grover is city engineer.

BALTIMORE, MD.—Plans are being prepared for the erection of a three-story power plant at the Church Home and Infirmary, Broadway and Fairmont Avenue. Wyatt & Nolting, Keyser Building, are architects.

INDIANHEAD, MD.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3924, for extension to power plant at Indianhead, to cost about $200,000. A deposit of $30 is required for plans.

MARTINSBURG, W. VA.—The Potomac Light & Power Company is planning to rebuild its local substation, damaged by fire. The cost is estimated at about $12,000.

SOUTH CHARLESTON, W. VA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 27, under Schedule 4099, for three electric locomotives, rack drive, at South Charleston.

SOUTH CHARLESTON, W. VA.—Contract has been awarded by the South Charleston Utilties Company for the erection of a new electric light plant and distribution system to the Engineering Service Company of Charleston. The cost is estimated at $15,000.

HAMPTON ROADS, VA.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 27, at Hampton Roads, under Schedule 4115, for one motor-generator set.

HAMPTON ROADS, VA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3960, for a fire-alarm system at Hampton Roads, to cost about $6,000. A deposit of $10 will be required for plans.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until June 24, under Schedule 4109, for miscellaneous flashlights and batteries at the various navy yards.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until June 30 for supplying to the various buildings under the control of the Treasury Department hand electric portable vacuum cleaners during the fiscal year ending June 30, 1920, in accordance with specifications, copies of which may be obtained at the above office.

North Central States

BATTLE CREEK, MICH.—The Advance Pump & Compressor Company is planning to build a foundry, machine shop and power house.

MIDLAND, MICH.—The Village Council is considering the installation of an electric lighting system, to cost about $15,000.

LEBANON, OHIO.—Plans are under consideration by the Village Council for the construction of a new electric light plant, to cost about $120,000. An election will be called to submit the proposal to the voters.

LORAIN, OHIO.—The Lorain County Electric Company is contemplating improvements to its local system, involving an expenditure of about $90,000.

NORTHFIELD, OHIO.—Bonds to the amount of $35,000 have been issued for the installation of an electric lighting system. Electricity will be secured from the Northern Ohio Traction & Light Company.

NORWOOD, OHIO.—The business men of Norwood have petitioned the City Council to grant the Union Gas & Electric Company of Cincinnati a franchise to supply electricity in Norwood for manufacturing purposes. The municipal plant is not able to provide the power required.

SPRINGFIELD, OHIO.—Plans are being prepared by the James Leffel Company for enlarging and equipping the plant of the Columbia Planer Company, which it recently acquired for the manufacture of water turbines.

WELLINGTON, OHIO.—Bonds to the amount of $50,000 have been voted for the extensions and improvements to the municipal electric lighting system.

JEFFERSONVILLE, IND.—Plans have been completed for improvements at the local government depot, to cost more than $100,000.

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MEDORA, ILL.—The village of Medora is considering the purchase of the local electric light plant, owned by L. C. Hard.

ORION, ILL.—The Illinois Public Utilities Commission has granted the Sherrard power system permission to erect an 11,000-volt transmission line from a point on its line south of Coal Valley to the village of Milan, and also to supply electrical service to residents along the route of the proposed transmission line.

SEYMOUR, ILL.—The Interstate Public Service Company is planning to erect a high-tension transmission line from its substation in Greenwood to its hydroelectric power station at Williams.

ASHLAND, WIS.—The municipal electric plant was recently damaged by fire, causing a loss of about $10,000.

PORT WASHINGTON, WIS.—The City Council is considering an issue of $30,000 in bonds for extensions and improvements to the municipal electric light plant.

MINNEHAHA FALLS, MINN.—Bids will be received by the Soldiers' Board, care C. F. Dolan, quartermaster, Minnesota Soldiers' Home, Minnehaha Falls, until June 24 for furnishing and installing the following equipment: (1) Engine, (2) generator, (3) electric elevator, (4) fire-alarm system, (5) refrigerating plant, at the above institution, in accordance with plans and specifications prepared by the Charles L. Pillsbury Company, engineer, Minneapolis and St. Paul.

TYLER, MINN.—The purchase of additional equipment for the municipal electric light plant is under consideration by the Village Council. When improvements are completed a twenty-four-hour service will be established.

NEWTON, IOWA—The Des Moines (Iowa) Electric Company, it is reported, has entered into a contract to supply electricity in Newton for a period of eight years. Plans are being prepared for the construction of a plant here in the near future, to cost about $90,000.

ST. JOSEPH, MO.—Bonds to the amount of $500,000 have been voted for extensions and improvements to the municipal electric light plant. Archer & Stevens, New England Building, Kansas iCty, Mo., are engineers.

ST. LOUIS, MO.—Bids will soon be asked by the Board of Public Service for the construction of two warehouses, one 120 ft. by 200 ft. and the other 200 ft. by 400 ft., including eleven concrete freight platforms, cranes, etc., to cost about $300,000. J. A. Hook is city engineer.

ST. LOUIS, MO.—A permit has been taken out by the St. Louis Manufacturing Corporation, a subsidiary of the General Motors Corporation, for the construction of additional units in connection with the branch plant now under construction. The plans provide for a power plant, to cost about $500,000.

AMENIA, N. D.—Bids will be received by the Amenia & Sharon Land Company of Amenia until June 27 for furnishing materials and construction of an electric lighting and power system and motor drive as follows: (1) For brick and tile power house; (2) furnishing and installing oil engines, necessary piping and accessories, two three-phase, 60-cycle, 2300-volt alternators with exciters, switchboard, etc.; (3) electrical distribution system, consisting of furnishing and erecting poles, wires, street lamps, transformers, etc., in the village of Amenia; (4) furnishing and erecting motors and wiring for motor drive in three elevators in Amenia. Plans and specifications may be obtained on application to Earle D. Jackson, consulting engineer, Capital Bank Building, St. Paul, Minn., for which a charge of $4 will be made to cover cost of printing and mailing. H. L. Chaffee is secretary of the company.

HICKMAN, NEB.—Plans are being prepared by Grant, Fulton & Letton, Bankers' Life Building, engineers, Lincoln, for the erection of an electric transmission line from Lincoln to Hickman and an electric distribution system in the town. An election will soon be called to submit the proposal to the voters. The cost is estimated at $16,000.

PHILLIPS, NEB.—Bonds have been voted for the erection of an electric transmission line from the transmission system of the Grand Island Power Company to Phillips.

ALEXANDER, KAN.—The erection of an electric transmission line from McCracken to Alexander is under consideration.

CHANUTE, KAN.—An election will soon be called to vote on the proposal to issue $60,000 in bonds for extensions to the municipal electric lighting service.

HERNDON, KAN.—The City Council is considering the installation of additional street lamps.

MULVANE, KAN.—Henrici & Lowry, engineers, 222 Commerce Building, Kansas City, Mo., have been engaged to prepare plans for the proposed new electric plant in Mulvane.

ROSSVILLE, KAN.—The Rossville Electric Light & Ice Company, it is reported, is preparing plans for the construction of a new power house.

OSAWATOMIE, KAN.—Bids, it is understood, will soon be asked for the installation of an oramental lighting system, to cost about $12,000. The plans call for cast-iron poles mounted with a single lamp. Black & Veatch, Inter-State Building, Kansas City, Mo. are enigneers.

Southern States

UNION, S. C.—Arrangements have been made whereby electricity for the municipal electric light and power system will be supplied from the plant of the Lockhart Power Company on Broad River near Lockhart, for a period of ten years. Under the terms of the contract transmission lines will be erected to the Monarch Mills, where power will be received until the plant on the Broad River is completed. The present power plant will be maintained by the city for use in case of emergencies.

DUBLIN, GA.—A committee has been appointed by the Merchants' Association to meet the Light and Water Commission for the purpose of securing additional electricity for industrial purposes.

MILLEDGEVILLE, GA.—Bids will be received by the trustees of the Georgia State Sanitarium, Milledgeville, until July 1, for construction of nurses' home, including heating system and electric lighting, etc. The cost is estimated at about $125,000. Plans and specifications may be obtrained at the office of T. H. De Saussure, Georgia State Sanitarium, and from A. Ten Eyck Brown, architect, Forsyth Building, Atlanta.

COLDWATER, MISS.—Bonds to the amount of $10,000 have been voted for the installation of a street-lighting system and the erection of an electric transmission line from Senatobia.

LEXINGTON, MISS.—Bonds to the amount of $40,000 have been voted for the installation of a municipal electric light plant in Lexington.

CONWAY, ARK.—Extensions and improvements, involving an expenditure of about $50,000, to the municipal electric light plant are under consideration.

MARIANNA, ARK.—The Arkansas Corporation Commission has instructed the Arkansas Light & Power Company to make improvements to its local plant, among which are included the installation of new boilers and pumps, overhauling engines, installation of additional machinery and equipment, repairing of switchboard, additional street lamps, etc.

AFTON, OKLA.—Bonds to the amount of $10,000 have been authorized for improvements to the municipal electric light plant and $18,000 in bonds for extensions to water system.

HUGO, OKLA.—H. R. Jones and others of Hugo are contemplating the construction of a flour mill here, to cost about $50,000. A power plant, it is understood, will be installed in connection with the project.

KEOTA, OKLA.—The Midland Valley Coal Company, it is reported, is in the market for coal mining and power plant equipment, to cost about $20,000. A. U. Davidson and others are interested in the company.

NEWKIRK, OKLA.—Bonds to the amount of $185,000 have been voted for extensions to the water and lighting systems.

TONKAWA, OKLA.—Plans are being prepared for improvements to the municipal electric light plant and waterworks system. The Benham Engineering Company, Colcord Building, Oklahoma City, is engineer.

DALLAS, TEX.—The Dallas Power & Light Company is contemplating the construction of a substation, to cost about $250,000.

ENNIS, TEX.—The installation of a municipal electric light plant in Ennis is under consideration.

HOUSTON, TEX.—Preparations are being made by the Mack Oil & Water Well Screen Company, Kress Building, Houston, for the construction of a new plant, to cost about $200,000. The plant will be equipped with electrically operated machinery. J. O. Mack is manager.

Pacific and Mountain States

HOQUIAM, WASH.—The Western Rolling Mills Company, which is building a steel mill in Hoquiam, is reported to be in the market for machinery, including cranes, open-hearth furnaces, and later on an electric furnace. About 1200 hp. in motors will also be required for the proposed plant. Power will be purchased from the Gray's Harbor Railway & Light Company.

OROVILLE, WASH.—Preparations are being made by the Okanogan Valley Power Company for the construction of a dam on the Similkameen River, 3½ miles above Oroville. The proposed dam will be 350 ft. long and 60 ft. high and will be built above the falls, which will give a total head of 80 ft. The first of the new units, it is estimated, will develop 2000 hp. The cost of the first unit is estimated at about $150,000. Eugene Enloe of Spokane is president.

SEATTLE, WASH.—In a communication to the City Council, J. D. Ross, superintendent of the municipal electric plant, states that the municipal plant is taxed to the limit and recommends an appropriation of $764,360 for the installation of a third unit of 15,000 kw. in the Lake Union steam plant immediately.

VANCOUVER, WASH.—The installation of cluster lamps on Washington and Main Streets is under consideration by the Commercial Club. Plans have been submitted by the Portland Railway, Light & Power Company for installation of the lamps.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has filed application with the State Engineer for storage of 40,400 acre ft. of water from Oak Creek for development of power along the Clackamas River. The cost of the reservoir is estimated at about $300,000.

MARE ISLAND, CAL.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 25, under Specification 3903, for electric traveling cranes for a structural shop at Mare Island, to cost about $250,000. A deposit of $10 is required for plans.

VENTURA, CAL.—Plans are being prepared by A. C. Martin, architect, Higgins Building, Los Angeles, for the erection of a County Hospital in Ventura, to cost between $150,000 and $200,000. The plans provide for hospital building, service and power house, nurses' home, residence building and four cottages.

IDAHO FALLS, IDAHO.—The Utah Power & Light Company of Salt Lake City, Utah, it is reported, is contemplating further developments in this section, including the erection of an electric transmission line from McCammon to Shelley, where it will connect with its present system serving the territory from Idaho Falls to Ashton. Another transmission line will also be built from Idaho Falls to St. Anthony. The company has entered into a contract with the Idaho Dry Farm Development Company to furnish energy for pumping operations.

Canada

PORTAGE LA PRAIRIE, MAN.—The by-law authorizing the construction of hydroelectric stations between Winnipeg and Portage la Prairie, to cost $275,000, has been approved by the ratepayers.

BROCKVILLE, ONT.—The Brockville Public Utilities Commission is considering equipping the Brockville and Westport branch of the Canadian government railway for electrical operation. The line is 45 miles long and serves a farming section.

PORT ARTHUR, ONT.—Bids will be received by M. H. Macleod, vice-president Canadian National Railways, 27 Wellington Street, Toronto, until June 30 for the construction of the superstructure of a grain elevator workhouse of 700,000 bushels capacity, with unloading shed and complete elevator equipment.

TORONTO, ONT.—Plans have been prepared by J. M. Jeffrey, architect, Confederate Life Building, for the erection of a theater on Victoria Street for the Paramount Film Company, 21 Adelaide Street West, to cost about $600,000.

SHAWINIGAN FALLS, QUE.—Bids will be received by the Town Council until July 1 for the construction of an electric light plant, to cost about $35,000. B. S. Atkins is engineer.

SWIFT CURRENT, SASK.—The municipal electric plant was recently destroyed by fire, causing a loss of about $60,000. The plant, it is understood, will be rebuilt and new equipment purchased.

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(Issued May 27, 1919)

1,305,202. WAVE METER; Harold P. Donle, Meriden, Conn. App. Dec. 15, 1917. Inductance and capacity in compact form.

1,305,213. PICKLING FERROUS ARTICLES AND ELECTRICALLY REGENERATING THE PICKLING BATH; Addison F. Hoffman, Pittsburgh, Pa. App. filed Jan. 23, 1917.

1,305,225. PRINTING TELEGRAPH; Charles Meriden, Conn. App. filed Dec. 15, 1917. Ill. App. filed Nov. 29, 1909.

1,305,227. ELECTRIC METER; Paul M. Lincoln, Pittsburgh, Pa. App. filed May 18, 1915. Produces a load-factor meter.

1,305,234. LIGHTING FIXTURE; Robert F. Pierce, Collingswood, N. J. App. filed June 1, 1915. Wide distribution.

1,305,240. AUXILIARY DEVICE FOR THE ETCHING OF ARCH-SHAPED WOLLASTON WIRES FOR THE HEAT CONDUCTORS OF THERMIC TELEPHONES; Robert Aernout Baron van Lynden, Utrecht, Netherlands. App. filed March 22, 1919.

(Issued June 3, 1919)

1,305,247. MANUFACTURE OF ELECTRIC CABLES; Charles J. Beaver, Hale, Eng. App. filed Nov. 27, 1918. Twin-core cable composed of two conductors.

1,305,250. MANUFACTURE OF DRY CELLS; Charles F. Burgess, Madison, Wis. App. filed Oct. 20, 1917.

1,305,251. MANUFACTURE OF DRY CELLS; Charles F. Burgess, Madison, Wis. App. filed Oct. 20, 1917.

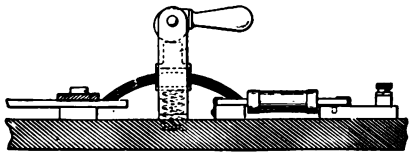
1,305,252. MANUFACTURE OF DRY CELLS; Charles F. Burgess, Madison, Wis. App. filed Oct. 20, 1917.

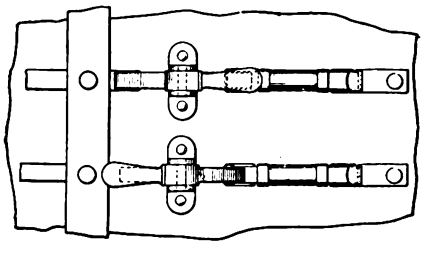
1,305,255. INDICATOR; William A. Dorais and Joseph B. Feise, O'Fallon, Mo. App. filed March 19, 1915. For use in railway trains.

1,305,268. CIRCUIT CONTROLLER; Clarence T. Evans, Milwaukee, Wis. App. filed April 15, 1916. Effects commutation and phase reversal of the windings of alternating-current motors.

1,305,285. ADJUSTABLE FIXTURE FOR ELECTRIC LAMPS; Charles A. Hinsdill, Troy, N. Y. App. filed Dec. 12, 1914. Mounted on pipe which serves as conduit.

1,305,295. INCANDESCENT ELECTRIC LAMP; Clarence H. McKay, Reading, Mass. App. filed Jan. 2, 1918. Incandescing member of thin sheet material having parallel sides.





1,305,376—Switchboard Mechanism

1,305,308. ELECTRIC PLUG AND SOCKET; Frederick W. Richter, St. Louis, Mo. App. filed April 12, 1917. Means for adjusting the contact shanks vertically.

1,305,315. TIRE-DEFLATING INDICATOR; Albert L. Stahl, Memphis, Tenn. App. filed March 30, 1918. Eliminates rim-cut tires.

1,305,323. CUTTER FOR PERFORATING MUSIC SHEETS; Bartolome Vergara, Mexico, Mexico. App. filed March 15, 1918. Includes a set of cutting knives.

1,305,350. EXTRACTION OF MOLYBDENUM; Tormod Reinert Forland, Haugesund, Norway. App. filed April 15, 1918. Free from carbon.

1,305,352. AUTOMOBILE-THEFT DETECTOR MEANS; Travilla C. Gettell, Philadelphia, Pa. App. filed Feb. 26, 1917. Sounds an alarm.

Record of Electrical Patents

Notes on United States Patents

1,305,360. ALTERNATING-CURRENT WELDING TRANSFORMER; Claude J. Holslag, Peekskill, N. Y. App. filed Oct. 24, 1917. Self-controlled apparatus; gives proper heat control.

1,305,361. ALTERNATING-CURRENT WELDING TRANSFORMER; Claude J. Holslag, Peekskill, N. Y. App. filed Jan. 14, 1918. Portion of the secondary winding is commingled with the primary winding, and the remainder of the secondary winding is wound on the core remote from the primary.

1,305,362. METHOD OF ELECTRIC ARC WELDING, CUTTING AND REPAIRING; Claude J. Holslag, Peekskill, N. Y. App. filed April 30, 1918. Constant rate of energy at the arc.

1,305,363. ALTERNATING-CURRENT METALLIC-ARC CUTTING AND WELDING APPARATUS; Claude J. Holslag, Peekskill, N. Y. App. filed Sept. 21, 1918. With closed-circuit core transformer.

1,305,374. SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed May 19, 1913. Allows busbars to get more insulated air space.

1,305,375. MOTOR-STARTING SWITCH; Hubert F. Krantz, Brooklyn, N. Y. App. filed Feb. 18, 1916. Two switch units may be operated from a single hand.

1,305,376. SWITCHBOARD MECHANISM; Hubert Krantz, Brooklyn, N. Y. App. filed June 16, 1917. Eliminates inter-exposed joints and extensions between fuse and switch-blade.

1,305,381. RELAY; Walter S. Levin, San Francisco, Cal. App. filed May 5, 1915. Line-circuit train signaling and stopping apparatus.

1,305,394. STOVE CONSTRUCTION; Robert H. Miller, Detroit, Mich. App. filed May 12, 1917. Insulated walls are built up of blocks.

1,305,443. ELECTROLYTIC CELL; Lewis W. Chubb, Edgewood Park, Pa. App. filed April 5, 1917.

1,305,458. ELECTROLYTIC CELL; Charles Le G. Fortescue, Pittsburgh, Pa. App. filed April 4, 1917. Long, narrow and deep trough composed of sheet aluminum, magnesium, tantalum or other filming metal.

1,305,485. COMPOSITION FOR THE MANUFACTURE OF DRY CELLS; George W. B. Nefe and Emanuel A. Jenkins, Sandy, Utah. App. filed May 20, 1918.

1,305,495. APPARATUS FOR EXCITING ROENTGEN-RAY TUBES; Frank Rieber, San Francisco, Cal. App. filed Jan. 29, 1917. Potential applied to the Roentgen tube may be altered.

1,305,503. SPOT-WELDING; Waddy R. Thomson, Lancaster, S. C. App. filed July 9, 1917. Method of splicing steel-bale strapping.

1,305,514. CURRENT INDICATOR; Arthur F. Berry, Ealing, England. App. filed May 12, 1917. Indicates whether heating device is in operation.

1,305,525. TRANSMITTING APPARATUS; John J. Comer, Chicago, Ill. App. filed March 25, 1914. Needle vibrates perpendicularly to the surface of the phonograph record.

1,305,536. PRINTING-TELEGRAPH RECEIVER; Harry V. Grotjohann, Chicago, Ill. App. filed May 10, 1918. Prevents the wheel carriage from advancing beyond a predetermined position.

1,305,541. ROTARY SNAP SWITCH; John P. Hayes and John E. Barnhart, Pittsburgh, Pa. App. filed July 17, 1917. Contacts are rotated into and out of operative connection.

1,305,559. TIMER; Henry W. Muhleisen and Clemmen Lund, Los Angeles, Cal. App. filed Oct. 21, 1918. Combined rolling and sliding contact.

1,305,601. IGNITION DEVICE FOR MOTOR-VEHICLES; John A. Heany, New Haven, Conn. App. filed July 27, 1910. Single unit.

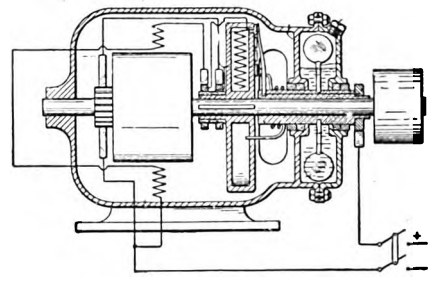
1,305,604. CORE MEMBER FOR DYNAMO-ELECTRIC MACHINES; George H. F. Holy, Pittsburgh, Pa. App. filed July 14, 1915. Turning plates is prevented.

1,305,609. DIRECTION INDICATOR FOR AUTOMOBILES; Thomas F. Kiernan, Salida, Cal. App. filed June 12, 1917. Mounted at rear.

1,305,610. FLOOR BOX; Hubert Krantz, Brooklyn, N. Y. App. filed Sept. 27, 1915. Water-tight.

1,305,611. OUTLET BOX; Hubert Krantz, New York, N. Y. App. filed May 4, 1916. Electrical connection with the supply mains is automatically controlled.

1,305,612. ELECTRICALLY CONTROLLED CLUTCH; Walter Langdon-Davies, Weybridge, Eng. App. filed May 5, 1917. Electromagnetic.



1,305,961—Speed-Controlled Rheostat

1,305,620. TELEGRAPH SYSTEM; Edwin Pope, Quebec, Canada. App. filed June 10, 1915. Number of independent messages may be simultaneously transmitted over the same wire.

1,305,649. CIRCUIT INTERRUPTER FOR TRAFFIC SIGNALS; Otto Freytag, Boise, Idaho. App. filed May 11, 1917. Mechanically driven device for the purpose of making and breaking the electrical circuit at short intervals.

1,305,657. SEPARATOR AND SECONDARY BATTERIES; Joseph O. Luthy, San Antonio, Tex. App. filed Jan. 16, 1919. Little resistance to the flow of the fluid.

1,305,658. SEPARATOR FOR SECONDARY BATTERIES; Joseph O. Luthy, San Antonio, Tex. App. filed Jan. 16, 1919. Permits free flow of the fluid from one battery plate to the other.

1,305,690. GRID-MAKING MACHINE; Henry S. Coyer, New York, N. Y. App. filed May 7, 1918. Automatically winds wire around two separated supporting posts.

1,305,712. INSULATOR CAP; Walter T. Goddard, Victor, N. Y. App. filed Dec. 8, 1917. Permits making the entire structure of stamped sheet metal.

1,305,725. ELECTRIC MASSAGE MACHINE; Charles W. Kent, Peoria, Ill. App. filed July 5, 1918. Strength of the secondary current may be varied.

1,305,814. ELECTRIC ACCUMULATOR PLATE; Henry Leitner, Westminster, London, England. App. filed Dec. 16, 1918. Lead sulphuric-acid bipolar type.

1,305,816. SPARK-GAP DEVICE; Fritz Lowenstein, Brooklyn, N. Y. App. filed Aug. 25, 1914. Quenched.

1,305,836. SIGNAL; Ferdinand L. Schoening, Brooklyn, N. Y. App. filed July 18, 1917. For broken wire in stitching machine.

1,305,937. ELECTROMAGNETIC OVERLOAD DEVICE; Charles H. Ripple, Cleveland, Ohio. App. filed July 6, 1917. Inverse time element.

1,305,961. SPEED-CONTROLLED RHEOSTAT; Hubert A. Burgess, Seattle, Wash. App. filed Dec. 5, 1917. Automatically regulates the current supplied to the armature and field coils of an electric motor in proportion to the demand to enable the motor being started from rest and accelerated to operate without injuring the motor.

1,305,963. OIL-GAGE SIGNAL AND CIRCUIT BREAKER; Herbert M. Dickerson, Evansville, Ind. App. filed May 10, 1917. Breaks ignition circuit of internal-combustion engine when oil falls below certain level.

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

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Daylight Saving Doomed

THE advantages of daylight saving are many and its advocates have advertised them far and wide; its disadvantages are, however, fast becoming known, and as a result the daylight-saving law ought to be, and in all probability will be, repealed at the present session of Congress. The claim that the electric and gas utilities are the mainstay of the opposition against the measure is false. That these utilities have suffered monetary loss because of daylight saving is a fact, but they bore the loss with good grace, knowing that it is futile to oppose any movement for the public good. A fair trial shows that the disadvantages of daylight saving outweigh its advantages. Farmers are bitterly opposed to its continuance, and the American Federation of Labor is apathetic to resolutions protesting against its repeal. With such opposition the law is doomed, and the electric utilities can look forward to regaining the increment of income which the law wrested from them.

When, in the future, we glance back over our use of our opportunities, what will the electrical industry say of itself? Is it looking carefully to the open doors of conservation, centralization of resources and interconnection, and will it take every chance for progress that the law and economics present?

The Obligation to Help

IT IS generally recognized that the commerce of to-day and to-morrow will be predicated on international intercourse. Intelligent self-interest, therefore, dictates that the American electrical industry should become international in viewpoint if not in scope. As every lover of pure science knows, wisdom and truth have no national barriers, and unless we profit from the skill, knowledge and experience of others, our development both nationally and individually is retarded. If, therefore, the world is to advance and humanity to be benefited, all departments of scientific thought and action must be coördinated, technics and economics must be studied together and individual efforts directed for the general good of all. There are three lines along which development can take place—financial, industrial and educational—and while we in the United States possess besides great wealth the ability to build super-organizations, we still lack the incentive to delve deeply into the hidden mysteries of science from the purely educational motives which have dominated our European brothers. From them and their progenitors we have learned much—ay, the electrical industry in particular is indebted to Europeans in greater measure than many are conscious of. It behooves it, therefore, to take cognizance of its obligations to European science and to repay the debt as promptly and as well as it can. Italy, France and England are at present backward in electrical applications, yet Italy gave the world Volta and Galvani, France contributed Coulomb, Ampère and Foucault, and England raised Faraday, Maxwell, Kelvin and a host of others, to all of whom electrical science is indebted. American skill and ingenuity as well as American capital can be utilized in developing the hydroelectric resources of Europe, in erecting superstations and high-tension transmission lines and in the operation of vast interconnected systems, because it is along these lines that American electrical engineers are particularly adept. European wants in this regard are pressing, and the response of the American electrical industry to these needs should be prompt and generous.

Bituminous coal production has improved a little from the low level reached a short time ago. Central-station companies naturally are reluctant to maintain large reserve stocks at high prices but they cannot escape the obligation to provide safeguards for continuous service. The coal situation is not yet stabilized.

Problems of Supervoltage Transmission

THE study by A. E. Silver of the possibilities of power transmission at a voltage hitherto untried, as presented in a paper read before the A. I. E. E. this week and abstracted elsewhere in this issue, is well worth careful consideration. The coming of long-distance power supply from coal fields and hydroelectric stations in immense quantities raises new questions of economy. Present voltages ranging to 150,000 have proved thoroughly workable, and the obvious step is to still higher figures to reduce the cost of conductors. General experience has been that the anticipated difficulties of increasing voltage have been greatly overestimated, like those apprehended from increased length of lines, so that Mr. Silver's proposition of 220,000 volts will hardly cause the raising of an eyebrow, so far as its practicability is concerned. As a mere engineering feat there is little doubt of success, for transformers for this pressure have already been constructed and the proper arrangement of suspension insulators for the line insulation is fully determined from experience now at hand. The unknown factors in the case are the reliability of the transformers in continued use, the adequacy of the necessary switching devices and the maintenance of the lines under the untried stresses which must be dealt with.

As to transformers, the situation is somewhat relieved by the fact that they would be of very great capacity, since 220,000-volt working would not be justified save for large amounts of power demanding large units. But

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no one now knows how well existing transformer insulation will stand the greatly increased dielectric stresses for twenty-four hours a day all the year. The transformers already built for extreme voltages have been mainly of the testing class used discontinuously or for comparatively short experimental runs, and their endurance at full load is as yet undetermined. It is not a question of possibility, for our transformer designers can be trusted eventually to meet the requirements, but merely whether or not a new scheme of insulation must be devised and what the product will cost in original outlay and maintenance. Other things being equal in the operative sense, line copper is an investment of more permanent character than apparatus, and the total annual charge as respects both is the thing to be considered. Of the apparatus required, the switching outfit is second only to the transformers. It becomes a rather formidable proposition at 220,000 volts, perhaps best met by switching as far as possible on the low-voltage side and regarding the transformers as part of the line, not of the generating plant. There is no reason why overload or out-of-balance relays should not clear the lines on the low-voltage side when trouble of a serious kind occurs, especially since in an important transmission project the circuits would certainly be in duplicate.

As to the upkeep of the lines, only experience can furnish even an estimate. At an extreme voltage like that proposed there are new elements to be considered. The magnitude and effect of the corona losses must be taken into account, and since the lines involved will be both exceptionally long and heavily loaded, the possibilities of surging and allied phenomena take on an importance not heretofore realized. Protection against lightning too may require considerable specialization on account of the extremely high normal stresses and resulting impairment of the factors of safety. On these matters of upkeep hinge the economics of the situation. As a matter of fact, the conditions that clearly call for a large increase of working voltages are as yet very rare. They will become common only as very large output must be transmitted over distances now unusual. And even so, the matter of necessary interconnection introduces practical difficulties since in a complete development many plants of moderate size must be taken into account in which very high voltage loses its economic advantage. We are inclined to think that the rôle of voltages of 200,000 and more is likely to be in the constitution of linkage networks, comparatively simple, interconnecting a few very large plants at suitable places with the main working network fed by stations of moderate capacity like most hydroelectric installations. When the need of sending several hundred thousand horsepower a few hundred miles actually arises we have little doubt that the voltage will be appropriately raised, and with operative success; but there is much yet to be learned about the practical economics of the situation. The first try-out should be on no colossal scale, but directly toward the determination of transformer and line endurance under conditions readily permitting dropping back to more conservative figures if need be, pending further experimentation. The whole history of power transmission furnishes one encouragement for the future. It is but five and twenty years since the sole 10,000-volt plant in our country was operating with twenty 500-volt transformers in series to obtain its superlative line voltage. Every uplift since then has met its reward.

International World Trade Conditions

MANUFACTURERS of electrical supplies have two purposes in their study of international trade conditions. One is to prepare to present to Congress data in connection with the tariff on the classes of products that they make; the other is to furnish information and advice about export markets. In their study of the tariff situation the manufacturers of electrical supplies are coöperating with the manufacturers of electrical apparatus (including generators, motors and control apparatus) so that the lines of inquiry are similar; and in the investigation of export markets substantial assistance is promised through the proposed organization or association to undertake research work in this direction. These matters were considered in some detail at one of the sessions of the Associated Manufacturers of Electrical Supplies at New London, Conn., as reported in last week's issue of the ELECTRICAL WORLD. They are all vital issues to the electrical manufacturers, and it is to be earnestly hoped that full support will be given to the various movements of this character so that all of the facts may be made perfectly clear. The electrical industry, like other industries, is completely in the dark as to just what international conditions will have to be faced. Day by day we are brought to a keener realization of the changes of war. Old currents of world trade are diverted and no one can tell just where and how they will run in the future. The industry is bound up with the international policies of the whole country. Economics and the trade relations of nation to nation will be large subjects which will require the best thought of the industry for a long time. Coördination of all effort in the investigation of international trade conditions and careful searching for the facts before any action is taken will be important. These measures will surely guide the electrical industry to a position in accord with the national policies. Necessarily it will be a question of a long period before the world future conditions can be seen, and no certain conclusions can be expected until they are more clearly defined.

It is when needed commodities become scarce that the world appraises their value highly. Just now this is the great fact on food. Yet we go blindly forward consuming our fuel resources, and the future years and generations will find us guilty of criminal waste of water power.

The Use of Protective Relays

AN EXTREMELY useful résumé of current practice in the application of protective relays to the operation of lines was presented before the American Institute of Electrical Engineers Wednesday by Messrs. Woodrow, Roper, Travers and MacGahan and is covered quite fully in this issue. In the beginning most central stations started out with a substantially radial system of feeders protected by current-limiting devices at the station. As the requirements of distribution grew this simple arrangement soon passed the limits of its usefulness, and steps had to be taken to prevent serious disturbance of the service by faults in the ever-increasing complex system of distribution. More particularly did extra protection become necessary when the radial systems were involved in networks, interlinking in various ways the feeders from the station, and when substa-

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tions in course of time were added operating in multiple with the original source of energy. The evolution of networks is a necessary part of modern distribution systems. A radial plan of operation in the long run involves very wasteful use of copper, bad enough at all times, extremely serious when the distribution is underground. The wandering of the load at different periods, a subject which even now has been very insufficiently studied, makes necessary for sake of economy network connections between parts of the system, which must now be considered almost universally as an interconnected whole.

Hence has grown up the use of protective relays so thoroughly studied by the authors of the paper in hand. The commonest and most generally used scheme of protection is that of inverse-time relays set for different periods of action so that in case of a short circuit or other extraordinary demand the relay system will not fall like a row of bricks, involving large areas in loss of service, but will act selectively, catching the overload in such wise as to segregate only the region immediately affected. In a comparatively simple distribution system such a plan can be carried out very effectively if the relays—and this is a point on which the authors lay stress—are systematically tested and set to the requirements of the existing situation. As networks grow, however, something more is necessary, and the most important development has been in directional relays, often referred to as reverse-power relays, which prevent particularly the serious interference of substations.

To these simple applications there have been added from time to time others, many of which are familiar, controlling abnormal increase or decrease of current, voltage, watts or frequency. And these instruments exist in various combinations and modifications concerning which the authors have something to say. It is perhaps worth while directing special attention to one composite form in which the under-voltage and over-current principles are combined. This arrangement at times is of large practical value.

Beyond these are still another group of protective devices depending on the balance between the currents in different circuits or at different points of the same circuit. These involve, when the scheme is thoroughly carried out, duplicate lines in parallel, split-conductor cables or cables with pilot wires, all of which have been successfully applied. So far as present practice goes, no one general system has found its way into very extensive use when one passes beyond the rudimentary necessities of a simple distribution. As complex networks have grown up the treatment of these safety precautions has necessarily been somewhat symptomatic, various devices being used as and where they promised good results.

If one could start out afresh and develop the distribution lines for a large central station, some unified system of line protection, quite likely on the balance principle, could be worked out to its logical end. As things are, the aggregate of the necessities which have arisen from time to time have compelled dealing with conditions as they are, which accounts for the very diverse practice now to be found. The authors of this paper have outlined the situation as it exists in an extremely useful and practical way, and station operators will find their study of the situation very much to the point.

Foreign Transmission Projects

THE stress of war, with the accompanying disorganization of the coal supply, has had a most powerful influence in arousing new interest in projects for general power supply, whether from steam or hydroelectric stations. When it is realized that a sudden stroke of war may entirely demoralize the transportation upon which fuel supply depends, the necessity of such steps is sufficiently obvious. Particularly is it so since the next war is likely to break out without a word of warning, the aggressor depending on the effectiveness of a sudden stroke delivered before the slow and creaking machinery of loosely organized alliances may find time to rouse resistance.

Two countries in particular may be mentioned as making vigorous efforts toward improvement of the electrical supply—the one England, formulating a broad plan of correlation for electrical enterprises; the other Japan, at the further side of the world, rising to the development of the unutilized water powers with a well-worked-out project for a general survey. We have described already at some length (in the June 7 and 14 issues) the English plans, which are directed toward the formation of district boards with plenary powers able to undertake on a large scale the provision of electric power, with due guard placed over the rights of existing private enterprises, and toward general coöperation among the superstations for power supply which have already been projected. From necessity England must depend very largely on generating stations placed at or very near cheap coal supply, her hydroelectric possibilities being somewhat limited.

Japan, on the other hand, is rich in water powers. About 1,000,000 hp. is now developed by hydroelectric stations; double this amount is under lease for exploitation, while about 5,000,000 hp. remains undeveloped and unsurveyed. The project of investigation for the Japanese government is a very comprehensive one. It includes the coöperation of twenty-two survey parties which are examining more than 300 streams and double that number of power sites, aggregating more than 5,000,000 hp. Three hundred and twenty gaging stations and more than 700 points of observation of rainfall and other phenomena are to be established, so that a great mass of precise information will be available to guide the future developments. No power site of less than 1000 hp. will be considered at present. In studying the possibilities of flow two classes of observing stations are made use of, one merely recording the quantities of rain and snow, the other, more fully equipped, in addition keeping records of evaporation and temperature. Between the two it should be possible in a very few years to get a much better idea of the real available resources than has usually been attainable.

In our own country comparatively few streams have been studied in a way sufficiently comprehensive to give at once information as to the flow and also as to the conditions which affect run-off. We have, it is true, large projects for universal power systems under consideration, but there is lacking as a rule the correlated effort and the unification of authority necessary to make them genuinely effective. The war has brought home to us the need of coördinated action in developing the great power resources of the country, and the vital question for the future is whether we shall forget this, like other lessons of the war, or shall drive ahead to obtain the benefits which are in sight.

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220,000-Volt Transmission an Immediate Possibility

Especially Adapted to Bringing Large Blocks of Power from Coal Mines and Water Powers to Industrial Markets—Technical Problems Not Serious—Some Research Necessary

THE dependence of industrial progress upon an adequate supply of electrical power, together with the vital need for a rational policy of conservation of the country's fuel resources, points to a probable early demand for transmission of large blocks of power from distant energy sources—coal fields and water powers. In the opinion of A. E. Silver, Electric Bond & Share Company, who presented an elaborate paper before the American Institute of Electrical Engineers at Lake Placid, N. Y., last Wednesday, 220 kilovolts is a logical voltage for such high capacity, long-distance transmission. Immediate adoption of this voltage is commercially feasible, he said, if established principles of design and present types of equipment are adapted to the new conditions. Current-design principles and materials now in ordinary use will be employed, the principal difference from present high-voltage equipment being the greater amounts of insulation and the larger clearances required. While all essential problems seem assured of solution, Mr. Silver directed attention to certain points which need further investigation and experimental research in order to determine the most effective designs. In doing so the important problems introduced by large concentrations of power, high voltage and high-service standards were discussed and several general designs considered as a basis for an economic study. Some of the features of his paper follow.

220 Kv. Adequate for Pending Needs

Two hundred and twenty kilovolts appears to be a logical voltage for the next step in transmission development because it is considered adequate for the pending needs of the industry and is commensurate with expected growth in transmission service for a considerable period. Such an advance in voltage would afford a distinct economic advantage and does not reach so far into uninvestigated fields but that the problems of development and design can be approached with full confidence of early commercial solution. Furthermore, this voltage is a multiple of 11,000 and 110,000. The advantages of 220 kv. over 150 kv. are shown by Figs. 1 and 2, which are based on a transmitted load of 500,000 kw. The same relative advantage will apply for larger loads and above a certain minimum for smaller loads.

The economic application of 220 kv. is primarily limited to the transmission of large blocks of power over considerable distances. It presumably will infringe to some extent upon present fields of lower transmission voltages, but will by no means supersede their use. It is not universally suitable for extensive interconnection of power systems. Interconnection at 220 kv. would be expected only where the equalizing duty reaches a great magnitude, where there is no existing secondary transmission system suitable to serve as a basis for interconnecting lines, or where interconnecting 220-kv. lines might function also as a supplementary or reserve link in a main 220-kv. trunk transmission system.

The initial investment in a 220-kv. transmission system, including as essentials the step-up and step-down stations, will be of such magnitude that there will be a strong inducement to utilize the investment as nearly continuously as practicable, thus reducing the unit transmission cost of energy supplied. Hence the tendency in introducing this voltage will be to supply base load, leaving peak loads to existing local generating stations. In view of the volume of industrial enterprises and public utilities which would be dependent on 220-kv. transmission, reliability and continuity of power supply would be of such a high order that new standards of care in design and conservation in construction would be necessary.

In arriving at his conclusions, some of which are presented here, Mr. Silver assumed that load per 220-kv. circuit would be from 100,000 kw. to 125,000 kw. A lower load would entail a considerable sacrifice of economy. No discussion is offered as to the maximum economic load per circuit since in any initial system the number of circuits would be determined by reliability insurance or load distribution rather than by maximum inherent economy. The economic transmission range of 220 kv. is very large, but for this study it has generally been assumed to be 250 miles (400) km.). A frequency of 60 cycles is considered best. Grounded Y-connections have a marked advantage for this voltage because of the distinct gain in dependability and the lower line and

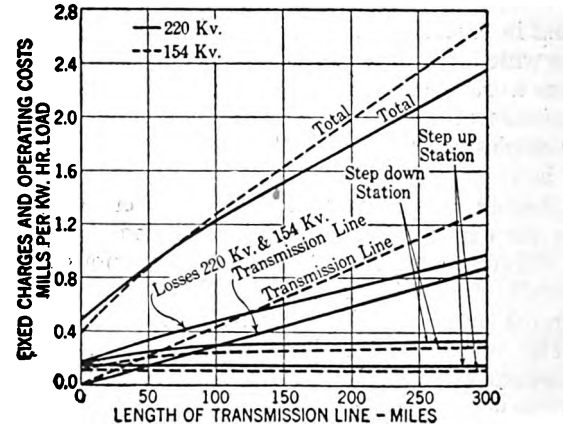

FIG. 1—ECONOMIC COMPARISON OF FIXED CHARGES AND OPERATING COSTS FOR 154-KV. AND 220-KV. TRANSMISSION LINES DELIVERING 500,000 KW.

Based on four 220-kv. circuits and seven 154-kv. circuits. Costs and losses include those of lines, step-up and step-down substations and synchronous condensers. Cost of line per mile: 154-kv., $20,000; 220-kv., $23,500 (early 1919 prices). Size of conductor, 92,900-circ.mil steel, 716,000-circ.mil aluminum. Losses based on 0.95 load factor and 0.85 power factor. Cost of energy, 5 mills per kw.-hr. Fixed charges and operating expenses of transmission lines, 13 per cent; substations, 15 per cent. Voltages on high side of transformers: Receiver end, 150 kv. and 200 kv. respectively; sending end, 170 kv. and 225 kv. respectively.

equipment insulation with their attendant effect upon size and cost of equipment.

For simultaneous conditions of conductor loading, used as a basis for design, the following were assumed: Wind pressure of 8 lb. per square foot of projected area, 1½ in. radial thickness of ice, and a temperature of zero deg. Fahr. Justification for these apparently extreme loads is found in the high service standards which are

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demanded. Corona formation and loss enter as a significant factor at a voltage of 220 kv. so an average elevation of 1000 ft. (300 m), a storm factor of 12.5 per cent and a barometer (during storms) of 28.4 in. (71 cm.) were assumed.

Three commercially practicable types of conductors—aluminum with steel core, copper with steel core and all

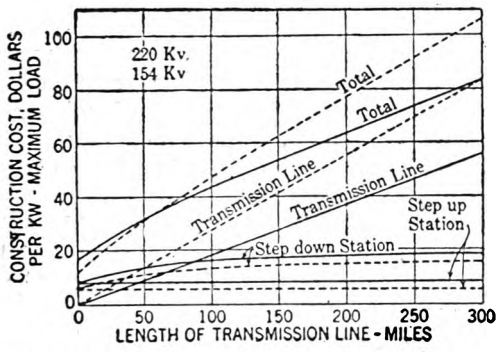

FIG. 2—ECONOMIC COMPARISON OF CONSTRUCTION COST FOR 150-KV. AND 220-KV. LINES (SEE FIG. 1)

copper—were considered. These may be compared as follows:

Aluminum steel versus copper steel:

1. Less corona loss, due to larger diameter.
2. Skin effect presumably approximately equal.
3. Greater area exposed to wind loading, hence greater transverse tower strength and greater clearances required.
4. Less tensile strength, hence more limitation upon height and spacing of towers.
5. Less weight (unimportant).

All-copper versus composite cable:

1. More corona, greater than either of above.
2. All material effective as a conductor.
3. Skin effect more serious in larger sizes, owing to high-priced material in the core.
4. Less area exposed to wind loading.
5. Less weight than copper steel.
7. Homogeneity of material, hence certain advantages in construction, more positive assurance of durability and higher scrap value.

For the purpose of developing tower designs a cable of 716,000 circ.mils of aluminum and 93,000 circ.mils of steel was used. Corona losses at various load factors are shown in Fig. 3, while the line characteristics for an aluminum-steel circuit are shown in Fig. 4. In the paper presented at Lake Placid the relative economy of various sizes and types of conductors was indicated graphically, but it is not reproduced here. It took into account interest, taxes and amortization charges and annual value of lost power. The curve falling lowest on the scale at any number of years which may be assumed as the life of the line represented the most economical conductor. If the life is considered to be about forty-eight years, the annual cost is about $200,000 for aluminum steel about 1 in. in diameter at 60 per cent load factor and from $400,000 to $450,000 for copper steel at the same load factor. At 90 per cent load factor the annual cost ranges from $575,000 to $630,000 for the copper steel and from $500,000 to $550,000 for the aluminum steel. While the total costs are higher for the higher load factors, the unit costs would be lower.

STRINGING COMPOSITE CONDUCTOR A PROBLEM

Within any limits thus far investigated, it appears economical, under the design loading assumed, to utilize the full strength of aluminum steel up to its elastic limit—*i.e.*, to keep sags to a minimum—thus enabling use of shorter towers or longer spans at the expense of stronger supporting structures at angles and dead-end points. With a new aluminum-steel cable, when the loading has been reached which will stress the steel core to its elastic limit, the aluminum will have passed its elastic limit and in consequence will be permanently stretched. As the heavy design loading is removed the aluminum strands will loosen infinitesimally on the steel core and take no stress. At lighter loadings the aluminum will be a dead load upon the steel core, which will carry all of the stress.

This difference in characteristics leads to the possibility of two different methods of stringing a composite cable—*i.e.*, it may be strung as received from the factory or it may be stressed, prior to sagging and tying in, to its full strength, 17,300 lb. (1211 kg. per sq. cm.), thus giving it nearly all of its "permanent set." (It would receive all of its "permanent set" if the stretching were done at zero deg. Fahr.). From the operating standpoint, however, it would seem preferable to string the cable without preliminary stretching. Possibly a combination of the two methods might be worked out whereby the cable would be stressed before tying in to some definite tension sufficient to insure giving the aluminum part of its "permanent" set.

Adequate splices for aluminum-steel cables no longer are considered to present a problem. In view of the

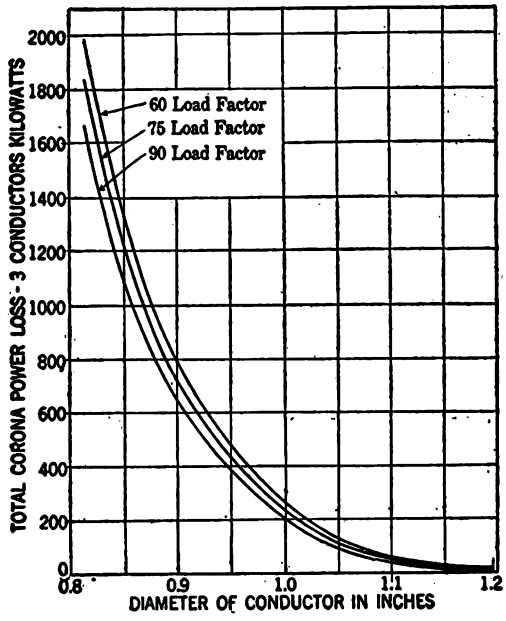

FIG. 3—CORONA POWER LOSS AT 220 KV. FOR 20-MILE CIRCUIT WITH GENERATING VOLTAGE HELD CONSTANT AT 230 KV.

The copper and copper-steel diameters considered range from 0.814 in. to 1.004 in., while the aluminum-steel diameters range from 0.952 in. to 1.196 in.

great importance of 220-kv. service it has been deemed conservative, until further experience is obtainable, to make provision for the use of ground wires.

There is no type of insulator as yet developed which has thus far demonstrated its ability to give adequate, or even reasonably satisfactory, results on high-voltage lines. Nevertheless, it is confidently believed that 220-kv. line insulation can, with existing types of insulators, be made as safe and dependable as can the line in-

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sulation of present installations. The design suggested by Mr. Silver makes provision for a string of fifteen standard units for regular suspension service on a 220-kv. grounded neutral line. This relatively large number of units affords a considerable margin for deterioration and, with proper care in maintenance, should assure a degree of reliability in service commensurate with the economic importance of 220-kv. service.

It should be noted that a string of fifteen standard units, with the necessary connecting pieces and fittings, will be nearly 9 ft. (2.7 m.) long. Such a length of insulator obviously will involve great expense in obtaining the necessary tower clearances and heights, and it is also the determining feature in fixing conductor separation. This serves again to call attention to the need of more efficient and suitable insulators. An improvement in insulator design which would justify shortening the string, in addition to improving the electrical characteristics of the insulator itself, would enable material saving in tower costs. A wholly new insulator, having no greater length than necessary to insure requisite air clearances from conductor to support, say 4 ft. or 5 ft. (1.2 m. or 1.5 m.) would enable a correspondingly greater and a very significant saving in tower costs.

Two methods are recognized as offering relief from an excessive voltage gradient at the line end of the insulator strings. The first is the grading of the insulator units used in the string. This should be accomplished by making up the string of units of two or more distinct types, differing in size or diameter or in some other feature which would cause them to have different condenser capacities, those with the larger capacities being placed nearest to the conductor. A second method of relieving this excessive concentration of stress consists in installing below or around the disk nearest the conductor suitably designed metallic shields or rings. The effect of such shields in improving the stress gradient may be even more marked than that of grading the insulator units.

A feature of the insulator situation which complicates the question of voltage stress distribution and which will have some effect upon methods of carrying out remedial measures is the fact that, in order to obtain adequate mechanical strength, two or three strings of standard disks must be used in parallel at suspension points and proportionately more at tension points.

It is believed improbable that a line sufficiently well insulated to withstand low-frequency high-power disturbances is likely to encounter trouble from high-frequency disturbances.

From the standpoint of deterioration, the non-cemented types of disk insulator, which avoid the effects of dissimilar expansion of the component materials, seem to offer and to be demonstrating marked advantages. For service at dead-end points the unsuitability of the standard disk is so pronounced that it is considered probable that resort will have to be made at once to an entirely different type of insulator. Considerable promise is offered by a relatively new type of insulator —a wooden rod insulated with compound and inclosed in a suitably petticoated procelain shell. Any desired mechanical strength can readily be obtained in an insulator of this type, so that the full dead-end tension would be carried on one unit.

Reliable and satisfactory clamps are now on the market for composite cables of somewhat smaller sizes as it is not expected that any significant difficulty will be encountered in the design of clamps suitable for a cable of the size proposed. In the design of all cable clamps for use at 220 kv., however, especial care would be required in the avoiding of sharp projections, ridges or points which might afford opportunity for formation of corona or static discharges.

Equalizer yokes and connectors present more of a problem than for present lines, since, as noted earlier, even at suspension points two or three insulator strings in parallel would be used, while if disk insulators were to be used at tension points, not less than six parallel strings would be necessary.

The long economic life which presumably a 220-kv. line would represent causes durability of material to assume even greater importance than in present practice, so that for most localities wood construction would not be economical, even assuming that the requisite strength for the heavy loads could be secured without resorting to unduly short spans. Therefore the conventional rigid steel tower has been adopted as the most available for construction in the immediate future, and a series of standard towers of different strengths, adapted to safe and economical use under varying conditions of span

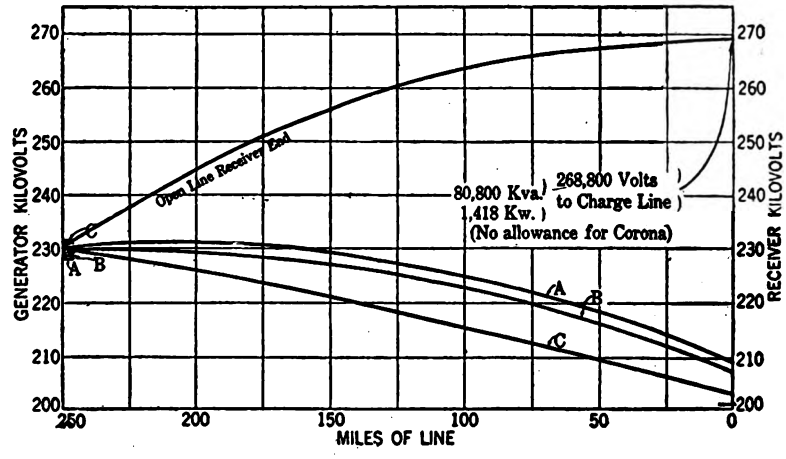

FIG. 4—CHARACTERISTICS OF ALUMINUM-STEEL TRANSMISSION LINE (SEE FIG. 1)

A refers to conditions with zero load and 49,800-kva. leading condenser capacity; *B*, 50,000-kw. load with 7500-kva. lagging condenser capacity; *C*, 100,000-kw. load with 81,000-kva. lagging condenser capacity. Loads delivered at 0.75 power factor.

lengths and angles, are considered according to the growing practice in heavy line construction. The loading basis assumed for a 220-kv. line makes it feasible, and desirable from the standpoint of economy of steel, to carry this differentiation to a greater extent than has been customary heretofore. The costs, plotted in Fig. 5, show maximum economy with normal spans of 800 ft. (240 m.) with the rigid type of tower, while longer spans or shorter spans are more expensive. The standard tower heights assumed for the four normal span lengths—550, 700, 800 and 1000 ft. (165, 210, 240 and 300 m.)—are 47, 57, 63 and 80 ft. (14.3, 17.3, 19.2 and 24.3 m.). Besides the margin of safety provided by the design loading, a further margin is introduced in the difference between working and test loads—*i.e.*, 25 per cent for suspension towers and 35 per cent for angle and dead-end towers.

While in general the character and arrangement of equipment at generating stations and substations were not a part of the primary scope of Mr. Silver's paper,

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there are certain features in connection with this equipment which directly concern the feasibility and the economic and general advantages of transmitting power at this high voltage. For instance, design for such large capacities and high voltage centers around one cardinal principle, simplicity and intrinsic strength of equipment, rather than flexibility and external protective measures. The number of buses should be reduced even to a rudimentary form, superfluous oil switches should be eliminated, and spare or reserve units need not be provided. Of course the complete omission of reserve equipment is predicated on adequate reserve capacity being available in local generating stations and on the high standard of construction formerly emphasized.

FACTORS THAT AFFECT FEASIBILITY AND ECONOMY

Certain features of the problem are high reactance of generators and transformers, ample insulation of transformers and an efficient oil circulation system, high mechanical strength of oil switches, avoidance of low-voltage buses and low-voltage paralleling, and an effective and dependable system of relay sectionalizing. All line switching, automatic or manual, should be done on the high-voltage side of transformers. The amounts of power involved, particularly under abnormal conditions, are so tremendous that the current values obtaining at lower voltages impose switch duties and heavy stresses generally which could be handled only with great difficulty and at an expense materially higher than would be required at 220 kv., when the currents involved are relatively small. No equipment of any character is contemplated for protection against over-voltages.

Considerations of simplicity in station arrangement and of economy in operation favor, in general, transformers of the largest size permitted by the conditions of each installation or by limitation of manufacture. At the present stage of the art the manufacturers advocate that transformers be not attempted beyond 50,000 kva. to 60,000 kva. for three-phase units, or beyond 35,000 kva. to 40,000 kva. for single-phase units. As to choice between three-phase and single-phase units, from the standpoint of simplicity and cheapness of installation, three-phase units would be preferable. At generating stations operating and economic considerations strongly favor the generator and its transformer equipment being connected and operated as a unit.

The large sizes of installations involved in a 220-kv. system, together with the necessity for careful attention to maintaining insulation strength and transformer reliability generally, will not improbably result in the abandonment of cooling the oil in each transformer and gravity circulation of oil through the windings in favor of forced oil circulation and external cooling. Short-circuit current values at 220 kv. are not extreme, and in a 220-kv. circuit breaker the large clearances and switch openings necessarily required by the high voltage contribute directly to giving the rupturing capacity required by the current to be handled. Two types of circuit breakers have been offered by the manufacturers for 220-kv. high-duty service. One type consists of a massive circuit breaker, each phase in one tank of heavy boiler plate, with two breaks in series for moderate duty and four breaks in series for heavy duty. Another type consists of two breaks in series per tank, one such tank being used for conditions of moderate duty and two tanks in series for heavy duty.

Substation layout rated at 220 kv. will be influenced largely by the particular local conditions of each installation. The usual type will probably serve to step down from 220 kv. to a secondary transmission voltage, such as 66 kv. or 110 kv. In such a case it will, in general, be necessary to have both a primary and a secondary bus system—at 220 kv. a simple bus with sectionalizing circuit breakers; at secondary voltage, where greater flexibility would seem desirable, probably a ring bus. Owing to the high current values which would obtain at the secondary voltage (it should be kept in mind that the large condenser capacity will aggravate short-circuit conditions), it appears advisable to provide sectionalizing reactors in this bus.

The station and substation arrangements which have been proposed are predicated upon a relay system which

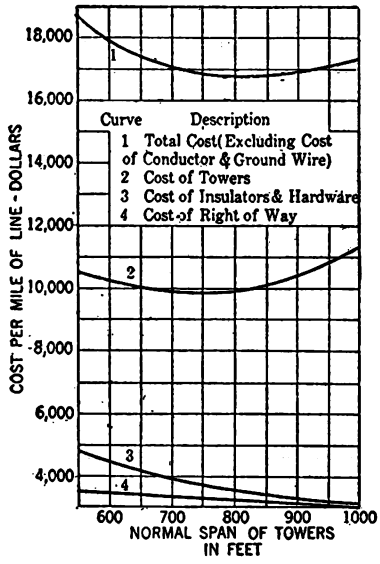

FIG. 5—RELATION OF SPAN LENGTH TO FIRST COST FOR 220-KV. TRANSMISSION

may be depended upon for insuring that a faulty piece of apparatus, transmission line or low-voltage feeder will be cut out correctly, promptly and in such a manner as to avoid interruption to the other elements of the system.

The following estimates are intended to give an indication of the installation cost of construction carried out along the lines of the assumptions and recommendations in this paper:

STEP-UP SUBSTATION

Outdoor transforming and switching structures and equipment (220-kv. apparatus and connections only), installations and indirect expense ..... $8 to $9 per kw.

STEP-DOWN SUBSTATION

Outdoor transforming and switching structures and equipment (does not include low-tension feeder bus or feeder switching equipment), synchronous condensers of capacity for length of connected lines, building, control equipment, installation and indirect expense ..... $15 to $20 per kw.

TRANSMISSION LINES

Single-circuit, steel towers, suspension insulators.

	Per Mile
Towers	$8,000
Insulators and hardware	2,800
Conductors and ground wire	5,000
Special structures	1,000
Right-of-way	3,000
Indirect expense	3,700
Total	$23,500

TOTAL COST 220-KV. TRANSMISSION

	Per Kw.
100 miles	$40 to $45
200 miles	$60 to $65
300 miles	$80 to $85

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Illinois Coal Mine Electrified Throughout

Coal Company Estimates 50 per Cent Saving by Using Central-Station Service—Energy Distributed at 2200 Volts Inside the Mine—Both Alternating-Current and Direct-Current Equipment Employed

THE proposition of erecting and operating a steam power plant was accurately balanced against using central-station service by the Valier Coal Company, a subsidary of the Chicago, Burlington & Quincy Railroad Company, after it had concluded in 1917 to mine the coal beneath its property at Valier, Ill. The decision was in favor of purchased power, it being estimated that central-station service would be cheaper

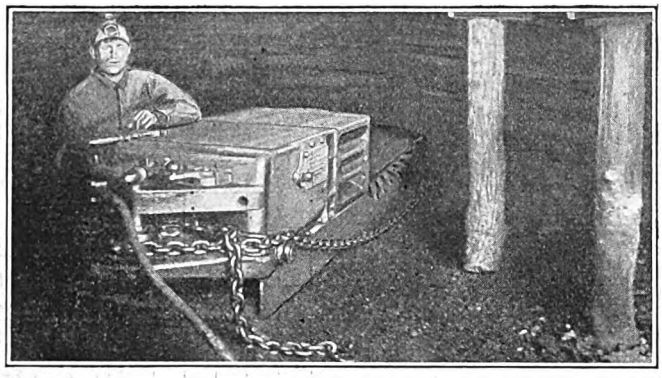

FIG. 1—ELECTRIC SERVICE FOR OPERATING THIS SULLIVAN COAL CUTTER IS SUPPLIED THROUGH CABLE IN FOREGROUND

by $30,000 or $40,000 per annum than equivalent service furnished by a steam power plant erected on the ground. This condition existed partly because the power company offered to supply service from three interconnected generating stations, the service from which could not have been duplicated without providing considerable reserve equipment in the isolated plant, which would have entailed an additional expenditure of about $200,000. Furthermore it would have increased the operating expenses for power by about 50 per cent. It was estimated that the total cost for electric power, including that used for hoisting, ventilating, hauling, undercutting and pumping, would be approximately 3 cents per ton of coal, whereas some of the best isolated steam plants operating under similar conditions were showing a power cost of about 5 cents a ton. These figures are all based on the mine's full output of 6000 tons of coal per day. When the mine runs only part time, the comparison would be even more favorable to purchased power because of the high fixed charges which are inherent in isolated-plant operation.

ELECTRIC SUPPLY AND DISTRIBUTION

Primary three-phase, 60-cycle service is purchased from the Central Illinois Public Service Company at 33,000 volts. Three 666-kva., single-phase transformers reduce the pressure to the general distribution potential of 2200 volts, although two of the transformers are expected to carry the entire load on open delta if for any reason one transformer has to be cut out of service. The high distribution potential of 2200 volts was desired because the underground workings of the mine will ultimately cover about 7500 acres (3000 hectares) and coal will be mined beyond a radius of 2 miles (3.2 km.) from the bottom of the mine shaft. It was also desired to keep the energy losses and copper investment as low as practicable without jeopardizing the safety of the mine. Before deciding on the 2200-volt distribution, however, the plans for the entire installation were laid before the Illinois State Mine Inspection Department and its approval was obtained. Two-hundred-and-twenty-volt service was adopted for lighting the mine and 110 volts for lighting in the miners' homes to discourage men stealing the company's lamps.

Stationary electric lamps are used only underground at the shaft bottom, charging stations, junction points, coal-cutting machines, etc. For locomotive headlights bare tungsten lamps of 60 watts or less are used. Carbon and mill-type tungsten lamps are being tried for this service as regular tungsten lamps will not stand the vibration.

The electric energy required for light and power underground is carried into the mine by a circuit of three single-conductor 300,000-circ. mil flexible "Okonite" lead-covered cables insulated for 5000 volts. A three-core cable was considered, but its greater liability to breakdown lead to the choice of the three single conductors, because this circuit is run down the air intake shaft, in which there is no hoist or other means of getting at the cables in case of trouble. Inside the air shaft, which is 660 ft. (200 m.) deep, the cables are spaced 12 in. (30.5 cm.) apart and held by split-pine

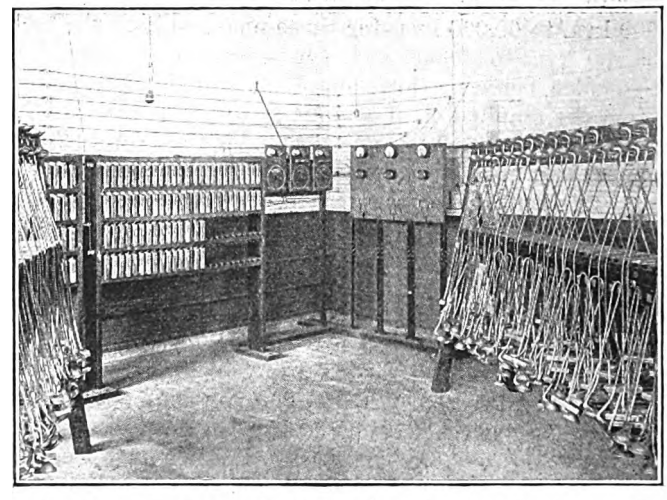

FIG. 2—CHARGING STATION FOR SAFETY LAMP BATTERIES

Control panels and charging racks for 100 batteries shown in center of picture. Flexible connections with lamp on one end and cover for battery case on the other are hanging on side racks. Covers are locked on to battery cases before outfits are given to miners.

clamps, spaced 18 ft. (5.5 m.) apart. As shown in Fig. 5, three notches are cut in each half to clamp the cables in position.

The main underground entries are in the form of the letter H, the air shaft intersecting it at the center of one of the sides. Switches are installed at this point to control the distributing feeders, each of which consists of No. 0 three-conductor armored cable insulated for

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5000 volts. Each cable is buried in a trench about 1 ft. (30.5 cm.) deep and covered with 1.5-in. (38-mm.) planks to protect the cable from picks and shovels. Earth is filled in over the planks.

The 2200-volt feeders are kept in the main entries through which the mine gets its supply of air. When it is required to set up a motor-generator or a bank of transformers to reduce the distribution voltage, the necessary space is excavated at one side of the entry and the equipment is installed on the floor. Care is taken to provide adequate ventilation, and fences are erected to keep unauthorized persons out of the room. Automatic oil switches are used exclusively to control and protect the 2200-volt feeders. On the secondary side of the transformers regular inclosed fuses are used.

The batteries are charged in sets of a hundred in a rack, which also serves for storage purposes. In the rack above each cell position are spring contacts which connect the cells in series with a 5-kw. motor-generator. To obtain the correct voltage, an adjustable resistance is used. Larger motor-generator sets are employed to supply direct-current service to the main hoist above ground and to the locomotives down in the mine.

Two types and sizes of 250-volt direct-current General Electric trolley-type mine locomotives are being used. One type, a 7½-ton (6800-kg.) locomotive, gathers the coal as it is mined and brings it to one point in each district. The other type, rated at 15 tons (17,600 kg.), hauls the coal to the main shaft, where it is hoisted out of the mine. The 15-ton locomotives are

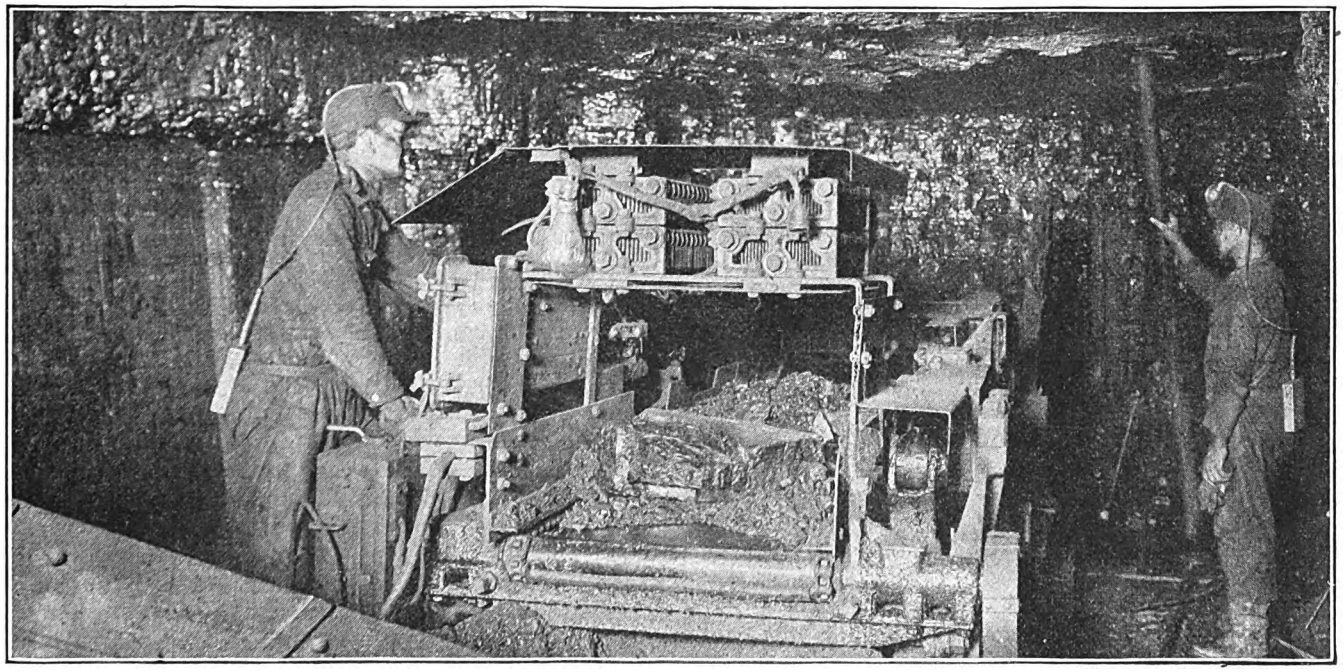

FIG. 3—DIRECT-CURRENT ENTRY DRIVING MACHINE IN OPERATION

This machine is taking the center out of the coal seam and leaving sufficient coal to serve as substantial walls and ceiling of entries without use of timbers. Note smooth wall on left-hand side. Coal is discharged through the square opening shown at the back of the machine and is dumped into cars by the conveyor in the foreground. Note electric safety lamps on operators. The main transformers on the right are each rated at 666 kva., 33,000/2300 volts, single-phase, 60 cycles, and the small transformers on the platform are used to supply lights and small motors above ground.

Open carbon circuit-breakers protect the direct-current end of the motor-generators from overloads and from short circuit on the trolley system.

When the mine was first put in operation the miners objected vociferously against the use of electric safety lamps. They claimed that the old carbide-flame lamps were much better and weighed only half as much as the electric lamp and battery. However, this was a new mine, and the management insisted that it be started correctly with electric safety lamps. Furthermore, the Bureau of Mines recommends electric miners' lamps because they decrease the hazards. Besides, the lamps provide more light in a more convenient form than the old safety lamps. The electric safety lamp used is known as the "Edison approval No. 10" and consists of a lamp inclosed in a steel reflector which is usually carried on the front of a man's cap. A two-cell Edison battery inclosed in a locked steel box is strapped around his waist. The entire equipment weighs 4 lb. (1.8 kg.) and can be carried without inconvenience. Having a capacity of 44 lumen hours, the battery will maintain the lamp at a brilliancy of 1.21 cp. for twelve hours.

equipped with two 90-hp., 250-volt direct-current series motors which are only operated from a trolley wire. The 7½-ton locomotives are equipped with two 28.6-hp. motors and an auxiliary battery. By means of the latter it is possible to get coal out of the parts of the mine where the quantities of gas make it dangerous to use a trolley.

In selecting the battery it was necessary to choose one which would need the minimum of expert care and attention, be reliable, have low maintenance expense and a high salvage value after at least four or five years of service. According to the company's engineer, the Edison battery came the nearest of all to meeting these requirements, and although the coal company paid about 25 per cent more for the Edison batteries than it would have had to pay for some other type, it feels that in the long run this battery will be cheapest.

One hundred and ten Edison A-60 cells were installed on each of the locomotives. Although the normal potential of the battery when operating a locomotive is 110 volts, it can be connected directly across the 250 volts and charged without injury. Normally, however, it is charged at 180 volts because it is not thought

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desirable from the standpoint of efficiency to have the 110-volt batteries floating on the 250-volt trolley. A throw-over switch permits connecting the motor to the trolley or to the battery, depending on the source from which the locomotive is to be operated. While the locomotive batteries could be removed for charging and replaced by others fully charged, the present practice is to charge the battery in the locomotive at night when it is not in use. To do this the locomotive is sidetracked near one of the motor-generator sets and the direct-current voltage reduced from 250 volts to 180. Each battery is rated at 24.75 kw.-hr. and the five-hour discharge rate is 45 amp. Energy is supplied to the trolley wire by 100-kw. and 150-kw., 250-volt direct-current generators driven by direct-connected, 2200-volt, three-phase, 60-cycle motors installed underground at the points of heaviest hauling.

Above ground is a 1000-kw. separately excited flywheel motor-generator set with Ilgner control for operating the main skip-hoist motor. This motor is rated at 1350 hp., 55 r.p.m., 550 volts, direct current, and is direct-connected to the 9-ft. (2.74-m.) drum of the hoist. Direct current was selected to operate this hoist because of the greater flexibility of control and because the motor-generator set was desired to reduce the surges on the power company's system. A skip hoist was chosen in preference to a self-dumping cage because in the

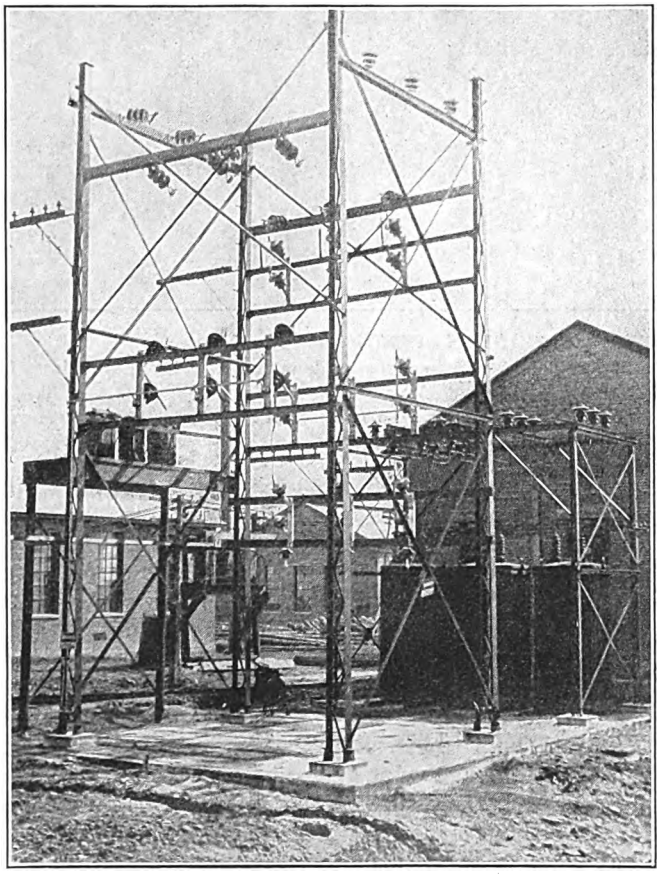

FIG. 4—OUTDOOR SUBSTATION SERVING VALIER (ILL.) COAL MINE

skip hoist the coal is about one-half the gross weight hoisted, whereas with a self-dumping cage under similar conditions only about one-third of the gross weight would be coal. A gross weight of about 25 tons (22,700 kg.) can be lifted by the hoist at a rate of 1550 ft. (472 m.) per minute, giving a capacity of 1000 tons (910,000 kg.) of coal per hour. Push-buttons at the bottom of the shaft are employed for starting the hoists. Once started it is automatically brought up to speed, retarded and stopped automatically at the top where the coal is dumped out. In case of emergency the operator can stop the hoist by pressing another button.

A mine of this character requires much direct-current equipment, but three-phase motors, connected through

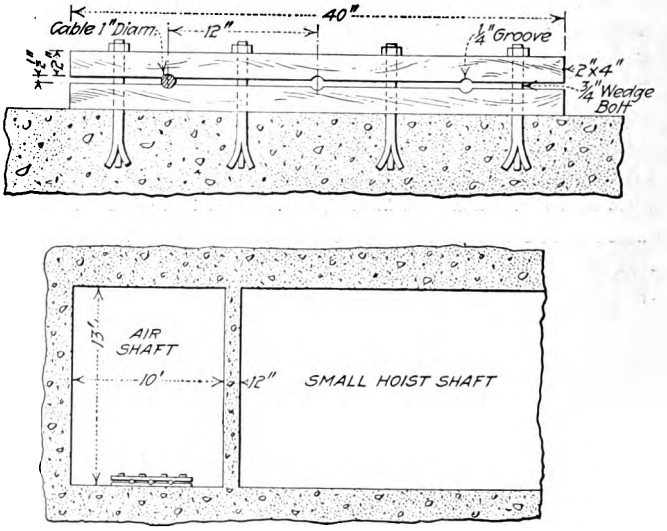

FIG. 5—DETAIL OF PINE CABLE CLAMPS AND SECTION OF AIR SHAFT, SHOWING LOCATION OF THREE 300,000-CINC-MIL. CABLES FEEDING UNDERGROUND WORKINGS

transformers to the power company's lines, are used wherever practicable.

Twenty C.E7 Sullivan coal cutters are being used to undercut the coal. Each of these machines is equipped with a 35-hp., 220-volt, three-phase, 60-cycle motor, and twenty more similar machines are on order. Two Jeffrey B34 entry-driving machines are being used for development work. These drivers are equipped with direct-current motors because they were the only machines of this type which the company could get at the time and the direct-current motors could not readily be replaced by alternating-current units. As the coal cutters advance into the seam some mines have pumping equipment to keep the mine free from water, but at this mine the pumping load is negligible.

In addition to the equipment mentioned about 200 hp. in motors is required for the tipple machinery, 25 hp. is used in the machine shop, a small motor operates the electric siren, and a 225-hp., 2200-volt motor drives the ventilating fan. All these motors are wound for three-phase, 60-cycle service. Since the main ventilating fan is the most important piece of equipment at the mine and must be kept operating at all costs, provision is made for driving the fan in emergencies by steam from a boiler ordinarily used for heating the buildings and supplying water. Clutches have been installed by which the fan drive can be quickly changed from motor to engine drive.

The entire alternating-current load connected to the central-station line will be the equivalent of about 3000 hp. when all the equipment has been installed, and when the mine reaches its full rated output of coal the maximum demand is expected to be in the neighborhood of 1300 kw. Carl Scholz, general manager of the Valier Coal Company, planned the entire layout of the mine, superintended the installation of the equipment and more than any one else is responsible for the success of this whole undertaking.

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Protecting Tie Lines with Relays

Extensive Data Have Been Collected Giving the Experience of Operating Companies with Various Methods of Relay Protection—Tests Should Be Made Under Conditions Approaching Actual Ones

IN MANY of the older electrical systems stations and lines have been added as required without taking into consideration the relay problem. Many newer systems also have been laid out without adequate provision for relay protective systems. But lines can no longer be adequately protected merely by overload and time setting of the relays, for the growth and complication of networks makes necessary the sectionalizing of trouble. In a paper entitled "Present-Day Practice of Transmission and Tie-Line Relay Protection," by H. R. Woodrow, D.

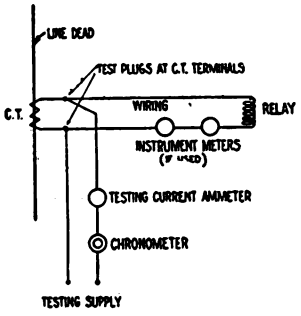

FIG. 1—TESTING CURRENT IN SECONDARY OF CURRENT TRANSFORMER

W. Roper, O. C. Travers and P. MacGahan, presented at the annual convention of the American Institute of Electrical Engineers this week, this problem was taken up in the light of answers to a questionnaire sent out by the committee on protective devices in which a study of the practice of thirty-two operating companies in relay protection has been made available.

The report covers the experience of companies with systems varying from 25,000 kva. to 455,000 kva. whose short-circuit currents at any point vary in value from 100,000 kva. to 1,650,000 kva. and sustained short-circuit kva. values vary from 20,000 kva. to 340,000 kva. Practically all the companies report some trouble with the operation of their protective relay systems. Of these troubles 46 per cent are reported as due to the difficulties in the relays, 20 per cent to improper application of the relays and 15 per cent to improper settings of the relays, 9 per cent to defective wiring, and 10 per cent to defective operation of the oil breakers. The economy of parallel feeders in established and approved methods of testing and setting of the relays are discussed in this paper.

ADVANTAGES OF PARALLEL FEEDERS

While the saving which can be effected by a parallel operation of feeders depends in a large degree upon the design of the transmission system, in one system supplying converters ranging in size from 500 kw., it was estimated that if the feeders could be operated in parallel a saving of 20 per cent would be made in the investment. As the installation in question had a book value of about $5,000,000, there was a possible saving estimated at $1,000,000. During two years of operation with feeders in multiple they have realized nearly 40 per cent of the possible saving in the investment in feeders notwithstanding a considerable increase in the maximum load. Cable burn-outs, due to operation of the feeders in multiple, have also been reported by this company. While the time is rather short to accept these figures as conclusive, it apparently indicates that the operation of feeders in parallel reduces the number of troubles due to internal causes. Of the companies reporting, 60 per cent operate with the major part of their lines in parallel and 40 per cent operate with some of their lines in parallel groups.

The most perfect relay system cannot be expected to give the best results unless the man in charge of its installation and operation be thoroughly competent and familiar with the various precautions to be taken. One of the principal factors controlling the setting of relays is the amount of short-circuit current available under various conditions. While the determination of short-circuit currents is a difficult problem in the case of networks, various formulas and calculating tables have been developed for simplifying this work which give sufficient accuracy for practical purposes.

TESTING AND SETTING RELAYS

To secure the best results from relays it is desirable to make a complete check on the current and time settings of each relay on the first installation and at least once every six months thereafter. The tests should be performed under conditions as nearly equal to oper-

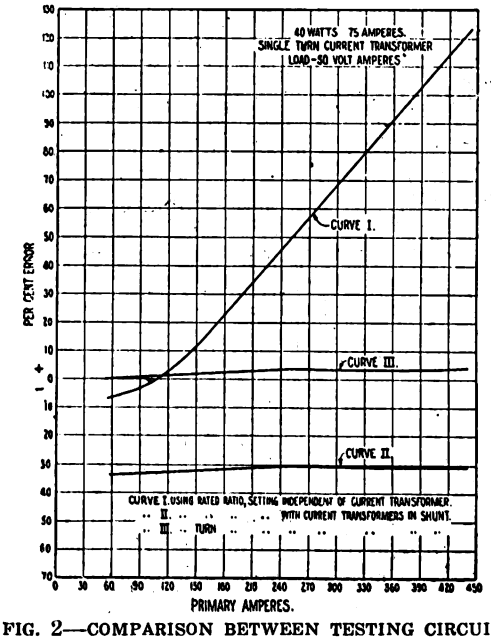

FIG. 2—COMPARISON BETWEEN TESTING CIRCUITS

ating conditions as possible, including the wiring and complete relay equipment in this test. Where it is impracticable to apply test current to the primary of the current transformer, this testing current may be supplied to the secondary terminals of the current transformer with the transformer left in circuit as a shunt as shown in Fig. 1. The results obtained under these conditions very closely approximate those under short

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circuit and check the relay wiring and current transformer as well as the relay. The degree of accuracy obtained when the relay is tested alone is dependent upon the type of transformer used in secondary load. The error in this method is due to the high magnetizing current of transformers under heavy short-circuit conditions. As an example, a 40-volt-ampere secondary load on a current transformer at full load imposes a 16-kva. load under short-circuit conditions of twenty times full load. This in many mases is above the saturation point of the transformer and the ratio breaks down badly. The accompanying curves in Fig. 2 illustrate these conditions.

It is desirable to have the relays so set that selective action will be obtained under all probable conditions. Where a large number of circuit breakers are in series and selectivity is desired between the several breakers, it is possible to apply at the various points relays having different characteristics in order to reduce the time that a short circuit is held on the system near the generating station. The time characteristic curves in Fig. 3 illustrate a specific case where this method was adopted. It may be observed from the curves that the maximum short-circuit current that can pass through relays *A*, *B*, *C* and *D* is 2800 amp. and that the relays at this point are set selectively with approximately three-quarters of a second between them successively. Greater currents may pass through circuits *A* and *B* with the short circuit on these feeders near the generating station, and the time characteristic curve being much steeper at this point will allow the relays to open the circuit very quickly.

Some companies have made the time of their relay operation longer in order to permit the system voltage to drop in value, thereby reducing the rupturing strains on the oil switches. It is pointed out, however, that considerable precaution should be taken when this is done as the prolonged current may do more damage than the greater rupturing arc in the switch.

Method of Tripping

The use of circuit-opening relays for alternating-current tripping has not given very satisfactory results. It is desirable to have a definite uninterrupted supply

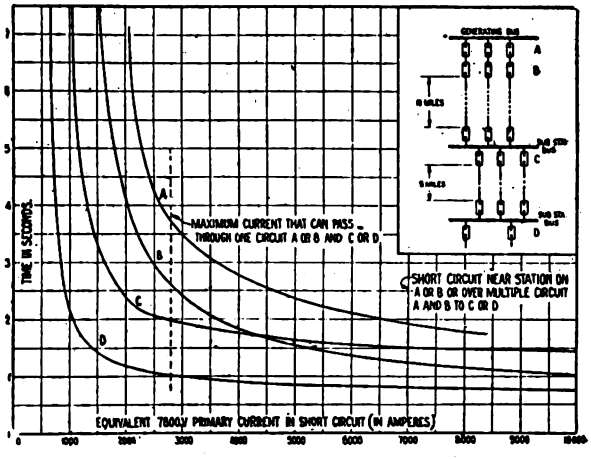

FIG. 3—TIMING RELAYS ON PARALLEL FEEDER SYSTEMS

of power for tripping, and the storage battery has proved to be reliable even in very severe system disturbances. In answer to the questionnaire it apears that 80 per cent of the companies used direct-current tripping and found it satisfactory and preferable. For accurate timing 63 per cent of the companies have adopted some form of automatic chronometer or cyclo-counter. Fifty per cent of these companies are testing under conditions approximating short circuits. It is also shown that the average time for which a short circuit is kept on the system is three and one-third seconds, although this time varies with different companies from one-quarter of a second to as high as fifteen seconds.

Protective Relay Schemes in Use

It was found that, of the companies reporting, 13 per cent prefer the combination of time current and directional relay schemes, 13 per cent the balanced pair,

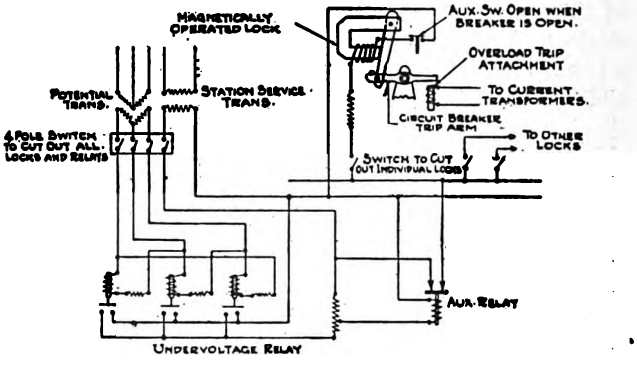

FIG. 4—CONNECTIONS FOR UNDER-VOLTAGE AND OVER-CURRENT RELAY SCHEME

6 per cent the split conductor, 6 per cent straight inverse time current protection, and 3 per cent balanced relay with pilot wires.

The directional relays produced at the present time are apparently giving very satisfactory results, even under low-voltage conditions down to 1 per cent of normal, and may be applied to loop or parallel group systems in series, in combination with inverse-time current relays, if a careful analysis is made of the proposed installation. In order to secure the operation of the directional relays under bad power-factor conditions, the connections are made so that the maximum torque is obtained with lagging power factor. This may be accomplished by several schemes of connections of the potential and current elements. Some operators have found it advantageous, when using directional relays with step-down transformers or reactors, to connect the voltage elements of the relays to the bus side of this apparatus in order to give a higher voltage in case of short circuit.

Many operating companies have installed on a portion of their lines protective equipment which is designed to be inoperative so long as the currents in different circuits at different points in the same circuit are substantially equal. To this end they have made use of (a) fully insulated lines in parallel between stations, (b) conductors in parallel having reduced separating insulation—*i. e.*, split conductor cable—and (c) pilot wires of relatively small cross-section between the two ends of a line to sense the degree of balance of the currents at these points. A series of diagrams were presented by the authors showing the wiring of relays for balanced protection of two parallel lines and indicating by arrows the operation of the relays under each condition. In the event of one line being in service alone, it is the general practice automatically, by means of auxiliary switches on the circuit breakers, to introduce time over-current relays in the protective equip-

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ment which will operate in conjunction with the directional relays in a manner similar to that of the tandem groups or loop circuits. Several companies reported that they had had difficulty in finding proper relay protection in cases where they have taps on the tie line between stations. This is particularly true where the protection of these lines would have been of the balanced-relay type were it not for the taps.

Split-conductor cables are being tried out in this country by two operating companies who report good results to date. The cable is composed of six conductors, each of the three phases being "split" into two halves. For specific information regarding this system the reader is referred to a paper by W. H. Cole, "Split Conductor Cables—Balanced Protection," *Proceedings A. I. E. E.*, July, 1918, page 793. Adaptations of the Merz-Price protective system have been used by two operating companies. One of these reports very satisfactory results; the other is not so favorable, due to an inherent difficulty in obtaining the proper degree of balance.

One company employs a combination of under-voltage and over-current relays for its system which has given it very good results. In this scheme all the circuit breakers in any section are mechanically locked in the closed position by means of a magnetically operated lock. It is controlled by a voltage relay which releases the lock when the voltage falls below a predetermined value, approximately 70 per cent. Upon the occurrence of a short circuit the voltage drops, and when it has fallen below the predetermined point the voltage relays act to unlock the circuit breakers, which are then free to be opened by the over-current relay or other over-current device. Referring to diagram, Fig. 4, the under-voltage relays are connected to the secondaries of potential transformers on the line busses. An auxiliary relay is actuated from the station service transformer and is controlled by the under-voltage relays. In its turn this auxiliary relay controls the locks on the circuit breakers. One set of under-voltage relays, with the auxiliary relay, may control a number of locks on a number of circuit breakers. The operation is as follows: When the line potential drops below a predetermined value, one or more of the under-voltage relays drop and short-circuit the auxiliary relay through a resistance which causes this auxiliary relay to open. This in turn releases the latch and leaves all the circuit breakers under its control free to operate in case of over-current. Thus, so long as the potential remains above the predetermined value, no breaker can be opened by its automatic over-current feature.

This scheme is reported as giving successful results on an overhead system covering 4000 sq. miles (100,000 hectares) where there are a large number of stations located, on an average, approximately 10 miles (16 km.) apart. As the lowest voltage occurs nearest the short circuit, it is probable that only the circuit breakers in the immediate vicinity will be unlocked and allow the circuit breakers to be automatically opened if the current is of sufficient magnitude.

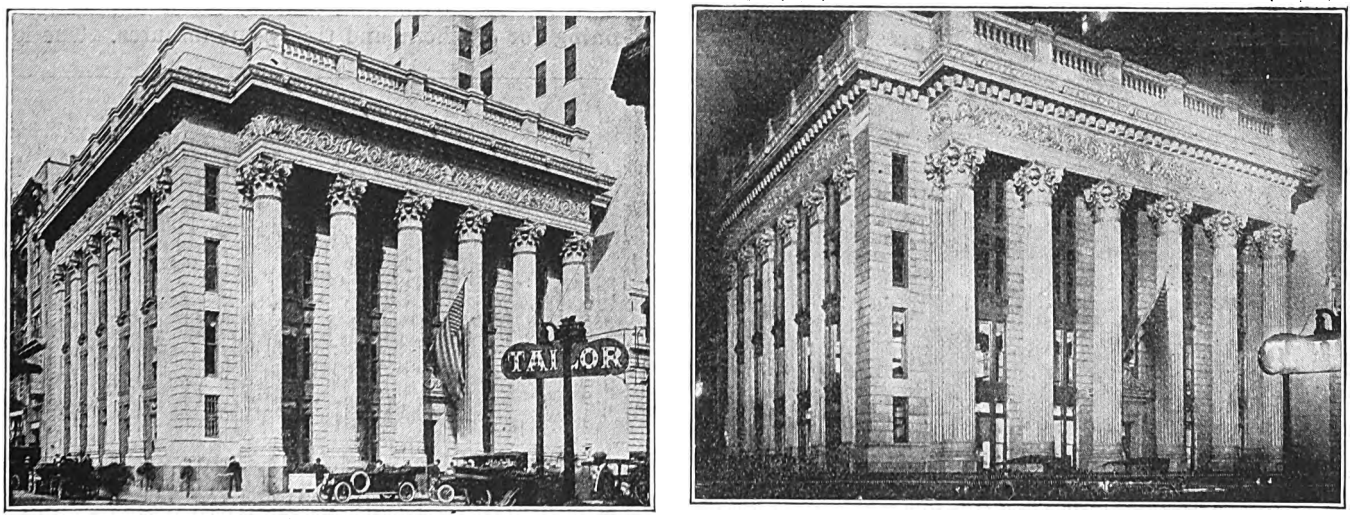
FLOODLIGHTING REQUIRES SPECIAL KIND OF TREATMENT

Must Produce with Artificial Light Same Effect of Light and Shade as That Obtained by Day to Emphasize Architecture

BY F. H. MURPHY

A GENERAL opinion prevails that floodlighting is an elementary matter, that it consists only in finding some place on which to mount the units and then in directing the light all over the object to be illuminated. This idea is erroneous. Such a method may sometimes attain its object, but often it will destroy it. Floodlighting, for the purpose of perpetuating throughout a longer day beautiful pieces of architecture or sculpture, is too technical an affair for such haphazard treatment.

A building worthy of floodlighting is usually attractive because of its architectural features. Destroy the effect of these, and there is nothing left to admire or to warrant the expense of lighting. Architectural effects are dependent upon light and shade. Shadows are the result of directional lighting. The great directional day-lighting unit is a constantly varying quantity. However, for a building whose front faces east or southeast the average effect when seen at its best would be that of mid-forenoon sunlight. It is assumed that the architect, therefore, worked out his details with this idea in mind.



DAYTIME AND NIGHT-TIME VIEWS OF SAME STRUCTURE

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If we are to perpetuate the architectural beauty of the building for the enjoyment of the public during the hours following daylight, which is usually the real object of having it illuminated, then every effort should be made to produce with the artificial light the same effect of light and shade as was obtained by daylight. It is probably impossible to make an exact reproduction of even the assumed average daylight effect because of many conditions. For one thing, it is usually impracticable to mount the lighting units at just the proper location. The light source is relatively much larger, hence less of a point source, than the sun, and at night there is a lack of the diffused daylight which tends to brighten the shadows and give a softer and more pleasing effect. If a point source of light, properly mounted, could be obtained at night, the deep contrasting shadows would be disagreeable without the diffused general light to soften them. However, the very limitations in location and size of light source serve to assist in overcoming the lack of general diffused lighting by throwing light from slightly different directions, thereby softening the shadows to a certain extent.

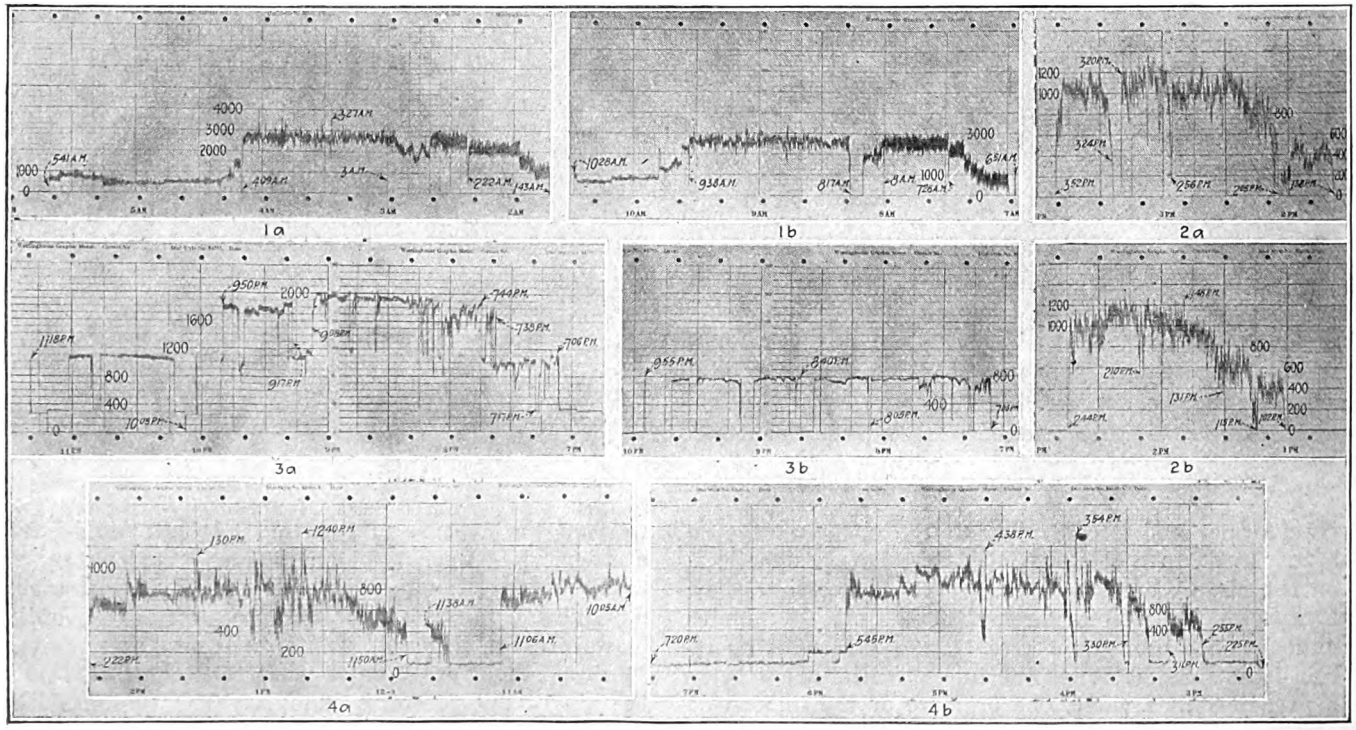
At the time the United States National Bank Building of Portland, Ore., was under construction the matter of properly floodlighting it was taken up with the owners. With their consent and with the hearty coöperation of the architect, A. E. Doyle, a system of floodlighting was designed that would as nearly as possible perpetuate the average daylight effect. The building is 100 ft. by 100 ft. (30 m. by 30 m.), four stories high, and the finish is a light terra cotta. It is on the southeast corner of the block, the front facing east. Diagonally across the street intersection is another building of about the same height. Permission was obtained from the owners of this property to erect an iron framework on the roof for supporting the lighting units. Twelve units were used, mounted upon the iron framework in three horizontal rows of four each, in as compact a formation as possible. There are four 1000-watt units and eight 750-watt units. The intensity of illumination is not high, but the success met in attaining the main object of the installation may be seen by comparing the daylight picture, taken at about 10 a.m., with the night view, taken at about 10 p.m. It is, however, impossible in a reproduction of this nature to do justice to the real night effect

Electric Furnace Operation at Buffalo

Operating Characteristics of Eight Steel Furnaces of Four Different Types, the Heroult, the Pittsburgh, the Snyder and the Greaves-Etchells, Are Described, with Information on Tonnage and Energy Supply

NINE electric steel furnaces are served from the lines of the Buffalo (N. Y.) General Electric Company. Some were installed in 1914 and others just before the war ended, in the latter part of 1918. They include four types, the Heroult, the Pittsburgh, the Snyder and the Greaves-Etchells, the sizes ranging from 2 tons to 10 gross tons.

Charts 1a and 1b, taken at the plant of steel company No. 1, where two Heroult furnaces of 10 gross tons rating are installed, show the kilowatt input for two heats with one furnace only operating. Curve 1a represents an operation in which the furnace was melting for two hours and twenty-seven minutes and refining for one hour and thirty-one minutes. The load



FIGS. 1, 2, 3 AND 4—OPERATION OF A 10-TON (GROSS) HEROULT FURNACE; A 3-TON PITTSBURGH FURNACE LOAD; CHARACTERISTICS OF TWO 2-TON SNYDER FURNACES; OPERATION OF A 2-TON HEROULT FURNACE

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factor for the heat was 62.3 per cent, based on a maximum peak of 2700 kw. While a momentary peak of 4000 kw. is registered, the demand during the melting process shows an average value close to 2500 kw. During the refining operation the load ranges from 500 kw. to 1000 kw. Curve 1b represents an operation in which the furnace was melting for two hours and thirty minutes and refining for one hour. The load factor for this heat was 70.3 per cent, based on a maximum peak of 2700 kw. The load characteristics are practically the same as in curve 1a. In both instances the load was entirely interrupted and reëstablished once during the heat.

DATA ON ELECTRIC FURNACE OPERATION AT BUFFALO, N. Y.

Installation Number	Number of Furnaces	Year Installed	Size of Furnace in Tons per Heat	Type of Furnace	Type of Lining	Phase and Frequency	Volts at Arc	Transformer Rating	Transformer Rating for Light and Power	Number of Months Which Data Cover	Monthly Average					Hours per Day Operated	Per Cent Load Factor per Heat
											Maximum Demand	Kilowatt-Hours	Tons Poured	Kilowatt-Hours per Ton	Per Cent Load Factor		
1	2	Oct., 1918	10 gross	Heroult	Basic	3–25	100 to 120	3000 kva. each 11,000/110-volt taps	250 kw.	6	2700	614,500	1050.9	585	33.0	Continuously except for charging and pouring	60 to 70
2	1	Oct., 1918	3	Pittsburgh	Acid	3–25	110 to 120	1000-kva. 11,000/110-volt ½ voltage taps	25. kw.	7	1150	45,143	.....	...	5.4	Varies	70
3	2	1914	2	Snyder	Acid	1–25	160	2250 kva. total* 60 per cent p.f.	270 kw.	12 (1917)	1600	155,817	248.6	627	13.5	Night only (four heats per night)	80
4	1	Dec., 1916	2	Heroult	Acid	3–25	100 to 120	645 kva., 2200/1980/107-volt	105 kw.	16	1023	186,924	196.0	970†	25.5	Six to twelve hours	75
5	2	1918	6	Greaves-Etchells	Acid	3–25	110 to 70	1300 kva. each	300 kw.	6	1650	168,950	.....	...	13.96	.....	65

* These transformers have a connection equivalent to the Scott (or T) connection, so as to give approximately a balanced three-phase load on the primary when both furnaces are operating.
† Includes shop load of 100 kw. to 150 kw. Figure for furnace use only should be between 600 kw.-hr. and 200 kw.-hr.

THE HEROULT INSTALLATION

These furnaces are operating with a basic lining consisting of magnesite brick to the slag line and metalkase brick around the slag line. They were installed for melting and refining and are equipped with General Electric electrode regulators. While the average record in the table shows that over a six-month period they produced steel at an average rate of 585 kw.-hr. per ton, a more detailed record shows that during the first month of operation, when only 459.4 tons of steel were made, the energy consumption was only 555 kw.-hr. per ton.

In March, 1919, when a total of 1316.9 tons of steel were made, the average monthly record of energy consumption was 560 kw.-hr. per ton. The greatest consumption per ton occurred in December, 1918, when the monthly record was 656 kw.-hr. per ton. Some of this variation in kilowatt-hours per ton is due to the fact that the period between meter readings does not cover the exact calendar month, while the tonnage record does. The six-month record is therefore a better indication of actual results.

Curves 2a and 2b, taken at the plant of steel company No. 2, represent the operation of a Pittsburgh 3-ton furnace. It is engaged in melting only, using high-grade scrap. The lining is of silica brick. In the upper curve a melting operation lasting two hours and fourteen minutes is shown. The load factor for the heat was 70.4 per cent, based on a maximum demand of 1125 kw. While this furnace is served from three 333-kva. transformers, the load registered momentary peaks of 1400 kw. In curve 2b a melting operation which lasted one hour and forty-two minutes is shown. The load factor for the heat in this case was 73 per cent, based on a maximum demand of 1125 kw. The furnace is equipped with a Thury regulator. Tonnage records for the six months in which this furnace was operated are not available. In one of the heats shown the load was interrupted and reëstablished once and in the other twice.

In comparing the curves 3a and 3b with the others, it should be remembered that they are taken from two Snyder single-phase 2-ton furnaces (installed in steel plant No. 3). While they were installed in 1914, the data given in the table are a record of their operation during the twelve months of 1917. The furnaces are both provided with an acid lining of silica brick. They are served from 2250 kva. of transformer rating for the two furnaces. The transformers are connected by a scheme equivalent to the T connection, which gives a balanced three-phase load when both furnaces are operating. They operate on a 220-volt circuit in which reactance has been permanently inserted between the transformers and the furnace. The power factor of this load on account of the external reactance is about

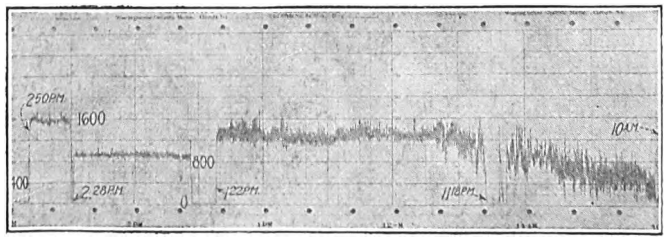

FIG. 5—A 6-TON GREAVES-ETCHELLS FURNACE LOAD

60 per cent. The furnaces are used for melting only, the electrodes being hand-regulated.

Curve 3a represents the load produced by one furnace operating part of the time and by two furnaces part of the time, with a shop load of 250 kw. to 300 kw. also included. Curve 3b represents the operation of one single-phase furnace melting for two hours and thirty-five minutes. The load factor for this heat was 81.6 per cent based on a maximum peak of 800 kw.

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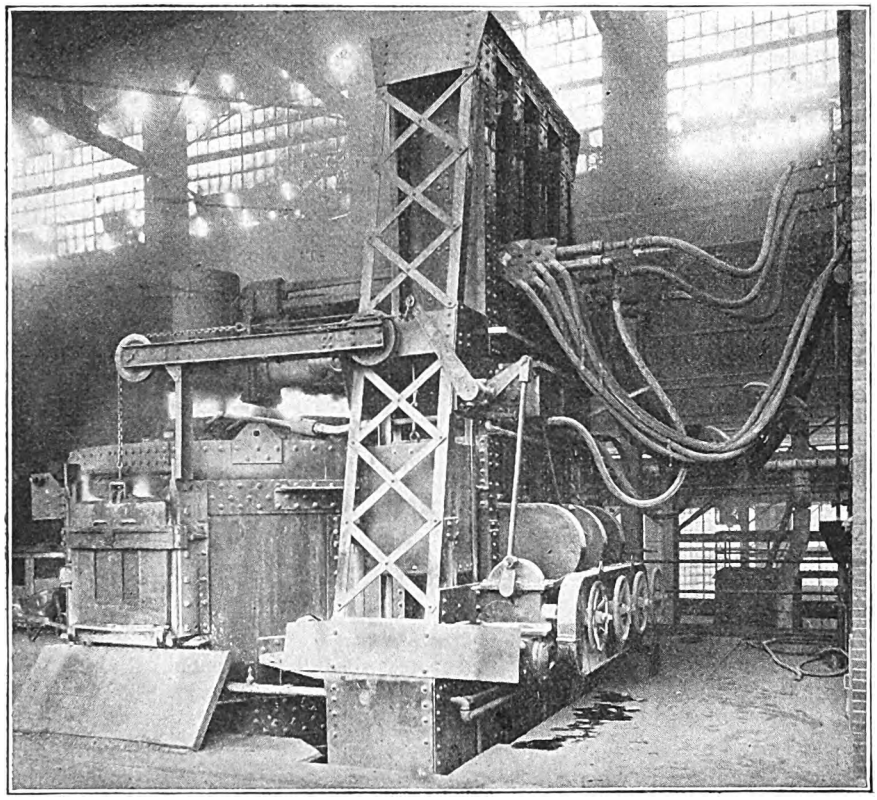
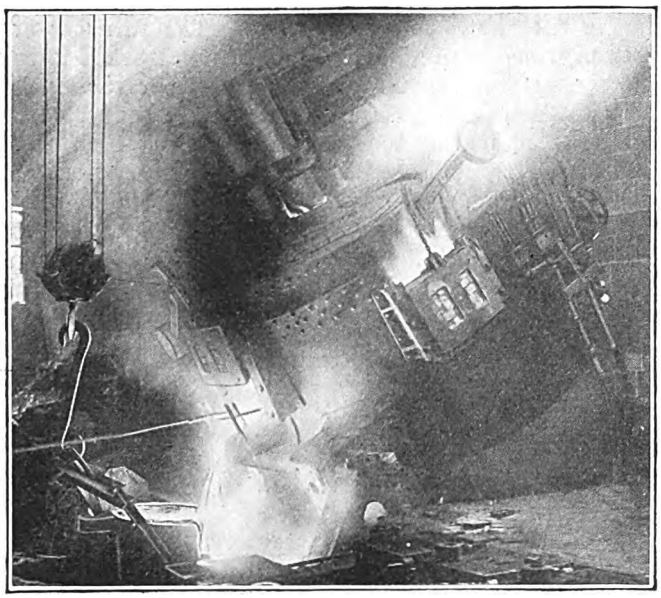
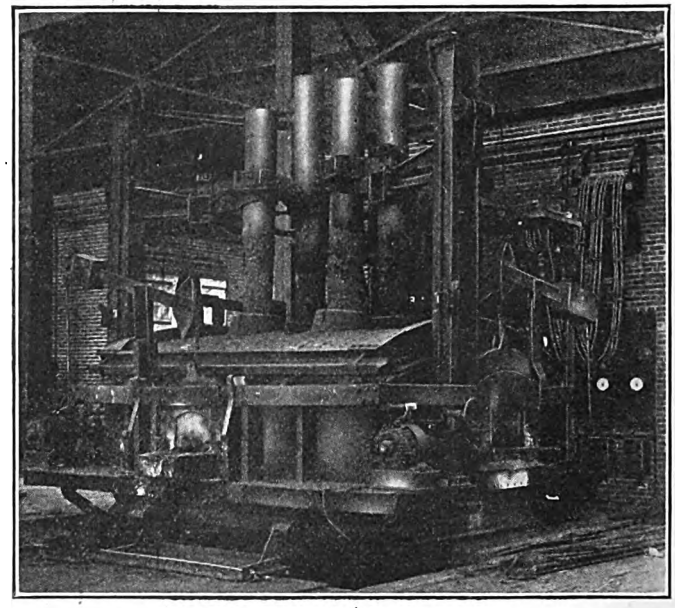
During this heat the load was interrupted and reëstablished six separate times.

An especially complete record is available on a 2-ton Heroult furnace installed at steel plant No. 4. This is a furnace with an acid lining which is used for melting high-grade scrap. It is served by transformers rated at 645 kva., 2200/1980-107 volts. In addtion to this, two 7.5-kva. transformers are installed to supply the furnace auxiliaries and three 30-kva. transformers supply energy for the general shop power. Unfortunately the meters measuring energy on this job are not arranged to separate the shop load from the furnace load, so the data on kilowatt-hours per ton and the curves 4a and 4c include this shop load of from 100 kw. to 150 kw. This accounts for the high average consumption of 970 kw.-hr. per ton. This figure would be between 600 kw.-hr. and 700 kw.-hr. per ton if the kilowatt-hours used by the shop load were taken out of the total. During the sixteen months covered by these data this furnace never ran less than forty-eight heats per month and in one instance poured 112 heats per month. The average for the sixteen-month period was seventy-nine heats per month. The practice was to run from two to four heats per day with approximately three hours per heat.



The curves show the characteristics of the electrical load operating under the control of a General Electric electrode regulator. Curve 4a represents a melting operation lasting two hours and fifty-two minutes. Taking out the estimated energy consumption of the shop, the furnace used 1555 kw.-hr. and had a maximum demand of 750 kw. This would give a load factor of 72.4 per cent. The charge consisted of 5000 lb. of steel scrap, making 622 kw.-hr. per ton. Momentary peaks of 1350 kw. are shown. While the average maximum demand shown in this curve is probably around 900 kw., there were many months when the measured maximum demand ran around 1100 kw. and 1200 kw. in spite of the fact that the transformer rating for the furnace installation is only 645 kva. These demands also include the shop load. The electrode control has been readjusted recently, however, and it is confidently expected that the demand will be less. Curve 4b shows a melting operation lasting two hours and fifty minutes, on which the estimated load factor of the furnace load alone for this heat was 71.5 per cent. This is based on a furnace demand of 850 kw. and a





FIGS. 6, 7 AND 8—TEN-TON HEROULT FURNACE SERVED BY 3000-KVA. TRANSFORMER; POURING A 2-TON HEROULT FURNACE; 6-TON GREAVES-ETCHELL FURNACE

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consumption of 1722 kw.-hr. During this heat the furnace used 690 kw.-hr. per ton. Its electrical characteristics are much like those of the upper curve. There are from two to three interruptions of the load on each heat.

The furnaces at steel company No. 5 are Greaves-Etchells 6-ton units and have been used for melting only. Later they will be used for refining, when a

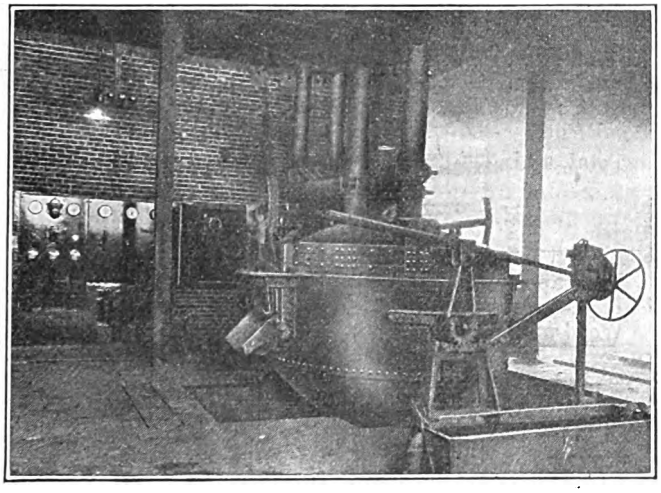

FIG. 9—THREE-TON PITTSBURGH FURNACE FED BY THREE 333-KVA. TRANSFORMERS

basic lining will be installed. Thury regulators are used for electrode control. These furnaces now have an acid lining consisting of ganister and silica brick. Each furnace is served from a 1300-kva. transformer bank, and in addition 300 kva. of transformers is installed for light and power service. In the six months these furnaces have operated the average maximum demand was 1650 kw., and during two months the maximum demand was 1800 kw. Fig. 5 shows load characteristics of one of these furnaces during a melting period lasting four hours and fifty minutes. The load factor was 64.2 per cent for the heat. The highest momentary peak shown on this curve is about 1750 kw. The voltage at the arc on these furnaces, ranging from 110 volts to 70 volts, is somewhat lower than on some other three-phase furnaces. Their load power factor averages 90 per cent or better, with one exception, that being the Snyder single-phase furnace, which has installed in the circuit an external reactor which lowers the power factor, as stated before.

Book Reviews

PRINCIPLES OF RADIOTELEGRAPHY. By Cyril M. Jansky. New York: McGraw-Hill Book Company, Inc. 242 pages, 179 illustrations.

This is an elementary textbook on radio-telegraphy, addressed not only to college students of electrical engineering in their earlier years of study but also to technical students out of college. The principles are therefore discussed quantitatively in relatively simple mathematics, well supplied with arithmetical examples. The book is divided into eleven chapters, dealing respectively with the following topics: Magnetic phenomena, electrostatic phenomena, electromagnetism, units of measurement, electromagnetic waves, elementary alternating currents, oscillatory currents, radio circuits, practical transmitting appliances and methods, practical receiving appliances and methods, vacuum tubes and their use in radiotelegraphy.

A CALENDAR OF LEADING EXPERIMENTS. By William S. Franklin and Barry MacNutt. South Bethlehem, Pa.: Franklin, MacNutt & Charles.

This little book, bearing as its title a name coined by Francis Bacon, is an unusual production. Refreshing and bracing in its style and in its conception of science, it starts with a brief outline of the laws of motion, proceeds to experiments in dynamics, passing on to experiments in heat, electricity and magnetism, light, sound and wave motion. The authors are not provincial. Their scope of reading is indicated by casual references to the best works in science, and we are glad to see their energetic protest against the stupid "scienticulist" methods of teaching. There are excellent points in this book, like the experiments on "gyroscopic motion" and on "balancing" in the chapter on mechanics. The statement of the "laws of motion" is perhaps not altogether to our liking, as we feel that it is impossible to improve upon the plain statement of the three laws of motion by Newton himself, adhered to by Maxwell and by Kelvin and Tait. The chapter on heat is less full than we should have wished it. The best chapter seems to us to be the concluding one on the "Dynamics of Wave Motion." This is so suggestive and interesting that in this connection reference should be made to W. S. Franklin's book on "Electric Waves," which should be read by every one interested in physical phenomena, and especially by electrical engineers.

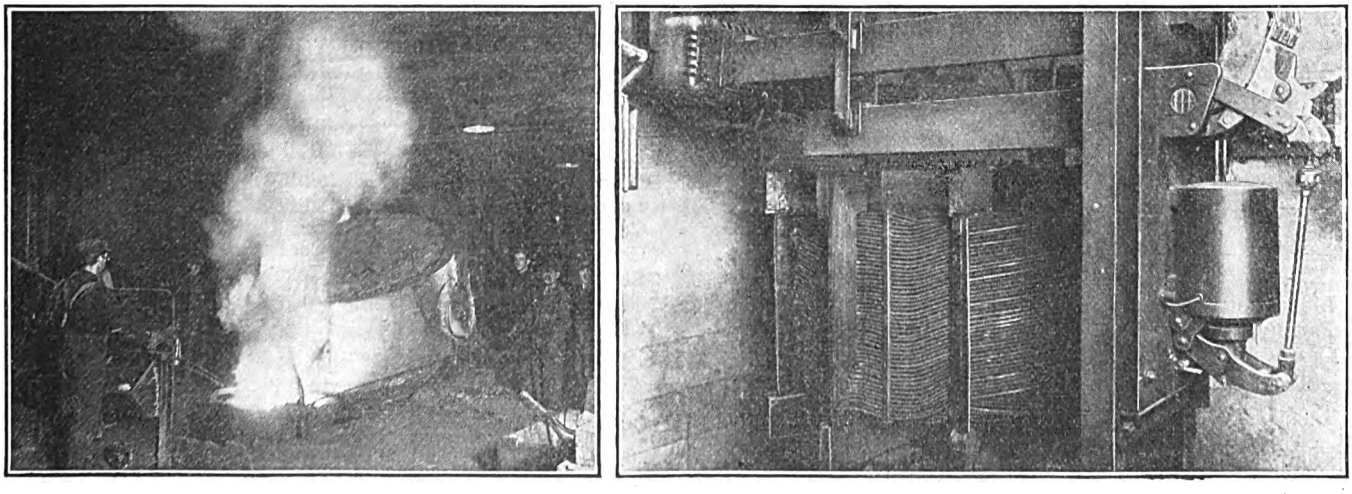

FIG. 10—SNYDER ELECTRIC FURNACE POURING CHARGE AND REACTOR IN CIRCUIT WITH IT

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RAW MATERIALS USED BY ELECTRICAL MANUFACTURERS

List Presented at Meeting of Associated Manufacturers of Electrical Supplies in Connection with Study of International Trade Conditions

At last week's meetings of sections of the Associated Manufacturers of Electrical Supplies at New London, Conn., one evening general session was devoted largely to the subject of international trade. A table was presented by William Burgess, expert adviser to the international trade committee, showing the number of raw materials entering into products of the industry. The details of these different materials, divided according to classes, are printed below:

MINERALS, CHEMICALS, ETC.

Aluminum
Antimony
Asbestos
Alcohol
Asphalt
Borax
Benzol
Boracic acid
Carbon
  Graphite
  Granular graphite
  Amorphous carbon
  Carbon electrode
  Silicon carbide
  Carbon bisulphide
Carborundum
Chalk
  Whiting
  English cliffstone
Copper cyanide
Cobalt oxide
Chrome alum
Chloride of zinc
Ebony formure
Formaldehyde
Gelatine
Glass C
Glass
Glue
Iridium
Linstun
Lampblack
Litharge
Lithopone
Mica
  White (Ind.)
  Amber (Can.)
Marble
Mercury
Magnesia
Manganese dioxide
Petroleum coke
Plaster of paris
Portland cement
Phenol
Phosphor
Rosin
Slate
Soapstone
Sapphire
Sodium fluoride
Sal ammoniac
Sulphur
Sulphuric acid
Sulphate alumina
Sodium cyanide
Zinc oxide
Zinc anodes

Total, 58.

Various aniline colors.

WAXES

Holowax
Montana wax
Beeswax
Paraffine wax
Sealing wax
Japan wax
Carnauba wax
Wax tailings

Total, 8.

OILS

Linseed oil
Petroleum oil
Castor oil
Chinawood oil
Dead oil of coal tar

Total, 5.

METALS

Iron
  Cast
  Malleable
  Chromite
  Tungsten
Steel
  Nickel steel
  Cast-drop forged
  Pressed sheets
  Rods, strips, etc.
Brass
Bronze
  Phosphor bronze
Babbitt
Copper
Lead
  White lead
  Red lead
  Lead foil
  Tin foil
Silver
German silver
Solder
Platinum
Tin
Zinc
Nickel
  Nickel silver
  Nickel chromium
  Nichrome
Metal alloys, various kinds
Rutile
Lavite
Guilding metal

Total, 34.

RUBBER AND COMPOSITION

Rubber
Gum
  Impregnating gum
  Manila gum
  Cobalt gum
  Asphaltum gum
  Fossil gum
  Gum shellac
Condensite
Bakelite
Benolite
Micarta
Vulkebeston
Micanite
Paste
Vulcanized fiber
Rubber cement
Shoddy (reclaimed rubber)

Total, 18.

PAPER

Paper
  Baeren paper
  Fishpaper
  Rope-cement paper
  Wood-pulp paper
Rope paper
Fullerboard
Pressboard
Pulpboard

Total, 9

COTTON, WOOL AND SILKS

Cotton
  Thread
  Cord
  Yarn
Linen
Cambric
Cotton cloth
Silk, silk yarn, thread
Wool felt, yarn
Canvas

Total, 13.

PAINTS AND VARNISHES

Paint
Varnish
Shellac
Enamel
Japans
Pitch
Pine tar
Coal-tar pitch
Asphaltum
Benzine
Turpentine

Total, 11.

WOOD

Yellow pine
Fir
Hardwoods
Wood flour

Total, 4.

MISCELLANEOUS

Chamois
Hemp
Jute
Burlap
Fiber
Leatheroid
Celluloid
Capsules
Starch
Glucose
Clay
Crucible clay
Feldspar
Silica
Ball clay
China clay
Spar
Sand
Coal
Coke
Asbestos flour filler

Total, 21.

SUMMARY

Minerals, chemicals, etc	58
Waxes	8
Oils	5
Metals	34
Rubber and composition	18
Paper	9
Cotton, wool and silk	13
Paints and varnishes, etc.	11
Wood	4
Miscellaneous	21
Total	181

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Lake Placid Convention of the A. I. E. E.

Work and Play Well Balanced—The Part Which Coöperation Can Play in Future Activities—System Protection, Technical and Development Committee Reports and Cable Problems Were Principal Business Features

THE ENGINEER'S PLACE IN THE WORLD PROBLEM

May we not as engineers utilize our training and experience, our method of thought of which we are so proud, to encourage clean, straight, unbiased and fair-minded thinking, and to encourage that broad, generous coöperative spirit which will mean so much in breaking down the barriers which separate classes within a nation, as well as the nations themselves, and which is essential to the solution of the world problem which is knocking so hard at our door?—*From the presidential address of Prof. Comfort A. Adams before the A. I. E. E.*

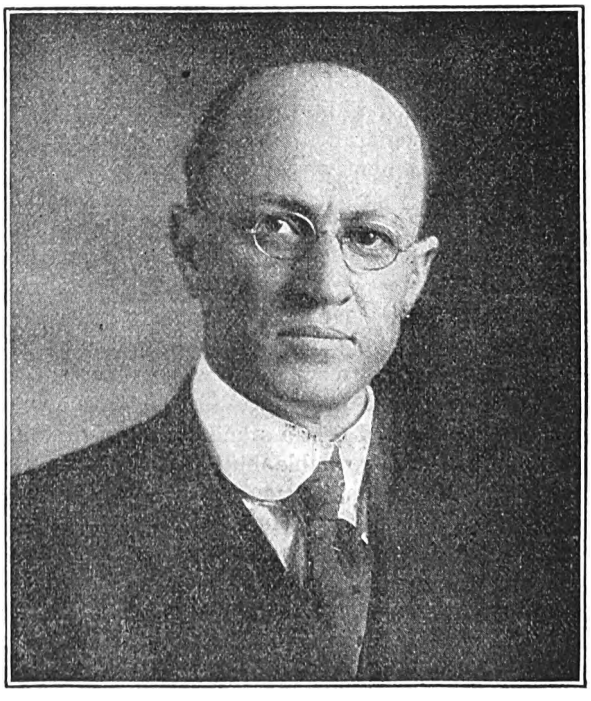
WHILE the Lake Placid (N. Y.) convention of the American Institute of Electrical Engineers, held on Tuesday to Friday of this week, was primarily for business and professional purposes and was highly successful in this connection, its outstanding feature was the liberal provision for relaxation between the periods of convention work. No one who attended can help feeling that he had a delightful vacation, the natural facilities of Lake Placid affording all that any one could wish in the way of entertainment. The woods, mountains and lakes, the friendly spirit, the outdoor sports, dancing, automobile rides, etc., all contributed to the most successful convention which has been held for years. By Wednesday evening, the second day of the convention, the registration had reached 370,

The plan arranged for the convention period was to hold business sessions during the mornings only and leave the afternoons and evenings free for recreation. On the first morning, following President Adams' address, papers and discussions were presented on relay protection and on grounding the neutral. So much interest was evidenced in these subjects that the discussion continued well through the forenoon of the next day. Some of the technical committee reports were read and discussions on them took place on Wednesday morning, but a following session was necessary to complete the forenoon's program. One of the very interesting phases of the convention was the conference on Thursday morning under the auspices of the committee on development. The report of this committee will appear next week, with an account of the discussion on cable problems.

PRESIDENT ADAMS DISCUSSES MANY SUBJECTS

President C. A. Adams, in the opening address of the convention, called attention to the general unrest in all sections of the world arising out of the great war, which has led to a change in the old order of affairs. As to the future he asked: "Are we as engineers, educated men, who pride ourselves on our breadth of vision, who complain because we are not properly recognized in large questions affecting the public welfare, going to crawl back into our little cabins and leave the steering of the ship to those we consider incompetent, or are we going to scrutinize the ship's log to see why she ran on the rocks and then revise the sailing orders accordingly?"

From this Professor Adams took up the general subject of coöperation. He said that the history of human society is the history of coöperation and that every commercial transaction is made on the assumption of mutual benefit to both parties concerned. "The more the mutual confidence and the coöperative spirit, the freer and the more efficient will be the interchange and the greater the mutual profit," Professor Adams said. "This is merely the simplest possible illustration of cooperation to show its fundamental nature. Industrial coöperation, from which my illustrations are drawn and with which engineers are mostly concerned, usually involves more than this simple and somewhat restricted coöperation between buyer and seller; it involves cooperation all along the line, internal and external, between producers, between consumers, and between producers and consumers.



PRESIDENT C. A. ADAMS

"The obstacles to coöperation, particularly between the larger units, are of two varieties, material and human or intellectual. The chief material obstacles are space coupled with imperfect means of communication and transportation, differences in language, differences in coinage, weights and measures, and duties or tariffs. Some of these bear obviously only on international cooperation. The chief intellectual obstacles are tradition, custom, prejudice, suspicion, distrust, jealousy, narrow-

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minded and short-sighted selfishness or greed, or in general ignorance and lack of understanding one of the other. Most of this latter group bear upon minor or internal as well as upon international coöperation."

COÖPERATIVE SPIRIT IN STANDARDIZATION

Professor Adams traced the connection between engineering and industrial standardization and coöperation, showing that as a result of standardization the confusing and conflicting claims of competing salesmen are eliminated because the purchaser is placed in possession of definite knowledge of the characteristics or capacities of machines, and thus is able to select discriminately and wisely. But this coöperative spirit apparently does not always prevail. The speaker continued: "Until very recently the French national committee of the International Electrotechnical Commission contained none of the designing or manufacturing engineers, it being assumed that the latter would be biased and partisan in their attitude. As a result the manufacturers formed a syndicate with a committee and standardization rules of its own, which were and even now are to some extent the rules generally employed in France, although much inferior to our own. In some cases the American rules are specified. Even now the French rules originate in the manufacturers' syndicate and are passed on to the French national committee for its approval with a consequent loss of time and efficiency.

"As the work of our own standards committee expanded we found it overlapping the work of other societies in adjacent fields, and coöperative relations were established. This failed from the lack of any suitable and generally acceptable coöperative machinery. A movement was then started by the Institute, more than two years ago, to organize a central body (the American Engineering Standards Committee) to coördinate all the work of engineering standardization being done by the various engineering organizations. The objects of this organization are to avoid overlapping, duplication of effort and the confusion of conflicting standards; to insure the employment of an effective and sound procedure in the development of standards, to the end that a standard when promulgated may be not only workable but also acceptable to all concerned and the only accepted standard of its kind; to stimulate desirable standardization and at the same time to shut off premature or ill-advised attempts at standardization.

"The consummation of these objects will mean an enormous saving of effort in the production of standards, a tremendous increase in the value and usefulness of standards, and, when the work is brought up to the needs of the time, an incalculable saving in the cost of production and the productivity of labor. International standardization," Professor Adams went on to say, "will be a tremendous stimulus to foreign commerce; but such international standardization is in most cases exceedingly difficult without a central authoritative body with which similar foreign bodies may coöperate. Several instances of this difficulty which have actually arisen during the past two years could be cited. These have resulted in hopeless confusion, misunderstandings and waste of time and money.

"Great Britain has its Engineering Standards Association, which during its eighteen years of life has demonstrated its reason for existence and its value to industry and to the government. The work in air craft standards alone which it is doing on behalf of the government involves some fifty odd sub-committees. France now has its permanent Standards Commission, a little more than a year old, and just getting under way. Holland also has its Normalization Bureau for the same purpose, and Switzerland is just starting a movement in this direction.

"With all these national bodies our American Standards Committee has already established cordial coöperative relations. The American Engineering Standards Committee, although organized last October, is now in process of reorganization; but the success of any such movement is in direct proportion to the degree in which the coöperative spirit prevails. It is the fear rather than the fact that causes the trouble. Even if the sacrifice were much more than it is, however, the price would be small in proportion to the result.

"It is the generous coöperative spirit for which I am pleading, rather than the timid spirit of him whose vision is of such short range that he dare not take a man's size step for fear of stubbing his toe, who holds the little present so close to his eye that it shuts out the whole landscape of the future, whose immediate self-interest or small-group interest is so dominant as to hide anything beyond.

INDUSTRIAL RESEARCH

"Another fertile but as yet little cultivated field for coöperation is that of industrial research. Here we have a field where the obstacles of the second group are specially dominant—particularly short-sighted self-interest and corporate interest and the timid desire for secrecy. That many of the most important and revolutionary developments of modern industry are dependent upon research needs no proof. It is not so obvious to many, however, that coöperation in industrial research is to any large extent feasible at the present time.

"After some experience in this field I am convinced that thorough-going coöperation in industrial research would mean not only a reduction of the cost of research to a small fraction of its present figure, a much more rapid industrial development of the country as a whole and a material increase in the productivity of labor, but also an increase in the profits of every intelligent party to the coöperation.

"Serious coöperation of any kind between widely separated groups is practically impossible without the mechanism of transportation and communication provided by the work of the engineer. Also, with this mechanism developed even to its present degree of perfection, coöperation becomes not only possible but also desirable and necessary, even between comparatively widely separated groups. Moreover, the problems which confront the world at this time are largely a direct result of this mechanism. Are we as engineers going to leave their solution to others? Are we going to be satisfied to play alone in our own little back yard and never look around us even after most of the fences have been removed by our own work? Are we going to fail to take an interest in our neighbor who has much that we need, from whom we have much to learn, and by coöperation with whom we can profit broadly? If we do offer coöperation, is it to be with the provision that we gain all and sacrifice nothing? Are we going to be

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satisfied to sit back and criticise destructively the details of a coöperative agreement, priding ourselves on our critical faculty, however valuable that may be at times, when the real basis of the criticism is either intellectual pride or short-sighted fear that we, as individuals or as a group, may lose a little of our independence or prestige; when the issue at stake is in some cases of such paramount importance even to us as individuals (had we only the vision to see it) as to overshadow our very existence?

"Let us rather make use of the logical habits of thought and freedom from bias which at least should be the result of our training and take our part in the solution of the problems we have helped to create. Let us see the goal ahead and start for it without thought of fear or favor, as sure-footedly as possible, but with that generous coöperative spirit which will surmount many an apparently impossible barrier, critical of details if so minded, but generously and constructively so."

LABOR AND OTHER MONOPOLIES

Professor Adams then touched upon the serious problems arising from the worldwide unrest in the labor group. He said: "It is very easy to criticise and condemn this attitude because of its unreasonableness, looking down from our superior height of intelligence. It is very easy to assume that it is merely a matter of showing the laborer the error of his ways and of forcing him into line. But would it not be wiser at this time to examine our own attitude with equal care, to make sure that we are setting an example which if followed by labor would solve the problem? Is demanding all the traffic will bear under the pressure of organized labor any worse than the same policy carried out by the capitalist whenever he has the monopoly grip? Unfortunately the two cases are not treated the same by our laws. Labor monopoly is not subject to the same limitations and responsibilities as is capital monopoly. That disparity should be removed. But there are two forms of monopoly other than of labor which are not only not limited by but are actually fostered and protected by our laws, and in which the only limitation ever dreamed of by the owner is 'all the traffic will bear.' These are patents and titles to land."

Professor Adams explained these monopolies at length and showed that is was incumbent on the engineer to assist in a progressive rational evolution of society rather than encouraging and inducing a revolution by a reactionary policy.

THE ENGINEER AS A CITIZEN

"Are we sincere in our desire to be more recognized in our broader capacity as citizens and to be consulted in matters of broad public interest if we are not sufficiently interested in those matters to make an intelligent study of them—if we are satisfied to accept without analysis the prejudices and propaganda of a biased group, however intellectually superior that group may consider itself—if we cease to utilize our logical habits of thought, our habit of analysis, of demanding the reason why, as soon as we step outside of the realm of those physical laws which force us to think straight? Are there no laws in this other realm of human relations which are just as inexorable as the physical laws with which we are so familiar? Is there no law of compensation which is the counterpart of our law of conservation of energy? Are we going to be allowed to go unpunished for crooked or careless thinking in this other realm any more than in the purely physical realm?

"What can we expect of labor in the way of intelligent fair-mindness if we, with our superior advantages, encourage the perpetuation of institutions which work for serious injustice to the many for the benefit of the few, or even if we allow them to persist because of our lack of intelligent fair-mindedness?

"My opinion as to the seriousness of the present world situation, as to the importance of the problem before us, is not mine alone but that of many thinking men in this country and in others. I have talked with many influential men in France and England and have found a striking unanimity on this point.

"May we not as engineers utilize our training and experience, our method of thought of which we are so proud, to encourage clean, straight, unbiased and fair-minded thinking, and to encourage that broad, generous coöperative spirit which will mean so much in breaking down the barriers which separate classes within a nation, as well as the nations themselves, and which is essential to the solution of the world problem which is knocking so hard at our door?"

DISCUSSION AT TUESDAY MORNING SESSION

The president-elect, Calvert Townley, in responding to President Adams' introduction, expressed his appreciation of the honor conferred on him and especially of the opportunity for leadership. He contended that the engineers should be just as able to be prominent in the public eye during peace times as they have been during the last few years in helping to carry the war to a successful conclusion. He could not see any far-reaching danger in the present labor agitation because he declared that any body which seeks to secure more benefits than are due it cannot succeed.

The first paper of Tuesday morning's session was presented by H. R. Woodrow, D. W. Roper, O. C. Traver and P. MacGahan on "Present-Day Practice of Transmission and Tie-Line Protection," an abstract of which begins on page 1375 of this issue.

Two papers on grounding the neutral were presented at the same session—one of them by H. R. Woodrow and the other by William E. Richards. In the paper by Mr. Woodrow, it was said that experience had shown unquestionably that the cable stresses are considerably relieved by grounding the neutral. Further, it is believed that it is desirable to limit the grounding current as much as possible, thereby reducing the stresses on the system, and particularly the burning of the lead sheath and grounding connections. The installation of grounding relays, which can be set to disconnect a feeder more quickly than the straight normal-current relays, will further greatly relieve the potential stresses due to prolonged grounding current which occur even with a grounded system.

In Toledo, where about 16,000 kw. is transmitted over 23,000-volt, 25-cycle transmission circuits connected with underground cable, considerable improvement in operation has been observed since changing from an ungrounded system to a directly grounded Y system, Mr. Richards said in his paper.

All of the papers presented at the Tuesday morning session were on allied subjects—namely, relay protection and grounding of the neutral—so the discussion of

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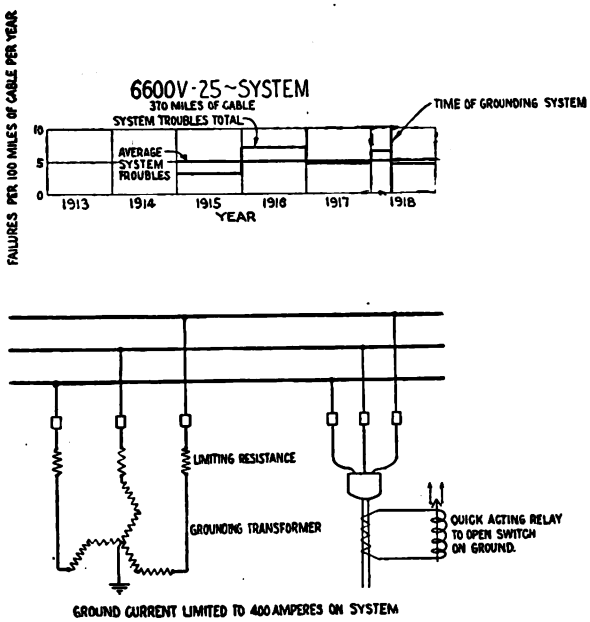
these papers was taken up at the same time. Among those taking part in the discussion were the following: H. B. Vincent, Day & Zimmerman, Philadelphia; J. R. Craighead, General Electric Company, Schenectady; J. A. Johnson, Ontario Power Company, Niagara Falls; A. H. Lawton, Consumers' Power Company, Jackson, Mich.; H. C. Albrecht, Philadelphia Electric Company, Philadelphia; Philip Torchio, New York Edison Company, New York; P. M. Lincoln, Westinghouse Electric & Manufacturing Company, Pittsburgh; Charles Proteus Steinmetz, General Electric Company, Schenectady, N. Y.; E. T. Moore, Halcomb Steel Company, Syracuse, N. Y.; F. D. Newbury, Westinghouse Electric & Manufacturing Company, Pittsburgh; W. de L. Carr, United Gas Improvement Company, Philadelphia; R. F. Schuchardt, Commonwealth Electric Company, Chicago; E. F. Creighton, General Electric Company, Schenectady; Don Carlos, Ontario Power Company; E. A. MacKenzie, Ontario Power Company; R. R. Honaman, Bureau of Standards, Washington; E. G. Merrick, General Electric Company, Schenectady, N. Y.; F. L. Hunt, Turners Falls Power & Electric Company, Greenfield, Mass.; D. W. Roper, Commonwealth Edison Company, Chicago; P. H. Adams, Public Service Electric Company of New Jersey; A. E. Silver, Electric Bond & Share Company; F. C. Hanker, Westinghouse Electric & Manufacturing Company, Pittsburgh; J. C. Parker, University of Michigan, Ann Arbor; D. C. Traver, Schenectady, and H. R. Woodrow, New York Edison Company.



GROUNDING SYSTEM THROUGH ZIGZAG-CONNECTED TRANSFORMERS

Results obtained by connecting limiting resistances in the primary side of the grounding transformer. Limit total of ground current with both generating stations operating in parallel to 400 amp.

TUESDAY'S DISCUSSION ON RELAY PRACTICE

Considerable of the discussion centered around the terminology used in connection with relay practice, some even objecting to the classification of devices given by the protective devices committee.

Mr. Craighead declared that the future practice in designing or extending transmission lines should take into consideration the principles of protection as well as economy. Furthermore, increase in speed of operation of oil switches has required a corresponding improvement in relays. By so doing he believes it will be possible to reduce the time differential of delays below the three-fourths of a second which is now believed to be the minimum. One of the greatest opportunities for improvement will be through the thorough understanding of operating conditions by actual measurements of current, etc.

Mr Johnson expressed the belief that improvement could be made on combined use of under-voltage and over-current relays, mentioned in Mr. Woodrow's paper and abstracted elsewhere in this issue, by letting the under-voltage relay control the current supplied to the tripping bus. This scheme has been used at Niagara Falls in the generator neutral and is worthy of more application, he contends. Greater improvement in circuit breakers will have to be looked to in the future for isolating cable faults.

At Philadelphia the cycle counter is used extensively, said Mr. Albrecht, for timing and setting relays. A differental of 25 cycles is allowed for relays, 15 cycles being allowed for the oil switch to operate and 10 cycles for inaccuracy of relays. He expressed the opinion that it is impracticable and expensive to test on the primary side of current transformers as suggested in Mr. Woodrow's paper and declared that too much emphasis is placed on the reduction in busbar voltage during short circuits.

Mr. Torchio admired the ideal which Mr. Johnson looked to—that is, a circuit breaker which would open any short circuit—but said it is too far in the future. The better way to do, in his opinion, is to reduce the amount of power that can go into a short circuit in order that the selective relays can be properly applied. He contended that it is better to follow this American development than to change to European practice.

With the increase in size of electric service systems, Mr. Lincoln pointed out, the possibility of interruption of service is increasing, and at the same time there comes a greater need of reliable service. Hence there is an extraordinary need at this time and in the future for considerable investigation of the protection of large systems in order to offset these contending factors. In this connection it is encouraging to note that the efficacy of grounded neutrals is fairly well demonstrated, the Toledo, New York and Montana companies having reported favorably in this connection.

The problem of relay protection, said Mr. Steinmetz, is the production of simple, reliable and automatic apparatus that will permit an abnormal circuit, cable or piece of apparatus to be disconnected without interfering with the operation of any normal line or cable. When disturbances occur normal circuits as well as the circuits in which the disturbance takes place are affected, so that devices that indicate or act merely when abnormal conditions take place will not solve the problem because the conditions require a device whose operation depends on the magnitude of the abnormality.

Mr. Moore called attention to the need of further study in the adaptation of relays to electric furnace protection.

Mr. Newbury was particularly pleased to hear operators speak favorably of a grounded neutral because this is desirable to machine and apparatus designers.

Mr. Schuchardt pointed out that it has taken a long time for engineers to recognize that relays reduce investment expense, due to the saving possible through interconnection. Now, he contended, it is a case of pro-

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viding the proper talent to maintain relays in order that the manufacturers may know where further improvement is necessary. To permit an interchange of information on this subject he suggested that the protective devices committee serve throughout the coming year as a clearing house on experiences with relays. Although Chicago has a larger system in a limited territory than probably any other company, the conditions met there may be the same as those of other systems in the near future, so their problems and solutions are worthy of considerable study by such companies. On this system the circuits are sectionalized by reactors to limit the power which can be supplied to any fault. In each section one unit is grounded through a 2½-ohm resistance.

In closing the discussion Mr. Creighton pointed out that balanced relays sometimes trip when circuits are being synchronized owing to the switch blades failing to make contact simultaneously. While the arcing ground suppressor was very effective when used on radial systems, it is not at all satisfactory now on parallel factors.

CONTINUATION OF DISCUSSION WEDNESDAY

Mr. Carlos questioned the need of such a small total time interval as two seconds in relay setting, saying that on the Ontario Power Company's system a total interval of eight seconds is allowed, while on an associated system four seconds is maintained without trouble, owing to the long time setting. The setting of three-quarters second between relays could not be maintained with satisfactory results, he said, at least double that time being necessary with the equipment used.

Mr. MacKenzie said that automobile batteries of both the lead and Edison types have been used for operating relays and that the lead type appears to be more economical for this particular purpose, although dry cells are still more so. The latter are being used by some companies even for 110-volt oil-switch control. He recommended Mr. Johnson's method of using under-voltage relays to control the tripping bus in conjunction with over-current relays, a master relay being employed for a similar purpose on the Ontario system with satisfactory results. For generator protection Mr. MacKenzie favored using definite-time relays. He does not consider it necessary to set relays from the primary side of the transformer and recommends testing them after each automatic operation for characteristics, including minimum current required to operate them. The latter should not be appreciably above the operating load.

Mr. Merrick considered that it is hardly necessary to reduce the total operating time of relays and switches below two seconds to protect generators and transformers, since they can withstand short circuits for several seconds anyway. On the Montana Power Company's system higher reliability of relay operation has been obtained by grounding neutrals, practically the only trouble now experienced being due to the high resistance of grounds which prevent relays tripping.

A total time interval of three or four seconds is allowed on the relays used on the Turners Falls system, said Mr. Hunt. Since grounding the neutral the results have been more positive than ever before.

The New Jersey company, declared Mr. Pollard, has come to the decision that grounding the neutral is better than not doing so. This is particularly interesting since the company operates about 200 miles of cable and 300 to 400 miles of overhead lines. Where the stations are in tandem one-half second interval is allowed between relays, which are the induction type, and three-quarters second should certainly be amply satisfactory. In addition to the ordinary type cables, this company operates twelve split-conductor cables which have given very satisfactory results.

Mr. Roper said that the Commonwealth Edison Company has conducted some tests which show that synchronous apparatus will be thrown out of step when a short circuit occurs very near the equipment if the relay action is not very rapid. However, if the short circuit occurs 100 ft. to 200 ft. (30 m. to 60 m.) away, thereby increasing the reactance and resistance of the circuit, this trouble will not be experienced so acutely if the relays and switches operate properly. Since the effect of burn-outs in cables and the spreading of damage is more severe when time element is introduced into relays, it is very important that rapid relay action be obtained to prevent this trouble.

Mr. Adams expressed the belief that a total time interval of two seconds might be the right value to maintain in relay settings for short-circuit conditions. but it does not need to be so long for mere overload conditions.

On systems which the Electric Bond & Share Company has been operating it has been found that very much better relay operation is obtained when the neutral is grounded, according to Mr. Silver. These experiences have been in connection with circuits operating at voltages of 60,000 and upward.

Mr. Hanker recommended the extension of investigations of relay application of grounded systems by the protective devices committee

Relay application should not be considered so much from the viewpoint of protection of apparatus, said Mr. Parker. as from that of insuring continuity of service. If this distribution is made, the problem of determining time settings is considerably simplified. Too often engineers fail to recognize the ultimate object of central stations, which is to give continuous service. To illustrate the penalty which has to be paid if this is not done, Mr. Parker cited one instance in which a company lost about $500,000 of revenue from two consumers through failure to eliminate interruptions. This loss is large enough to justify spending considerable money on relays. The moral is not to wait for perfect devices to be developed before providing protective means but to use those already available in the best manner possible.

Mr. Traver entered a plea for using high turn (300 or so) ratio for bushing transformers, because the accuracy is liable to be very poor otherwise.

Mr. Woodrow closed the discussion on relay protection and grounding neutrals by replying to comments made during the discussion and supplementing points brought out in the papers. He emphasized the fact that the time interval between relays depends on several factors including the characteristics of the relay, the time required for switch operation, and the nature of the system of which the apparatus is employed. While some of the more recently developed oil switches have a speed of operation as high as one-quarter to one-half second, others are not so rapid, so the time interval of three-quarters second is not so far wrong, he contended. Until high-speed breakers are developed there is no

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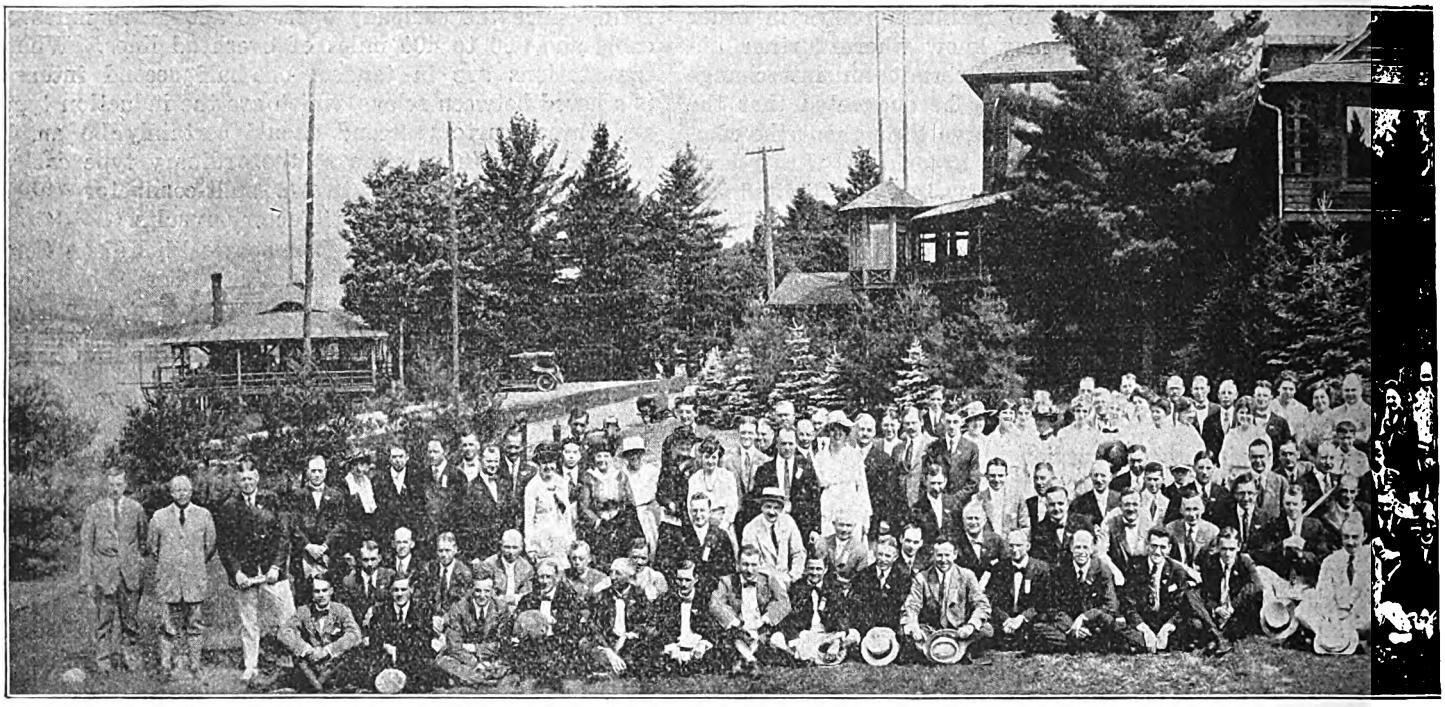

AT THIS WEEK'S CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AT LAKE PLACID,

way of reducing the time interval near the generators, although this would be desirable. On large systems it may be possible and desirable to reduce the total time interval below two seconds, although on smaller systems it is permissible to allow a longer interval. Referring to the possibility of synchronous apparatus falling out of step, Mr. Woodrow pointed out that the tendency to fall back into step again will not be so great if the time interval is increased. Comparing single-turn and multiple-turn current transformers, Mr. Woodrow pointed out that the former are very accurate on overloads, but that the accuracy depends greatly on the secondary load. This load may cause the speed to range from one-half to three-quarters second. For this reason it is advisable to use the primary-test method recommended instead of applying current directly to the relay terminals. The next best method, so far as accuracy of results is concerned, is to apply the test on the secondary terminals of the current transformer. Testing beyond the flat part of the relay characteristic curve is not essential, in Mr. Woodrow's opinion. Unless current is limited considerably by reactors, Mr. Woodrow believes eight seconds is rather long for the total time interval because all apparatus will not withstand full short-circuit current the way some people believe. In addition to using short-circuit protective relays, the company with which Mr. Woodrow is connected employs ground relays to clear faults before they develop into short circuits.

REPORTS OF TECHNICAL COMMITTEES

Despite the press of war work during the last year, the technical committees were able to gather important information and the reports show that considerable time and thought were spent in learning the conditions in the industry. Brief outlines of these reports are given below.

COMMITTEE DISCUSSION OF INSTITUTE PAPERS

In reporting the activities of the power stations committee Philip Torchio, chairman, advocated a revision by which it is hoped to improve the character of discussion of A. I. E. E. papers and even the papers themselves. He thought that the Institute papers should be fully discussed by each committee before being presented to the membership. The committees should discuss any necessary revision and help to get the paper in the best form before its presentation at a general meeting. The committee will then stand behind this paper, and the discussion brought out will be more fully considered. It is suggested that in some instances the work of the committee may well be broadened to the extent of sometimes invading the field of other technical societies and committees of the Institute where it is thus necessary to make a comprehensive study of the subject. For example, the power stations committee has under consideration three papers to be prepared on the subject "Limits of Speed and Power of Single-Shaft Steam Turbo-generator Units." Two of these will deal with the mechanical end of the unit and one with the electrical end. While in a way this work might overlap that of the American Society of Mechanical Engineers or similar societies, still the features of engineering and design of machines can be discussed only constructively with the coöperation of the users and the assistance of engineers thoroughly familiar with calculation and design of machinery. For future activities of the committee the chairman proposed a paper outlining the statistical items which are essential in reporting efficiencies of power plants, a comprehensive review of the relative merits of shunt and compound-wound exciters, steam and motor-driven exciters, etc.

Following the presentation of Mr. Torchio's report, President Adams called attention to the importance of the suggestions made by Mr. Torchio, saying that considerable benefit will result to all concerned if the papers committee will coöperate in the future with authors in presenting concise, accurate and suitable information in Institute papers.

Professor Slichter of Columbia University, chairman of the papers committee, pointed out that national meet-

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N. Y., ABUNDANT OPPORTUNITY WAS PROVIDED FOR DISCUSSION AND FOR RECREATION BETWEEN SESSIONS

ings in the future will be still more dignified than in the past, and hence greater care than ever must be exercised in selecting papers.

Electrical Applications in Industry

Each sub-committee of the industrial and domestic power committee concentrated its efforts on its branch of the work and subdivided its activities into the application of electric power to specific processes and the application of electric power to specific electrically driven machinery. A brief statement was given of the work planned by the sub-committees on the printing industry, the elevator industry and machine-tool applications. An excellent paper was presented by R. B. Williamson, as a result of the work of the sub-committee on the cement industry. H. G. Pierce, chairman of the committee, recommended that the personnel of this committe be kept intact and the work be continued in the way it has been started.

Considerable Progress Made in Telephony

Donald McNicol, chairman of the committee on telegraphy and telephony, stated that during the last year considerable improvement has been made in the design of lightning protective apparatus for the protection of telephone and telegraph lines. Some progress has been made in coöperation between power companies and telephone companies in the solution of problems arising out of inductive interference. For the improvement of long-distance telephone transmission, the vacuum-tube amplifier has been highly developed for use in telephone receivers and has become the preferred form of amplifier used.

Thermocouples for A. C. Measurements

The activities of the committee on instruments and measurements said S. G. Rhodes, chairman, during the last year have been principally in connection with the Bureau of Standards, working with the War Department to standardize purchasing specifications for electrical instruments for overseas service. Among the interesting developments in this work have been development of thermocouples for accurate measurements of alternating currents of any frequency. These are greatly improved over former German instruments which were on the market.

Ship Electrification Increasing

As a result of shipbuilding activities brought out by the war, the marine committee has been divided into two parts, a ship installation committee and an electric ship propulsion committee. The ship installation committee, moreover, was further subdivided into a power apparatus committee, a lighting committee and a distribution committee. H. A. Hornor, chairman of the committee, suggests five items which have been taken up by the power apparatus and the lighting sub-committees but not considered by the main committee, as follows: Control equipments, alternating-current apparatus control, radio installation, running lights and fire alarms.

New Powerful Searchlight Developed

Now that war-time restrictions have been raised from street lighting considerable activity is expected in this direction. C. E. Clewell, chairman of the committee on lighting and illumination, says there is an increased tendency to apply some form of prismatic reflector to incandescent street lighting. Interesting developments in lighting have been brought about by the requirements of searchlights during the war and the development of the so-called Lynn searchlight, said to be the most powerful searchlight in the world. Moreover, the spectrum of the light which is derived from these units is of the daylight character.

Aim to Better Physicist and Engineer Relations

The aim of the committee on electrophysics has been: (1) To encourage original papers of a high technical standard, marking advances in electrophysics; (2) to have each year a broad, interesting general lecture, free from mathematics, dealing with modern physics; (3) to promote a more complete coöperation and mutual understanding between the engineer and physicist. F.

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W. Peek, Jr., chairman of this committee, suggests general lectures on electrophysics for the purpose of keeping engineers in touch with this work.

MOVE TO STANDARDIZE EQUIPMENT

By far the largest amount of electrical energy required in any one industry is used by the iron and steel industry. The motor equipment requires 650,000 kw. in generator capacity, and electric furnaces about 250,000 kw., or a total of 900,000 kw.

Particular emphasis is laid upon the possibilities of standardization by the chairman of the iron and steel industry committee, E. Friedlaender. In this connection coöperation with the Association of Iron and Steel Electrical Engineers is essential. Mr. Friedlaender states that the Institute should go considerably further than it has in the past in the matter of standardization and extend its work to standardize mechanical dimensions, shafts, gears, pulleys, etc., as desired by the American Iron and Steel Electrical Engineers.

URGES APPARATUS PROTECTION RESEARCH

The work of the protective devices committee is largely set forth in a paper dealing with a relay questionnaire presented at the convention. D. W. Roper, chairman of the committee, recommends that similar investigations be carried out on the following subjects, in order of preference: (1) Schemes of relay protection; (2) oil circuit breakers; (3) grounding of the neutral; (4) lightning arresters; (5) current transformers; (6) potential transformers. The necessity of coöperation and mutual understanding of research problems should be fully understood by operating companies.

ELECTRIC SERVICE MEMBERS IN WAR SERVICE

The committee on economics of electric service, as reported by William B. Jackson, chairman, did not function during the year on account of the fact that the chairman and several members were in the military service.

RECOMMEND COÖPERATION WITH CHEMICAL SOCIETY

In connection with many electrochemical and electrometallurgical plants there are features of purely electrical character, such as regulation, power factor, load factor, balancing of loads, different kinds of currents, etc., which chemists and metallurgists are not qualified to discuss. Papers of that character should go to the A. I. E. E., or, better yet, be presented at joint meetings of the A. I. E. E. and the American Electrochemical Society. The chairman of the committee on electrochemistry and electrometallurgy, Carl Hering, recommends that this plan of mutual coöperation between the societies be fostered.

INSULATORS AND CABLES CAREFULLY INVESTIGATED

The transmission and distribution committee has been quite active during the past year and has dealt particularly with high-tension insulators and underground cables. Aside from the results set forth in several papers developed by this committee, it is pointed out that a proper appreciation of the factor of depreciation of insulators will go far toward improving operating results. There is little doubt of the tendency to go to considerably higher voltages wherever there is sufficient load to warrant a conductor large enough in diameter to keep down the corona losses.

For future activities of this committee, E. B. Meyer, the chairman, asks for more research work in the determination of dielectric losses in underground cables and standardized methods of testing. He also suggests that more data are desired on the question of the safe operating temperature of cables.

MUST WORK WITH MINING ENGINEERS

In suggesting future activities of the committee on the use of electricity in mines K. A. Pauly, chairman, suggests closer coöperation between various technical societies, national and local. Several papers were presented at the Institute meetings on mining questions.

MIND TEST FOR ENGINEERING STUDENTS

In commenting on the activities of the educational committee, Prof. V. Karapetoff, chairman, stated that at one time during the war there was considerable talk about radical changes in technical education, but it appears that colleges of engineering are essentially going back to the pre-war standards, methods and curricula. One important contribution of the war to the problem of education has been the introduction of elaborate psychological tests for analyzing a person's intelligence, fitness and caliber for a particular kind of work. Some leading universities have either introduced this system to test students or are planning to use it in addition to regular examinations.

ENTERTAINMENT FEATURES

The situation of the Lake Placid Club was ideal for the carefully planned programs for golf and tennis under the direction of A. M. Schoen of Atlanta for the golf tournaments and of G. A. Sawin of Newark, N. J., for tennis. The Mershon golf trophy was again offered, with the prospect that the final score on Friday would call for the addition of another new name. The following names are already engraved on it: A. M. Schoen, 1913; J. C. Mock, 1914; E. W. Allen, 1915; L. F. Deming, 1916. In order to secure the cup as a permanent possession, it must be won twice by the same contestant. For Thursday the annual baseball game was scheduled with W. A. Hall of Lynn, Mass., in charge.

For the ladies a special entertainment program was arranged. It included automobile trips each day, boat trips around Lake Placid, golf, cards and dancing. The automobile trips through the beautiful drives in the sections surrounding the Lake Placid Club, under the direction of W. L. Merrill, were made possible by members who contributed their cars for the purpose. On Tuesday afternoon a delightful piano recital and interpretation of Schumann's "Carnaval" was given by Prof. Vladimir Karapetoff. To the winners of the various games and highest card scores eighteen silver cups and thirty-two other prizes were offered.

A noteworthy feature of the entertainment and a finishing touch was added by a brass band of about thirty pieces made up of engineers of the General Electric Company, led by J. B. Taylor, assisted by two of his sons. Besides Mr. Taylor, who is a vice-president of the A. I. E. E., Past-vice-presidents Robinson and Merrill were conspicuous and effective figures.

Great credit is due to the convention committee, on which Farley Osgood, of Newark, N. J., served as chairman, for a type of program that provided a place for the play instincts of amateurs as well as the professionals and offered as well an opportunity for the ladies and others to see and enjoy the natural beauties of the Lake Placid district.

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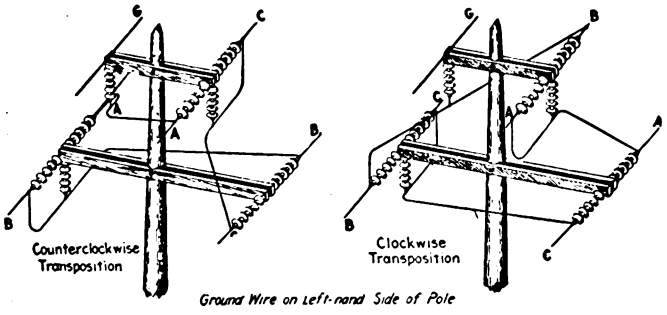
STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

SINGLE-POLE TRANSPOSITION FOR HIGH-TENSION LINES

Combination Dead End and Transposition of 120 Deg. Made with Solid Wire Jumpers Held by Suspension Insulators

A method of making a combination dead end and transposition of 120 deg. was described by D. F. Parrott of the Minneapolis General Electric Company before a meeting of the Minnesota State Electrical Association some time ago. Illustrations of this one-pole transposition with jumpers of solid wire equal in size to the line wires are shown. The minimum size of wire for jumpers in this type of construction is No. 2 B. & S. gage. Any smaller wire will prove too flexible to hold the original position which is given to it.



CONNECTORS MUST NOT BE LESS THAN NO. 2 B. & S. GAGE TO MAINTAIN STIFFNESS

ECONOMICAL METHODS OF FIRING COAL IN FURNACES*

Fire Should Be Replenished When Bed Falls Below Normal Instead of Waiting Until Steam Falls—Lump Coal Should Be Broken Up

During the war there were several agencies which advocated economies in the boiler room in order to allow more fuel to be diverted to the war industries. Effecting these economies is just as essential now on account of the continued high cost of coal and the scarcity of good coal. One of the greatest economies can be effected in firing by keeping a uniform fuel bed at all times. The time to replenish the fire by adding coal is when the fuel bed has burned down below the normal standard and not after the steam pressure falls.

In using mine-run or lump coal the lumps should be well broken up. With screenings or the fine portion of mine run the coal will cake, and these caked masses should be carefully broken, on the top, after the cake has formed. This should be done with a light rake, but the fire should not be stirred or poked. The coal should be evenly spread over all the surface of the fire, giving special attention to the side and corners and always maintaining a good strong, hot fire. While a good fire bed should be maintained, care should be taken that it does not get too thick.

A good strong fire may make too much steam if the draft is strong. Therefore draft dampers on each boiler should be adjusted as often as necessary to keep the fire in the proper state. The steam pressure should be controlled by the draft, because the speed at which the fire burns or at which the heat is produced is dependent upon the amount of opening given the damper.

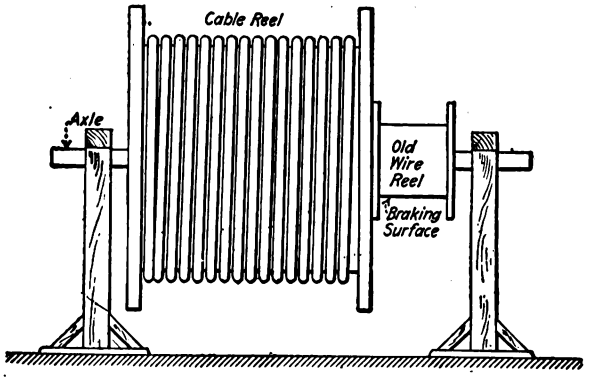
When fires are banked at night the draft should be cut off so that the bank will lie without burning. In the winter time, when steam is needed for heating, the same kind of fire should be maintained as in the day time, and the draft should be controlled in the same manner as during the day.

*This information was contained in a weekly letter from the Illinois Fuel Administration.

CABLE-DRUM BRAKE MADE BY THE USE OF OLD REEL

Weight of Cable Hanging in 80-Ft. Shaft Was So Great that Ordinary Braking Methods Might Not Have Prevented Unreeling of Cable

When the Cleveland (Ohio) Electric Illuminating Company was laying heavy cable in a deep tunnel the construction force needed an effective method of applying a brake to the cable reel. The weight of the cable hanging in the vertical shaft, which was 80 ft. (24 m.) deep, was great enough to unreel all of the cable if the drum became unmanageable. The ordinary method of applying a 2-in. by 4-in. (5-cm. by 10-cm.) piece of lumber to the periphery of the drum was not considered sufficiently effective so a better braking surface was obtained by placing a small reel on the same shaft with the cable reel and attaching it there. A heavy scantling arranged to be held securely against the surface of the smaller reel served as a brake. This



OLD WIRE REEL ATTACHED TO CABLE DRUM SERVES AS BRAKING SURFACE

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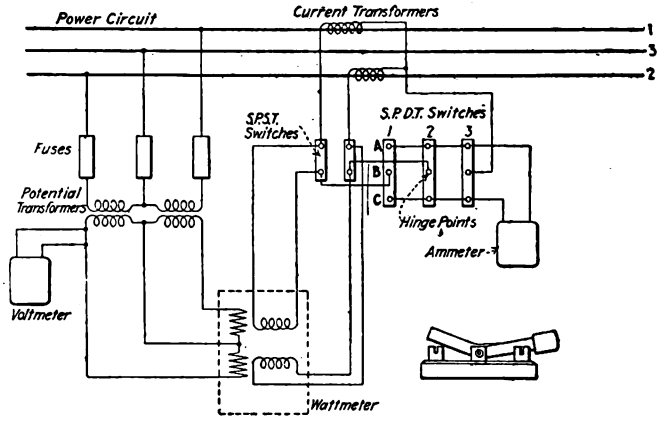
attachment was easy to make, and the cost was extremely low because nothing had to be purchased for its construction.

IMPROVED POWER FACTOR RESULTS FROM INVESTIGATION

With Simple Testing Apparatus Central Station Has Been Able to Show Customers Advantages to Be Gained

In connection with a thorough investigation of the power-factor conditions obtaining over its entire plant and distribution system, the Springfield (Ohio) Light,



BROKEN-BACK SWITCHES PREVENT SECONDARY OF CURRENT TRANSFORMER FROM BEING OPENED

Heat & Power Company has devised the following scheme for determining power factor:

Three single-pole, double-throw 15-amp. knife switches were provided with a blade extension which makes them similar to broken-back switches. When placed in a single ammeter circuit, as shown, they eliminate the possibility of the opening of the secondary of the current transformers at any time and indicate the current flowing in each leg of a three-phase circuit. Properly combined with simultaneous voltages,* these readings give the kva. of the system.

The normal position of the switches, with no current flowing through the ammeter, will be *A-B*. Closing the switches one at a time to the position *B-C* will give the currents flowing. A three-phase wattmeter inserted in the circuit gives the kw., and the power factor can thus be determined. For convenience in inserting and removing this wattmeter, two single-pole, single-throw 15-amp. knife switches are used.

The two-wattmeter method, using a polyphase instrument, was first tried out, but soon abandoned because of the fact that in most cases the load is unbalanced. However, this method is used to some extent for testing individual motors.

Tests have been made of all power circuits, both generator and feeder, at the power station and of most of the primary meter installations of this company. A number of the larger power customers whose load had a low power factor are rearranging their induction motors to load them up and reduce the connected horsepower, and in two cases synchronous motors are being installed. One company in particular is installing a 300-hp. synchronous motor and a 100-kw. synchronous converter, the former to displace a steam engine, the latter to provide direct current for variable-speed drive. This customer has a fifteen-minute demand of about 150 kw. at 65 per cent power factor, which with the new demand will be increased to approximately 95 per cent.

The power contracts of this company contain no power-factor clause, so that all changes are being made on the basis of reduced motor horsepower, decreased losses and improved service.

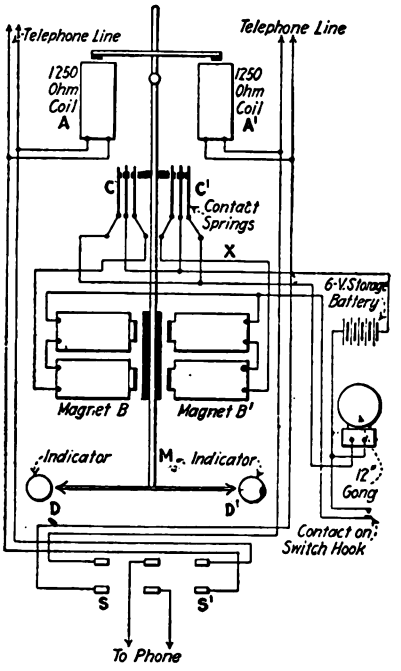
L. E. BROWN,
Springfield, Ohio. Superintendent of Distribution.

*In the cases investigated, the voltages were never sufficiently unbalanced to introduce serious error in kva. measurement.

POWER-HOUSE SIGNAL FOR TELEPHONE CALLS

Sensitive Relay Actuated by Ringing Current in Either of Two Telephone Lines Causes Closing of Contacts of Magnet, Operating Loud Bell

Excessive noise in power houses caused by rotating machinery often makes it difficult to get the operator on the telephone. The ordinary bell-ringing apparatus is usually not effective, and some means must be provided to have a constant-ringing bell that will be heard at a considerable distance from the telephone booth. The efficient and positive method shown in the diagram has eliminated all trouble of this kind in a station which has two telephone circuits. A 1250-ohm coil is placed in each telephone line so that a ringing current in either will cause the armature *M* between them to close contact *C* or *C'* respectively. This action closes the circuits of the magnet *B* and the bell, which are in parallel, energy being supplied by the 6-volt storage battery. When the operator answers the telephone the arrows at *D* indicate which line is calling, and he throws the switch accordingly. Lifting the receiver from the hook



INDICATING DEVICE TELLS WHICH TELEPHONE LINE IS CALLING

opens the magnet (*B*) circuit and allows the armature to return to neutral position.

The entire outfit is inclosed in a case with only the indicating device exposed. Trouble caused by weak construction of the annunciator drops and careless operation was in that way effectively eliminated.

Parlin, N. J. J. W. TRUESDELL.

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MIXED TRANSFORMER POLARITY BLOWS HIGH-TENSION FUSE

Although Practically All Transformers of Southwestern Utility Are of Additive Polarity, Polarity Is Always Checked When Trouble Occurs

While extended discussion is taking place between manufacturers concerning standardization of transformer polarity, central stations must continue to check connections when banking transformers. On the lines of the Texas Power & Light Company nearly all of the transformers have additive polarity, but in case of trouble in a bank of single-phase transformers after they are connected the first thing that is done is to check the polarity. The blowing of the high-tension fuse, when the transformers were apparently connected correctly on one occasion was at first puzzling, especially when it was found they operated satisfactorily on open delta. A check later indicated that one transformer was of subtractive polarity.

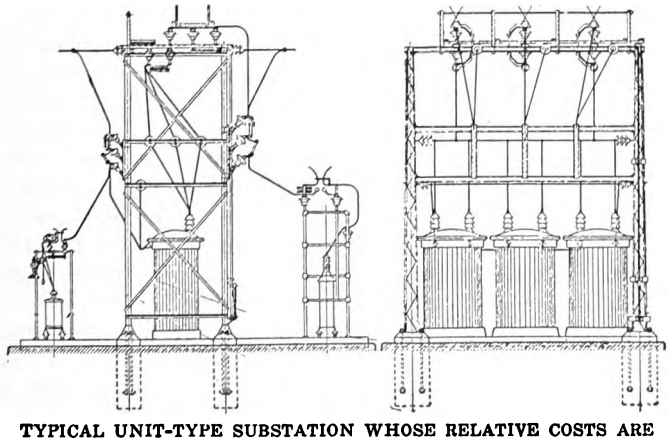
DISTRIBUTION OF COST IN OUTDOOR SUBSTATIONS

Seventy per Cent of Total Cost of 1200-Kva. Steel Tower Station Is Needed for Transformers Stepping Down 33,000 Volts to 13,200 Volts

Although the cost of outdoor substations varies with size, there is some relation between costs of the various materials and apparatus which go to make up the station. The outdoor substation shown herewith is a typical unit-type station so that the distribution of costs given in chart will be applicable to similar designs. It is used on a 33,000-volt transmission system and supplies a 13,200-volt line about 7 miles (11.2 km.) in length, at the end of which is the entire load.

The bill of material of this station gives the type of apparatus used as follows:

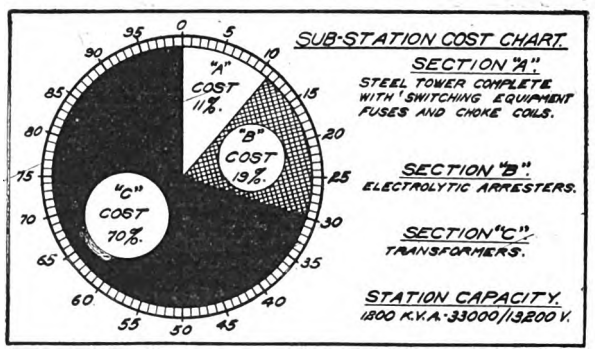
Section A of chart, representing 11 per cent of total cost, covers: One 200-amp., three-pole, 33,000-volt double-break-per-phase switch; three 33,000-volt, 200-amp. long-turn choke coils; three 33,000-volt fuse mountings with



TYPICAL UNIT-TYPE SUBSTATION WHOSE RELATIVE COSTS ARE REPRESENTED IN CHART

100-amp. carbon-tetrachloride fuses; one interlocked operating mechanism for the three-pole switch; three 33,000-volt, 300-amp., single-pole combination disconnecting switches with fuse mountings equipped with 15-amp. carbon-tetrachloride fuses for the 33,000-volt arrester circuit; three 13,200-volt, 300-amp., single-pole combination disconnecting switches with fuse mountings equipped with 20-amp. carbon-tetrachloride fuses for the 13,200-volt arrester circuit, and one expanded steel tower with bolts, nuts and clips for mounting equipment as shown in illustration.

Section B of chart, representing 19 per cent of total cost, covers: One three-phase, 33,000-volt electrolytic light-



TRANSFORMERS REPRESENT NEARLY THREE-QUARTERS OF TOTAL SUBSTATION COST

ning arrester and one 13,200-volt arrester of the same type.

Section C of chart, representing 70 per cent of total cost, covers: Three single-phase, 25-cycle, 400-kva., 33,000-13,200-volt outdoor transformers.

The above information was contributed by H. W. Young, president of the Delta-Star Electric Company.

FREQUENT CAUSES OF OIL-SWITCH TROUBLES

Why Switches Fail to Open or Complete Their Stroke, or Continue to Open and Close After Being Operated

Station operators of the Pennsylvania Water Power Company have been given a very complete set of instructions which indicate the procedure in operating and maintaining the hydraulic and electrical equipment under normal and abnormal conditions. These instructions, which were compiled by F. A. Allner, general superintendent, and Alex Bauhan, superintendent of stations, refer principally to conditions which have been found to require certain treatment. Some of the instructions follow, and more will be printed in future issues:

Whenever an oil switch has opened up on a short circuit, it is to be given a hasty inspection to determine what damage has been done to it. Ordinarily an oil switch may be returned to service after having opened under a heavy short, even if considerable oil has been spilled.

Numerous troubles may occur to oil switches from loose nuts, bolts, contacts, springs, friction, etc. If a switch fails to open it may be due to an open circuit in the control wire, a blown fuse, friction holding trip coil too tight, benchboard control button failing to make contact, or worm-gear thrust bearing being out of place, thereby jamming the worm and gear.

If a switch does not complete its stroke—that is, does not compress its springs for another operation—it may be due to an open circuit in the motor or in the magnetic clutch circuit, a bent master finger, opening motor circuit too soon, a blown fuse on motor circuit, or the magnetic clutch slipping, due to oil.

If an oil switch "pumps"—that is, continues to open and close after having once been operated—it may be due to a short circuit between the opening and closing wire, the tripping toggle not being properly locked after each operation, due to too fine an adjustment, or broken springs or parts of the mechanism. The quickest way to stop an oil switch from pumping is to open the control supply switch which feeds the particular group of switches where the trouble lies.

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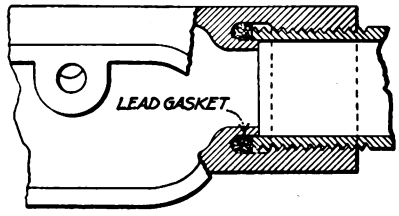
INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

MODIFYING CONDULETS TO FACILITATE FITTING

Lead Gasket Provides Inside Condulets to Give Water-tight Joint When Turned Into Place—Filing Off Conduit Ends Too Slow a Task

When malleable-iron or cast-iron condulets are screwed on to conduits they will often split or a thread will be stripped in, forcing them into the desired position. On the other hand, if they are not screwed up tight the joint will not be waterproof. Of course this



LEAD GASKET IN FITTING OBVIATES SPLITTING AND GIVES WATER-TIGHT JOINT

difficulty can be overcome by filing off the end of the conduit, but this operation takes too much time.

The foregoing difficulties can be overcome by modifying all the condulets so that they will receive a lead gasket which will bear against the end of the conduit but will compress when necessary. Other compressible substances can also be used. The inclusion of such a modification in manufactured fittings would help considerably.

J. G. KOPPEL.

Sault Ste. Marie, Mich.

TROUBLES IN ELECTRIC WELDING OPERATIONS

The Spot Welder Which Throws the Most Sparks Is Not Necessarily the Machine Which Is Doing the Best Work

Successful spot-welding in commerical practice is largely dependent upon the quality of the steel to be welded. Rusty, scaly or dirty steel is difficult to weld on account of the tendency of the steel to burn at the surface before heating up uniformly to the welding temperature. When a well-finished, pickled and oiled steel is used good welding is very easy to achieve, and the saving in labor and rejected pieces results in increased production which will more than offset the increase in cost of good steel over the burned grades.

Since the process of welding is a combination of heating and pressure, it is necessary not only to regulate the amount of heat by means of the voltage but also to vary the pressure for this class of work. The average welder operator makes the mistake of using too high a temperature and insufficient pressure, and while this method gives a quick weld and enables the operator to turn out the maximum amount of work, especially when working on a piece-work rate, it usually results in poor welds because of the burning of the steel. Whenever a welder is throwing sparks it is a clear indication that too much voltage and insufficient pressure are being used and that the welds will probably be poor. This can always be corrected by decreasing the voltage and increasing the pressure. Most operators have the erroneous idea that in order to make good welds they must make the "fire fly"; on the other hand, the best welding is done when steel is not quite up to the sparking temperature with the application of sufficient pressure to bring the parts to be welded into intimate contact. Furthermore, from the standpoint of power consumption it is desirable to use as low a voltage as possible and to make the weld in a reasonable length of time.

This information was brought out by H. B. Craft, General Fireproofing Company, Youngstown, Ohio, and C. I. Crippen, Mahoning & Shenango Railway & Light Company, Youngstown, Ohio, before a meeting of the commercial men of the Ohio Electric Light Association.

AUDIBLE ELECTRIC SIGNALS IN INDUSTRIAL PLANTS

Pressing Demand for Higher Efficiency in Production Has Led to Wide Introduction of Audible Signals

Audible signals installed in proper places throughout an industrial plant serve a variety of useful purposes. A needed person, no matter where he may be in the plant, hears his call, comes to the nearest telephone booth and reports to the operator. A craneman comes to the part of the aisle where he is needed, or he notifies the foreman by his call that he is ready for the next job. Special calls are issued for the beginning or ending of certain operations. In the middle of a noisy textile mill or shipbuilding plant, where the human voice is hopelessly lost in the din of machinery, a workman can get the necessary instructions for his work from an invisible but insistent source, or he may make his needs known without leaving his place.

Usually the signal device consists of a round diaphragm fastened around the edge and provided in the center with a small anvil which is struck by a toothed wheel driven by a small electric motor. In some other devices the diaphragm is made to vibrate by means of an alternating-current electromagnet.

An early objection to the introduction of audible signals in industrial establishments was due to the fact that the motors of these devices used to be wound for low voltages, necessitating separate storage batteries of 6 volts to 12 volts. Of late years electric horns have been developed with motors wound for 110 volts or 220

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volts, alternating current or direct current, so that they can be connected directly to the power circuit. The operating switch may be either connected directly to the same circuit, or it may be on a local bell wiring, closing the motor circuit through a relay.

Ithaca, N. Y. V. KARAPETOFF.

ELECTRICITY ECONOMICAL FOR JAPANNING AND ENAMELING

Because of Smaller Output and Larger Rejections from Gas Ovens, Electricity Is Considered 20 per Cent Cheaper than Gas

To determine the relative advantages of gas and electricity for japanning and enameling automobile parts, the Chandler Motor Car Company conducted tests on a double gas oven and a double electric oven, the input of energy to each being measured carefully. In one week's time parts for 498 cars were enameled in the electric ovens at an average cost of 28 cents per car for heat, and the rejections were only 3 per cent. With the gas ovens, however, parts for only 210 cars were turned out, at an average cost of 23 cents per car, and the rejections were about 18 per cent.

Considering the greater amount of work and the better quality turned out by the electric ovens, Charles E. Lohr, assistant production manager, considers that electricity is about 20 per cent cheaper than gas. At that time gas cost about 30 cents per 1000 cu.ft., but it is now 35 cents and is likely to go higher. Electricity was secured at 9 mills per kilowatt-hour.

ALARMING TEST READINGS TURNED OUT HARMLESS

Potential Between Conductors and Core or Frame or Between Insulated Conductors When Energized Not Always Sign of Insulation Fault

The two phase windings of quarter-phase motors are generally insulated from each other, and ordinarily one might not expect to get a deflection on touching one terminal of an alternating-current voltmeter to a conductor of one of the phases, the motor being in operation, and the other terminal of the voltmeter to a conductor of the other phase. However, a considerable deflection will be obtained because of the capacity included between the phases. Similarly, if the voltmeter terminals be applied to any one of the phase conductors of a three-phase machine and to the frame of the machine, a considerable deflection will be obtained, although the frame necessarily is well insulated from all phase conductors. This, however, does not hold good in the case of a grounded neutral, which is another proposition and one not calling for consideration in the present article.

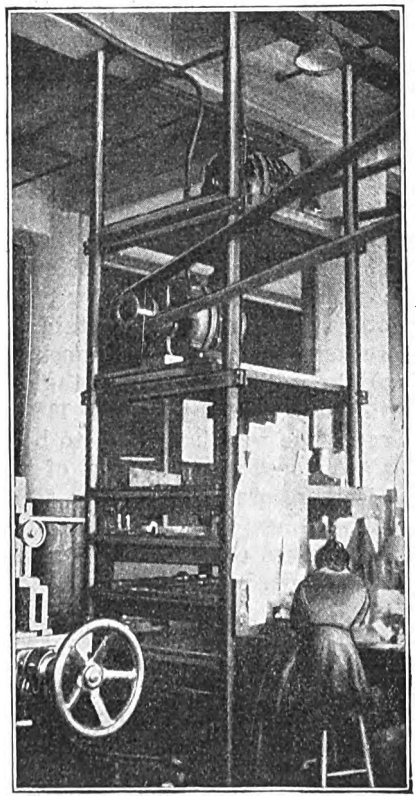
It is not at all surprising that such a deflection should obtain, but it was surprising in a certain instance to find that the value of the capacity deflection increased and decreased with the value of the load of the motor. The experience had to do with the measuring of the output of a 40-hp., 440-volt, three-phase motor that was used for driving a Jordan grinder the duty of which was to shred cotton. The operator had noticed that a deflection could be obtained by touching the voltmeter to a phase conductor and to ground, and he had become alarmed about it because he thought that the insulation of the motor was failing. On taking the capacity deflection with two voltmeters the rise and fall of the deflection with the motor load was found to be about the same on all of the phases. With the motor operating at about half load the deflection was about 75 volts, but when cotton stock got jammed in the grinder, sending the motor to about 400 per cent of full rated load, the deflection would increase to more than 300 volts. Measuring of the insulation after the test showed the insulation resistance to be several megohms.

Brooklyn, N. Y. E. C. PARHAM.

UTILIZING THE SPACE UNDER MOTOR SUPPORT

Installation That Might Have Wasted Space Made Effective by Placing Two Motors on Standard and Using Other Space for Shelves

Having to install a motor for driving a line shaft in the middle of a floor in order to furnish the desired drive, one industrial plant made the best of what might have proved an inefficient mounting by fully utilizing the space occupied by the supports. The mounting consisted of four verical 2.5-in. (6.3-cm.) pipes embedded in the concrete floor and fastened to the ceiling. Attached to these were angle irons on which the motor platform was laid. It so happened that another motor was needed near the same position, so the space directly below the first motor was used for the support of the second. The remainder of the space was utilized for trays in which were kept various tools used by the operators of machines in the vicinity, who were thereby saved much time by not having to make trips to the tool room for needed implements.



TWO MOTORS AND TOOL TRAYS UTILIZE FULL SPACE TAKEN BY SUPPORTING STANDARD

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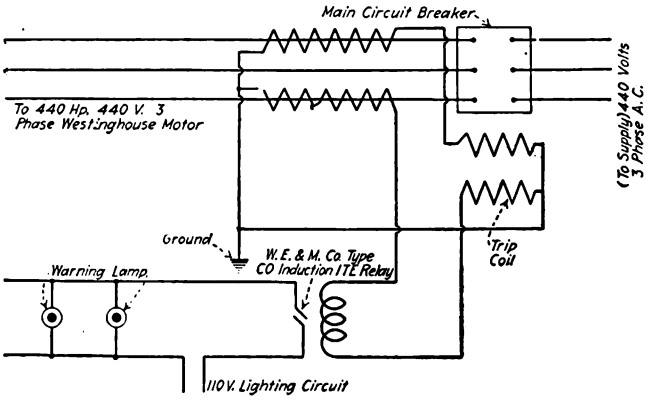
HEAVY OVERLOAD INDICATED BEFORE CIRCUIT BREAKER OPENS

Signaling System Notifies Operators When It Is Not Best to Feed Raw Material to Rubber Machines, Thus Preventing Circuit Breaker Opening

Frequent opening of circuit breakers and consequent delay are sometimes encountered in rubber mills when several machines are driven by one motor, even if it is



RELAY IN TRI-COIL CIRCUIT ENERGIZES LAMPS BEFORE LOAD OPENS CIRCUIT BREAKER

of sufficient capacity for normal operations. This is especially true in connection with the mixers on account of the instantaneous overload duty exacted from the motor when several operators working on machines driven from the same shaft place pieces of crude rubber in the machine at the same time. In order to eliminate this trouble, engineers of Lockwood, Greene & Company designed a signaling system that warns the operators when they should not add raw material to the machine. It consists essentially of one relay and a red lamp placed in front of each of the eight machines. When the motor current reaches a certain percentage of the circuit-breaker opening current (amount determined by operation) the relay, which is of the Westinghouse CO type, will close the switch of a 110-volt lighting circuit and cause the warning lamps to be lighted.

The lamps are placed near the level of the operator's eyes, and it is therefore easy for him to see when he can safely put in a new batch of rubber. Vapor-proof fittings with the glass cover omitted are used for the lamps, but a wire guard prevents breakage.

New York, N. Y. H. A. DODGE.

INDUCTION MOTOR AS A SYNCHRONOUS MACHINE

Low-Speed Induction Motor Has Better Characteristics When Operated as Constant-Excited Synchronous Motor

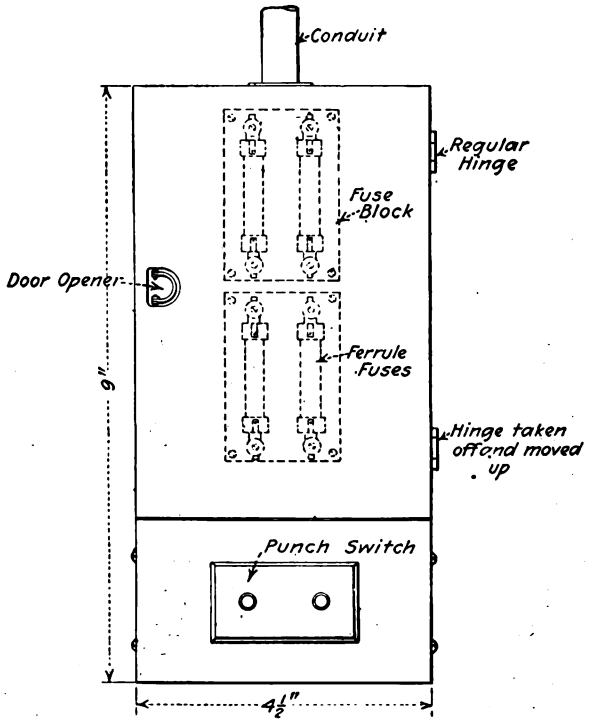
Since the power factor of low-speed, large-capacity induction motors is low at the best and drops off rapidly with decrease in load, some industrial plants may find it advantageous to operate them as synchronous machines if they are of the wound-rotor type. This can be done by connecting one side of a direct-current supply to one slip ring and providing means whereby the other side can be connected to the other two slip rings after the machine has been brought up to synchronous speed as an induction motor. Of course such operation will not be satisfactory unless the motor operating as an induction machine has high magnetizing current, has a low rotor resistance and is not loaded too heavily when the conversion to synchronous operation is made. The best exciting current to use can be determined by conducting a power-factor test, care being taken not to allow the field current to exceed the slip-ring current when the motor is running as induction motor.

Operating as a synchronous machine, the speed will, of course, be constant regardless of load and the rating will be increased compared with that when operating as an induction motor. Furthermore, the power factor and efficiency will be considerably improved. It should be understood that the characteristics will under no conditions be so good as those of a motor primarily designed for synchronous operation and that the suggested method is merely an expedient.

REMOTE-CONTROL RECEPTACLE IS MADE FROM CUT-OUT BOX

Cover Is Sawed in Two Parts and Hinge Moved Up—Makes a Neat-Appearing Receptacle Which Can Be Mounted Close to Machine Operator

Needing a receptacle for a remote-control push-button switch on short notice, the electrical department of an industrial plant in New Jersey made a neat-looking device from an ordinary 4.5-in. by 9-in. (11-cm. by 22-cm.) cut-out box. About 3 in. (8 cm.) of the lower half of the lid of the box was sawed off and permanently



NO EXTRA PARTS NEEDED TO CONVERT THIS BOX

fastened to the box by means of screws—after a hole had been punched out and a push switch placed in position. The hinge formerly attached to this piece was removed and placed on the part having the other hinge. This gave a swinging door which could be opened by the original ring attached to it. In the open space two fuse blocks are mounted and are thus easily accessible.

IRVING E. SWEAZEY.

Plainfield, N. J.

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CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

DISCUSSION ON POWER FACTOR BY ALEX DOW

Conditions Affecting Application of Clause in Rate Schedules—Not Yet Within Reach Except in Experimental Form

In connection with the presentation of the report of the rate research committee by the chairman, Alex Dow, president Detroit Edison Company, at the recent Atlantic City convention of the National Electric Light Association, there was a discussion on the power-factor clause. In his remarks on this subject Mr. Dow said:

Another clause which had a considerable vogue during the war period was the power-factor clause. Now, everybody with a power-factor clause says it is all right, but I sometimes think that the professions which reach me, that it is absolutely all right, are like those of the fellow who married the wrong girl and would not acknowledge it. It is troublesome to enforce a power-factor clause, especially a graduated power-factor clause. While the committee has recommended the use of it where possible, and pointed out the equity of it, the methods of application of the charge, whether it be a charge for additional cost of service due to bad power factor, or whether it be a penalty intended to be a deterrent, in each case necessitate an adjustment of costs which must be worked out.

Power-Factor Clause Not Yet Within Reach

The safe thing to say about the power-factor clause is that it is something that is not yet within our reach in such form that we can consider it as anything but an experiment.

It is perfectly feasible with an educated customer who has either electrical knowledge or good technical advice, and who is a reasonable person, to get along very nicely with a power-factor clause. It is still more easily possible to persuade such a customer in his own interest to keep a better power factor, pointing out to him that he is neglecting his own interests as well as impairing service to his neighbors by maintaining a poor power factor, and if the methods of correction are simple, and clearly advantageous to him, you can do something with him.

But, remembering that we serve the general public, and remembering that the users of alternating-current motors are legion, remembering that every man buys the motor "a little bit big" so that he will have power when he needs it, I do not know what you can do to better a general power factor by any rate method. The mere determination of the power factor, for the purpose of making an adjustment monthly or annually with each medium-size customer, is an expense, combined with the possibility of argument, which I certainly could not recommend any member company to undertake lightly.

Power factor in a street-railway contract and in a large industrial contract is a matter of education, of method and of mutual understanding or mutual helpfulness. Power factor with the man who puts in 100 hp. or 150 hp. or 300 hp. of induction motors, and who runs at 50 to 75 per cent power factor, is something he does not know about and does not much care to know about.

A number of questions were then asked by delegates. Mr. Dow said in answering them that they did not belong in the field of the committee and that the answers must be considered as by him personally. He added:

Every man making motors, and every salesman selling motors, and every curbstone contractor who scalps a commission on a motor when he has a friend who wants a little wiring done, wants to sell the biggest motor so as to get the biggest commission. The great power-factor difficulty is due to many small motors with power too great for their work. If you convince a man that he can buy a motor big enough to-day which will be a safe motor, and later trade it in for the larger motor which he expects and hopes he will soon need, you will be able to do a great deal. But your greatest trouble is the man who proposes to get his commission on the biggest motor he can sell. We all frequently give our commission accounts the benefit of the doubt.

The trouble with low power factor is that it is not due to your big customers, such as electric furnaces and welders. The thing that makes trouble is the multiplicity of the average motor user. It is like the London smoke. London smoke is the result of the everlasting little single household grate. That is what makes the smudge there. Now, in our case the grief is the small motor, and if you cannot tell the man that he can save money now, and then when he needs more power he can make a trade quickly, the case is hopeless. On the other hand, if you can make a ready exchange, at small loss to yourself, you will do much good unquestionably.

As to power-factor-correction devices, you can do much to encourage the use of power-factor correction by the synchronous motor. Now, right here let me say, for the benefit of the proper committee, that the small synchronous motor is not an impossible proposition, and its costliness is now so great in proportion to the induction motor because it is not manufactured in quantities. You go after a synchronous motor of 100 hp. and upward, and you find it is something special, and the customer you want to buy it will not wait for something special.

I do not know why the production of synchronous motors in commercial sizes—I would not say as low as 50 hp., but say 75 hp. and up—should not be standard; and why the synchronous motor with the direct-connected exciter should not be marketed at a price to make it acceptable; but when the difference is 30 to 35 per cent, you come up against obstacles. The customer says, "I want service; I do not know anything about power factor, and I do not want to know." You can convince the larger customer where the increase is 30 or 40 or 50 per cent in transformer or wiring capacity, if his power factor is bad—you can convince him, but you cannot convince the 50-hp., 75-hp. or 150-hp. man that he should pay 30 per cent more on that which does not make a direct return to him on the investment.

Static Condensers Considered

If static condensers come into use and prove to have commercial value, that will be of some help. But most companies must recognize that the public is better and more cheaply served by induction motors whose power factor will be somewhere about 75 per cent than by the more efficient, and that the problem resolves itself into the equitable division of the cost between the company and the customer. You will end by proving to the customer that it is worth his while to change it, or he will not make the change; or else you will apply enough correction at your expense to balance the cost, and nothing more.

Another question was asked, whether penalty for low power factor should be equalized by bonus for high power factor. What difference does it make? If you want leading current supplied to your system to cancel lagging

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current, you should pay for the leading current. It is theoretically immaterial whether you pay for it by a bonus proportional to the angle of lead or whether you hire the customer to run his synchronous apparatus with over-excitation, but the latter is likely to be the simpler way.

But let me make again the point I made in my first talk, which is that you must distinguish between the two ideas as to rates intended to correct low power factor. One idea is that low power factor merely adds to the cost of the service, and therefore the increased cost of the service should enter into the rate as part of the total cost, before you begin to get your reasonable profit on the service. The larger idea is that poor power factor—needlessly, sloppily poor power factor—is a nuisance and ought to be penalized as such. The inherent difficulty with this large idea is that we all want the growth of our business which is anticipated to arise from the use of the smaller electrical furnaces in metal working and other applications of electric arcs whereof the power factor is essentially low.

You have, when inviting the use of such devices on your circuits, to deal not only with the man who wants to sell to your customers a device having a needlessly bad power factor, but you have also to deal with the man who wants to sell devices which needlessly give you all sorts of unbalanced loads. You must face the fact that your public wants to be served and must be served, and you must distinguish in your rulings as to acceptable devices, and as to the use of these devices, between conditions which injure service to other customers and therefore should be specially penalized and conditions which, if they be given too much importance, will compel your customer to purchase regulating and balancing apparatus which will needlessly increase his cost of running.

You will have to say, in so many words, that apparatus which has a power factor below a certain value will not be tolerated on your circuits unless the disturbance which it causes is simultaneously corrected at the expense of the customer. It is right that the customer desiring to use a public service should pay for the correction of intolerable conditions introduced by him. But you simultaneously have to acknowledge that low power factor is an inherent characteristic of electric power service by alternating currents, and that the correcting of the system conditions resulting from the use of devices which can reasonably be tolerated is part of the total cost of the service.

A Penalty or a Bonus?

Now as to whether you should put a penalty on very low load factor or pay a bonus for reasonably good load factor, let me ask, why should we pay a man for being ordinarily good? If you penalize him for a power factor lower than, say, 70 per cent, you are thereby interfering with his freedom in order to protect the common good and your action is equitable. Between the man who should be penalized because he is spoiling service to his neighbor, and the other extreme where the man so operates his plant as to help his neighbors, there is such a wide zone of reasonable or normal alternating-current practice that the penalty imposed upon the trouble-maker may be contrasted with or counterbalanced by compensation given to the remover of the trouble. The equities applicable to the two extremes are obvious. But in the intervening normal zone I should hate to have to settle with each customer according to his mean or average power factor during the settlement period.

Answering the inquiry as to meters, I would say that the Sheffield (England) municipal plant, which has had tremendous development during the war and which has served a logical as well as a national necessity, was possibly able to do things summarily which in time of peace it could not have done with less than fifteen letters to the *Times* and two acts of Parliament. It has used recently a Hopkinson form of rate for energy supplied for mixed loads, including steel furnaces, in which the first charge is a fixed charge per kilowatt of demand, followed by a meter rate per kilovolt-ampere-hour. There is good argument for doing it the other way around—making a fixed charge per kilovolt-ampere of demand and a meter charge per kilowatt-hour. And, again, water-power practice and steam-power practice may find it desirable to differentiate. But without going into any complexities I suggest that what we might call the Sheffield idea might well be applied to the tremendously large portion of the power supplied in the United States by our member companies which is now served under the Hopkinson form of two-part rate. . . .

Solving the Meter Problem

Therefore let me say, once more passing the buck and standing from under, that the rate research committee two or maybe three years ago pointed out that if utility commissions, guided by technical officers or possibly by the United States Bureau of Standards, would consent to approve a meter of the ordinary form which was lagged in such a way that it did not read correctly kilowatt-hours but did run at an increased speed as power factor went down, we could without the application of any new meter principle, and without promoting too much patent litigation, obtain from at least three makers a meter looking exactly like our present meters and having no new elements, which meter would penalize or correct the charges for service proportionately as the power factor fell off and in any degree that was desired. You know how it is with any of the ordinary meters, that they can be made to speed either proportionately or inversely as to power factor or some function of the power factor. The metering device, therefore, is ready at hand, and it seems only to need, as a preliminary to its use, the approval of some forty-eight separate state authorities, a few bureaus at Washington and a trade name.

OFFICE SYSTEM ASSISTS SERVICE TO CUSTOMERS

Forehanded Methods of Arranging Records and Routine Make It Easy to Do Business with Central Station

Service to the customer of the Columbus (Ohio) Railway, Power & Light Company begins even before he comes in to make his contract. Dodge building reports are received by the central station, and the company later sends out a man to make an investigation on each new house, from which a record of the location, builder, size of house, etc., is made. This is filed in what is termed the "preliminary file," which consists of a system of 6-in. by 9-in. envelopes open at one end and made without a flap, into which all matter concerning a particular house goes. These are filed according to street and number.

When the customer ultimately comes in to sign a contract the company brings this envelope from the file and is able to tell the customer things about his own house that he did not know himself in some instances. With the signing of the contract the envelope is transferred from the preliminary file to the customers' file, where it is again placed according to street and number, and thereafter it contains a record of all transactions between the company and the resident at that address. All printed forms used are 5½ in. by 8½ in. (14 cm. by 22 cm.)—one-half letter size—or smaller, so that they are contained in the envelope without any necessity for folding.

If a customer coming in to sign a contract is living in a house previously occupied, the envelope for this address in the permanent file is consulted, and from the data therein shown he can be told whether he will have service "to-day or to-morrow." In addition, the information is there from which to make out the work order for connecting the new customer.

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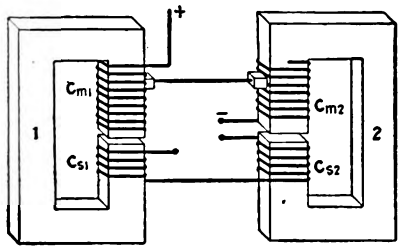
DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Motors, Generators and Transformers

Transformation of Direct Current to Alternating Current.—O. LI GOTTI.—The problem of transforming direct current to alternating current and vice versa without the use of commutators, valves or interrupters was solved thirteen years ago by L. Magrini. A new solution of the problem is now given, and from it is developed a novel form of direct-current motor without a commutator. The principle on which the devices act is the generation of electromotive force in a closed winding by causing the coefficient of self-induction to vary. One method of effecting this is illustrated in the figure, in which two magnetic circuits are shown, each having a primary winding C_{m_1} and C_{m_2}, connected in series to the direct-current mains, and secondary windings C_{s_1} and S_{s_2}, connected in series as shown. The brushes shown on the two primary windings move downward and upward together, thus increasing and decreasing the fluxes in the two circuits respectively. The result is to produce electromotive forces in the two secondary circuits that add, so that these secondary circuits become the seat of an alternating electromotive force of a frequency depending on the period of the up-and-down motion of the brushes. The apparatus can be reversed so as to convert alternating current into continuous current, the secondary winding being connected to a direct-current source to provide the magnetization of the cores. The use of brushes rubbing on contacts may be avoided in the above-mentioned devices in two ways: (1) By winding the wire backward and forward off one primary on to the other, or (2) by varying the reluctance of the two circuits by moving an armature consisting of solid magnetic masses so that the reluctance of one circuit is increased when that of the other is decreased, and vice versa. Several designs of direct-current motors are developed from the ideas underlying the above devices. An armature containing a winding revolves between a series of pairs of poles (north poles on one side and south poles on the other) and the winding has a pitch equal to that of two poles. Direct current is sent through the armature winding, and the strengths of the successive poles are unequal and vary according to the position of the armature. This variation of the strengths of the poles may be effected either by brushes rubbing on the exciting windings and rotating with the armature or by magnetic masses moving with the armature. By suitable choice of the conditions continuous motion of the armature may be produced, so that it acts as a continuous-current motor.—*Technical Supplement to Review of Foreign Press*, April 29, 1919. (Abstracted from *Revue Générale de l'Electricité*, March 29, 1919.)



GENERATION OF ELECTROMOTIVE FORCE IN A CLOSED WINDING CAUSES COEFFICIENT OF SELF-INDUCTION TO VARY

Lamps and Lighting

Notes on Railway Lighting and Its Maintenance.—A. CUNNINGTON.—The writer presents a curve showing the remarkable increase in illumination of railway cars in the last twenty-five or thirty years. The measurements show illumination in the middle of a compartment at the ordinary level of a book or newspaper under lamps with colza oil, gas burners, gas burner with mantle or electric filament lamp. These are roughly associated with the periods 1890, 1900 and 1910 respectively. The rapid rise of the curve may be taken as typical of the general tendency in standards of illumination.—London *Illuminating Engineer*, March, 1919.

Generation, Transmission and Distribution

Low-Voltage Direct-Current Electromagnets and Solenoids.—HENRY W. TOWNSEND.—Data on the construction of direct-current-action as well as solenoid types of magnets for use on battery circuits are given for magnets and solenoids which have been built and tested.—*Power*, May 27, 1919.

A Modern Substation.—ROY R. KIME.—Design features of the Forty-fifth Street substation of the United Electric Light & Power Company in New York City are taken up. The substation is installed in a building with narrow front and walled in by other buildings, as is typical of Manhattan building sites. The substation has limited floor space at street level and extends upward for several stories. The capacity is 10 kw. per cubic foot, which is said to be about double the usual concentration.—*Power Plant Engineering*, May 15, 1919.

Power System of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company.—GRAHAM BRIGHT.—The load of the Philadelphia Electric Company is somewhat greater during the winter months than during the summer, so that this company has a surplus capacity during the summer months. The South Philadelphia works, on the other hand, are steam-heated, requiring steam at pressures from 2 lb. to 4 lb. This steam can be produced most economically by generating it at high pressure and passing it through non-condensing turbines operating at a back pressure of from 2 lb. to 4 lb. It was therefore decided to install non-condensing turbines and generate all power required during the winter months. The power plant is located at the works. When steam is not required for

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heating purposes power is purchased from the Philadelphia Electric Company. Details of the substation and distribution system are given in this paper. It may be of interest to note that control wires are carried from the power plant to the outdoor substation by the underground system and that the outdoor substation can be operated from the power-plant switchboard.—*Electric Journal*, April, 1919.

Light-Weight Electric Generating Sets.—A light-weight generating set composed of gasoline engine and electric generator for use close to the front-line trenches was designed for military purposes. British designs are described and illustrated in this article. As typical of the results mention may be made of a generating unit of 2-kw. output with over-all dimensions of 2 ft. 6½ in. (77 cm.) long, 1 ft. 10 in. (56 cm.) wide and 2 ft. 5¼ in. (74 cm.) high. The weight inclusive of the switchboard is 175 lb. (79.4 kg.). The efficiency of the generator is 82 per cent, with a petrol consumption at full load of about 0.44 gal. (1.66 l.) per hour.—London *Engineering*, April 25, 1919.

Russian Water-Power Possibilities at Dnieper River Rapids.—V. V. TCHIKOFF.—The total potential water power of European Russia alone is estimated at 20,000,000 hp. or more. The rapids of the Dnieper River present one of the more interesting possibilities for early utilization. These rapids constitute one of the greatest obstacles to navigation on the canal system connecting the Baltic and the Black Seas. The development of the Dnieper River rapids to the extent of some 600,000 hp. is planned at a cost of some $60,000,000. A table giving the estimated cost of construction and operation of these plants is appended to the article.—*Engineering News-Record*, May 29, 1919.

Traction

Main-Line Electrification.—In connection with the proposal for general electrification of the British railways system it has been proposed to run extensive transmission systems along the railway right-of-way. In this article the problem of providing for an adequate transmission system over the right-of-way is discussed, and it is pointed out that the space limitations make the use of extensive overhead structures difficult, if not out of the question, especially in passing through cities. The other alternative of putting high-tension cables under ground is discussed, but this is shown to be a very expensive proposition.—London *Times Engineering Supplement*, April, 1919.

Installations, Systems and Appliances

Electrical Application of the Schoop Process.—W. KASPEROWITZ.—A description is given of the method of heating the metal to be squirted by means of the electric arc. Besides this method, in which two wires of the metal are fed to form the two electrodes of the arc, it is also possible to use a single-wire electrode, although this arrangement is subject to considerable technical difficulties. It is to be hoped that the single-wire process may be capable of development for use with the more easily fusible metals and alloys. The Schoop process may be used for forming the plates of condensers by depositing metal on glass. Also good electrical contacts may be produced by squirting metal onto the metal surfaces to be electrically connected. Carbon electrodes may be joined to metal terminals by the use of the squirting pistol. This has important application in the manufacture of electric furnaces for carbide and other substances and in the construction of carbon brushes for dynamos. Brushes may also be made of metal deposited on paper of another such support. The Schoop process is suitable for replacing soldering or brazing, for instance, in the construction of squirrel-cage armatures with aluminum bars, which are first coppered and then soldered. The joints of steel rails of electric railways may be connected by a deposit of zinc, thus eliminating copper bonds. Insulators may be coated with metal so as to improve in certain places the distribution of the electric field and so avoid local high intensities. It has even been proposed to make light accumulator plates by coating asbestos, fiber or other light materials with a layer of lead. Electric heaters are produced by squirting metal on the fireproof slabs.—*Technical Supplement Review of Foreign Press*, April 1, 1919. (Abstracted from *Elektrot. Zeits.*, Jan. 16, 1919.)

Electric Furnaces in the United Kingdom in 1918.—R. G. MERCER.—The author states that there are installed in the United Kingdom 141 electric furnaces with a total capacity of 112,000 kva. Of these twenty-four are or will be used for Swedish substitute, cupro nickel, allundum, manganese, copper and ferro alloys. The remaining 117 are electric steel furnaces, having a total charging and kva. capacity of 384 tons and 98,789 kva. respectively and a total nominal output of 31,170 tons per month, based on five days a week, four weeks per month. Assuming that these furnaces are working at full load, the total output for a year would be 405,000 tons. The 117 furnaces now in operation are made up as follows: Heroult, 45; Electro-Metals, 27; Greaves-Etchells, 26; Snyder, 6; Stobie, 5; Rennerfelt, 4; Stassano, 2, and special, 2. The following table is offered by the author as typical of British electric furnace practice:

Ingots or Castings	Size, Tons	Kva.	Average Hours per Heat	Number of Heats per Day	Nominal Tons per Month 20 Days
Ingots	½	250	2.75	7	70
Castings	½	250	2.25	8	80
Ingots	1½	500	3.25	6	180
Castings	1½	500	3.00	7	200
Ingots	2 2½	650	4.25	5	240
Castings	2 2½	650	3.5	5	240
Ingots	3 3½	850	5.75	4	280
Castings	3 3½	850	4.75	4	280
Castings	5	1,000	4.00	5	500
Ingots	6	1,500	7.5	3	360
Ingots	7	1,800	7.5	3	420
Ingots	10	2,500	7.5	3	600
Ingots	15	3,000	7.5	3	900

—London *Electrical Times*, May 8, 1919.

Application of X-Rays to Testing Materials.—The application of X-rays to determine the nature of crystalline structure is most important from the scientific standpoint and as yet has hardly passed the experimental stage, but their use for the detection of flaws and blowholes in masses of steel and iron seems to be already a practical fact of immediate commercial value. Instances of the use of X-rays in this way were given in the general discussion of the subject at a recent joint meeting of the Faraday Society and the Röntgen Society. It was shown that a needlessly high factor of safety and consequent waste of material have been incurred owing to mistrust of internal flaws in material. The method of examination of lead-sheathed cables and rubber appears to be a promising application of X-rays. —London *Electrician*, May 9, 1919.

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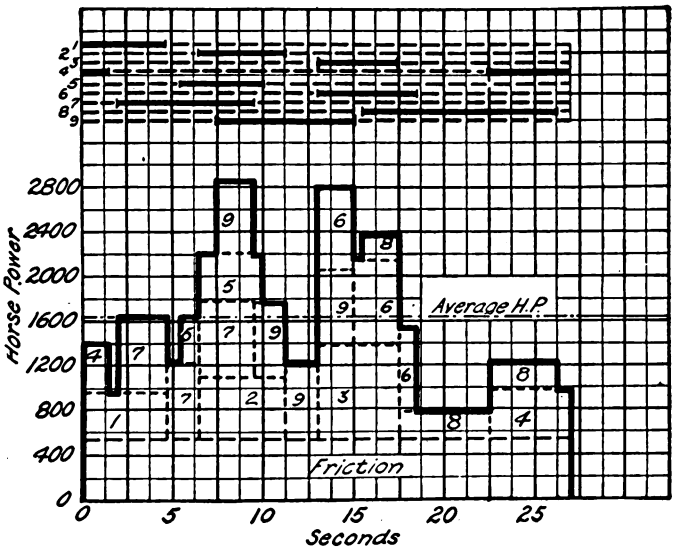
Application of Synchronous Condensers to Large Power Systems.—G. V. ADENDORFF.—The discussion is confined to systems in which the capacity effects are negligible in comparison with the inductance effects and in which several power stations are interconnected and operated in parallel with a ring main scheme of distribution networks. The system is investigated particularly from the point of view of efficiency, with and without synchronous condenser. Charts are offered to make the calculation of size of synchronous condenser easily selected, and also to show how low the power factor must go, under given conditions, to make the synchronous condenser installation economical.—*Transactions South African Institute of Electrical Engineers,* March, 1919.

Electric Drive for Steel-Mill Main Rolls.—K. A. PAULY.—Steel-mill roll drives may briefly be divided into three classes, non-reversing single-speed mills, non-



REVERSING MILLS ARE SUBJECT TO HEAVY OVERLOADS FOR A SHORT TIME

reversing adjustable-speed mills, and reversing mills. The requirements of the single-speed mills are the simplest from the standpoint of the motor equipment; they may be driven by either direct-current shunt or compound motors, or by single-speed induction motors. For adjustable-speed mills two-speed slip-ring induction motors have been used to a limited extent, but where reasonable efficiencies are demanded the so-called Scherbius system has been found to give the most satisfactory results and the widest range of speed. The motors driving reversing mills are subjected to extremely severe usage. They are required to carry tremendous overloads at all speeds in either direction of rotation and must be capable of rapid acceleration. Direct-current motors are used for these mills, with the Ward Leonard system of speed control or a combination Ward Leonard and motor field control. The satisfactory operation of any of these installations is dependent upon the control apparatus, and the design and construction of this equipment demands equally careful consideration with the motors themselves, down to the minutest details.—*General Electric Review,* May, 1919.

Wires, Wiring and Conduits

Cable Lay-Outs for Works and Factories.—A. F. W. RICHARDS.—The author takes up problems encountered by engineers in designing cable lay-outs and in the installation of heavy cables in factories. His article is divided into two parts, the selection of cables and the installation of cables.—London *Electricity,* May 16, 1919.

Standard Specifications for Hard-Drawn Copper Wire.—This bulletin contains specifications drawn up by the American Society for Testing Materials in giving the standard physical and electrical tests for hard-drawn copper wire and trolley wires.—*U. S. Department of Commerce Industrial Standards No. 50,* 1919.

Measuring the Capacity of Three-Phase Armored Cables.—RAYMOND BUZON.—The author indicates a method by which to find by a single measurement the value of what he calls the "starred capacity" of a three-phase cable, which permits the calculation of the current of capacitance in the cable when functioning without load under its three-phase service voltage.—*Revue Générale de l'Electricité,* May 3, 1919.

Electrophysics and Magnetism

Piezo-Electricity and Its Applications.—It is said Piezo-electric crystals develop electric polarities when heated and that the phenomenon might be of use in studying the physical phenomena connected with explosion.—London *Engineering,* April 25, 1919.

Fatigue of Selenium Cells.—P. LENARD.—Until recently selenium cells were erratic in their behavior, showing variation in the dark resistance, a great dependence on previous treatment, considerable inertia and marked fatigue. The new cells now obtainable are much more reliable. The tests described were made with cells obtained from the Radiologie company, Berlin, and had the object of ascertaining under what conditions these cells would be suitable for the measurement of light intensity. Some of the cells assumed a constant resistance forty-five seconds after being exposed to light and were thus specially suited for the purpose in question. The test specimens were subjected to alternate periods of light and darkness. With increasing length of the dark periods the difference between the resistance at the successive light periods diminished, and at periods of eight minutes of darkness the resistance during the light periods became constant with an illumination of 47.4 lux. The length of the dark periods producing this constant resistance under successive light stimuli was found to vary with the intensity of the illumination. When the intervals are long several cells may be used in rotation to save time.—*Technical Supplement to Review of Foreign Press.* (Abstracted from *Electrot. Zeits.,* March 6, 1919.)

Electrochemistry and Batteries

Dry Cells.—French Patent No. 487,645 of A Heintz describes a form of dry cell that may be stored permanently without deterioration. The positive electrode of manganese dioxide and graphite is inclosed in a tube of zinc, forming the negative electrode. The zinc tube is closed at the ends by cardboard caps, and a hole is provided at one end to introduce the electrolyte just before the cell is put into service. The two electrodes are separated by a tube composed of paper boiled in a solution of carbonate of soda and then compressed. This tube is provided with a series of vertical slits.—*Technical Supplement to Review of Foreign Press,* April 29, 1919. (Abstracted from *Revue Générale de l'Electricité,* March 29, 1919.)

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NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

PRESIDENT ADAMS RETURNS FROM HIS TRIP TO EUROPE

Efforts on Behalf of Standardization Made by Him in Association with H. M. Hobart Promise Beneficial Results

Prof. Comfort A. Adams, president of the American Institute of Electrical Engineers, has returned from the trip which he made to England and France with H. M. Hobart of the General Electric Company in the interest of standardization. Professor Adams landed at Halifax, N. S., and reached his home at Cambridge, Mass., on June 15. He spent several days in New York at the close of last week before going to Lake Placid for the annual convention of the Institute. Mr. Hobart remained abroad and is doing important work of the same character as that in which he and Professor Adams were engaged. Mr. Hobart will probably return about the middle of July.

Professor Adams and Mr. Hobart crossed the Atlantic to adjust certain differences between the American and French rules with regard to the rating of electrical machinery which had arisen during the war, when a meeting of the International Electrotechnical Commission was not possible. As a result of the conferences held abroad an arrangement was made satisfactory to all concerned, and certain changes from the previous International Electrochemical Commission rules will therefore be recommended at the next regular meeting of that commission. This meeting will probably be held in London during the latter part of October in this year.

Another commission of Professor Adams and Mr. Hobart was on behalf of the American Engineering Standards Committee in order to establish relations with corresponding committees in other countries. In France the corresponding organization is called a Permanent Commission on Standardization and is appointed by the Minister of Commerce. In Holland the organization is known as the Normalization Bureau. In England it is the Enginering Standards Association and was organized originally by the five national engineering societies. It has government affiliations and regularly does the standardization work of the government in certain important fields. In Switzerland a similar organization is contemplated, but it has not yet been perfected. The organizations of Holland and France are of comparatively recent origin, as is the American Engineering Standards Committee. The British association has been in operation about eighteen years and is doing an enormous amount of very important work, having secured the confidence of the government and many organizations (including those in the railway and shipbuilding fields) not directly represented on the main committee. For example, the aircraft section alone of the Engineering Standards Association has about fifty sub-committees.

As a result of the conference held by the American delegates with the representatives of the organizations of other countries, very cordial relations were established with those associations. The resulting coöperation should prove of immense value to international commerce, as well as effect a reduction in cost of production in many fields.

RELATIONS WITH LABOR AN INDUSTRY PROBLEM

Arthur Williams, Who Presented Resolution at Atlantic City Convention for Committee to Consider This Subject, Gives His Views

At the Atlantic City convention of the National Electric Light Association a resolution was introduced by Arthur Williams, New York Edison Company, requesting the president to appoint a committee for the purpose of considering the subject of what is ethical and just in the relations of the industry and labor. In presenting this motion, Mr. Williams said that the industry had already been paced on record as in accord with the best modern thought on the question through the report prepared some years ago by a committee of which Charles L. Edgar was chairman. Mr. Williams urged in his brief discussion of the matter that, if possible, the services of Mr. Edgar should be secured as chairman of the new committee.

W. C. L. Eglin, who seconded the motion, suggested that the whole scope of the labor situation be studied, and particularly with the thought of suggesting that some profit-sharing methods be considered as applicable. The resolution was passed.

Mr. Williams was asked by a representative of the ELECTRICAL WORLD to state further what ideas he had in mind in presenting the matter. He said:

"The central-station industry has always been a leader in public movements. Its officials have always taken a leading part in movements relating to the public interest. There is no more serious question before the world than that of adjusting the relations between capital and labor. At this time it is important for the industry to settle its own problem of labor, to set an example, so far as it can do so, to other industries. This question should be taken up, in my opinion, not as a matter of welfare work, but as a matter of equity. What in justice should the industry do to have its bodies of workers feel that they are partners and as partners concerned in the success of the enterprise? My suggestion was that a committee could carry further the work which was done admirably a few years ago by the committee of which Mr. Edgar was chairman. Then any company in the industry will find laid down an equitable plan which it may follow in establishing fair relations with its employees in accord with the new conditions in the world."

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Officials of the American Telephone & Telegraph Company Under the New Plan of Organization After the Government Returns the Wires

THEODORE N. VAIL

chairman of the board of directors, who will devote his attention to the larger problems of the corporation.

H. B. THAYER

the new president, has been identified with the system for forty years in manufacturing and administrative capacities.

N. C. KINGSBURY

first vice-president, has been concerned with both operation and public relations of the company.

N. T. GUERNSEY

vice-president, in charge of the legal department, has been general counsel of the system for a number of years.

COL. JOHN J. CARTY

vice-president, in charge of development and research, has long been head of research, experiment and development work.

W. S. GIFFORD

vice-president, in charge of accounting and finance, has hitherto been comptroller of the company.

BANCROFT GHERARDI

chief engineer, has been Colonel Carty's chief aid and acting chief engineer of the company during the war.

CONGRESS SETS DATE FOR RETURN OF WIRES

Conference Committee Comes to Agreement—Systems Will Probably Be Given Up Aug. 1—Present Rates to Remain in Effect Ninety Days

Conferees from the Senate and House of Representatives came to an agreement on Tuesday of this week as to the terms of legislation for returning telephone and telegraph lines to private control. The bill, which then went to both houses for ratification, provides for return of the wires at midnight of the last day of the calendar month in which the law is approved by the President. This means that government control will probably end Aug. 1, as President Wilson is expected to sign the measure early next month.

The Senate and House compromised on the question of continuing toll and local exchange telephone rates, which will remain in effect for four months unless sooner changed by state commissions. The Senate bill prescribed originally a rate extension of ninety days, while the House measure provided for a continuation for six months.

The plan for return of the wires on the last day of the month was adopted to avoid complications in accounting which would occur if the government should relinquish control in the middle of a month, as the Senate bill provided.

EMPLOYEES REPRESENTED ON BOARD OF DIRECTORS

Men and Women Working for St. Louis Central Station Are Given Voice in Management of Company—W. T. Beam Chosen

A long step forward in relations between utilities and their employees is credited to the Union Electric Light & Power Company of St. Louis, which invited its employees to elect one of their number to represent them on the board of directors of the company.

Following the practice of the Employees' Mutual Benefit Association the election was conducted by secret ballot, and ballot boxes in charge of members of the association were used. The honor and responsibility of being the first one to represent the employees in the councils of the company was given to William T. Beam, senior watch engineer of the Ashley Street power plant. Mr. Beam was born in California, Mo., 150 miles from St. Louis, in 1873, and he has been in the employ of the company for about fourteen years.

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CHANCES ARE NOW GOOD FOR WATER-POWER LEGISLATION

Action in Congress This Week Greatly Strengthens the Hope for the Enactment of a Law That Will Conserve and Apply Water-Power

Chairman Esch of the interstate and foreign commerce committee of the House of Representatives asked unanimous consent during the early part of this week that the water-power bill be taken up for consideration and passed by the House on Thursday afternoon. He was suported by Mr. Sims of the Democratic side, and the unanimous consent was granted.

The Washington representative of the ELECTRICAL WORLD telegraphed that the bill would undoubtedly be passed at that time without much debate and probably without the change of a word. It is the Esch bill, which is identical with the bill reported out of conference and approved by the House at the last session.

Both the commerce committee of the House and the public lands committee of the Senate have appointed sub-committees of five on the water-power question, and these committees will confer with the hope that both committees will be able to get behind the same bill, which, while it will differ somewhat from the House bill, will be along the same general lines.

It would seem almost certain that water-power legislation of a workable nature will be enacted at the present session of Congress, according to the information obtained by the Washington representative of the ELECTRICAL WORLD.

TRADE CONDITIONS AS THEY ARE FOUND IN EUROPE

Frank E. Watts, After Journey in Interest of Electrical Manufacturers' Export Association, Discusses Situation in Various Countries

Frank E. Watts of F. E. Watts, Inc., has returned to New York from a trip to Europe which he made in the interest of the Electrical Manufacturers' Export Association, of which he is president. This association, as stated in the ELECTRICAL WORLD on March 22, is composed of electrical manufacturers in non-competing lines.

On his trip, which lasted ten weeks, Mr. Watts visited England, France, Belgium and Spain. In speaking to a representative of the ELECTRICAL WORLD about the conditions which he found, he said that English manufacturers told him that "American competition is clean." They expect to find American competition and are prepared to meet it. There will be a market in the British Isles for specialties, Mr. Watts believes.

In France the import restrictions, carrying also restrictions against payment in money for foreign goods, combine with the present unfavorable rate of exchange to prevent trade. All kinds of rumors are afloat concerning the policies which will be adopted in future. The need for materials is so large that Mr. Watts expects there will be a large amount of business for American manufacturers in Europe when trade can be resumed.

Conditions in Belgium are not hampered by restrictive regulations at present, and Mr. Watts found in that country a general desire to do business with the manufacturers of the United States. As the country is absolutely stripped its needs are large. In Belgium as well as in France it will be necessary to arrange for credits on a basis that will enable the foreign buyers to finance their purchases without strain.

Mr. Watts obtained the impression that Germany will not have sufficient financial power to become a large factor in world trade for several years. He is also of the opinion that the Scandinavian countries, excepting Sweden, will be large buyers in America. During his stay in Spain he found that that country, which has become rich during the war, is manufacturing many lines of electrical materials. Among these are pole-line hardware, transformers, motors, electrical measuring instruments, switches, sockets, receptacles, fuses, porcelain, wire and cable, bells, marine fittings, etc.

BOSTON EDISON COMPANY SELLS $6,000,000 NOTE ISSUE

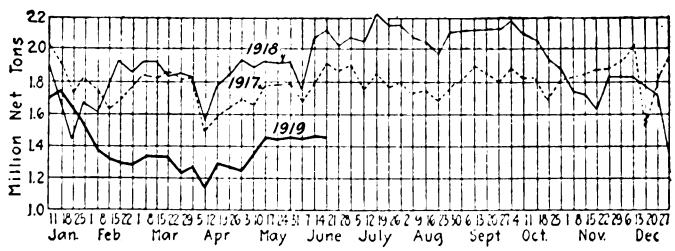
President Charles L. Edgar Says that $3,000,000 of the Funds Are Needed for General Extension and Enlargement of Distributing System

An issue of $6,000,000 of 6 per cent notes has been sold by the Edison Electric Illuminating Company of Boston. It is offered at 99½ by the bankers, Lee, Higginson & Company, Old Colony Trust Company, F. S. Moseley & Company, Kidder Peabody & Company and Parkinson & Burr. The notes are dated July 1, 1919, and are due on Feb. 1. 1922.

In a letter to the bankers Charles L. Edgar, president of the company, says that the proceeds will be used to retire $3,000,000 notes due on Dec. 1, 1919, and for the general extension of the distributing system. He adds:

Sufficient funds are in hand from the sale of previous notes to complete the construction program referred to in my letter to you of July 17, 1918. Since that letter was written and the notes to which it referred were issued the armistice has been declared and the growth of the company's business has been along more normal lines than during the war. The restrictions placed upon new commercial business during the war forced the company to concentrate practically all of its efforts upon industries incidental to the war. These restrictions have been removed and the company is now taking on new business more nearly approximating its pre-war policy. Funds will therefore be needed for the general extension and enlarging of the company's distributing system. Before the war it was the company's practice to expend from $2,000,000 to $3,000,000 per year in this class of work. During the war this was reduced to about $750,000 per year, and it is thought that with the proceeds of $3,000,000 notes now being sold to you the company will have sufficient funds for such needs for at least two years.

Bituminous Coal Production Still Under 1917 and 1918 Levels



The weekly report of the United States Geological Survey shows that for the last few weeks the production of bituminous coal has been at about the same rate but still considerably below the record of the last two years.

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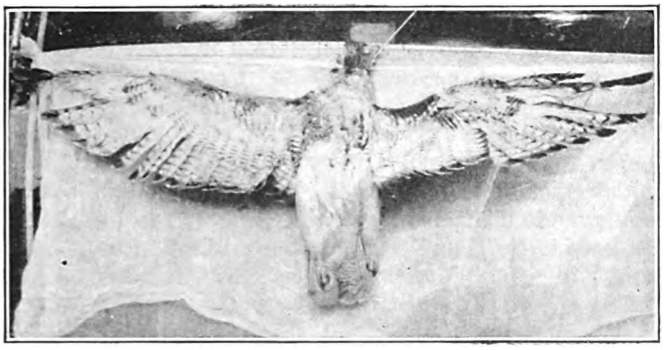
Birds Also Cause Outages



A chicken hawk, laid out for the camera, after getting mixed up in one of the 33,000-volt lines of the Iowa Railway & Light Company.

REVISIONS CONSIDERED FOR NATIONAL ELECTRICAL CODE

Electrical Committee of National Fire Protection Association Announcements in Regard to Work of Preparation for the 1920 Code

The electrical committee of the National Fire Protection Association in its work of preparation for the 1920 National Electrical Code wishes that all who are interested shall be kept advised of the subjects under consideration and be given an opportunity to present suggestions and recommendations to its sub-committees.

With this object Dana Pierce, chairman of the committee, has made public the following:

Revision of Rules on Motors and Motor Fuses.—Several questions on motors and motor-fuse protection are under consideration by the electrical committee of the National Fire Protection Association in its work of preparation for the 1920 edition of the National Electrical Code. The investigations are being conducted by the standing committee on industrial applications, under whose direction several technical sub-committees have been appointed.

Among the topics receiving attention are the following:

The general question of the size, location and installation of fuses designed for the protection of motors and their starting devices as distinguished from other fuses primarily intended to protect the main or branch feeders. It is expected that more definite and readily applicable rules can be formulated on this very important matter. (Rule 8.)

Present rules limit quite closely the use of oil-filled transformers in industrial applications in buildings, and this subject is again being reviewed. (Rules 11 and 36.)

A clarification of the rules on the installation of starting devices is proposed especially as regards distinctions between direct-current and alternating-current apparatus and the disconnecting switches now called for with autostarters or compensators (Rules 8-c and 8-d).

It is possible that some provision can be made to permit the application of a demand factor in certain types of motor-driven equipments which will reduce in a specified manner the necessity of running supply circuits of the larger current-carring capacity now required by a rigid interpretation of present rules.

Other questions are those of fireproof motor rooms or inclosures and the grounding of motor and generator frames.

Persons having suggestions or recommendations on the Code rules covering these topics are invited to communicate with G. S. Lawler, chairman of the standing committee on industrial applications, 31 Milk Street, Boston, Mass.

Revision of Code Rules.—The standing committee of the electrical committee of the National Fire Protection Association on cars and railways has under consideration the revision of the requirements of the National Electrical Code on wiring of carhouses and the equipment of cars.

In addition to a review of the present rules attention will be given to the question of formulating rules applicable to railway systems and cars operating at voltages from 600 to 1500.

In this work two special committees of the American Electric Railway Engineering Association are coöperating.

Any one having suggestions or recommendations on the code rules covering these subjects is invited to communicate with the chairman of the standing committee, Martin Schreiber, Public Service Railway Company, Newark, N. J.

CO-OPERATIVE COURSE IN ELECTRICAL ENGINEERING

Arrangement of Massachusetts Institute of Technology and General Electric Company for Distinctive Training Will Be Re-established

The co-operative course in electrical engineering which was established under the joint supervision of the Massachusetts Institute of Technology and the General Electric Company is to be re-established in the autumn. It was established in 1917. On account of the Student Army Training Corps course established at the engineering schools in the fall of 1918 it was found necessary to omit the co-operative course during that year.

This course is conducted by the Massachusetts Institute of Technology in co-operation with the General Electric Company and it affords a distinctive training for the technical and executive responsibilities of the manufacturing industries. The course covers a period of five years, of which the first two are identical with the old and well-established course in electrical engineering at the Institute and the last three are divided between instruction at the institute in Cambridge and experience associated with instruction at the West Lynn and other works of the General Electric Company. The work of the final year of the course is of advanced nature, with emphasis laid on the problems of administration, the design and development of engineering projects, and creative work such as research. The training at the works of the General Electric Company is laid out and conducted with a view to the maximum educational value and is intimately correlated with the instruction at the institute.

The co-operative training which occupies the last three years of the course will be entered upon by the new class on Oct. 6 of this year. The successful completion of the course leads to the degree of master of science. The number of men who may be admitted each year is at present limited to forty, and candidates for admission are subject to the approval of both the Institute of Technology and the General Electric Company. Students who have successfully completed the first two years of the electrical engineering course of the Institute of Technology are eligible to enter this co-operative training, and well-qualified students who have completed the substantial equivalent at other institutions are also eligible for admission.

While students are at work at the General Electric Company they receive regular compensation but are under supervision of teachers, and their work in the shops is supplemented by conferences with works department heads in which technical and administrative problems which arise from time to time at the works are discussed.

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IOWA MEETING BRINGS FULL DISCUSSION OF MANAGEMENT

Rates, Municipal Ownership and Service for Farmers Are Topics in Which Central-Station Men Show Interest

Of the recent central-station conventions in the Middle West, the eighteenth annual meeting of the Iowa Section, National Electric Light Association, at Colfax, Iowa, June 18, 19 and 20, was most lively in point of business discussion. President H. Bellamy of Knoxville was compelled in almost every session to limit the free discussions on the topics presented. Those phases of the business which claimed the greatest attention of the delegates were more uniform rates, methods of handling municipal ownership adjudication, and methods of providing transmission line service for farmers.

In his annual address President Bellamy suggested some important changes in the plan of operation of the association. During the past year Rex H. Fowler, Des Moines, has been made assistant secretary of the association and has opened a permanent office for the section at Des Moines. To carry out further this idea of active association work, Mr. Bellamy advised that the executive committee of the association be enlarged in number and that the following additional active committees be organized: Finance, convention, membership, legislative, engineering, accounting, public policy, rates and publicity.

FACED WITH A NEW PRICE LEVEL

In reviewing the situation among Iowa utilities during the last year, President Bellamy expressed the belief that operators were faced with a new price level which would not be materially reduced. This being true, rates for electric service which were reasonable and compensatory prior to the war have become entirely inadequate. The increase in the price of steam coal of approximately 300 per cent and of labor of approximately 100 per cent, as well as the advanced interest rate on the securities of utility companies, together with other cost increases, constitute a gap which cannot be bridged by any operating economies that might be utilized in a business already conducted with high efficiency. Mr. Bellamy also pointed out the need for legislative action which would compel the use of better accounting systems by municipal plants.

The prearranged convention program consisted of the following papers: "Rate Litigation in Iowa," by William Chamberlain, general counsel United Light & Railways Company; "The Iowa State Board of Conciliation —Its Work and Possibilities," by William G. Raymond, dean engineering department, State University of Iowa; "Rates as Affected by the Increased Cost of Production, and the Attitude of Regulatory Bodies Thereto," by F. A. Warfield, rate engineer Illinois Traction System, Peoria; "Principles to Be Observed in Determining a Rate for Electricity in Cities Under 5000 Population," by J. B. Hill, professor electrical engineering, State University of Iowa; "The N. E. L. A. System of Accounting as Applied to Small Plants," by W. A. Jones, secretary Empire District Electric Company, Joplin, Mo.; "Meter Testing for the Small Electric Company," by F. D. Paine, associate professor engineering department, Iowa State College; "Public Utility Regulation," by John F. Gilchrist, vice-president Commonwealth Edison Company, Chicago; "The Plan of Operation of the National Electric Light Association," by E. W. Lloyd, general contract agent Commonwealth Edison Company, Chicago; "The Electric Transmission Line and Telephone Interference Situation in Iowa with Respect to Farm-Line Service," by Howard S. Phelps, electrical engineer Iowa Railroad Commission, Des Moines; "Electric Service for Farmers," by A. H. Latimer of Colmar and P. H. Atwood of Armstrong; "Municipal Ownership in Iowa," by A. Huntington, Cedar Rapids, and "The Menace of State Socialism," by F. G. R. Gordon, National Electric Light Association, New York.

LEGAL SITUATION IN IOWA

Mr. Chamberlain's address was a masterly statement of the legal situation in Iowa, where the utilities in order to secure much needed rate increases have taken their cases into the federal court. The final results of this procedure will not become known until the Supreme Court has rendered a decision in the matter. Dean Raymond's paper was a historical treatise setting down the facts about the conciliation board which was formed at the suggestion of Federal Judge Wade to make an amicable disposition of the many rate cases that reached his court. While this board has performed a remarkable service during the war, it will pass out of existence with the signing of the treaty of peace, as it was organized on a purely temporary basis.

The paper by Mr. Warfield was an array of logic and data to show that the present high costs are permanent. Mr. Warfield expressed the opinion that it will be impossible for utilities to bridge the gap in their financial situation by means of operating economies. More money from the consumers in the way of increased rates will be necessary if the utilities are to survive. Professor Hill's paper reviewed all of the more common forms of electric service rates used in the United States and concluded with an expression of opinion that a rate consisting of a readiness-to-serve charge and an energy charge—that is, something in the nature of a combination of the Hopkinson and the Doherty rates—would prove most advantageous for central stations in Iowa.

Discussion of these papers brought out in an impressive manner the desirability of securing a uniform method of arriving at rates throughout the state. Where city councils regulate rates for each local community and where towns are numerous and distances are short, as they are in Iowa, there is apparent a very decided tendency to compare the rates of one company in its town with the rates of another company in the towns where it may be operating. When no uniformity of rates or of rate-making exists, utilities sometimes find it difficult to offer a satisfactory justification of rates which they seek from a city council.

The major portion of Mr. Jones' paper consisted of an explanation of the standard classification of accounts recommended by the National Electric Light Association with a view to emphasizing its flexibility. Mr. Jones urged the larger companies of the state to aid the smaller companies in installing better accounting systems, if this should prove necessary, in order to protect themselves against the small company which sells below cost because it does not know its cost, and thereby reflects discredit on the industry. Many questions regarding methods of handling depreciation on lines which have been required through various contracts with farmers constituted the principal discussion on Mr. Jones' paper.

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In his paper on meter testing, Professor Paine told of the short course for the education of metermen which the Iowa State College conducted last year and will conduct again this year. One delegate who had attended this short course testified to the benefit which the thirty-five students had received from its teachings last year.

ADDRESSES OF MESSRS. GILCHRIST AND LLOYD

The addresses of John F. Gilchrist and E. W. Lloyd of Chicago, which were delivered at the annual banquet of the association, were among the features of the convention. The subjects on which Mr. Gilchrist touched were utility publicity, utility securities, the advantages of commissions over local city council regulation and the development of good will. A report of a similar address by Mr. Gilchrist was given in the ELECTRICAL WORLD of June 21, page 1331. Mr. Lloyd predicted that there was a live year ahead for the national association and expressed the belief that a very much more important part would be played by the geographic sections, these bodies taking up more of the detailed association work than they had been doing in the past, leaving the national association free when the plan has been worked out to devote more of its time to the broader questions affecting the industry.

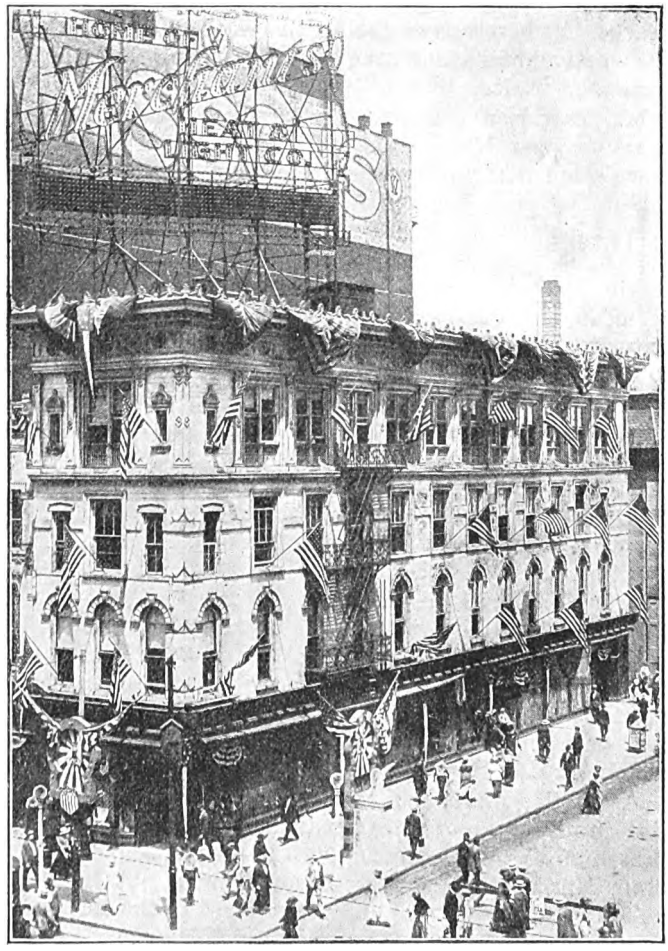
There were three addresses dealing directly with municipal ownership and socialism. Mr. Huntington cited figures regarding the operations of several Iowa municipal plants, showing that they were using tax money to make up deficits incurred in operation. Mr. Gondon, publisher of *Public Service*, read a short paper dealing with the work which he is undertaking in combating municipal ownership. Mr. Gordon's address dealt with the broader phases of government ownership and bristled with data on the unsuccessful operation of many foreign and domestic municipal undertakings.

The important point which appeared in all of the papers and discussions relating to farm lines was that the companies are convinced that they must serve the farmer. The average wealth of the Iowa farmer is at present so great and his demand for electric service is so well recognized that the situation is one in which the utilities are likely to have competition of an undesirable character so far as they refuse service or attempt to discourage the farmer in his endeavor to secure it. Mr. Phelps' paper, in addition to citing sixteen cases in which inductive interference had been encountered and remedied, also gave data concerning farm line specifications which would more nearly comply with the wishes of the Iowa Railroad Commission than some construction now employed by certain builders. Data brought out on farm-service rates show that there has been a considerable stiffening in this matter within the last few years, so that companies are now asking a $5 per month minimum charge plus an energy rate, and there appears to be some doubt as to whether or not even this charge is adequate to cover the cost. Considerable information relative to this point was brought out by Mr. Latimer. Practically all of the farm-line construction seems to be carried on at 2300 volts to 6600 volts. The practice of tapping high-tension trunk lines for individual farm use is being discouraged quite generally. The latest problem which is confronting the companies serving these scattered customers is that of liability insurance to cover property damages occasioned through failure of the apparatus or line. The companies are all carrying their own risks, but many feel they can ill afford to do this as a single loss might wipe out any profit which they will secure from the farm-line business for many years to come. It is probable that the executive committee of the association will collect data which will permit the association to take up the insurance question with the idea of insuring members as a whole.

The report of the legislative committee, of which Frank J. Hanlon of Mason City was chairman, indicated that practically no undesirable legislation had been passed by the Legislature of the state during the past session and that some of the legislation which the utility companies desired had met with the approval of the lawmakers. As one item of particular interest, he mentioned the fact that the workmen's compensation law had been changed so that payments would be increased from 50 to 60 per cent.

The following officers were elected for the ensuing year: President, O. H. Simonds, Dubuque; vice-president, J. P. Ingle, Keokuk; secretary-treasurer, M. G. Linn, Des Moines; directors, B. G. Schmidt of Elkrader, Austin Burt of Waterloo, John Drabelle of Cedar Rapids, F. J. Hanlon of Mason City, Paul Myers of Grinnell, C. G. Johnson of Davenport, Charles Miller of Claremont, C. E. Farney of Ottumwa, C. E. Burke of Sioux City and F. W. Brooks of Omaha.

Decorations on Indianapolis Utility Building in Honor of Shriners



The home of the Merchants' Heat & Light Company of Indianapolis was decorated as shown for the Shriners' conclave, which was held in that city during the week of June 9. The 5-ft. by 8-ft. flags show to very good advantage, and some of the base decorations around the display windows were the subject of favorable comment.

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NEBRASKA DISCUSSION ON POLICY AND FINANCE

Technical Subjects Are Subordinated to Those on Public Relations at State Annual Convention— T. H. Fritts Made President

At all of the sessions of the annual convention of the Nebraska Section, National Electric Light Association, at Grand Island, Neb., June 18 and 19, references to the public feeling toward utilities constantly cropped out. Major J. L. Cleary of Grand Island mentioned it in connection with an address of welcome, in which he referred to the city's municipal light and power plant as "something that kept him busy writing checks that totaled close to the entire income of the plant."

President J. E. Davidson of Omaha dwelt on the topic of policy at some length. He told how the high cost era had affected Nebraska stations and stated that only in a few cases had it been possible to secure relief from higher rates on account of the lack of sympathy for utilities among the many local regulatory bodies to which the companies had to appeal. He warned central-station executives against presuming that there would be any great reduction in the costs of operation within the next two years. Some Nebraska city councils, acting on the assumption that costs will recede, are endeavoring to pass ordinances to eliminate surcharges made effective during the war. The fallacy of such action must, said the speaker, be pointed out to local authorities.

Mr. Davidson also made a strong appeal for more hearty coöperation in the legislative work which the association must undertake from time to time. While in the last year the central stations were successful in preventing the passage of any obnoxious bills, the members must hold themselves ready to assist the industry in times when help is needed. One such time soon to come is the occasion of the formation of the constitutional convention, which will endeavor to present to the people of the state a new constitution. In this work the changed plan of operation of the National Electric Light Association will be of assistance locally.

As one bright ray in the utility situation, the president told of the fuel survey now being made by the Nebraska Power Company. This has brought out that some of the Kansas coal men are somewhat worried over the fact that certain large industries and utilities in Nebraska are tending to favor Illinois coal. Only recently the Kansas coal operators contemplated a reduction in price to $2.50 a ton to meet this situation, but as yet the reduction has not been made. This situation may remain unchanged until the peace treaty has been signed and the subsequent wage demands which the coal miners will then make have been settled.

A detailed discussion of the dire possibilities to capital in the acts of the constitutional convention was presented to the association by Charles Kelsey, a lawyer from Norfolk, Neb. Mr. Kelsey pointed out that the action of this body will be as important to the corporate interests of the state as twenty-five sessions of the Legislature, because the new document which it will prepare will become the basic law of the state. Moreover, it can act without precedent and with practically unlimited power. Its action toward utilities will follow one of three plans, as follows: First, it may merely mention them, which is improbable; second, it may provide for state or municipal ownership, which is likely to be proposed but unlikely to pass, because of the general knowledge of the failure of the government's attempt at utility operation; third, it may provide for some form of regulation, in which event central stations must see to it that the regulation is not of a confiscatory nature. The new constitution will no doubt also contain a clause on water power. In the meantime Mr. Kelsey advised the utility men to take steps to educate the public, as it will be the final judge of the new constitutional provisions.

Other papers dealing with phases of public relations were "Sale of Utility Securities to the Public," by J. R. Smith, Omaha; "Attitude of the Public Toward Utilities," by Frank E. Helvey, Lincoln, and a paper entitled "The Man in the Street," which was written by S. M. Kennedy of Los Angeles and read by R. J. Andrus of Grand Island. The technical and business papers presented were "Modern Steam Central-Station Practice," by H. A. Lynette, Chicago; "Safety Measures and Accident Prevention," by Charles B. Scott, Chicago, and "New Business," by W. S. Byrne, Omaha.

P. A. B. Sahm of the Bureau of Standards was present at the convention and discussed with the operators some of the features of the field survey which the bureau is now making to determine the workability of the National Electrical Safety Code. Investigations in Nebraska on lines which operators feared were substandard have showed that these lines do meet the requirements of the code. There seemed to be some sentiment against revising the requirements of the rules upward.

On the last afternoon of the convention the delegates were driven about 25 miles out to the hydroelectric station of the Central Power Company at Boelus. Officers elected for the ensuing year were: President, T. H. Fritts, Grand Island; vice-president, James B. Harvey, Omaha. The secretary's office will probably become appointive with the change to a paid secretary.

CHEMICAL ENGINEERS TALK ON THE ELECTRIC FURNACE

American Institute, Gathered at Boston, Devotes Day to Subject—Papers on Various Types of Furnace

The American Institute of Chemical Engineers, which held its eleventh semi-annual meeting at Boston, Mass., from June 18 to 21, devoted the sessions of the first day to a symposium on electric furnaces. C. W. Bragg, Michigan Smelting & Refining Company, introduced the subject with a talk on "The Future of the Electric Furnace," followed by "The Utilization of Electric Brass Furnaces," by W. H. Gillette, Bureau of Mines, and "Electric Furnaces of the Resistance Type," illustrated by motion pictures, by T. F. Bailey, Electric Furnace Company. In the afternoon the following papers were presented: "Ajax Wyatt Induction Furnace," with slides, by G. H. Clamer, Ajax Metal Company; "Some Practical Results Secured with High-Frequency Induction Furnaces," by Dr. E. F. Northrup; "Booth-Hall Rotating Furnaces," with motion pictures, by Carl H. Booth, Booth-Hall Company, and "The Rocking Electric Furnace," by H. M. St. John, Detroit Electric Furnace Company. E. F. Collins, General Electric Company, spoke on the muffle-type electric arc furnace.

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ACTION OF CONGRESS ON THE DAYLIGHT-SAVING LAW

Both House and Senate Approve Measures to Repeal the War-Time Act—Attitude of Farmers and Labor

Friends of the daylight-saving law received a severe blow last week when the House of Representatives, by a vote of 233 to 122, passed the bill repealing the daylight-saving law and the Senate, by a vote of 56 to 6, decided in favor of a rider to the agricultural appropriation bill intended to effect the same object.

The House bill was presented by Mr. Esch, chairman of the interstate and foreign commerce committee, and found in him a strong champion. He said that numerous complaints had come from a committee of miners of Indiana and Ohio advocating that the law be repealed. He also pointed out that the early rising hour was a great inconvenience to the farmer. He said in part:

"The hired man on the farm is assimilating some of the doctrines of organized labor in the cities. In many parts of the United States he is claiming an eight-hour day. Suppose he reports at 6 o'clock in the morning, clock time. The dew is yet on the grass and on the fields. He cannot work until the dew has been dissipated, or he engages in some unimportant work until he can get to the fields. That is really lost time to his employer. But when the whistle in the nearby town sounds 5 o'clock he stops. His eight hours are accomplished."

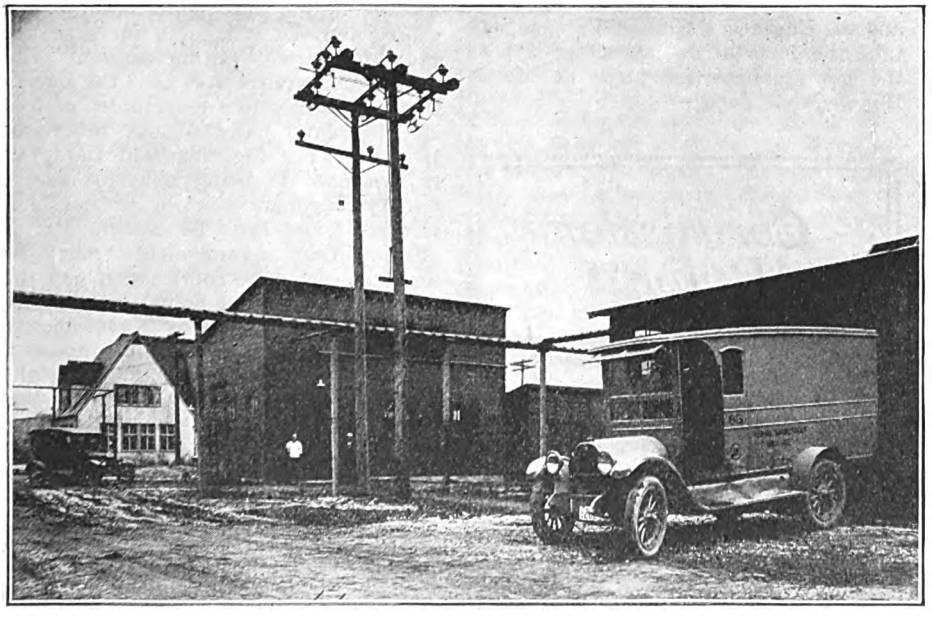
Mr. La Guardia of New York argued in favor of the retention of the law and held that city dwellers were pleased with it and benefited because of its adoption. In answer to the contention that organized labor favored the old time schedule, he read a letter from the secretary of the American Federation of Labor suggesting that arrangements be made for a hearing upon the bill so that those who oppose the repeal of the law could be heard.

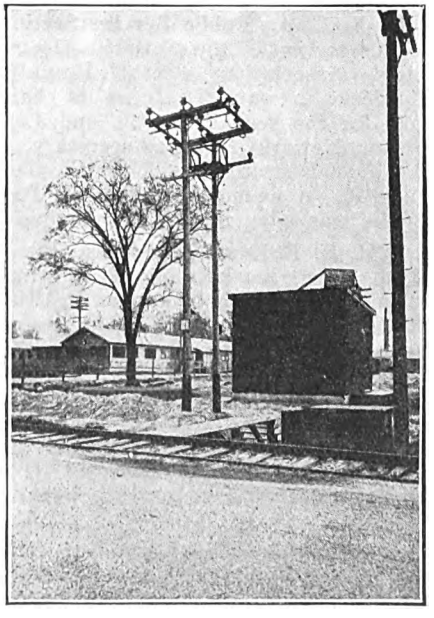
Mr. Focht of Pennsylvania declared that the claim of the Fuel Administration that more than 1,000,000 tons of coal were saved last winter because of the daylight-saving provision would not stand the test of either reason or fact. He said that the saving was due to the constant admonition to save coal, the warning that there might be a coal shortage, and to the fact that the winter of a year ago, with which the Fuel Administration compared last winter, was the severest on record, whereas the winter of 1918 and 1919 was one of the mildest experienced since the Weather Bureau was established.

Mr. Garland of Pennsylvania said that the repeal of the law would tend to increase the hours of labor and that such an act would arouse every laboring man in the United States against the advocates of the old time standard

In the Senate the amendment to the Agricultural appropriation bill was sponsored by Senator La Follette. Senator Calder of New York made a statement in favor of the retention of daylight saving.

Electricity's Part at the United States Naval Training Station at Great Lakes, Ill.





The United States naval training station at Great Lakes, Ill., will in all probability be one of Uncle Sam's great permanent naval universities. Electric service established for it during the war is delivered through two combination indoor-outdoor substations. One is rated at 1500 kva., 22,000/4000/2200 volts, and the other at 900 kva., 22,000/2200 volts, energy being supplied from the lines of the Public Service Company of Northern Illinois. The output of these stations has dropped off some since the signing of the armistice but is still at a fairly high figure. For instance, on Jan. 24, 1919, the maximum demand on the 900-kva. station was 912 kw., and on Feb. 7 it was 852 kw. On the 1500-kva. station the maximum demand was 1220 kw. on Jan. 31, 1919, and 848 kw. on Feb. 7. The energy consumption from the two stations totaled 614,600 kw.-hr. in January, when 28,000 men were in camp, and 500,600 kw.-hr. when 22,000 were on hand. In these months the relative consumption was high, ranging around 22 kw.-hr. per capita, because the station's population was low as compared with August, 1918, when it had 48,000 inhabitants. According to L. A. Pease of the public works department of the station, from whom these data have been obtained, a better figure can be had by taking the records for October, when there were 42,000 men in camp and when the total maximum demand on the two substations and the main plant was 2000 kw., or about 0.05 kw. per capita.

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Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. I. E. E., Spokane Section.—The June 13 meeting of this section of the American Institute of Electrical Engineers was devoted to a discussion of the metric system.

Joint Excursion of Detroit Engineering Society and Detroit-Ann Arbor Section, A. I. E. E.—The annual excursion of these two organizations to Bob-Lo is to take place on June 28.

Los Angeles Jovian Electric League.—Prof. Kio Sue Inui, University of Southern California, spoke on "Japan's Policies in the East and How They Affect American Interests" at the June 11 meeting of the Jovian Electric League of Los Angeles, Cal.

Massachusetts State Association of Electrical Contractors and Dealers.—Fred W. Lord, president of the Lord Electric Company, New York City, addressed the June 19 meeting of the association, urging a closer association, not only among consulting engineers and electrical contractors, but among contractors themselves.

N. E. L. A., Public Service Section.—This section of the National Electric Light Association elected Franklyn Heydecke, Newark, N. J., as its chairman for the year 1919-1920, and J. T. Foster, Newark, N. J., as secretary, at the annual meeting, which took place June 16. A memorial to the late Paul Lupke was adopted at this meeting.

A. I. E. E., Madison Section.—Prof. C. M. Jansky has been elected chairman of this section of the American Institute of Electrical Engineers for the coming year. At the June 11 meeting C. B. Hayden, electrical engineer, Railroad Commission, discussed the influence of maximum demand on rates, and F. A. Kartak demonstrated the principles upon which most of the modern type of maximum-demand meters are based.

N. E. L. A., Brooklyn Company Section.—The annual meeting of this section of the National Electric Light Association was held on June 10, with more than 500 in attendance. E. A. Baily was elected chairman for the coming year and F. J. Farley secretary. During the past year no papers were presented at the section meetings; instead, some individual prominent in national or local circles gave an address on a timely topic, and the remainder of the evening was usually devoted to entertainment. All of these meetings were thrown open to the members of the company regardless of whether they were members of the section or not.

American Association of Engineers, Portland Chapter Formed.—A Portland (Ore.) Chapter of the American Association of Engineers has been formed with W. H. Marsh as its president and R. W. Barnes as secretary.

A. I. E. E., Pittsfield Section.—R. E. Wagner and N. F. Hanley have been elected chairman and secretary-treasurer respectively of this section of the American Institute of Electrical Engineers for the season 1919-1920.

A. I. and S. E. E., Cleveland District Section. — The next meeting of this section of the Association of Iron and Steel Electrical Engineers will take the form of an outing, which will be held in July at the Old East Shore Country Club.

A. I. and S. E. E., Philadelphia Section.—Fred H. Woodhull, superintendent of the electrical department, Lukens Steel Company, Coatesville, Pa., has been elected chairman of this section of the Association of Iron and Steel Electrical Engineers for the coming season.

District of Columbia Association of Contractor-Dealers.—J. C. McLaughlin, commercial manager of the Potomac Electrical Company, Washington, D. C., has been elected chairman of this association and L. D. Carroll of the Carroll Electric Company, Washington, D. C., secretary.

A. I. E. E., Panama Section, and Engineers' Club of Panama.—The July meeting of the Panama Section, American Institute of Electrical Engineers, and the Engineers' Club of Panama will take the form of an inspection trip to the new cold-storage plant at Mount Hope, Canal Zone.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Prohibitively High Rates.—In deciding to decline rates asked by the Ava Electric Light Company the Missouri Public Service Commission declared that although existing rates for electric energy result in a loss and a proposed increase in rates does not permit of a reasonable return to a hydroelectric utility, prohibitively high rates—maximum, 20 cents per kilowatt-hour—would not be approved where it appears that an increase in rates will result in decreased returns through the discontinuance of service, and a readjustment of rates may result in increased returns through the sale of all available energy, as a fair return on public utility investment is secondary to the utility's obligation to serve the public. It is unreasonable that a water-power electric system should demand higher rates than a fuel-burning system, the commission said. The decision states: "It is, therefore, considered unfair to the community to allow the increase as asked for and that such rates would not profit the company. If the company will prepare and submit to the commission full consumers' data, its experts will assist the company in preparing a rate schedule with rates arranged in blocks in such a manner as to stimulate the use of electric energy by the inhabitants of Ava, and thus eventually the company will earn greater revenues. This course is deemed wiser than to strangle the present consumption of electric energy by means of prohibitively high rates."

Making Service Remunerative.—Increased rates for general consumers, but not for street lighting, were authorized by the Illinois Public Utilities Commission in a decision affecting the Dahlgren Electric Light Company. The commission said in part: "Evidence discloses that the financial resources of the village are such that, under present conditions, it would be unable to pay the increased rates for municipal lighting. Obviously under such conditions the increase of rates could afford to the petitioner no increase of revenue and would only result in the village being inadequately lighted with very little corresponding saving on the part of the utility. Until such time as the village is able to readjust its finances by means of new appropriations, the commission believes that it would be unwise from the standpoint both of the utility and the village to increase the rates for street-lighting service. The commission appreciates that the operation of a utility in a community of this size presents many serious problems. In many ways the village of Dahlgren is fortunate in being able to receive twenty-four-hour electric service and if this service is to be continued it is obvious that arrangements must be made whereby the service will pay the utility operators the actual cost of rendering the service plus a reasonable return upon the actual capital invested. Otherwise the natural outcome of the entire undertaking will be that the service will become poorer as the utility attempts to economize in its operations and the village will be inadequately served. This condition would continually become more aggravated with resulting losses of consumers until the system will have to be discontinued. The commission wishes to urge upon the Dahlgren Electric Light Company and the citizens of Dahlgren that a concerted effort be made to increase the business of the company to a point where it will be remunerative. In any community it is essential to the best interests of all concerned that the utility, the municipal authorities and the citizens sholl coöperate in order that the city may receive the full benefit of the service. This is particularly true in a community the size of Dahlgren, and the necessity of such coöperation can scarcely be overemphasized."

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Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Ex-Soldiers Choose Electrical Work.—Classification of the cases approved for training by the Federal Board for Vocational Education shows sixty-one former soldiers enrolled in electrical engineering courses, according to the "Vocational Summary" for May. In addition, there are 178 electricians, thirteen electrical bench workers, three power plant operators and sixteen students of wireless.

Announce Civil Service Examinations.—Several examinations for electricians and radio experts are announced by the United States Civil Service Commission. On July 8 there will be tests for expert radio aid, laboratorian, radio, and laboratorian aid, radio, and on July 23 for electrical assistant. Vacancies in the navy department at Washington and in the navy yard service throughout the country will be filled from the examinations.

Electrical Manufacturers Share in Cincinnati Promotion.—The manufacturers' division of the Cincinnati Chamber of Commerce, which was recently formed to take care of the interests of the different industries, embracing country-wide advertising and proposed legislation, has received the electrical manufacturers as a subsidiary group. J. C. Hobart of the Triumph Electric Company was chosen chairman, and representatives of all the electrical manufacturing concerns in the greater Cincinnati territory attended the meeting at which the movement was indorsed.

New York Electrical Show to Be Resumed.—The Electrical Exposition and Motor Show is to be resumed in New York this year, opening at the Grand Central Palace on Sept. 24. This will be the first show since 1917, last year's display having been omitted because of the war. In announcing the resumption Arthur Williams, president of the Electric Show Company, said that while there had been some uncertainty as to the time and place of the exposition, there had never been any doubt that the first year of peace would see the exposition back in its accustomed place. In fact, the show plans began to take form soon after the armistice was signed. The Grand Central Palace was used during the war as a debarkation hospital. An indication of the importance with which the electrical industry regards this show is seen in the fact that 40 per cent of the space had been assigned to exhibitors before the date of the exposition had been finally set tled upon.

Glass Company Appeals on Rate.—Declaring that its requirements from the standpoint of service are extremely favorable to the power company, the Illinois-Pacific Glass Company has applied to the California Railroad Commission for an order approving the 1916 contract the company proposes to renew with the Great Western Power Company. In asking that the commission approve a rate of 1 cent per kilowatt-hour for direct current and 7.8 cents per kilowatt-hour for alternating current, the glass company says that its demand for energy is regular and constant and therefore deserving of the terms sought.

To Improve Broadway Lighting.—The Broadway Association, an organization of New York business men, has inaugurated a campaign for better lighting of the city's chief business thoroughfare. Jefferson Q. Thompson, president of the association, has appointed a committee to study the situation and to make recommendations to city officials. Among the members are A. F. Berry, United Electric Light & Power Company, and C. L. Law, New York Edison Company. A recent demonstration in which lights in private buildings were turned off for several minutes showed the inadequacy of the present municipal lighting.

Widespread Use of Electric Trucks by Bakeries.—A. Jackson Marshall, secretary of the Electric Vehicle Section, National Electric Light Association, has issued a statement showing that representative bakery concerns in this country have selected after exacting tests the electric commercial vehicle as the mode of transportation best suited to their business. The Ward Baking Company employs about 225 electric delivery wagons; the Consumers' Bakery Company, Kansas City, Mo., uses more than sixty electric trucks, and the Mills-Fox Baking Company, Detroit, more than fifty. The Campbell Baking Company of Kansas City employs thirty-five electrics. Kansas City is a city of hills but the electric trucks used daily there by the two bakeries climb them easily.

Norway's Great Water-Power Resources.—Norway possesses more water-power in proportion to population than probably any other country, says a report of the United States Department of Commerce. The developed horsepower per capita is also larger than in any other country. The population of Norway is 2,500,000 and the developed hydroelectric power is 1,300,000 hp., which gives more than 0.5 hp. for every person in the country. The corresponding figure for Sweden is 0.17 hp. In the past few years the Norwegian government has bought a large number of waterfalls in all parts of the country, and it now owns more than 1,500,000 hp. From 200,000 hp. to 300,000 hp. are being held in reserve with a view to ultimate electrification of the Norwegian state railroads. Only a small portion of the state's water powers are under development.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Depreciation of Land Values.—The Court of Appeals of Kentucky has pointed out (211 S. W. 153) that where a right-of-way is condemned through land, cutting it into two parcels, pointed at each end, it is a matter of common knowledge that the lands not taken are materially depreciated in value.

Charges Rendered or Materials Furnished.—The Supreme Court of Appeals of West Virginia has pointed out that services rendered or materials furnished to public service corporations subject to the provisions of the public service commission act must be compensated for by payment in money, not by a pass, and a contract for a pass, though valid when made, becomes illegal and unenforceable under the provisions of the act (9 S.E. 207).

Regulation by Contract or Ordinance.—It has been held by the Supreme Court of Minnesota (172 N. W. 217) that the rates charged by a public service corporation for service furnished to the inhabitants of a municipality may be regulated by contract as well as by ordinance. Regulation by ordinance calls for the exercise of governmental functions, and by contract for the exercise of the business or proprietary powers of the municipality.

Rights of Electric Railway and Highway Traveler.—The Supreme Court of Appeals of West Virginia has held that the recognized legal status and reciprocal duties each toward the other of an interurban railway company and a traveler on a rural highway at a public grade crossing are materially different from those prevailing in a municipality, the rights of the traveler ordinarily being subordinate to those of the company, in that to the latter is accorded priority of passage, and the reciprocal rights and duties of the respective parties in such case being predicated upon that basis (99 S.E. 180).

Personal Judgments for Damages.—Although a corporation vested with power of eminent domain, having undertaken to condemn land for its necessary use under the state statutes, might, after judgment and before possession is acquired, elect to take or not the land in question, this right of election having once been exercised is, under such statutes, the bill of rights and the constitution, binding upon the corporation, and a personal judgment may be rendered against the corporation in the circuit court, where jury awarded damages exceeding amount of deposit made, according to Court of Appeals of Kentucky (211 S. W. 193.)

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W. D. Weaver, formerly editor of the ELECTRICAL WORLD, has received the honorary degree of LL.D from Kentucky University, at which Dr. Weaver was a student prior to entering the United States Naval Academy.

A. P. Merrill has been made manager of the Ogden division of the Utah Power & Light Company. Mr. Merrill succeeds P. M. Parry, who has been advanced to the position of commercial manager of the company.

Lewis A. Lewis has recently been appointed sales manager for the Washington Water Power Company at Spokane, Wash., and J. F. Farquhar general agent for the Palouse and Big Bend districts. Both men have won their promotion through several years of service with the company.

J. C. Johnson, formerly of Davenport, Iowa, has been made general manager of the Iowa Southern Utilities Company, with headquarters at Centerville, Iowa. D. G. Fisher, the newly elected president of the company, will maintain his headquarters at Davenport and will divide his time between Centerville and Davenport.

Anton G. Hodenpyl, who has retired from the presidency of the Commonwealth Power, Railway & Light Company, Grand Rapids, Mich., on account of ill health, will be succeeded by George F. Hardy, vice-president of the company. Mr. Hodenpyl has been president of the company since its organization about ten years ago. He will remain a member of the board of directors.

J. R. Roberts has been made chief engineer of the Central Illinois Public Service Company, with headquarters at Mattoon, Ill. He will serve under the direction of B. F. Tucker, general superintendent of the company. The Central Illinois Utilities Company has had no chief engineer since A. J. Authenreith resigned to go with the Middle West Utilities Company. Mr. Tucker in the meantime has carried most of the responsibilities of chief engineer in addition to his own work. Mr. Roberts has heretofore been associated with the Wisconsin Gas & Electric Company, with headquarters at Madison, Wis.

J. C. Hail, for the last three years electrical engineer in charge of the bureau of electrical engineering of the Department of Gas and Electricity of the city of Chicago, has joined the engineering force of the Pierce Electric Company of that city, contracting electrical engineers, who are expanding their organization to engage more extensively in power-station and substation construction work. Mr. Hail's activities for the last three years have been principally confined to the engineering and supervision of the addition to Chicago's electric street-lighting system, to cost $3,750,000. His previous experience was obtained with Sargent & Lundy, H. M. Byllesby & Company, the Public Service Company of Northern Illinois and the Sanitary District of Chicago.

Men of the Industry

Changes in Personnel and Position— Biographical Notes

Col. H. M. Waite has been appointed chief engineer of the Lord Electric Company and the Lord Construction Company. Colonel Waite was graduated from the Massachusetts Institute of Technology and secured his early engineering experience in railway work. In 1912 he accepted the position of city engineer of Cincinnati, Ohio, and in 1914 he was made city manager of

COL. H. M. WAITE

Dayton. He remained in Dayton until 1918, when he entered government service as lieutenant-colonel of engineers. He was sent to France and assigned to the Transportation Department, shortly after being made assistant to General Atterbury, Director-General of Transportation. Later he was made engineer of construction of the Transportation Department, having charge of new work at all ports and on the railways used by the American Army. At the time of taking up this work he was advanced to the rank of colonel. In September last he was sent to the front with the Second Army, and he was assigned to the Third Army in the same capacity after the armistice. When the Third Army was settled in the occupied territory he was detached and sent to Trier, Germany, and placed in charge of all public works in the occupied territory. This position he held until he returned to the United States in February.

John F. Vaughan, formerly manager of the New England district of the United States Shipping Board Emergency Fleet Corporation, has returned to his consulting engineering office at 185 Devonshire Street, Boston. During the war that office has been in charge of his principal assistant, E. A. Ekern.

Frank Steinhart, president and general manager of the Havana (Cuba) Electric Railway, Light & Power Company, has been elected a director in the Sinclair Oil & Refining Corporation, which promises to become one of the largest oil concerns under one management and control.

J. R. Perkins has recently been made assistant to J. S. Pevear, general manager of the Birmingham Railway, Light & Power Company, Birmingham, Ala. Mr. Perkins is an engineer and an expert operating man who has been connected with the operating department of the American Cities Company since 1913.

Raymond H. Smith has resigned as vice-president and general manager of the Eastern Wisconsin Electric Company, with headquarters at Sheboygan, Wis., and as president of the Wisconsin Electrical Association and the Wisconsin Gas Association, to become connected with the Electric Bond & Share Company, New York. Mr. Smith entered the utility field in 1897 at Waterbury, Conn. He has been very successful, particularly in dealing with labor and in building up good public relations. A portrait and a sketch of Mr. Smith's career were published in the ELECTRICAL WORLD of April 5, 1919, at the time of his election as president of the Wisconsin Electrical Association.

Obituary

Paul M. Einert, formerly foreign auditor of the Westinghouse Electric & Manufacturing Company, died on June 5 at his home in New York City. Mr. Einert entered the accounting department of the Westinghouse company at East Pittsburgh in 1900. One year later he was sent to Havre, France, to take charge of the accounting department of the French Westinghouse Company, and in 1905 to the British Westinghouse Electric & Manufacturing Company, Ltd., at Manchester, England, in the same capacity. In 1910 Mr. Einert was appointed foreign auditor of the Westinghouse oompany, with headquarters in London. After the purchase of the controlling interest in the French and Italian companies by the British Westinghouse Company from the Westinghouse Electric & Manufacturing Company, he accepted service with the British Company, as traveling auditor, holding that position until the latter part of 1916. Then he returned to this country as assistant to the comptroller of the Westinghouse company at East Pittsburgh. In January of this year he was appointed special representative to the chairman, with offices in New York, his chief duties being in connection with foreign trade of the company, in which capacity he served until his death. He was fifty-six years old.

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TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

ENLARGED MARKET EXPECTED ON THE SIGNING OF PEACE

Utilities and Industrials Which Have Been Holding Back Are Now Expected to Start a Big Buying Movement

At this writing the table is all set for the signing of the peace treaty on Monday of next week after a wait of seven and a half months. Judging from the amount of construction and development work that has been reported awaiting definite peace, a flood of new business should be loosed shortly.

The bulk of this new business will probably come from industrials and utilities which have held back on any enlargement or change-over plans until they were absolutely sure of being able to go ahead under a peace schedule. For this reason the market for power-plant and line equipment for motors, switches, refillable fuses, lamps, shades, controllers and other industrial electrical materials is apparently on the edge of a large buying movement.

Contrary to the expectation in the minds of many people, peace will not bring an immediate lowering of prices. If anything, the immediate effect of peace will be an advance.

Small materials and wire will probably be first to advance. Apparatus, there are reasons for believing, will remain at current quotations for some time unless the prices of raw materials and labor advance considerably above what they are now. A number of articles did not decline after the armistice, on the theory that the raw materials had been stocked at the peak war prices. Since the first of the year it has been possible to replenish these stocks at very much lower prices. Such products therefore should not go any higher. There have been some labor increases since the armistice, it is true, but these, on the whole, have not been of sufficient magnitude, all things considered, to warrant advanced prices.

Electrical supply jobbers are, on the whole, in an excellent position to take care of any sudden increased demand. Stocks, while not so large as last year, are in reality in better shape because of the improvement in deliveries.

Electrical manufacturers will do well to look to their stocks of raw materials and parts. Prices are now low in comparison with what they will be, and shipments are not likely to be any better this year.

MAJESTIC WINS PORTABLE RADIANT HEATER PATENT CASES

California Jury Holds "Hedlite" Heaters to Infringe Design Patent No. 51,043, Which Was Issued July 17, 1917

The validity of design patent No. 51,043 of the Majestic Electric Development Company of San Francisco, issued July 17, 1917, was sustained on June 16 last, in favor of the Majestic company, in two cases in the District Court of the United States for the Northern District of California. One of these suits was against the Holabird Electric Company and the other one was against Hale Brothers, Inc., R. H. Henderson and the Hotpoint Electric Heating Company; now the Hotpoint Division of the Edison Electric Appliance Company. The cases involved the two forms of the "Hedlite" heater put out by the Hotpoint company. Both of these forms, the Majestic company writes, were held by the jury to be infringements on the design patent.

This type of heater has enjoyed a very large market in the short time it has been out. Prior to its development heater sales were not large in volume. In the past two years the sales of this type of heater have run into very large figures. All of the larger electric appliance manufacturers now have heaters of the same general appearance. An Eastern manufacturer was the last to come out with one, bringing out a round portable heater this spring.

HOLDOVER OF ELECTRIC HEATER STOCKS LARGE

Reports from Different Sections of the Country Indicate Smaller Buying This Fall by Electric Jobbers —Some Orders Placed at Low Prices

A check-up on jobbers' stocks of electric heaters held over from last winter shows that many jobbers still have rather heavy stocks. But a stock of several hundred held over by some jobbers might not be termed by them excessive in view of the number sold. The same number held by other jobbers would, on the other hand, show a poor season or else stocking away out of proportion to the market.

No one will deny that the past winter was warmer than expected. The winter before that, with its extreme cold, exhausted available stocks of electric and oil heaters, and on the strength of that condition manufacturers were ready in the past season to meet a repetition of cold weather. Oil heaters were in sufficient stock and had some effect on sales of electric heaters. Jobbers, of course, had ordered their stocks before the armistice, after which time there was more coal available than there would otherwise have been. This supply of coal and the warm winter combined to make the heater season dull.

Some jobbers with low stocks expect to put in initial orders at the regular time. Others with more or less large stocks say they will dispose of them before ordering anew. In not a few cases overstocks are due to late manufacturers' deliveries.

Although electric heaters are generally termed a seasonable article, they have a light all-year sale. Even now one jobber is getting orders for a dozen at a time for use in summer homes, and he says that he expects to move his left-over stock by fall. Others are finding a light market in summer residences, camps, etc.

Of eight representative jobbers in the New York district, one with only 100 left expects to order 5000 for next season. One with thirty left over anticipates ordering 3000. One with 900 on hand, although having sold a great quantity, would not hazard an estimate of the number to be ordered. Those eight jobbers might be tabulated as follows:

	On Hand	First Order		On Hand	First Order
A	30	3000	F	500	0
B	100	5000	G	700	0
C	120	0	H	900	0
D	200	1000			
E	300	0	Total	2850	9000

Southern Stocks Cleaned Out

A survey of the Atlanta field indicates a small hold-over stock. From information obtained from manufacturers' and jobbers' representatives covering the Southeast it appears that the same condition exists outside of Atlanta. This section has experienced an exceptionally cool spring, which has tended to clean up straggling stocks left over

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from the 1918-19 winter season. At the present time there are practically no heaters in Atlanta either in jobbers' or dealers' stocks. Since the armistice the dealers have been especially careful in their buying, and for this reason they have practically no investment in heaters. One large jobber, however, has already placed his order for 1919-20 heaters, and half of this order will come in shortly. He placed this early order on the speculation that prices later on would be higher, and possibly he obtained a slight shade from the market price sufficient to cover interest and storeroom charges up to the time that he would have purchased under normal conditions.

New England Stocks Large

Twenty-seven of the leading jobbers and dealers in New England report 2894 electric radiators now on hand, and their expectation of buying for fall delivery totals 2271 outfits. These jobbers include the larger houses in Massachusetts, Connecticut and Rhode Island as well as smaller houses, and the dealers include representative central stations and retailers selling appliances to the general public. The jobbers' total stock of radiators is reported at 2186, and their expectation of purchase for fall delivery totals 2135. The largest number of radiators reported by any single jobber was 900, with no intention of buying again before fall. Another large jobber, however, with 200 holdover radiators, expects to purchase 1000 radiators for fall and early winter delivery; another with none in stock expects to purchase 500. Nine jobbers intend to purchase no radiators this summer. In a few cases the jobbers are holding off for price reductions; in others the opinion is firmly held that prices will hold at present levels. There appears to be a strong feeling among these retailers in New England that prices will go lower before winter. Most of the jobbers, however, appear to believe that the cost of labor will hold up the price. Frequently the maximum number of radiators on hand at any time since last fall in jobbers' stocks was two or three times the minimum now on hand. Only two of the jobbers reported having no radiators whatever in present stocks. So far price-cutting has not been conducted on a scale sufficient to upset the market as a whole, but one jobber in Massachusetts has been disposing of his holdover stock, about 200 units, at less than half the retail price. So far as can be learned, there was no material shortage of radiators last winter in this section. It may be very roughly estimated that possibly 4000 to 4500 radiators are held over in the principal New England distributing centers and that 3000 to 3500 may be purchased for fall delivery.

Jobbers*	Held Over	To Buy	Jobbers*	Held Over	To Buy
A	900	0	N	100	0
B	200	1000	O	0	20
C	100	0	P	200	0
D	100	0	Q	200	0
E	0	500	—	—	—
F	25	300	27	2186	2135
G	40	200	Ten representative retailers†	708	136
H	12	40			
I	25	0			
J	12	50	Total hold-overs from above representative cases	2994	
K	50	0			
L	110	0			
M	112	25			

* Classified without regard to size or locality.
† Including some of the larger central stations.

Pacific Coast Conditions

The electric radiator season of 1918-1919 in California formed a curious contrast to the heating season of 1917-1918. In the earlier year stocks were hard to get and were doled out in very small quantities to the public. There was hardly a heater left over from the previous season when the present season began last October. In the next place competitive conditions were bad.

During the season just closed no such conditions existed. It is true that stocks were rather late in arriving, but they came in time to handle the emergency orders. The orders, however, that were expected to be built up on sales work did not materialize. At the present time practically every electrical dealer, hardware store and distributer of electrical goods in California has large stocks that will require carrying over until next season because there is no summer radiator season in California.

The jobbers have in the majority placed their orders for next season, so as to secure prompt deliveries in August and September. In several cases these orders have specified delivery within sixty days so as to secure advantage of the old list price of $9 each. The present list ranges from $10 to $10.50.

Climatic conditions in the Northwest are so different from those in the East that the volume of sales of electric heaters does not vary to any great extent. Naturally, the heaviest sales are made in the fall and late winter, but many are sold during the summer months. The cool evenings in this section call for some form of heat in bathrooms and bedrooms, and the electric heaters answer these requirements. For that reason there is a good all-the-year-round demand for these appliances. At present stocks of jobbers and retailers are in good shape. Since the signing of the armistice shipments have been easy to obtain and are coming through regularly. Orders for early fall delivery will be placed about the middle of the summer.

BELGIAN ELECTRICAL PLANTS IN NEED OF RAW MATERIAL

Many Factories Are Ready to Start Production on a Reduced Scale as Soon as the Necessary Material Arrives

Throughout Belgium, in every district and in almost every industry, the cry is the same: Raw material is wanted. The electrical industry, which was once one of the important branches in Belgian engineering, is particularly dependent upon outside supplies of raw material. Copper, of course, is vitally necessary. At least 15,000 tons of copper ingots, sheets, and wire bars, it is reported in the London *Times Engineering Supplement*, are required in the country for the electrical industry (principally) and the requirements of general engineering production, and large quantities of bare and insulated wires and cable. Until supplies come to hand resumption of work in electrical works will not be possible. Already there are a number of factories ready to recommence production on a reduced scale. One cable factory has succeeded in recovering nearly all its stolen machinery and is in a position to start up when material arrives.

Everywhere the demand for electrical equipment is enormous. Apart from that which was commandeered, there is wear and tear and wastage to be made good upon an enormous scale. The central lighting and power stations, the street-railway systems and their power houses, have reached an advanced stage of wear and disrepair. Belgian electrical production alone will not suffice to make the damage good, and so much equipment will have to be purchased abroad.

ELECTRIC SIGN BUSINESS EXCEPTIONALLY GOOD

Prices, While Steady, Are Higher than Normal, and No Immediate Decrease Is Looked for by Producers

Electric sign business since the signing of the armistice has gone ahead by leaps and bounds, and current sales are better than at any previous time in the history of the business. One manufacturer reports that more electric signs were put up in January last than during the whole of 1918. Another reports the demand 20 per cent greater than it was before the war, with export business doubled; while a third states that during the first three months after the armistice was signed it did as much business as it did during the biggest six months in the history of its business. Others report similar conditions for business east of the Rockies.

The rush of business came, of course, with the removal of the war lighting restrictions. To this must be added the after-war boom in advertising and the effect produced by signless nights. As one manufacturer put it, it required

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signless nights to teach a good many of the public the real value of electric signs.

Prices generally are higher than they were before the war, owing to increased cost of materials and labor. None of the manufacturers reporting believed that there was any indication of lower prices for some time. While certain of the materials had decreased, it was pointed out that labor was higher than ever. Prices have been steady for some months now, and indications seem to point to a continuation for some time.

The outlook appears bright to the manufacturers, and is expected to remain so, as one producer expressed it, for two or three years.

METAL MARKET SITUATION

Copper Is Quoted at 18¼ Cents—Government Restrictions on Tin Have Been Removed

Copper continues to rise, having come up ½ cent to 18.25 cents. Prime Lake is up ⅝ cent and casting ⅜ cent. Wire base has advanced ¼ cent. September, October and November deliveries are quoted at 19 cents. The domestic market has been very firm the past week, but the volume of buying was rather light. The London market for spot copper is up £4, to £86 plus.

Nearly 4000 tons of copper were exported last week, of which France and the Scandinavian countries took 3000 tons. A large percentage of recent shipments was in wire, rods, tubes and bars. The combined foreign and domestic demand is consuming the present curtailed output, so producers are experiencing a feeling of some satisfaction.

It was officially announced on June 23 that all allocated tin has been disposed of, and that licenses for the purchase of tin are no longer required. A careful estimate of the supply of tin on hand in the United States shows there is sufficient, at the normal rate of consumption, to provide for consumptive requirements until the end of October. In order that consumers whose stocks of tin are low may be provided with their necessary requirements, all restrictions on trading in tin between consumers, dealers, jobbers and smelters are immediately discontinued, all guarantees heretofore given under the tin regulations to the contrary notwithstanding. The quotations on Straits tin were opened at 70 cents per pound.

Zinc has responded to considerable activity, and the price has advanced from 6.90 to 7.35 cents.

Other metals show few price changes, and strength is the prevailing feature.

The old-metals market is experiencing some little activity, but the only price change noted is for scrap copper, which is up 1 cent.

NEW YORK METAL MARKET PRICES

	June 9	June 26
Copper:	£ s d	£ s d
London, standard spot	82 5 0	87 5 0
	Cents per Pound	Cents per Poupp
Prime Lake	18.00	18.62½
Electrolytic	17.75	18.25
Casting	17 37½	17.75
Wire base	20.00 to 20.50	20.25 to 20.75
Lead, trust price	5.40	5.40
Antimony	8.37½	8.37½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	10.00	10.00
Spelter, spot	6.90	7.35
Tin	Govt. price 72.50	70.00
Aluminum, 98 to 99 per cent	33.00	33.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.00 to 15.50	16.00 to 16.50
Brass, heavy	8.50 to 9.25	8.50 to 9.25
Brass, light	7.50 to 8.00	7.75 to 8.25
Lead, heavy	4.75 to 4.87	4.75 to 4.87
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

THE WEEK
IN TRADE

BUSINESS conditions throughout the country are gradually getting better, and both jobbers and manufacturers feel more assurance in the growing stability of the market. Building contracts are being let in larger number in all sections, and these embrace more and more the larger commercial structures. The South reports the greatest movement of rigid conduit—the barometer of big building.

Upward price changes are reported in flexible armored conductor and non-metallic conduit; otherwise prices are rather firm, excepting the cutting on schedule material practised by some of the jobbing trade.

Labor difficulties are causing shutdowns in several sections of the country, but no uneasiness is manifest in the outcome.

NEW YORK

With the peace treaty about to be signed jobbers anticipate a better buying movement, while they report business gradually picking up in practically all lines. Prices of both flexible armored conductor and flexible non-metallic conduit have stiffened. The fan business is going along in fair volume, but another hot spell is needed to bring large sales again.

Jobbers' fan sales have increased their month's business to a considerable extent, but there has been little effect on collections. Collections on May sales are coming through in good shape. Many dealers, however, are asking larger credits on account of their fan purchases and in many instances are getting the desired accommodation.

There is a little more unrest in the labor market, although the electrical industry around New York City has not suffered to any extent. The strikes of workers in brass mills in Connecticut are not settled, but they have not spread outside their territory.

Contracting on industrial work is in fair volume; it is running at this time to work incidental to removals from one factory to another or to reconstruction of space and equipment.

FLEXIBLE ARMORED CONDUCTOR.—Prices have stiffened again, this time $2 per 100 ft. Jobbers still report inability in obtaining sufficient stocks to meet their requirements, but there is a slightly better condition existing at the factories, so that better shipments may be hoped for in the future.

FLEXIBLE NON-METALLIC CONDUIT.—There has been an increase of approximately 20 per cent in prices as of the end of last week. The market outside of the city is reported good. The upward tendency of prices probably has been anticipated, for factories are working at good capacity. New orders require about two weeks to fill. The price tendency is reported still upward.

POLE-LINE HARDWARE.—Business is gradually picking up in better shape. Orders are growing bigger, although rather in anticipation of filling needs before prices advance than for any stocking purposes. Factories are making stocks for an anticipated demand.

FANS.—There is a fair volume of sales always going through, but nothing like the quantity sold during the hot spell four weeks ago. Stocks are in better shape now to meet another heavy demand, although the supply of 16-in. fans is behind in some places. Later calls are expected for residence work, when the smaller sizes will, without doubt, come to the front. Ceiling fans and low-voltage fans are finding an increasing sale. Garment factories in particular are using many of the ceiling fans, owing, it is said, to demands from the workers for more comfort, or the desire of owners to forstall possible labor uneasiness.

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SCHEDULE MATERIAL.—Manufacturers' prices appear steady, but jobbers report considerable price cutting among the trade.

RANGES.—The electric range business, according to one manufacturer, is getting a little better in the outlying districts in the country estate field. One large department store is meeting with success in the sale of ranges.

WEATHERPROOF WIRE.—Larger sizes are selling in better volume for transmission work outside of New York City. A representative base is 23 cents.

MOTORS.—Early this month agency discounts on some motors eased up a bit. Certain fractional motors dropped off about 5 per cent in price, while one line of motors in general dropped from 5 to 10 per cent.

CHICAGO

The business outlook for the electrical industry in this section of the country is remarkably bright. Retail stocks are moving rapidly. Manufacturers' and jobbers' business is generally good. For the first time in about three years permits for buildings, residences, apartments, etc., in the city of Chicago are up to normal. Two hundred and forty-five building permits were issued last week, of which 205 were for residences and apartments. The money involved is about $4,000,000.

Industrial towns and cities in the Middle West are exerting every effort to overcome the housing shortage, realizing that the first to offer good homes will get the pick of the labor. With this end in view a number of manufacturers in Kenosha, Wis., organized a corporation to build at least 1000 homes this year. Grand Rapids, Mich., is attacking the problem in much the same manner. Nearly all the small industrial towns report a shortage of labor.

COPPER WIRE.—There is a growing demand for use in new buildings. Demand for transmission-line copper is being maintained. The price advanced on rubber-covered to a 24-cent base, although some is still selling at 22 cents. Weatherproof is around a 23-cent base.

CONDUIT.—The demand is spotty, with no change in price.

NON-METALLIC CONDUIT.—The price was increased 20 per cent last week. This is the second increase of about the same amount within a month.

SCHEDULE MATERIAL.—Sales are increasing, and prices are firm.

HOLLOW WARE.—Retailers are doing a big business and are able in most cases to get shipments from stock.

IRONS.—Stocks are getting low, and one manufacturer is about two weeks behind on deliveries.

RANGES.—Central-station stock, some of which was purchased before the war, has been largely disposed of, and new orders are being placed. The demand has grown so rapidly that one manufacturer is from thirty to forty-five days behind on shipments.

FANS.—The exceptionally warm weather for this time of year has increased fan sales to a point where stocks are uniformly low for all sizes. This does not mean that the manufacturers have accurately gaged the demand, but that the call for fans has been so insistent that buyers are willing to take what they can get if they can't have what they want. From present indications there will be few if any fans left over at the end of the season.

PORTABLES.—Manufacturers of wooden table portables and floor lamps in this section of the country are from three to four months oversold, due principally to lack of skilled help, which is mostly foreign-born. The limited supply of wooden lamps has increased the demand for metal portables to some extent. Retailers are experiencing difficulty in getting silk shades.

TRANSFORMERS.—There is a heavy demand for small distribution transformers up to 5 kva. for primary pressures up to 13,200 volts.

TRACTORS.—One manufacturer is able to make deliveries of three-wheel and four-wheel industrial electric tractors from stock. Sales for export to Europe are increasing more rapidly than domestic business.

POLES.—Last week the price of Northern white cedar poles advanced 10 to 20 per cent, depending upon the size. Stocks are getting low considering the present demand.

BOSTON

Trade is rather streaky this week, with uneven distribution of business in different parts of New England. An enormous demand for socket appliances is noted and a good deal of repair and minor reconstruction work is under way. In the Connecticut Valley building operations continue on a substantial scale. A fair amount of central-station line construction is in progress in northern New England. The demand for industrial material, on the other hand, is quieter this week. Engineers are doing a lot of proposition work, but large commitments along industrial lines are retarded by the disposition to await lower prices.

The feeling is general throughout the electrical trade that lower prices are a long way off and that it is a waste of time to hold back necessary construction because of present price levels. Wire prices tend upward, but other material shows little change either way. Deliveries are for the most part good, though the demand for washing machines and cleaners in this section is beginning to tax the factories heavily. Collections are good at present. Labor is much disturbed in the brass-manufacturing district of Connecticut and electric railway strikes are adding to the burdens of industrial life in the northern Massachusetts district. Jobbers' stocks are in very good shape with a few exceptions, such as metallic flexible conduit and some makes of vacuum cleaners.

FANS.—The demand is steady and retail stocks are somewhat low. The trade is particularly strong in 10, 12 and 16-in. oscillating outfits. The 8-in. non-oscillating fans are also moving well. Six-blade fans are not selling as well as last year.

WIRE.—Bare wire is up a cent to 21 cents base and weatherproof and rubber-covered wire are quoted on 23 cents base, also an advance over last week. Flexible armored conductor is scarce.

FARM-LIGHTING SETS.—Business is brisk and the foundations are now laid for a big fall business. The demand has reached a point where some care has to be taken to maintain local stocks for immediate delivery. On very large units the deliveries are much improved and one representative maker guarantees shipment in thirty days, and even in two weeks on rush orders, compared with former shipments of from sixty to ninety days. The demand from summer cottagers is healthy.

WASHING MACHINES.—Carload shipments into New England are the order of the day, and the market grows like a rolling snowball. Washers cannot in some cases be supplied fast enough to suit distributers.

VACUUM CLEANERS.—Trade is very active. Factories are hard pressed to meet the demand, and some agencies have all that they can do to make deliveries promptly enough to suit the market.

ELECTRIC TABLEWARE.—June will show an excellent business in these outfits. Sales for gift purposes have been unusually active.

STORAGE BATTERIES.—A temporary lull in the demand for automobile batteries appears to be the feature of this week's trade. The electric vehicle market is quiet for the moment.

INDUSTRIAL ELECTRIC TRUCKS.—The market is quieter than for some time. Underlying conditions, however, are sound.

PORTABLE LAMPS.—Sales are progressing well. Money is being expended plentifully in beautifying summer homes, and this means a steady demand for artistic portables.

WIRING MATERIAL.—Stocks are ample to meet current demands. The consumption of this material is still below expectations, but will respond immediately after building operations get started on a large scale.

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ATLANTA

Business in nearly all lines is intensely active. Jobbers report a larger volume of sales than recorded for the same period a year ago, when purchases for government account had reached their height. Collections are good. The Allied Packers' Company, Savannah, Ga., has been incorporated for $25,000,000 and will proceed with construction immediately.

CONDUIT.—Black and white rigid are moving fast, keeping pace with industrial requirements and apartment construction. Prices remain steady; stocks are normal and incoming shipments are averaging two weeks.

PANELBOARDS.—This item is picking up rapidly as building advances. The volume of business is considerably in excess of that during May. There has been no material change in prices since last August.

CONDUIT FITTINGS.—Prices are steady with the exception of connectors, which have declined approximately 15 per cent. Business is active and stocks are in good shape.

ARMORED STEEL CABLE.—The market has been stimulated by textile lighting and apartment house demand. Prices have increased gradually about 10 per cent during the last few months. Stocks are lower this week.

STAMPED-STEEL BOXES.—Coincident with a growing demand for conduit products and wiring materials, this item has experienced a brisk trade. Local stocks are in fair condition. Eastern shipments are prompt.

PRINTING-PRESS MOTORS.—The demand for this equipment is growing and activity was further accelerated this week. Manufacturers are looking forward to a substantial future business. Prompt deliveries are being made from central points.

FLEXIBLE STEEL CONDUIT.—There is very little call. Stocks are well filled.

SMALL SWITCHBOARDS.—The demand from apartment-house, small building and theater construction has stimulated the market, and a satisfactory volume of business is being transacted. Prices are steady and shipments are ranging from four weeks on the standard to two months on the more elaborate boards.

FIXTURES.—Jobbers and dealers report a heavy demand which they have difficulty in filling. Deliveries are slowing up to an average of eight weeks. Prices have advanced about 12 per cent this week.

GLASSWARE.—Requirements are increasing steadily. Factory shipments are uncertain, owing to labor troubles, and it is rumored that prices will be higher shortly.

FANS.—A shortage of direct-current fans exists. Especially is this true of Atlanta, but as the season is rapidly advancing dealers are not making any effort to fill in. The return of normal weather conditions is evidenced by a brisk movement this week of all alternating-current types. Oscillating fans are becoming more popular than the non-oscillating type. Stocks are ample.

BELL RINGING TRANSFORMERS.—Residence construction has accelerated the demand and a big volume of business is being done. Deliveries are prompt and prices firm.

FLASHLIGHTS.—The market is lifeless, compared with previous months. Stocks are accumulating.

SEATTLE—PORTLAND

Jobbers in Seattle report that with the exception of an increasing movement of domestic appliances sales are still running light. This condition is particularly true in connection with shipyards, lumber mills and industrial plants. Sales to shipyards last week showed further decreases. In preparing for the day when government construction shall end, the Skinner & Eddy Corporation, Seattle, has placed an order for sufficient steel to build four 10,000-ton cargo carriers, to be built as soon as the contract ships are completed. It is believed probable that other steel yards may follow this lead. Reports from all over the Northwest show wood yards nearing the end of their program and plants will shut down unless foreign contracts are received.

Realty men report the demand for vacant lots increasing weekly. The demand for houses shows no decline.

An ordinance providing for constructing a 10,000-kw. unit addition to Seattle's municipal hydroelectric power plant is in Council, and no doubt exists that the bill will pass. A new unit costing $280,000 and transmission line to cost $150,000 are proposed. The ordinance providing for a penstock to cost $195,00 has passed. The proposition of issuing bonds in the sum of $300,000 for the purchase of the Lake Cushman power site will be submitted to voters in Tacoma.

Portland territory reports business in small motors and equipment good. The Tutler Manufacturing Company recently placed an order for fifty ¼-hp. and ½-hp. motors for apple graders. The Pacific Power & Light Company purchased a 2000-kw. Curtis turbine-driven alternator for its plant at Astoria. The Crown Williamette Pulp & Paper Company placed an order for three additional 350-hp. Jordan motors for its paper plant at Camas, Wash.

COPPER WIRE.—Seattle jobbers report better sales, particularly in smaller sizes. A slight advance along all lines became effective June 23. Stocks are in good condition.

WASHING MACHINES.—Demand is still on the increase and deliveries are well maintained. During the week several dealers in rural districts reported increasing sales. Stocks are well filled.

DOMESTIC APPLIANCES.—Further increases in sales were reported by retailers during the week. Gradually the electric dishwashing field is being opened up and excellent results are being obtained. Dishwashers in this region are comparatively new, but from present indications no trouble will be encountered in moving stocks.

FIXTURES. — Retailers specializing in fixtures report conditions betwixt and between. Sales of higher-class merchandise compare favorably with the movement of cheaper grades. Business has boomed owing to the enormous amount of residence construction. Shipments from the East are coming through well. There has been no decrease in prices.

SAN FRANCISCO

Business is excellent, with many new wiring jobs reported. After many months of counter and house-to-house sales, dealers find that they can again work their contracting force.

A strike of the telephone operators and linemen of the lines of the Pacific Telephone & Telegraph Company has interfered with service to some extent. Unless there is an early termination of the strke, the electrical workers of the state intend to strike in sympathy.

LAMPS.—Because of competition and the signing up of new agents there is very little let-down in demand. The Pacific Coast factory of the National Lamp Works will close for the annual two weeks' shut-down early in July. The new 50-watt C-4 Mazda lamp, listing at 65 cents, is now ready for delivery, and it is gratifying to note that a safe stock was accumulated for delivery before the actual announcement was made.

RADIATORS.—Spring and early summer radiator sales have been hurt by unusually fine weather conditions, and contractors are loaded up. The suit instituted by the Majestic Electrical Development Company against the Hotpoint Division has been decided in favor of the former.

FARM-LIGHTING PLANTS.—The demand is excellent, but because of strikes and other factory troubles deliveries have been rather poor.

INSULATING MATERIAL.—Prices have remained fairly constant, and local stocks are good, but the demand is nowhere near what it was last year. This is principally because conditions do not call for motors as they did last year, and also because a far larger proportion of new motors on invoices are being received, thus lessening the need for returning patched-up motors to the firing line.

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Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit.

Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

Armored Conductor, Flexible Steel

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

Twin-Conductor

No. 14 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%
No. 12 Solid	
Less than coil	+10% to 20%
Coil to 1000 ft	List to 25%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	5%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Twin-Conductor

No. 14 Solid	
Less than coil	$100.00
Coil to 1000 ft	82.50
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	5%

Attachment Plugs

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20% to list
1/5 to std. pkg	List to 20%
Std. pkg	23% to 36%

Batteries, Dry

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.36— .36	.36— .37
Barrel lots	.32— .329	.33— .339

Batteries, Dry—*Continued*

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.362	.372
Barrel lots	.332	.342

Conduit, Metallic Flexible

Size, In.	Ft. per Coil	List per 100 Ft.
⅜	250	$5.00
½	250	7.50
¾	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
½-in. single trip	$75.00	$63.75— 69.75
½-in. double strip	75.00— 82.50	72.00— 75.00
¾-in. single strip	100.00	85.00— 93.00
¾-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
½-in. single strip	$75.00	$63.25 to $63.75
½-in. double strip	78.25	71.25
¾-in. single strip	100.00	75.00 to 85.00
¾-in. double strip	105.00	93.00 to 95.00

Conduit, Non-Metallic Flexible

Size, In.	List per Foot	Size, In.	List per Foot
½	$0.05½	1	$0.25
¾	.06	1¼	.33
¾	.09	1½	.40
¾	.12	1¾	.47
⅞	.15	2	.55
¾	.18	2½	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
½-in.—	$25.00	$20.75	$21.50
¾-in.—	30.00	21.50	20.50

NET PER 1000 FT.—CHICAGO

	Less than 250 ft.	250 to 2500 ft.	2500 to 10,000 ft.
½-in.—	$33.00	$17.50	$16.25
¾-in.—	36 00	19.00	17.25

Conduit, Couplings and Elbows, Rigid Iron

Card No. 40

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37½
2½	.58½
3	.76½

Conduit, Couplings and Elbows, Rigid Iron—*Continued*

Size, In.	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 12.1%	6% to 14.1%
2500 to 5000 lb.	9% to 15.1%	11% to 17.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ to ½ In.	¾ to 3 In.
Less than 2500 lb.	+3% to 6.1%	2% to 8.1%
2500 to 5000 lb.	+1% to 11.1%	4% to 13.1%

(For galvanized deduct six points from above discounts.)

Flatirons

NEW YORK

List price	$6 50 to $7.50
Discount	25%

CHICAGO

List price	$6.50 to $7.50
Discount	25% to 30%

Fuses, Inclosed

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40%

Fuse Plugs

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to std. pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

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Lamps, Mazda or Tungsten

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg	List
Std. pkg	10%

DISCOUNT—CHICAGO

Less than std. pkg	List
Std. pkg	10%

Lamp Cord

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$26.47–$35.01
Coil to 1000 ft	23.82– 29.17

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00
Coil to 1000 ft	21.00

Lamp Guards, Wire

Standard packages from 50 to 150

NEW YORK

Net per 100	$29.70 to $33.00

CHICAGO

Net per 100	$29.70 to $33.00

Outlet Boxes

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%–38%	20%–33%
$10.00 to $50.00 list	36%–47%	31%–43%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	33%–40%	24%–32%
$10.00 to $50.00 list	45%–50%	32%–43%

Pipe Fittings

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	10%
1/5 to std. pkg	20%
Std. pkg	30%

Porcelain Cleats—Unglazed

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$15.00 to $22.40
1/5 to std. pkg	12.00 to 15.35

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg	$17.85–$24.15
1/5 to std. pkg	14.70– 21.00

Standard pkg., 2200. List per 1000, $20.00 to 21.00

Porcelain Knobs

NEW YORK

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$15.00	$22.00–$22.40
1/5 to std. pkg	10.50– 11.20	15.35– 18.00

CHICAGO

Per 1000 Net.	Std. Pkg. 3500.	Std. Pkg. 4000
	5½ N.C.—Solid Nail-it—N.C.	
Less than 1/5 std. pkg	$13.60–$18.40	$27.20–$36.80
1/5 to std. pkg	11.20– 16.00	22.40– 32.00

Sockets and Receptacles

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20 to list
1/5 std. pkg	List to 10%

Switches, Knife

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T	$0.80
60-amp. S. P. S. T	1.20
100-amp. S. P. S. T	2.25
200-amp. S. P. S. T	3.48
300-amp. S. P. S. T	5.34
30-amp. D. P. S. T	1.20
60-amp. D. P. S. T	1.78
100-amp. D. P. S. T	3.38
200-amp. D. P. S. T	5.20
300-amp. D. P. S. T	8.00
30-amp. 3 P. S. T	1.80
60-amp. 3 P. S. T	2.68
100-amp. 3 P. S. T	5.08
200-amp. 3 P. S. T	7.80
300-amp. 3 P. S. T	12.00
Low Grade:	
30-amp. S. P. S. T	$0.42
60-amp. S. P. S. T	.74
100-amp. S. P. S. T	1.50
200-amp. S. P. S. T	2.70
30-amp. D. P. S. T	.68
60-amp. D. P. S. T	1.22
100-amp. D. P. S. T	2.50
200-amp. D. P. S. T	4.50
30-amp. 3 P. S. T	1.02
60-amp. 3 P. S. T	1.84
100-amp. 3 P. S. T	3.76
200-amp. 3 P. S. T	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5%
$10 to $25 list	8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%
$10 to $25 list	+10%
$25 to $50 list	+5%
	Low Grade
Less than $10 list	+15%
$10 to $25 list	2%
$25 to $50 list	5%

Switches, Snap and Flush

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

Switches, Snap and Flush—*Continued*

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	23%

Switch Boxes, Sectional Conduit

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	18%–20%	List–18%
$2.00 to $10.00 list	28%–30%	5%–28%
$10.00 to $50.00 list	45%–50%	10%–47%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	30% to 33%	24% to 25%
$2.00 to $10.00 list	30% to 33%	24% to 25%
$10.00 to $50.00 list	30% to 45%	25% to 55%

Toasters, Upright

NEW YORK

List price	$6.00 to $7.00
Discount	25%

CHICAGO

List price	$7.00
Discount	25% to 30%

Wire, Annunciator

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.42
No. 18, full spools	.35– .40

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.46 to $0.56
No. 18, full spools	.41 to .51

Wire, Rubber-Covered, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$14.15–$14.50	$10.50–$12.65	$10.50–$10.60
12	18.90	18.90	14.18
10	25.50	25.50	17.00
8	34.94	29.10	23.28
6	55.38	46.15	36.92

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$18.50	$10.00–$11.00	$9.50–$10.00
12	22.05	22.05	18.90
10	29.68	29.08	25.44
8	40.9	34.62	24.62
6	63.84	54.72	54.72

Wire, Weatherproof

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$27.00–$29.25
25 to 50 lb	27.00– 25.25
50 to 100 lb	26.00– 23.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$25.75 to $26.50
25 to 50 lb	25.75 to 26.50
50 to 100 lb	25.75 to 26.50

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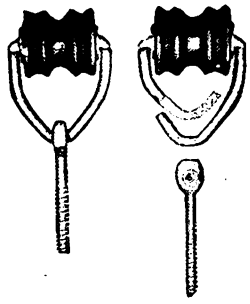
NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Easily Installed Wiring Bracket

In order to make the installation of its "Holdem 'E-Z" type brackets more convenient, the B. & K. Manufacturing

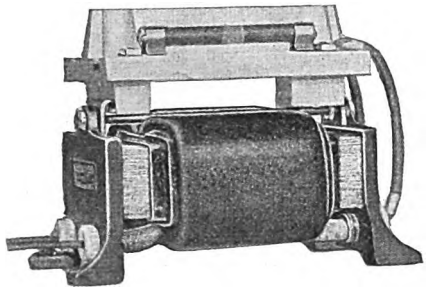


BRACKET SHOWN ASSEMBLED AND SEPARATED FOR INSTALLATION

Company of New Britain, Conn., has made the screw part of the bracket separable from the insulator and its holder, as can be seen in the illustration. This construction makes it possible to insert the screw in the wall first and then attach the rest of the bracket, an improvement over the customary manner of holding the entire bracket and screwing it into the wall.

Dry-Insulated Potential Transformers

For use in conjunction with alternating-current instruments and meters where a high degree of accuracy is desired the Condit Electrical Manufacturing Company of South Boston, Mass., has developed type W potential transformers with a maximum voltage of 5500, 25 or 60 cycles. They have a ratio such that at normal rated primary pressure the secondary pressure is 110



EQUIPPED WITH CUT-OUT BASE AND FUSES

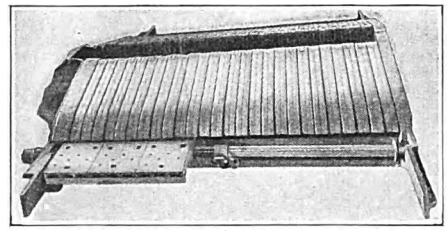
volts. The temperature limits specified by the A. I. E. E. are said not to be exceeded even though these transformers are operated continuously at 10 per cent above their normal rated pressure and at their rated volt-ampere capacity.

A high factor of insulation has been provided, it is pointed out, the transformers being dry-insulated and thoroughly impregnated. One primary and one secondary lead, properly marked to indicate the polarity, are provided. The windings are so related that the instantaneous ingoing current of the marked high-voltage or primary lead corresponds to the outgoing current of the marked low-voltage or secondary lead.

For pressures of 2500 volts or less a cut-out base may be obtained as an integral part of the transformer. On pressures in excess of 2500 volts the fuse base must be separately mounted. The construction of these transformers allows them to be installed in a minimum of space.

Square-Bar Dump

In its type "E" stokers the Combustion Engineering Corporation of 11 Broadway, New York City, has incorporated an improved dumping ar-



SQUARE BARS USED INSTEAD OF ROUND ONES

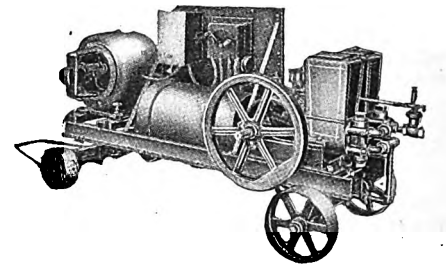
rangement which is declared to be superior to the trunnion design. Square bars instead of round ones are employed and make for greater ease in handling the dumps for cleaning the fires.

Portable Electrically Driven Air Compressor

In shipbuilding, subway construction, mining operations, or where conditions are such that gasoline or kerosene may not be used, or wherever electric power is available, the portable electrically driven air compressor marketed by Chris D. Schramm & Son, Inc., Philadelphia, is said to be particularly useful.

The electric motor and the compressor are mounted on a truck, the weight being properly distributed so that the unit can be easily moved around. A pliable and wide weatherproof belt is used to connect the motor and the compressor.

The compressor used in this outfit is a double-cylinder, single-acting type, which does not take up much space. A further advantage is that the water-hopper cooling feature entirely elimi-



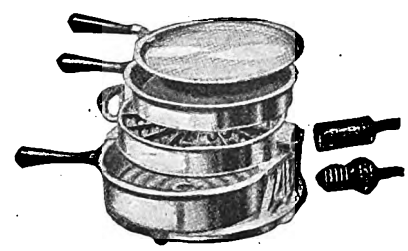
WATER-HOPPER COOLING FEATURE ELIMINATES PIPE CONNECTION

nates the pipe connection for inlet water or outlet water. An automatic unloader, a complete oiling system, a belt pulley and flywheels are furnished with the compressor.

Electric Grill for Frying, Boiling, Baking and Broiling

Baking, boiling, broiling or frying can be performed on the electric grill which Manning, Bowman & Company of Meriden, Conn., are marketing for use in light housekeeping and for cooking meals directly on the dining table. As one pan fits under the heating coils and another above it, two things may be cooked at once.

The grill is rated at 550 watts, but gives a low and medium heat of 137 and 275 watts in addition to the full heat. Three cooking pans with diameters of 8⅜ in. (206 mm.), and depths of 2, 1½ and ⅜ in. (50, 38 and 9.5 mm.) are supplied, the deepest pan having a grid



HAS LOW, MEDIUM AND HIGH HEATS

for broiling, toasting and kindred culinary operations. The grill is nickel-plated and equipped with a detachable plug, 6 ft. (2 m.) of cord and lamp-socket connections.

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Light-Weight Portable Electric Drill

A motor-driven portable drill which can be used on hard wood up to $\frac{5}{16}$ in. (7.9 mm.) and on metal up to $\frac{1}{4}$ in. (6.3 mm.) has recently been brought out by the Stow Manufacturing Company of Binghamton, N. Y. Lightness is one of its features, the maker points

LIGHT IN WEIGHT; CAN BE USED ON BOTH METAL AND WOOD

out, since the weight of the drill including chuck is but 6 lb. (2.7 kg.). The over-all length of the tool is 11 in. (27 cm.).

The universal motor with which the drill is equipped has a maximum horsepower of $\frac{1}{8}$, a loaded-spindle speed of 1000 r.p.m., and is wound for either 110 volts or 220 volts alternating current, single-phase.

Motor-Driven Window Advertising Machine

The "Symetriscope," a motor-driven advertising display device for use in store windows, etc., which is now being marketed by J. B. Beans, 1216 Land Title Building, Philadelphia, consists of a rotating chamber formed of a series of triangular mirrors so arranged that they present to the eye all the effects of a kaleidoscope. It differs, however, from the kaleidoscope in that a score of persons can see the changing figures at the same time, and, in place of transparent objects or bits of stained glass, opaque objects of any kind can be used —artificial flowers, ribbons, banknotes, etc.—all of which can readily be changed.

The device contains 22 ft. (6.7 m.) of advertising space. This space is divided into ten independent sheets which appear successively from the same roller, all being readily changed for others. While the sheets appear the attraction—that is, the rotating mirrors —disappear, thus leaving nothing to detract the spectators' attention from the advertisement.

The device can readily be changed into a machine of different appearance. It is so constructed that nine cardboard disks can be placed in a circle around the chamber in which the figures are displayed, all turning with the chamber and maintaining an upright position, so that any lettering thereon can at all times be read with ease by the passer-by.

Ampere-Hour Meter for Storage-Battery Applications

Especially designed to meet the severe overload and vibration requirements of mine locomotives, industrial tractors and storage-battery trucks, a locomotive-type ampere-hour meter has been placed on the market by the Sangamo Electric Company of Springfield, Ill. This meter registers the ampere-hours which the battery discharges in driving the vehicle. When the battery is put on charge the meter registers as the charge proceeds, and when the battery has been fully charged zero is registered and contact is made within the meter, tripping a circuit breaker in the charging circuit.

Giving the battery a certain amount of excess charge each time it is charged has been provided for in the locomotive-type ampere-hour meter by a variable resistor device which causes the meter to run slower by any desired percentage on charge than on discharge for equal current flow. It automatically provides that the battery will be given any desired percentage of overcharge, for by the time the meter indicating hand gets back to the full charge position all of the previous discharge plus certain percentage overcharge, depending upon the setting of the variable resistor elements, will have been put back into the storage battery.

Heavy-Duty Oil Engines for Station or Marine Service

In designing its heavy oil engines for station and marine use the Pittsburgh Filter & Engineering Company, Pittsburgh, Pa., has aimed to combine accessibility with the simplicity of the Hvid type engine, a strong effort being made to minimize attention on the part of the engineer in charge. Furthermore, the parts of these engines are interchangeable so that if repairs are necessary new parts of perfect fit can be obtained.

The engine is of the inclosed type, cam-shaft bearings, roller levers and gears being inclosed as well as the crank case. These parts run in an oil bath, yet the cam shaft can be removed merely by taking off the front cover. The crank pins are accessible through large openings in the crank case. Slotted mufflers admit air to the cylinders.

Means of starting is provided by compressed air supplied to each cylinder through an air-starting valve. Compression relief valves are also provided to assist in starting. The start and the relief valve rockers are mounted upon eccentric shafts so that by a single turn of the control gear the engine is brought from the starting to the running position, and this control lever also shuts off fuel to the cylinders during the starting period. A compressor driven by the engine shaft provides compressed air for the starting tanks.

The fuel supply is regulated by a governor mounted upon a vertical shaft. Besides this automatic regulation, which provides constant speed, a hand control lever regulates the speed while running. The lubricating system is automatic. Two grades of lubricant are used, one for the pistons and the other for bearings. Lubrication of the pistons is accomplished by a Richardson-Phoenix force-feed oiler driven by the cam-shaft. Individual feeds are used in this lubricator as well as a float valve for keeping the lubricator filled from an overhead oil reservoir.

The crank shaft of open-hearth steel is forged from the solid billet, and in the smaller sizes of the engines up to the four-cylinder sizes it is forged in one piece. Since no cross-heads or guides are employed, the piston is made of the trunk type and sufficiently long to insure long wear. The inside of the top of the piston is equipped with ribs providing with radiation of heat as well as increasing strength. The cylinder head is of high-grade gray cast iron, efficiently water-cooled.

Individual Beverage Heater

Liquid weighing 8 oz. (236 ml.) may be individually heated in one minute through using the "Thermovac" electric beverage heater which is being made by the H. B. Gibson Company, 123 Liberty Street, New York City. The resistance heating element of this heater is in the form of a nickel chromium built-in coil. The inner receptacle is surrounded by a vacuum chamber so

HEAT INTENSIFIED BY VACUUM CHAMBER SURROUNDING HEATING COMPARTMENT

that the heat is forced directly into the heating compartment.

Both the outside and inner wall of the heater are spun from one-piece heavy plate copper. The inside wall of the vacuum chamber is covered with "Thermoval" insulation, while the outer wall of the chamber has an inner covering of "Thermo" heat and cold resistance lining. The intensified heat radiator which is surrounded by the heating coil is made for four separately "cured" sections.

This heater can be placed underneath any electric drink mixer having an overhead motor and the drink may be mixed directly after it has been heated;

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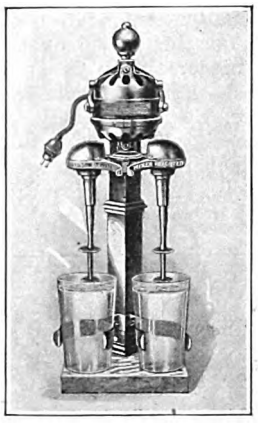
a detachable plug is attached to the heater's handle and lamp socket connections are provided.

Storage-Battery Locomotives for Industrial Service

Rugged construction, simplicity of operation and ease in maintenance are pointed out as features of the storage-battery locomotives which have been developed by the Ironton Engine Company of Ironton, Ohio, for industrial haulage. Three types are made: Type "K" is intended for shifting heavy cars and for general yard work; type "L" is designed for general light haulage work, and type "J" can be used for plant and intershop haulage. The first two styles are equipped with inclosed cabs for the engineer, while the third style has none but can carry a load on its deck.

Double Electric Drink Mixer

Two drinks can be mixed at the same time with the "twin mixer" which is being placed on the market by the H.



BOTH AGITATORS OPERATED BY ONE MOTOR, TOGETHER OR INDEPENDENTLY

B. Gibson Company, 123 Liberty Street, New York City. One Hamilton-Beach electric motor is used to operate both agitators, they being operated together or separately. A velocity of 8000 r.p.m. is obtained in the mixer, which uses no gears.

Radiation-Cooled Ventilating Fan Motor

The "Autovent" fan motors now being marketed by the Batterman-Truitt Company, 736 West Monroe Street, Chicago, are radiation-cooled and dispense entirely, the maker says, with the necessity for cooling by exposure or by passing air through the motor. Through cooling by simple radiation the motor is said to be protected against the entrance of contaminating substances contained in the air discharged from the ventilating fan.

At the fan end of the motor there is normally a considerable neutral air space created by the interference of the motor itself with the current of air passing through the fan wheel. On the Autovent fan wheel there is a special device, the centripetal vanes, at the axis of the fan wheel, which causes the inner air currents nearest the motor to converge closely around the motor at the fan end and also increases the velocity of these air currents through the fan wheel at the axis. This convergence of inner air current greatly diminishes the size of the neutral air space and brings these air currents into such position as to create an ideal means for taking up and carrying away the heat radiated from the fan end of the motor. Because the converging air currents keep the smaller neutral air space constantly cooler than the interior of the motor the heat generated in the windings of the motor radiates immediately through the apertures into this cooler neutral space and comes into immediate contact with the swiftly moving walls of air currents and being instantly carried away with the general exhaust.

The front end of the fan motor, or the end opposite the fan wheel and standing against the air currents, is securely closed up, with covers removable for inspection. Since there is no current of air entering or passing through the motor there is no means for the conveyance therein of contaminating, corroding or depositing substances.

Notes on Recent Appliances

Farm-Lighting Set

The "Reeco" low-speed electric lighting plant has been placed on the market by the Rural Electric Equipment Company of Canton, Pa.

Electric-Steam Vulcanizer

An electrically heated steam vulcanizer has been placed on the market by James C. Heintz & Company, 2069 East Ninth Street, Cleveland, Ohio.

Portable Reading Lamp

A spun-brass, white-enameled and hand-decorated portable electric reading lamp with a figured silk shade is marketed by William R. Noe & Sons, 53 West Twenty-first Street, New York City.

Turbo-Generator for Car-Lighting Service

A 500-watt, 32-volt turbo-generator for car lighting is being marketed by the Gould Coupler Company, 30 East Forty-second Street, New York City.

Cord Coiler for Electric Irons

The Haynes Manufacturing Company, Salt Lake City, Utah, has placed on the market a cord coiler for obviating the tendency of an electric iron to get in the user's way.

Dry Cells for Ignition and Flashlight Use

A complete line of dry batteries, comprising the regular No. 6 1½-volt igniter and telephone types and eight sizes for flashlight use, has been developed by the Delta Electric Company of Marion, Ind.

Portable Direct-Current Instruments

The Roller-Smith Company, 233 Broadway, New York City, has improved its "Handy" type portable direct-current instruments, which are offered in such combinations as ammeters, milliammeters, voltmeters, millivoltmeters and voltammeters.

Generator Set

The Anderson Engine Company, 3046 North Rockwell Street, Chicago, has developed an electric generator set driven by a gasoline engine.

Miner's Type and Tubular Flashlights

Miners' type and tubular flashlights are included in the line of flashlights which the Delta Electric Company of Marion, Ind. is placing on the market.

Underslung-Battery Industrial Trucks

Electrically driven industrial trucks with underslung batteries are made by the Cowan Truck Company of Holyoke, Mass.

Motor-Driven Clothes Washer

The Sandusky Washer Company of Sandusky, Ohio, has placed on the market an improved type of electrically operated clothes-washing machine.

Mechanical Overload Release

Frank E. Aurand, 123 South Cuyler Avenue, Oak Park, Ill., has developed the "Lettgo" mechanical overload release, which is a device for automatically disengaging the driving power from driven machinery should the load exceed a predetermined amount.

Vibration Meter and Electro-Tachometer

The electro-tachometer referred to on page 817 of the ELECTRICAL WORLD of April 19, 1919, was designed and invented by K. G. Frank, president of the American Precision Works, and H. Sticht, who have applied for a patent on the device. The vibration meter described on page 765 of the ELECTRICAL WORLD of April 12 was also designed by K. G. Frank, and both instruments are manufactured by the American Precision Works, 135 Cedar Street, New York City.

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Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Italy (No. 29,625) wishes to secure an agency for the sale of electrical goods. Correspondence may be in English.

A person in Spain (No. 29,626) desires to secure an agency for electric lamps. Correspondence may be in English.

The purchasing agent (No. 29,711) of a firm having large department stores in several different countries is in the United States and wishes to purchase for immediate delivery, among other things, electrical goods, etc. Payment cash, or terms suitable to seller.

The purchase by a company in India (No. 29,687) of electrical industry supplies, gas and electric fixtures, iron, steel boilers, electrical cable-making machinery, porcelain insulators, and porcelain articles used in electrical industries is desired. Terms, cash against documents.

A firm in Brazil (No. 29,682) desires to purchase electrical materials of all kinds, such as wire cables, insulators, sockets, globes, plugs, fuses, switches and interrupters. A list and description of the supplies required was forwarded and may be examined at the bureau or its district offices. (Refer to file No. 117,955). Correspondence should be in Portuguese.

K. F. van den Bergh, trade commissioner from the Dutch East Indies to the United States, has stated that a special demand exists in his native country for electrical appliances.

Armas Saastamoinen, the new Finnish Minister to the United States, says that "recognition of the independence of Finland by the United States and Great Britain would be a great stimulus to business. We are in America for every kind of raw materials and manufactures, notably iron and steel, oil and electrical machinery. We prefer to deal directly with Americans and not through intermediaries. In return there are wonderful possibilities in Finland for American buyers."

Francis Furnier, member of the French Republic Committee, has come to New York to arrange for the purchase of large quantities of commodities most needed by France. He is here with the sanction of the French government. Electrical motors are among the articles he expects to purchase. Samples will be sent to the prospective buyers in France and after the selection is made payment will be arranged by the Crédit Lyonnais and the National City Bank of New York.

JULIUS ANDRAE & SONS COMPANY, Milwaukee, Wis., electrical supply jobbers, have begun the practice of issuing a monthly price book. The second issue, dated June, is now out.

A RENNERFELT electric furnace of 300 lb. capacity and 60 kva. has been sold by Hamilton & Hansell, Inc., New York, to the General Chemical Company, to be installed at its plant at Laurel Hill, Long Island.

THE BORDEN COMPANY, Warren, Ohio, announces that Charles A. Greene, Chicago representative for the Borden Company, manufacturer of "Beaver" pipe tools, has opened a downtown office at 549 West Washington Boulevard, Chicago.

THE HOOVER SUCTION SWEEPER COMPANY, North Canton, Ohio, will establish its Canadian headquarters in Hamilton, Ont., where it will erect a plant. Heretofore it has had a small plant at Windsor, Ont., but this will be moved to Hamilton, where temporary offices at 20 Macnab Street South have been secured.

THE FLEXLUME SIGN COMPANY, Buffalo, N. Y., announces that Albert Dodge of Buffalo has been elected secretary and treasurer to take the place of the late W. S. Wright. Its Canadian office and factory has been moved from St. Catharines, Ont., to Toronto, where it is located at 92-94 Adelaide Street, East. Its volume of business this year has compelled the company to enlarge greatly its floor space and to make radical changes in its office force and office location.

THE OHIO ELECTRIC & CONTROLLER COMPANY, 5800 Maurice Avenue, Cleveland, Ohio, has placed a contract for a two-story plant, 80 ft. by 100 ft.

THE EDISON ELECTRIC APPLIANCE COMPANY, INC., Chicago, has asked for bids on the structural steel for a 340-ft. by 350-ft. addition to its plant at 5660 West Taylor Street.

H. L. GARBUTT, formerly manager of the line-material section of the supply department of the Westinghouse Electric & Manufacturing Company, has recently been made local supply manager of that company at San Francisco, Cal.

THE CHINA ELECTRICITY COMPANY is a new concern being organized by the Sino-Japanese Industrial Company and the China Industrial Development Association to combine the Japanese branches in China dealing in electrical goods.

C. McKEW PARR, general sales manager for the Hart & Hegeman Manufacturing Company, Hartford, Conn., has returned after about a year and a half in the service. He was connected with the bureau of exports of the War Trade Board at Washington. Later he was sent as special representative of the War Trade Board with a commission as special assistant of the Department of State, also being appointed vice consul at Las Palmas, Canary Islands, and at Barcelona, Spain. He also had missions in France and England.

C. M. PARR

RATHBONE, SARD & COMPANY, stove and range manufacturers, have recently opened branch offices in San Francisco, Portland, Los Angeles and Salt Lake City. The company is starting a vigorous selling campaign to increase its sales of electric ranges, especially in the coast and mountain states where low energy rates prevail. The organization in the West is directed by C. F. Jaques, district sales manager, with headquarters at the Portland branch. The San Francisco branch is in charge of M. S. Barnett, the Los Angeles branch of M. M. Merritt, and the Salt Lake City branch of M. C. Bennett.

WILLIAM B. SCAIFE & SONS COMPANY, of Pittsburgh, Pa., announce the opening on July 1 of a Chicago sales and engineering office, at 38 South Dearborn Street, with Charles F. O'Hagan, formerly chief engineer of the company at Pittsburgh, as resident engineer and manager. This company is one of the oldest manufacturing concerns west of the Allegheny Mountains. During the more than 100 years since its business was founded, it has from time to time, as conditions arose, added to its manufacturing facilities. It now manufactures black or galvanized, riveted, brazed or welded steel tanks for air, gas and liquids, steel shipping drums, range boilers, steel structures, and also the "We-Fu-Go" and Scaife water softeners and filtering equipment.

THE TRIUMPH ELECTRIC COMPANY, Canfield, Ohio, has placed a contract for a one-story plant, 60 ft. by 80 ft.

THE DAVIS STORAGE BATTERY COMPANY, Lynn, Mass., has decided to enlarge its plant from 20,000 sq.ft. to 50,000 sq.ft. of floor space.

THE PACIFIC STATES ELECTRIC COMPANY, San Francisco, Cal., announces the creation of a sales promotion and advertising department in charge of M. T. Dolman.

THE HART & HEGEMAN MANUFACTURING COMPANY, Hartford, Conn., announces the opening of its new office at 505 Fifth Avenue, New York City, under the management of A. F. Wilson.

THE ALLMUR MANUFACTURING COMPANY, Marion, Ind., announces that it has just received an order from the Mexican government for two carloads of automatic electric cooking stoves for use in the government institutions in Mexico City.

THE DOEHLER DIE-CASTING COMPANY, Brooklyn, N. Y., announces the organization of employees of the company under the name Doehler Die-Casting Employees' Association. The initial issue of "Doehler's Topics" for June, 1919, has just been published.

THE JAMES LEFFEL COMPANY, Springfield, Ohio, maker of turbine waterwheels, whose present plant was sold to the Robbins & Myers Company, is having plans prepared for enlarging and fitting up the plant of the Columbia Planer Company, which it has acquired. Its present capacity will be more than doubled.

THE CLEVELAND ELECTRIC MOTOR COMPANY, Cleveland, Ohio, announces that it has recently moved into larger quarters and is now in a position to expand on its line of polyphase induction motors. The local success of its product having been established, the company is in a position to distribute it throughout the country.

THE COOPER HEWITT ELECTRIC COMPANY, Hoboken, N. J., announces that it has recently opened a district sales office in the Majestic Building, Milwaukee, Wis., in charge of H. T. Braschler, district sales manager, and also a district sales office at University Building, Syracuse, N. Y., in charge of George D. Senior, district sales manager.

THE DIEHL MANUFACTURING COMPANY, Elizabeth, N. J., announces the removal of its Boston office from 201 Devonshire Street to 566 Atlantic Avenue, at which address the storeroom and service department will be located. In Chicago the company's branch is at 1017 West Jackson Boulevard, with a stock of motors and parts eady for immediate delivery to customers.

J. LIVINGSTON & COMPANY, INC., constructing engineers, 104 East Eighty-first Street, New York City, who for the past twenty years have devoted practically their entire time to electrical construction and engineering, have recently entered the electrical appliance field. Display rooms have been opened at 104 East Forty-first Street, where are shown electrical labor-saving appliances for the household. The company is metropolitan district distributer for the "Easy" vacuum electric washer.

THE UNITED ENGINE COMPANY'S LINE, heretofore sold in the Northwest by the Waterbury Implement Company of Minneapolis, is now being sold direct to dealers through the company's new branch house at 22 North First Street, Minneapolis, under the management of Charles Bishop, who for more than twenty years was connected with the International Harvester Company. The company's electrical school for dealers is well under way. In this school dealers are instructed in the workings of farm-lighting plants, how to install and sell them. A new instruction and guide book is under way.

LEONARD F. FULLER has resigned as chief electrical engineer of the Federal Telegraph Company to become assistant manager of the Ohio Insulator Company, with headquarters at Barberton, Ohio. Mr. Fuller has been connected with the Federal Telegraph Company during the years in which the Poulsen arc has taken a leading place in long-range radio communication, and much of the improvement in recent years which has made these high-power sets a success is credited to him. He recently received the degree of Ph. D. from Stanford University for his original work in magnetic circuits as used in arc generators.

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MAJOR GILBERT H. CRAWFORD of the 302nd Engineers has returned from France to the De La Vergne Machine Company, New York City, as assistant chief engineer of the ice machine department.

K. P. ROYCE, formerly a lieutenant in the Sixth Field Signal Battalion, U. S. A., is Detroit sales representative of the Burke Electric Company. Before entering the army Mr. Royce was assistant sales manager in the local office at Erie, Pa.

THE MUNICIPAL COUNCIL, Roberval, Que., will make repairs to its hydro-electric plant at a cost of $20,000, and is in the market for one 300-hp. horizontal-shaft turbine, head 50 ft., 600 r.p.m.; also one 250-kva. alternating-current generator and switchboard. J. F. Trenton, Chicoutimi, Que., is the engineer.

THE WARD LEONARD ELECTRIC COMPANY, Mount Vernon, N. Y., has recently issued a folder entitled "The Twenty-Year Club." Portraits of the founders, H. Ward Leonard and J. L. Kebler (now deceased), are shown on the cover, while inside are those of seven members of the company who have completed twenty years' service.

THE DELTA ELECTRIC COMPANY of Marion, Ind., has brought out a line of "Giant" batteries comprising the regular No. 6 1½-volt igniter and telephone type and eight sizes for all types of flashlight cases. A complete new line of flashlights has also been developed. A special factory is devoted exclusively to the manufacture of the new line.

THE FLETCHER ELECTRIC COMPANY, 15 West Seventeenth Street, New York City, has taken up the manufacture of annunciator and magnet wires of all sizes in silk, cotton and enamel. The trade name is to be "Flecto." All arrangements have been made for raw materials, and deliveries are expected to begin in two or three weeks. Complete stocks will be kept for the general trade.

A. M. PAPASIDERIS & COMPANY, 197 Hermes Street, Athens, Greece, announce that they are general importers and commission agents trading in industrial products, electrical machinery and supplies. They act as agents of various manufactures, taking up the exclusive sale of these products upon a stock basis or upon a commission basis. It is their desire to assist in introducing more American products into Greece.

THE INTERNATIONAL OXYGEN COMPANY, Newark, N. J., announces the appointment of Preston Belvin as assistant sales manager in charge of the Pittsburgh district sales work, with offices at 1319 First National Bank Building, Pittsburgh, Pa. The Chicago offices, in charge of Philip G. Wesley, have been removed from 223 Railway Exchange Building, to 817-20 Chicago Stock Exchange Building at 30 North LaSalle Street.

AKERLUND & SEMMES, INC., New York City, announce that they have recently brought into operation a 500-hp. producer plant for the Maritime Electric Company, Charlottetown, Prince Edward Island, Canada. This plant is for municipal electric lighting purposes and is operating on bituminous coal mined in Canada. The company is now shipping two 500-hp. units for operation on wood for the government of the Netherlands at Sumatra, Dutch East Indies.

IRVING E. BROOKS, recently with the Pensacola Shipbuilding Company as assistant to the naval architect and formerly electrical engineer with the Arnold Company, has opened an office as consulting engineer at 807 Stock Exchange Building, Chicago, for the practice of general engineering work. Mr. Brooks was formerly in charge of mechanical work in the city engineer's office and prior to this was on the engineering staff of the Commonwealth Edison Company.

THE ILG ELECTRIC VENTILATING COMPANY, Chicago, Ill., announces the development of a sales promotion department in charge of G. C. Bleidert. In order to enlarge its factory space the company has placed upon the market $400,000 worth of first mortgage 6 per cent. serial bonds. Within the past year sixty "Ilgair" unit heaters were installed in the new Ford "sub-chaser" plant in Detroit. The company states that its sales policies are becoming more and more strengthened and finds it necessary to discourage the selling of its product by any one other than recognized electrical and heating and ventilating trade.

THE COLE STORAGE BATTERY COMPANY, 219 East Twenty-fourth Street, Chicago, has purchased property at 2435-2439 Indiana Avenue, which will be improved with a factory to cost $10,000.

THE KILLARK ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., announces the return of Joseph Desloge, president of the company, from France, where he saw two years' active service as an officer in the French army.

THE BENNETT ARRESTER COMPANY has been formed at Atlanta, Ga., to manufacture a new design of high-voltage lightning arresters. The officers are C. E. Bennett, M. P. Maxwell and G. N. Lemmon. Mr. Lemmon, general manager, was recently with the Railway & Industrial Engineering Company, Pittsburgh, Pa.

C. S. COLER, who was graduated as an electrical engineer from Cornell University in 1911, after which he entered the graduate student course of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa., has been appointed manager of the educational department of the Westinghouse company, and president of the Casino Technical Night School. He

C. S. COLER

succeeds C. R. Dooley, who has joined the Standard Oil Company to promote educational work in that organization. Mr. Coler was formerly manager of the entire evening school and director of trades training of the company.

THE BRANDYWINE FIBRE PRODUCTS COMPANY, Wilmington, Del., announces that Norman Sparks has been placed in charge of manufacturing. Additional machinery and special equipment have been added to handle the vulcanized-fiber tubing business. The company states that it believes in concentrating and giving its whole time and attention to the manufacture of hard vulcanized-fiber tubing, as in that way it can serve the trade to better advantage than otherwise.

THE MUTUAL ELECTRIC & MACHINE COMPANY, Detroit, Mich., has purchased a three-and-a-half-story reinforced concrete building at the corner of Fourth and Porter Streets, formerly occupied by the Doble Detroit Steam Motors Company. Alterations and additions will be made to allow for ultimate floor space of approximately 100,000 sq.ft. H. J. L. Frank is president and L. H. Frank is secretary. The company maintains sales offices and carries stock in New York, Chicago and San Francisco.

THE ELECTRICAL MANUFACTURING COMPANY, 41 Alexander Street, Vancouver, B. C., will erect a new factory in that city. A large site has been secured, and a factory, 50 ft. by 110 ft., of heavy mill construction, covered with galvanized iron, will be built. Extra full equipment of machinery has been ordered for manufacture of heavy-type slate-back switches and the new type of externally operated switches, which will be compulsory under the amendments to the electrical bylaw effective July 1. The company hopes to be turning out electrical equipment early in July.

THE REYNOLDS ELECTRIC COMPANY, 426 South Talman Avenue, Chicago, has filed plans for a new brick manufacturing plant at 2634-2644 Congress Street, to cost $85,000.

HOLBROOK, MERRILL & STETSON, of San Francisco, have been appointed agents for the Simplex Electric Heating Company, Cambridge, Mass., in California, Arizona and Nevada.

PASS & SEYMOUR, INC., Syracuse, N. Y., manufacturers of electrical supplies, announces that its export department has removed to 66 West Broadway, New York City, where all export inquiries should be sent.

THE ELECTRICAL MANUFACTURING COMPANY, Cleveland, Ohio, whose new address is 4149 East Seventy-ninth Street, announces that it has increased its machinery equipment about 40 per cent since the first of the year.

DAVID McNAUGHTON has opened an office at 528 Lincoln Life Building, Fort Wayne, Ind. He will specialize in report and rate investigations of electric light and power companies, illuminating surveys, valuations and industrial engineering.

THE J. P. DEVINE COMPANY, Buffalo, N. Y., manufacturer of vacuum drying apparatus, announces that S. S. Wells, second vice-president, has taken charge of the sales department. The company has established new sales offices in Chicago and in Cuba and the Philippine Islands. It has recently shipped to the Philippine Islands an extraction plant of new design and to a concern in the United States a large impregnating unit for electric cables.

W. G. BALPH has been appointed manager of the safety switch section of the Westinghouse Krantz factory, Brooklyn, N. Y. As head of this section Mr. Balph will have entire responsibility for the sale of all Krantz products, and in addition will have charge of the extension and development of this line to meet the needs of the country for safety switches. Prior to working as salesman in the New York office Mr. Balph was head of the fan-motor division with offices at East Pittsburgh, Pa.

THE DUBILIER CONDENSER COMPANY, INC., 217 Centre Street, New York City, announces that it has changed its factory from war to peace production and is now making mica condensers especially for line and machine protection from high-frequency surges and lightning discharges. At present it is experimenting with condensers for power-factor correction. This problem has been given serious consideration by its London company, which is now experimenting with a 2-kw. plant at its works, with satisfactory results.

THE KILBOURNE & CLARK MANUFACTURING COMPANY, Seattle, Wash., radio apparatus, with American sales offices at Seattle, New York City and San Francisco, has recently made some additions to its foreign agencies, now bringing the number of these agencies to something over 100, representing practically every country in the world. Its new factory, covering approximately one and one-half acres of floor space, has recently been completed. C. B. Cooper is in charge at New York City, and D. F. Mahaffy at San Francisco.

THE HENRY ENGINEERING COMPANY announces that it has opened offices at 71 Bay Street, Toronto, Canada, as consulting engineers on general engineering work. It has also opened a department at this address which will specialize in the purchase and sale of power equipment of every kind—steam, electrical and hydraulic—both new and used. The new company will continue to handle the special agencies carried in the past by Thomas Henry at 58 Front Street, West, and will also from time to time add other lines of engineering equipment and supplies.

THE ELECTRO DYNAMIC COMPANY, Bayonne, N. J., announces that since the first of January, 1919, its sales department, conducted under the supervision of D. B. Wilson, formerly of the General Electric Company, has extended its plans of distribution by establishing agencies in the principal cities east of the Mississippi. The factory has been increased 10 per cent. during the last year, it is stated, and has been equipped with the most modern machine tools capable of meeting the stringent demands of the day. Foreign trade is in the process of development, an order from Belgium for twenty motors having been received in February.

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THE SHELTON ELECTRIC COMPANY has moved from 30 East Forty-second Street to 16 East Forty-seventh Street, New York City.

THE STANDARD ELECTRIC COMPANY, Newark, N. J., has acquired a portion of the building at 126 Pell Street and will establish a plant.

THE B. A. WESCHE ELECTRIC COMPANY, Cincinnati, Ohio, reports that its New York address has been changed to 110 West Fortieth Street.

F. J. McMORRAN has succeeded George Bonnell, resigned, in charge of the St. Louis office of the Underfeed Stoker Company of America.

THE ELECTRIC SALES SERVICE COMPANY has removed its sales office from 109 Stevenson Street, San Francisco, to 2532 Sixth Street, West Berkeley, Cal., where the headquarters are located.

THE F. BISSELL COMPANY, Toledo, Ohio, jobber and manufacturer of electrical supplies and machinery, announces that W. J. Crawford has been made manager of the power-apparatus department.

THE INDUSTRIAL ELECTRIC FURNACE COMPANY, 53 West Jackson Boulevard, Chicago, announces that it now owns all patents covering the Snyder electric furnace, F. T. Snyder, formerly vice-president, having left the organization, effective June 1.

THE BECKMAN & LINDEN ENGINEERING CORPORATION is installing a 100-kw. electric furnace in its laboratories at 41 Minna Street, San Francisco, Cal., to be used in research and investigation work for its clients. The corporation believes that this is the only electric furnace installed for such purposes west of Niagara Falls.

THE BETSON PLASTIC FIRE BRICK COMPANY, INC., announces that with its recent incorporation Frank J. Jewell was elected president and secretary, and Nelson Adams vice-president and treasurer. The company's products are plastic fire brick for boiler-furnace linings and baffle walls and "Hi-Heat" cement for use in the boiler room.

MAJOR SAMUEL W. FLEMING, JR., electrical engineer, member of Gannett, Seelye & Fleming, consulting engineers, Harrisburg, Pa., has returned from overseas after two years' service in the army. The firm will now resume its practice in electrical engineering, a branch of its business which was discontinued to a large extent during the war.

GRIGGS & MYERS, consulting engineers, New York City, desire to announce their recent affiliation with Charles A. Fuller, heating engineer of New York, and Osborn Monnett, heating engineer of Chicago, as associates. Mr. Fuller is a specialist in heating and ventilating, and Mr. Monnett enjoys a wide reputation as an authority in the field of combustion and power-plant economics.

THE METROPOLITAN ELECTRIC MANUFACTURING COMPANY, Long Island City, N. Y., announces that Patrick J. Shelley, treasurer of the company, is now general sales manager. E. S. White, Jr., has been promoted to manager of agencies. The company is making a special effort to work with the jobbers throughout the country and has established agencies in almost every large center.

THE SAFETY INSULATED WIRE & CABLE COMPANY, Bayonne, N. J., announces that Foster Callahan, formerly of the American Electrical Works, has returned from service as a first lieutenant of field artillery and is its representative in several Southeastern states. F. H. Donohoe, formerly associated with the National Conduit & Cable Company, is special representative of the Safety company as of June 1.

THE PREMIER RUBBER & INSULATION COMPANY, Dayton, Ohio, announces that it has recently enlarged its factory space, having acquired an additional 15,000 sq.ft. of floor space. To its line of molded electrical insulation has been added a line of mechanical rubber goods, both soft and semi-hard rubber products being manufactured to specification. The sale of its products is handled entirely at the home office and plant at Dayton.

THE WIZARD ELECTRIC LAMP COMPANY, San Francisco, Cal., announces that it has just moved into new and larger quarters at 521 Howard Street. This move was necessitated by the increase of sales in local territory as well as in foreign countries. Through additional machinery the company has been able to more than quadruple its former output. Its traveling representative, Harold W. Bennett, who has made extensive trips through foreign countries during the last year, reports a very bright outlook for the export business throughout South America, especially in Brazil and Argentina.

Trade Publications

SINGLE-PHASE MOTORS. — The Wagner Electric Manufacturing Company of St. Louis, Mo., has issued bulletin No. 118 on single-phase motors.

STOKER.—In a circular about its type E stoker the Combustion Engineering Corporation, 11 Broadway, New York City, shows details of its improved dumping arrangement.

HIGH-TENSION SWITCHES.—The Pacific Electric Manufacturing Company, 827 Folsom Street, San Francisco, Cal., has issued bulletin No. 600 on high-tension disconnecting switches.

MILL-TYPE LAMP.—The new Westinghouse "Mazda B" mill-type lamp is the subject of a mailing folder circulated by the Westinghouse Lamp Company, 165 Broadway, New York City.

CURRENT TAPS. — Harvey Hubbell, Inc., of Bridgeport, Conn., is distributing circular No. 183, covering double current taps, single current taps and pull-socket current taps with screw bases.

FLUSH RECEPTACLE.—Flush receptacles with adjustable aligning plates are covered in bulletin No. 16-11 issued by Harvey Hubbell, Inc., Bridgeport, Conn., which is to supersede bulletin No. 16-3.

MULTIPLE ATTACHMENT PLUGS.—Harvey Hubbell, Inc., of Bridgeport, Conn., is distributing bulletin No. 16-10 on multiple attachment plugs—in both screw-base and knife-blade contact styles—with porcelain caps.

ELECTRICAL AND STEAM MACHINERY.—The National Power Machinery Company, 1914 Scranton Road, Cleveland, has issued stock list No. 20, covering electrical and steam machinery for light, power and heat.

ELECTRIC IRON.—"The Aristocrat of the Laundry" is the title of a folder illustrative and descriptive of the C-H electric iron being furnished by the Cutler-Hammer Manufacturing Company of Milwaukee and New York.

OIL SWITCHES AND CIRCUIT BREAKERS.—The Condit Electrical Manufacturing Company of South Boston, Mass., has issued bulletin No. 435, describing and illustrating type F-6 oil switches and circuit breakers.

ELECTRIC RANGES. — The Hughes Division, Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, is mailing to dealers a folder showing reproduction of its electric range advertisements in national popular magazines.

ELECTRICAL MEASURING INSTRUMENTS.—The Jewell Electrical Instrument Company, 1646 Walnut Street, Chicago, has issued catalog No. 12, containing illustrated descriptions of its electrical measuring instruments, both portable and switchboard types.

MOLDED ELECTRICAL INSULATION. —The International Insulating Corporation, foot of Mechanic Street, Springfield, Mass., has prepared a twenty-two-page booklet telling about its "synthetic composition" and "rubber substitute" molded electrical insulations.

INDUSTRIAL TRUCK CONTROLLERS. —"Ogden type NS" automatic controllers for storage-battery industrial trucks, tractors and engines are the subject of bulletin No. 615, a twelve-page illustrated folder from the Automatic Electrical Devices Company, 120 Opera Place, Cincinnati, Ohio.

HOUSEHOLD APPLIANCES. — The Hotpoint Division of the Edison Electric Appliance Company, Ontario, Cal., and 5660 West Taylor Street, Chicago, is distributing a colored folder about its dealer-helps. A parts list and a parts price list, known as forms No. 1500-25219 and No. 5500, are also available.

New Incorporations

THE EASTLAND (TEX.) ELECTRIC & GAS COMPANY has been incorporated by H. P. Brelsford and others. The company is capitalized at $50,000.

THE WYNONA (OKLA.) PUBLIC SERVICE & MANUFACTURING COMPANY has been incorporated with a capital stock of $30,000 by Earl Chowins and others.

THE MAPLETON LIGHT & POWER COMPANY of Provo, Utah, has been incorporated with a capital stock of $2,000 by J. P. Johnson, H. Johnson, P. Nelson and M. Johnson.

THE NEW LAND LAMP COMPANY of Newark, N. J., has been incorporated by Nicholas Striglia, R. J. Farese and Michael Bonito. The company is capitalized at $100,000, and proposes to manufacture lighting fixtures, etc.

THE COLEMAN-MILLER ELECTRIC COMPANY, 516 West Grace Sreet, Richmond, Va., has been organized to manufacture electrical appliances and equipment. James A. Miller and associates are interested in the company.

THE A. C. ELECTRICAL MANUFACTURING COMPANY of Dayton, Ohio, has been incorporated with a capital stock of $100,000. R. H. Croninger, Fifth Street and Norwood Avenue, Dayton, Ohio, is interested in the company.

THE E. W. HALL ELECTRICAL COMPANY of Los Angeles, Cal., has been incorporated by E. W. Hall, Elihu Goldson and Herman Barney. The company is capitalized at $10,000 and proposes to manufacture electrical equipment.

THE BRYAN WASHING MACHINE COMPANY of Bryan, Ohio, has been incorporated by E. C. Carroll, N. W. Carroll and Harry Huffman. The company is capitalized at $50,000 and proposes to manufacture electric washing machines.

THE BUFFALO POWER COMPANY of Lenoir, N. C., has been chartered with a capital stock of $125,000 by T. H. Broyhill, J. E. Broyhill, and R. S. Crisp of Lenoir. The company proposes to generate and distribute electricity for lamps, heaters and motors.

THE RADIANT LIGHTING FIXTURE COMPANY of New York, N. Y., has been incorporated by H. E. Bohl, Abraham Miller and Samuel Miller, 1276 Grant Avenue, the Bronx. The company is capitalized at $5,000 and proposes to manufact re lighting fixtures.

THE CHARLES B. SCOTT COMPANY of Scranton, Pa., has been incorporated by Charles B. F. Stewart and C. Ezra Scott, both of Scranton. The company is capitalized at $250,000 and proposes to manufacture machinery, engines, electrical supplies, automobile, mine and mill parts.

THE BRAZIL LIGHT, TRACTION & POWER COMPANY of Wilmington, Del., has been incorporated with a capital stock of $1,000,000 to operate electric light and power plants and other public utility properties, etc. The incorporators are T. L. Croteau, P. B. Drew and C. L. Rimlinger.

THE ROBERT SCOTT COMPANY of Philadelphia, Pa., has been chartered with a capital stock of $15,000 by John G. Hughes, of Haddonfield, N. J., and Bernard A. Illoway, 6638 Green Street, Philadelphia, Pa. The company proposes to manufacture power and mechanical equipment.

THE SPARDON ELECTRIC PRODUCTS COMPANY of Ottawa, Ont., Can., has been chartered by Richard J. Sims, Albert E. Honetwell, John C. Grant and others. The company is capitalized at $50,000 and proposes to manufacture electrical and mechanical signals, machinery, tools, etc.

THE ROANOKE (VA.) ELECTRICAL CONSTRUCTION COMPANY has been incorporated with a capital stock of $10,000 to do general electrical construction work and to deal in electrical supplies, etc. The officers are: H. K. Stone, president; R. A. Bondurant, vice-president, and J. C. Bondurant, secretary and treasurer.

THE PROSPECT ENGINEERING & WELDING COMPANY of Brooklyn, N. Y., has been incorporated by F. J. Walkowski, 108 Pearsall Street, Long Island City, and W. H. Johnson, 55 Hanson Place, Brooklyn. The company is capitalized at $100,000 and proposes to do a general contracting, electrical and welding business.

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New England States

NASHUA, N. H.—The Nashua Manufacturing Company has entered into a contract with the Manchester Light, Heat & Traction Company to furnish electricity to operate its mill for a year or more, until its new power plant is completed. The Nashua company is planning to erect a large hydroelectric plant and operate its mills entirely by electricity.

FAIRFAX FALLS, VT.—Work has started on the construction of the new power plant of the Public Electric Light Company of St. Albans. The plant will be located on the opposite side of the Lamoille River from the present power house. The new plant will have a generating capacity of 4000 hp.

BOSTON, MASS.—Plans are being prepared by the Board of Waterworks for extensive additions to the high-pressure water system, including the installation of two multi-stage turbine centrifugal pumps, each with a capacity of about 3000 gal. per minute, at the power station of the Boston Elevated Railroad at Lincoln Street, and two electrically driven units of the same rating and capacity at the power house of the Edison Electric Illuminating Company at Atlantic Avenue. The installation at both plants will include auxiliary operating equipment. The plans provide for the installation of a third unit at both plants later on. The installation of two additional motor-driven pumps at the Edison company's power station on Stanhope Street is also contemplated.

LOWELL, MASS.—Work, it is understood, will begin at once on the extension to the power plant of the Massachusetts Cotton Mill.

NEW HAVEN, CONN.—Contract has been awarded by the Seamless Rubber Company for the erection of a manufacturing plant in New Haven, to cost about $1,000,000. Details for equipment for power plant and factory have not yet been decided upon.

NEW LONDON, CONN.—Contract for electrical work for the new dormitory building to be erected at the Connecticut College for Women at New London, to cost about $100,000, has been awarded to the Delta Electric Company, 5 Barton Street, Worcester, Mass.

Middle Atlantic States

BABYLON, N. Y.—Plans, it is reported, are under consideration by the Babylon Railroad Company for the installation of an electric generating plant. The company now purchases energy to operate its system.

BINGHAMTON, N. Y.—The Endicott-Johnson Corporation has awarded the Binghamton Light, Heat & Power Company a contract for wiring and supplying electricity for thirty-six new houses to be built by the company.

CHATHAM CENTER, N. Y.—Steps have been taken by the residents of Chatham Center to secure electric service here.

NEW YORK, N. Y.—Plans are being prepared by McKenzie, Voorhies & Gmelin, architects, 1123 Broadway, New York City, for the erection of a telephone exchange building for the New York Telephone Company on Tratman Avenue, west of Rowland Street, to cost about $200,000.

PLATTSBURG, N. Y.—The Plattsburg Gas & Electric Company has been granted a franchise to install a lighting system in Schuyler Falls. Surveys are being made by the company for the erection of transmission lines from its local plant to Cadyville to furnish electricity in that village.

ROCHESTER, N. Y.—Arrangements are being made by the North East Electric Company, 348 Whitney Street, for the erection of a six-story plant, 61 ft. by 206 ft. The company, it is understood, is planning to manufacture electric starting and lighting systems. H. W. Fowler is superintendent of construction.

ROCKAWAY, N. Y.—Plans are being prepared by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for the installation of an electric plant and distributing system at the local naval air station, to cost about $60,000. (Specification 3958.)

SPENCERTOWN, N. Y.—The Chatham Electric Light, Heat & Power Company is extending its electric transmission lines to Spencertown. For the present electricity will be provided for domestic lighting only.

TRENTON, N. J.—Plans have been completed by the Hutchinson Storage Battery Company, 230 South Warren Street, for the erection of a new storage-battery plant and administration building.

HARRISBURG, PA.—Notice has been filed with the Public Service Commission of bond issues by the following companies: Metropolitan Edison Company of Reading, $45,000 in bonds; Sayre (Pa.) Electric Company, $8,000 in bonds; Harrisburg (Pa.) Light & Power Company, $50,000 in bonds; Beaver County Light Company of Pittsburgh, $24,000 in bonds; Philadelphia (Pa.) Electric Company, $1,803,205 in capital stock, and the Lehigh Valley Light & Power Company of Allentown, $15,600 in capital stock.

LEBANON, PA.—Extensive improvements are contemplated to the local plant of the Bethlehem Steel Company, including extensions to power plant, erection of new warehouse and installation of new threading departments. The proposed work, it is understood, will cost about $5,000,000.

MOUNT JEWETT, PA.—The Interstate Public Service Corporation of Rochester, N. Y., has applied for a franchise to supply electricity in Mount Jewett. If a franchise is granted the Mount Jewett tannery, it is understood, will be equipped for electrical operation.

PHILADELPHIA, PA.—The Niles-Bemont Pond Company is contemplating the construction of a power plant at Meadow and Mifflin Streets.

PHILADELPHIA, PA.—Contract has been awarded to Horace H. Burrell, Philadelphia, for the erection of a new power plant at the Orthopedic Hospital, Seventeenth and Sansom Streets.

READING, PA.—Plans have been prepared by the Philadelphia & Reading Railroad Company for the erection of a power plant, 38 ft. by 50 ft., at its local properties.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 16 for installing lighting fixtures in the south building, Hygienic Laboratory, United States Public Health Service, Washington. For details see Searchlight Section.

North Central States

DETROIT, MICH.—Contracts will soon be awarded by the Public Lighting Commission for construction of conduit in John R. Street to the new Public Library, in Cass Avenue from Grand River Avenue to Willis Avenue, in Chene Street from Grand River Avenue to Boulevard, in Kercheval Avenue from Mount Elliott to Hurlbut Avenue, and in Junction Avenue from Michigan Avenue to Michigan Central Railroad viaduct. The work will consist of 5½ miles of 1-5-in. duct conduit, 17 manholes, 170 handholes and 350 lamp-pole foundations. F. T. Bowler, 56 East Atwater Street, is secretary.

AKRON, OHIO.—The Public Utilities Commission has granted the Northern Ohio Traction & Light Company permission to issue $4,998,000 in bonds. Part of the proceeds, it is understood, will be used for improvemennts.

CLEVELAND, OHIO.—Plans are under consideration by the Crucible Steel Castings Company, Champlain Avenue, for the erection of an electric steel foundry on seven-acre site on the Big Four Railroad and Elmira Avenue, near Dennison Avenue, S. W., this fall. The plans provide for the installation of two electric furnaces.

DAYTON, OHIO.—The Public Utilities Commission has authorized the Dayton Power & Light Company to issue $232,000, the proceeds to be used for completion of a transmission line between Wilmington and Xenia and for other improvements under way.

LORAIN, OHIO.—Work will begin at once on improvements to the local system of the Lorain County Electric Company. The cost is estimated at about $90,000 and will include the reconstruction of the electric distribution system, erection of new substation and the installation of new copper wire. The new power plant will be completed in August.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

MARION, OHIO.—The street-lighting committee has petioned for extensions to the street-lighting system.

ELKHART, IND.—A special election will be held July 2 to submit to the voters the proposal to issue $60,000 in bonds for extensions and improvements to the municipal electric light plant and waterworks system.

GARY, IND.—Work will soon begin on the first unit of the Gary Tube Works. The first unit will cost approximately $25,000,000 and will consist of four blast furnaces, three Bessemer converters, blooming mills, plate mills, skelp mills, tube mills and soaking pits.

INDIANAPOLIS, IND.—The contract for the construction of the power house of the G. & J. Tire Company at Georgie and Cook Streets has been awarded to the William P. Jungclaus Company of Indianapolis. The cost is estimated at about $50,000.

INDIANAPOLIS, IND.—Bids will be received until July 11 for the construction of the first division of the sewage disposal plant for the city of Indianapolis, to cost about $2,000,000. The cost of the first division will be about $300,000. The plans provide for building the system in five divisions, the first two to be completed this year. The pumping station will be equipped with six electrically driven pumps with a daily capacity of 100,000,000 gal.

MONTICELLO, IND.—The local electric light plant of the Interstate Public Service Company of Indianapolis was badly damaged by the carrying away of the dam across the Tippecanoe River. The loss is estimated at between $40,000 and $50,000. The plant furnishes electricity for twelve towns.

ATHENS, ILL.—The Athens Electric Light & Power Company is contemplating extending its electric transmission lines to Cantrall, Indiana Point and Fancy Prairie.

CHICAGO, ILL.—Plans have been filed by the Reynolds Electric Company, 426 South Talman Avenue, for the erection of a new manufacturing plant at 2634-44 Congress Street, to cost about $85,000.

COLUMBIA, ILL.—Bids will be received by E. H. Brucker, village clerk of Columbia, Ill., until June 30 for construction of a municipal electric light and power plant. The work consists of removing the present 14-ft. by 60-in. boiler and smokestacks of both boilers, furnishing and installing one new boiler, engine, generator, exciter, switchboard, heater, boiler-feed pump, steam separator, trap, pipe work and covering, erecting concrete chimney, horizontal breeching, constructing concrete foundation for new equipment, and an addition to power house. The changes must be made without interruption to the service of the plant. Plans and specifications may be seen at the office of the village clerk, Columbia, and at the office of Fuller & Beard, engineers, Chemical Building, St. Louis, Mo.

PETERSBURG, ILL.—Farmers in portions of Mason, Menard, Cass and Sangamon Counties are organizing a company, to be known as the Little Grove Light & Power Company, for the purpose of erecting transmission lines (about 40 miles) to connect with the lines of the Abbott Light & Power Company of Petersburg.

ROCK ISLAND, ILL.—The plant of the Victor Storage Battery Company will be removed from Moline to Rock Island, and a new factory, to cost about $52,000, will be erected here.

URBANA, ILL.—The installation of an ornamental lighting system for the entire southwest portion of the city, adjacent to the campus of the University of Illinois, to cost about $100,000, is under consideration by the City Council.

VIENNA, ILL.—The installation of a municipal electric light plant in Vienna is under consideration by the City Council.

ELROY, WIS.—Bids are being asked for the purchase of $22,000 in electric light bonds.

MILWAUKEE, WIS.—The Milwaukee Electric Railway & Light Company is asking for bids for the erection of a substation, 60 ft. by 80 ft., at Twenty-sixth avenue and Burnham Street. Plans are on file in the office of R. H. Pinkley, Public Service Building.

BRAINERD, MINN.—Bids will be received by the City Council until July 7 for pumping equipment consisting of two motor and engine-driven, three-stage centrifugal fire pumps, each of 1000 gal. per minute capacity; two motor and belt-driven vertical centrifugal low-service pumps, each of 900 gal. per minute capacity; one motor-driven centrifugal low-service pump of 1200 gal. per minute capacity, and two motor-driven sump pumps. Plans and specifications may be

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seen at the office of R. T. Campbell, city engineer, Brainerd, and at the office of L. P. Wolf, consulting engineer, Guardian Life Building, St. Paul, Minn.

GENEVA, MINN.—The installation of a municipal electric light plant in Geneva is under consideration by the City Council.

HUTCHINSON, MINN.—Work, it is understood, will be resumed on the extension of the Electric Short Line from Hutchinson to Clara City, a distance of 54 miles. Col. Erie D. Luce will have charge of the work.

LE SUEUR, MINN.—Bids will be received by Thomas Hessian, clerk of school board, Le Sueur, until July 7 for new boilers, new pump and receiver, motor and gasoline engine, repairs to the present heating plant and new coal bunkers for the high school building. Plans and specifications may be seen at the office of Harry W. Terry, engineer, St. Paul, and the clerk of school board, Builders' Exchanges, Minneapolis and St. Paul.

SUPERIOR, MINN.—Plans are under consideration for the rearrangement of the entire street-lighting system in Duluth, with the installation of ornamental lamps on Superior Street. The Duluth-Edison Company has the contract for lighting the city. C. A. Van Bergen is treasurer and manager of the company.

TYLER, MINN.—Bids will be received by the Village Council until July 8 for equipment for the municipal electric light plant, including an 80-hp. to 125-hp. either oil or gas engine with producer gas; generator, belt-driven or direct connected, three phase, 60 cycles, 2300 volts, to be run in parallel, exciter and switchboard complete. John Johnson is village recorder.

BURLINGTON, IOWA.—The American Utilities Company, recently organized to furnish electrical service in Des Moines County, has petitioned for a franchise to erect electric transmission lines on every public highway in six townships in Des Moines. The company proposes to supply electricity for lamps and motors to the residents of towns or rural communities in the townships of Augusta, Concordia, Danville, Pleasant Grove, Washington and Yellow Springs.

STORY CITY, IOWA.—Bids will be received by the city of Story City until July 7 for construction of electric light plant. The equipment will include an engine, generator, switchboard, constant-current transformer fire tube boiler and breeching and boiler-feed pump. The Henningson Engineering Company, National Bank Building, Omaha, Neb., has charge of the engineering work.

ST. LOUIS, MO.—The Wood & Lane Company, 915 Olive Street, it is reported, contemplates the purchase of a horizontal steam turbine-driven generator, with motor-driven surface condenser and other equipment.

ST. LOUIS, MO.—Plans have been prepared by the Scullin Steel Company, 6700 Manchester Avenue, for the construction of a rolling-mill plant, to cost about $2,000,000. The mills will be equipped with electric motor-driven machinery. Perrin & Marshall are engineers.

MANHATTAN, KAN.—The power plant of the Rocky Ford Milling & Power Company, of Abilene, 6 miles north of Manhattan, was recently destroyed by fire, causing a loss of about $150,000. Arrangements are already under way to rebuild the plant. The company supplies electricity in Manhattan, Abilene, Blue Rapids, Junction City and other small towns.

Southern States

CORNELIUS, N. C.—C. F. Asbury of Charlotte has been awarded contract for the erection of a municipal electric distributing system in Cornelius, to include the installation of transformer at point of connection with the system of the Southern Power Company, which will supply electricity to operate the local system.

SPRINGFIELD, GA.—The installation of an electric lighting plant in Springfield is reported to be under consideration.

BOWLING GREEN, FLA.—An election will soon be called to submit to the voters the proposal to issue $20,000 in bonds for the installation of an electric light plant and waterworks system.

WINTER GARDEN, FLA.—An election will be held July 5 to submit to the voters the proposal to issue $70,000 in bonds for improvements to the electric light plant and waterworks system and to construct a sewer system.

KNOXVILLE, TENN.—Steps have been taken by the Board of Commerce for a new power plant in Knoxville. A committee, composed of Larkin H. Brown, chairman; B. L. Johnson, Morris Bart, J. E. Miller and Prof. J. A. Switzer, has been appointed to raise the necessary funds and engage an engineer to make a survey of the city to determine whether a plant is advisable, and if so, whether it will be cheaper to locate the plant at the nearby coal mines or construct a hydroelectric plant.

COLDWATER, MISS.—The Town Council is considering the erection of an electric transmission line from the corporate limits of the town to Senatobia to secure electricity from the municipal electric plant there. The cost is estimated at about $10,000.

MERIDIAN, MISS.—The installation of an electric plant in the Masonic Home of sufficient capacity to maintain 300 lamps is under consideration. For further information address E. J. Martin, superintendent.

MARIANNA, ARK.—The installation of an electric lighting system in Marianna is under consideration by T. E. Hobbs and others.

SPRINGDALE, ARK.—Contract has been awarded by the city of Springdale for construction of an electric light plant, waterworks and sewer system to Frank L. Wilcox, engineer, Syndicate Building, St. Louis, Mo.

NATCHITOCHES, LA.—The City Commission has engaged Xavier A. Kramer, of Magnolia, Miss., as consulting engineer in connection with improvements to electric light plant and waterworks system and for construction of sanitary sewers and street paving. The cost of the proposed work is estimated at about $200,000.

NEW ORLEANS, LA.—The American Sugar Company is planning improvements to its power plant, including the installation of generators and other equipment.

GOTEBO, OKLA.—Bonds to the amount of $20,000 have been voted to establish a municipal electric light plant.

LAWTON, OKLA.—The City Commissioners have decided to call an election to submit to the votes the question of municipal ownership of the electric light and ice plants.

TULSA, OKLA.—The city of Tulsa is contemplating the construction of waterworks system and a hydroelectric plant, to cost about $4,853,000. The plans include construction of dams, 30 ft., 35 ft. and 50 ft. high, and hydroelectric power house, to cost $248,445; conduits, $2,900,405; three 20,000,000-gal. capacity reservoirs, $225,000; one 80,000,000-gal. capacity reservoir, $314,000; power plant, $225,000; pumping plant, $150,000; transmission lines, $360,000; engineering, $230,000; land and clearing, $150,000, and right-of-way, $50,000.

BRECKENRIDGE, TEX.—The Texas Power & Light Company of Dallas has purchased the local plant. New equipment, it is understood, will be installed at the plant.

WACO, TEX.—Plans are under consideration for the erection of the Abe Mulkey memorial building for school purposes at the Methodist Orphanage, to cost about $75,000; also a chapel, to cost $40,000. A separate building will be built for heating plant, power house and laundry. M. W. Scott, 412½ Franklin Street, is architect.

Pacific and Mountain States

KELSO, WASH.—Preparations are being made by the North Coast Power Company for rebuilding its transmision line from Kelso to Kalama. The line now carries 6600 volts and wil be rebuilt for 22,000 volts. The cost is estimated at about $30,000.

ESTACADA, ORE.—Application has been filed with the State Engineer by the Clackamas Power & Irrigation Company asking for water rights to develop 11,705 hp. The company asks for permission to take 1000 second-ft. of water from the Clackamas River near Estacada. The proposed project, which will utilize a 103-ft. fall of water, involves the construction of a ditch and flume 6.6 miles long and a dam 400 ft. long, to cost about $1,250,000.

SALEM, ORE.—The Oregon Pulp & Paper Company is contemplating the construction of a paper and sulphite pulp mill on the Williamette River, to cost about $1,000,000. C. E. Eaton, Sherman Building, Watertown, N. Y., is engineer.

FRESNO, CAL.—Preliminary work has been started by the San Joaquin Light & Power Company on its proposed hydroelectric power plant near Big Sandy in the vicinity of Auberry, to cost including equipment, about $2,000,000.

GLENDALE, CAL.—Extensive improvements are contemplated to the municipal waterworks system, including the construction of a hydroelectric power plant to supply electricity for municipal purposes. The cost is estimated at about $196,000.

LOS ANGELES, CAL.—A permit has been granted the Clune Production Company for the erection of an electric plant at its works.

LOS ANGELES, CAL.—Bids will be received by the Department of Public Service, Knickerbocker Building, Los Angeles, until July 1 for hydraulic equipment, electric generators, transformers, auxiliary electric equipment and appurtenances in accordance with Specification No. 196, on file in the office of the Public Service Commission.

PALO ALTO, CAL.—An election will soon be called to submit to the voters the proposal to issue $72,000 in bonds for the installation of a Diesel engine in the municipal electric light plant.

SAN FRANCISCO, CAL.—Contract has been awarded by the Great Western Power Company for design and construction of the proposed hydroelectric development on the Feather River in the San Francisco district, to be known as the Caribou plant. to the Stone & Webster Engineering Corporation, Boston, Mass. The initial installation will provide for an output of 40,000 kw.

SAN FRANCISCO, CAL.—Bids will be received at the office of the Board of Public Works, City Hall, San Francisco, Cal., until July 30, for construction of the Hetch Hetchy dam and appurtenant works in Tuolumne County. The dam site is accessible directly by railroad, and electricity for construction purposes is available. Plans and specifications may be obtained from M. M. O'Shaughnessy, city engineer, upon deposit of $20.

IDAHO FALLS, IDAHO.—Bonds to the amount of $35,000 have been voted for improvements to the municipal electric light plant and waterworks system.

Canada

CALGARY, ALTA.—Improvements are contemplated to the municipal electric light plant, to cost about $50,000.

LONDON, ONT.—The Public Utilities Commission has instructed E. V. Buchanan, engineer, to prepare plans for placing the high-tension electric wires underground in the downtown section of the city. The cost is estimated at about $45,000.

TIMMINS, ONT.—The Northern Ontario Light & Power Company is contemplating the construction of a new electric station.

WALKERVILLE, ONT.—The Walkerville Hydro-Electric Commission is contemplating the construction of a power station, cost about $25,000, near the plant of the General Motors Corporation.

WINDSOR, ONT.—Arrangements are being made by the Champion Spark Plug Company of Toledo, Ohio, for the erection of a plant at Windsor, to cost about $750,000.

LUMSDEN MILLS, QUE.—Work has been started on the erection of the power house in connection with the works of the Kipawa Fibre Company now under construction at Lumsden Mills. The proposed plant will develop about 20,000 hp.

REGINA, SASK.—The municipal electric light plant was recently destroyed by fire, causing a loss of about $60,000.

SASKATOON, SASK.—The contract for construction of new intake at the municipal power house has been awarded to R. J. Arrand, at $13,550.

SWIFT CURRENT, SASK.—The municipal electric light plant was recently destroyed by fire causing a loss of about $60,000. The plant, it is understood, will be rebuilt at once.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, Panama Canal, Washington, D. C., until July 9 for furnishing steel, brass, copper, brass and copper tubing and pipe, bell metal, bearing metal, pipe covering, gaskets, etc. Blanks and information relating to this circular (1286) may be obtained from the above office, or the offices of the assistant purchasing agents, 24 State Street, New York City; 606 Common Street, New Orleans, La., and Fort Mason, New Orleans, La.

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(Issued June 10, 1919)

14,665 (reissue). AUTOMATIC TELEPHONE SWITCHING APPARATUS; Talbot G. Martin, Chicago, Ill. App. filed April 3, 1917.

1,305,998. ELECTRIC SWITCH DEVICE; Albert I. Fromager and Joseph F. Six, Montreal, Quebec, Canada. App. filed Jan. 17, 1917. Wires terminating in contact plates are adapted to be connected by a sliding member for closing circuit.

1,306,018. DYNAMO-ELECTRIC MACHINE; William B. Moses, Watertown, Mass. App. filed Jan. 8, 1918. Thin sheet metal stamped and drawn into machine parts.

1,306,054. IMPULSE TRANSMITTER; Joseph C. Field, Orange, N. J. App. filed May 10, 1916. Selective for telephone party lines.

1,306,063. TELEPHONE SYSTEM; Lewis H. Johnson, Bloomfield, N. J. App. filed Jan. 2, 1918. Connection between automatic and manual exchanges.

1,306,069. METHOD OF AND APPARATUS FOR MAKING ELECTRICAL MEASUREMENTS; Ervan L. McDonald, Salt Lake City, Utah. App. filed July 5, 1916. Can measure resistance, capacity, inductance and reluctance and be used for electrical comparisons.

1,306,071. CIRCUIT BREAKER FOR IGNITION SYSTEMS; George B. Maegly, Kansas City, Mo. App. filed June 18, 1917.

1,306,072. SPEED-CONTROL GOVERNOR; Benjamin F. Merritt, East Orange, N. J. App. filed Oct. 1, 1917. Can change adjustment while motor is in operation.

1,306,074. SIGNALING SYSTEM; John F. Moran, Jersey City, N. J. App. filed June 8, 1917. Telephone.

1,306,076. AUTOMATIC MOTOR SWITCH; Winfred F. Pfister, Leipsic, Ohio. App. filed Jan. 18, 1918. Centrifugally operated.

1,306,079. CAR-LIGHTING SYSTEM; Harry D. Rohman, New York, N. Y. App. filed Feb. 20, 1917. Maintains constant voltage.

1,306,085. ELECTRIC REGULATING RESISTANCE; Ernst A. E. Thornblom, Eskilstuna, Sweden. App. filed Oct. 14, 1918. Electric welding.

1,306,087. SHEET-FEEDING DEVICE FOR PRINTING PRESSES; Frederick M. Turck and Bruce C. White, New York, N. Y. App. filed Aug. 29, 1917.

1,306,098. TIRE-UNWRAPPING MACHINE; Charles Brown, Knoxville, Tenn. App. filed Jan. 7, 1918.

1,306,116. IGNITION APPARATUS; William B. Moses, Brookline, Mass. App. filed Jan. 17, 1916.

1,306,118. DIRECTION INDICATOR FOR MOTOR CARS; Charles A. Ott, Ottawa, Kan. App. filed Aug. 15, 1918.

1,306,124. LINE SWITCH; John N. Reynolds, Greenwich, Conn. App. filed Oct. 26, 1916. Telephone switching mechanism.

1,306,134. MOUNTING FOR MAGNETO IGNITERS; Arthur R. Baker, Indianapolis, Ind. App. filed July 20, 1918.

1,306,137. ENGINE-STARTING SYSTEM; William A. Chryst, Dayton, Ohio. App. filed Sept. 30, 1915.

1,306,141. ELECTRICAL SWITCH; William Ellerd-Styles, London, Eng. App. filed May 27, 1918. Spindle makes it watertight and gas-tight.

1,306,142. CONDUIT; John M. Fitzgerald, Oak Park, Ill. App. filed June 15, 1917. Affords access to its contents.

1,306,145. AERIAL FOR AUTOMOBILE TORPEDOES; John Hays Hammond, Jr., Gloucester, Mass. App. filed March 15, 1912.

1,306,147. BATTERY ARRANGEMENT; Simon B. Hess, New York, N. Y. App. filed Dec. 26, 1914. Large ampere-hour capacity obtained while using dry cells.

1,306,151. ELECTROLYTIC APPARATUS; Philip J. Kroll, Pittsburgh, Pa. App. filed Nov. 5, 1917.

1,306,170. METHOD OF AND APPARATUS FOR ELIMINATING STATIC EFFECTS; Elmer E. Butcher, Interlaken, N. J. App. filed July 20, 1915. Adjustable inductance and capacity.

1,306,174. ELECTRIC REGULATION; John L. Creveling, New York, N. Y. App. filed Sept. 29, 1911. Dynamo regulated by carbon-pile resistance.

1,306,191. ENTRANCE-SWITCH UNIT; Clarence D. Platt, Bridgeport, Conn. App. filed March 9, 1918. Top-proof with meter.

1,306,202. AUTOMATIC CONTROLLER; John E. Thompson and Clarence W. Jameson, Chicago, Ill. App. filed April 7, 1917. Varies the resistance in the circuit motors.

Record of Electrical Patents

Notes on United States Patents

1,306,208. WIRELESS TELEGRAPHY; Roy A. Weagant, Roselle Park, N. J. App. filed Feb. 24, 1915.

1,306,212. MOTOR-CONTROL SYSTEM; Harry R. Canfield, Cleveland, Ohio. App. filed Dec. 15, 1916. Switches close in a predetermined order.

1,306,214. BATTERY; Richard J. Crowley, Dallas, Tex. App. filed May 1, 1917.

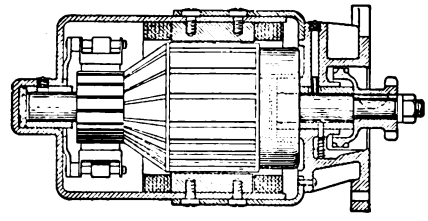
1,306,223. RADIO-TELEGRAPHY; Leonard F. Fuller, San Francisco, Cal. App. filed May 15, 1916.

1,306,231. SPARK-PLUG INDICATOR; Charles F. Pinneo, Detroit, Mich. App. filed July 3, 1917. Determines cause of the engine trouble.

1,306,237. ELECTROLYTIC CELL; Clinton P. Townsend, Washington, D. C. App. filed July 24, 1917.

1,306,248. ACOUSTIC APPARATUS; Edward E. Clement, Washington, D. C. App. filed March 16, 1912. Relays reinforce and increase the volume of transmitted sound vibrations, without distortion or loss of sharpness.

1,306,250. ELECTRIC FURNACE; Ora A. Colby, Larimer, Pa. App. filed Oct. 13, 1917. Electric resistance.



1,306,018—Dynamo-Electric Machine

1,306,251. ELECTRIC FURNACE; Ora A. Colby, Larimer, Pa. App. filed Oct. 24, 1917 For heating steel to forging temperatures.

1,306,259. ELECTRIC LAMP; Frederick G Keyes, Hoboken, N. J. App. filed Jan 17, 1916. Tungsten filament of considerable diameter.

1,306,289. ELECTRIC FURNACE; Frank Thornton, Jr., Pittsburgh, Pa. App. filed Oct. 24, 1917. High temperatures are obtainable without a high rate of deterioration.

1,306,294. ELECTRIC WELDING SYSTEM; David H. Wilson, Franklin Township, Bergen County, N. J. App. filed Feb 23, 1917. Maintains an arc from a common source of power.

1,306,298. TROLLEY HARP; Joseph Basil and Frank Girardi, Detroit, Mich. App. filed Jan. 2, 1919.

1,306,299. TELEGRAPH SYSTEM; John H. Bell, South Orange, N. J. App. filed Dec. 27, 1918. Duplex.

1,306,315. VOLTAGE-REGULATING MEANS FOR STORAGE BATTERIES; John J. Sinclair, Upper Montclair, N. J. App. filed Nov. 15 1916. For compressor motor on rapid transit cars.

1,306,335. ALTERNATING-CURRENT RECTIFIER; Julius F. G. Hartmann, Copenhagen, Denmark. App. filed Dec. 30, 1915. Conducting liquid jets passing through a magnetic field and striking a combined electrode dependent on the velocity of the jet and the frequency of the current.

1,306,340. ELECTRIC SWITCH; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 13, 1915. Quick break.

1,306,341. SHIFT-SOCKET METER PANEL; Hubert F. Krantz, Brooklyn, N. Y. App. filed Feb. 18, 1916. Metering panel has a switch busbar mounted on the board.

1,306,342. SWITCH PANEL; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 10, 1916. Affords direct connection from a busbar to a branch-line terminal by the use of a single switch element.

1,306,343. SAFETY-SHUTTER PANEL; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 22, 1916. Readily inspected.

1,306,344. SAFETY SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 22, 1916. Protected both front and rear.

1,306,345. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed March 31, 1917. Prevents the improper manual operation of two or more switches.

1,306,346. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed April 11, 1917. Insures the proper assembly.

1,306,347. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed Aug. 17, 1917. Plurality of independent operable switch mechanisms.

1,306,356. ELECTRICITY METERING; Edmund O. Schweitzer, Chicago, Ill. App. filed April 9, 1917. Circuit is electrolytically opened after a predetermined quantity of energy has been consumed.

1,306,360. SNAP SWITCH; Clarence C. Stirling, Hartford, Conn. App. filed June 22, 1917. Eliminates arcing.

1,306,406. TRUNK CIRCUIT; Hiram D. Currier, Chicago, Ill. App. filed April 5, 1915. Two-way.

1,306,410. ELECTRICAL APPARATUS FOR TRANSMITTING OR RECEIVING SIGNALS; Arthur T. Dawson and George T. Buckham, Westminster, London, Eng. App. filed June 16, 1915. Motor armatures perform intermittent or step-by-step movements.

1,306,411. LIGHTING-SYSTEM CONTROL; Evan J. Edwards, East Cleveland, Ohio. App. filed Dec. 10, 1915. Protects lamps against excessive voltage.

1,306,445. TELEPHONE-RECEIVER SUPPORT; Katharine L. Standish, New York, N. Y. App. filed Sept. 21, 1917.

1,306,474. RADIO RECEIVING APPARATUS; Alonzo N. Edmunds, Charleston, S. C. App. filed Oct. 2, 1915.

1,306,479. PROCESS FOR THE ELECTROLYTIC DEPOSITION OF LEAD; Dell F. Harbaugh, Chicago, Ill. App. filed July 5, 1918.

1,306,480. METHOD OF RECOVERING METALS FROM THEIR ORES; Dell F. Harbaugh, Chicago, Ill. App. filed July 5, 1918.

1,306,484. MOTOR CONTROLLER; Richard P. Hunter, Milwaukee, Wis. App. filed March 19, 1917. Motor-accelerating means requires resetting for successive operations.

1,306,494. PARTY-LINE SELECTIVE SIGNALING SYSTEM; Talbot G. Martin, Chicago, Ill. App. filed Nov. 29, 1909. For calling automatically.

1,306,520. INSULATING MATERIAL; Clem J. Burkley, Columbus, Ohio. App. filed Dec. 6, 1917. Asphaltic material.

1,306,525. CONSTANT-CURRENT REGULATOR; Guerney H. Cole, Mount Oliver, Pa. App. filed Dec. 4, 1915. No moving coils.

1,306,532. INDUCTION MOTOR; Bernard Elshoff, Newark, N. J. App. filed Dec. 14, 1915. Conducting bars and end rings have substantially the same electrical conductivity.

1,306,537. SYSTEM OF CONTROL; Arthur J. Hall, Wilkinsburg, Pa. App. filed Feb. 3, 1916. Governing translating device reversely manipulated to increase automatically the circuit resistance and lower the motor.

1,306,539. CONTROL SYSTEM, Rudolf E. Hellmund, Pittsburgh, Pa. App. filed July 12, 1915. Surplus field current shunt through energy-consuming devices.

1,306,542. CONTROL FOR ELECTRIC HEATING DEVICES; George H. Hill, Schenectady, N. Y. App. filed March 31, 1917. For maintaining substantially constant current.

1,306,544. MEANS FOR CONTROLLING THE CIRCUITS OF ELECTRIC MOTORS; Leonard P. Hutt, Schenectady, N. Y. App. filed May 18, 1916. Switch closed by a shunt coil under the control of the motor current.

1,306,545. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; Benjamin W. Jones, Schenectady, N. Y. App. filed May 26, 1916. Limit switches.

1,306,548. MOTOR-CONTROL SYSTEM; Robert H. McLain and John Eaton, Schenectady, N. Y. App. filed June 29, 1916. Reversible for hoisting.

1,306,551. ELECTRIC SWITCH; Ezra B. Merriam, Schenectady, N. Y. App. filed June 7, 1916. Prevents ejection of oil in switches.

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Vol. 73, No. 26 New York, June 28, 1919 Pages 1365–1428

Electrical World

F. M. FEIKER, *Editorial Director* W. H. ONKEN, JR., *Editor*

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ELECTRICAL WORLD—*Member Society for Electrical Development, Inc.*—"DO IT ELECTRICALLY"

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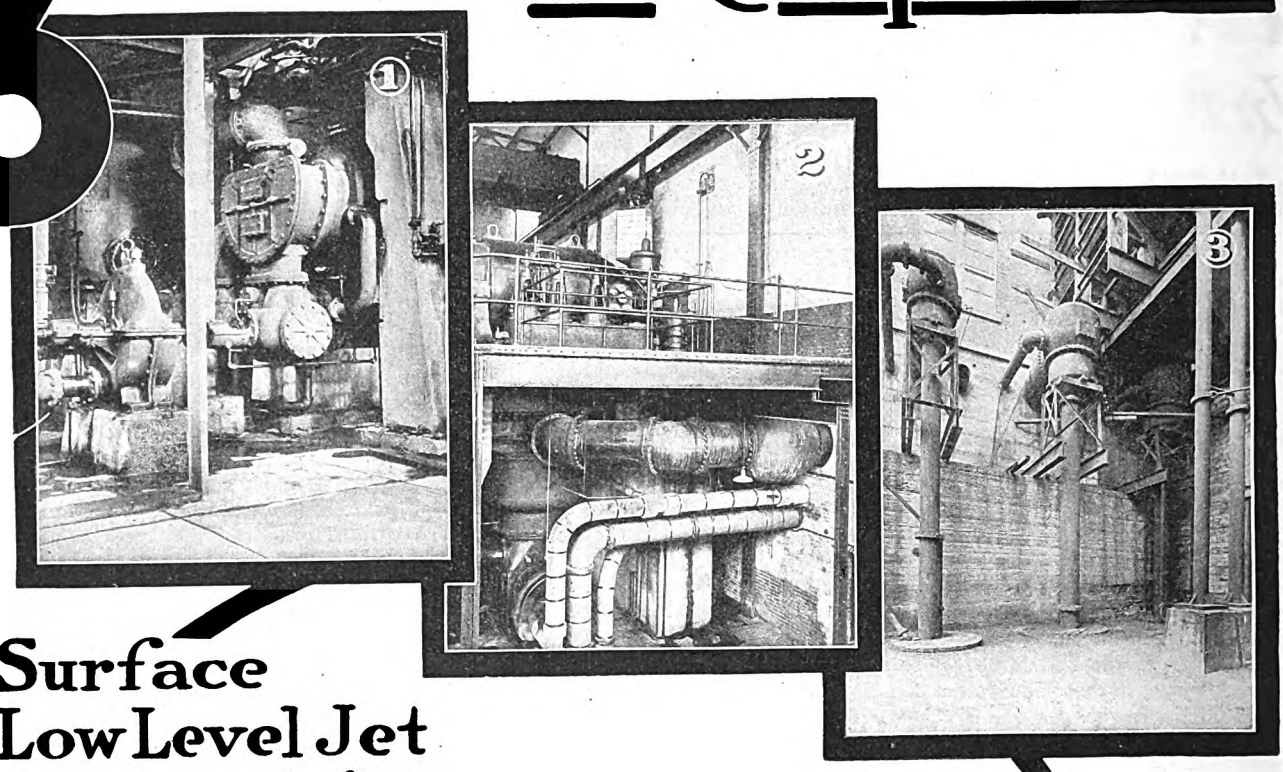
3—No Compromise



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2-Low Level Jet
3-Barometric

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To have but one type of condenser is a handicap both to the purchaser and the condenser builder. Frequently it results in an unfavorable compromise and an ultimate performance neither satisfactory to the purchaser nor creditable to the condenser manufacturer.

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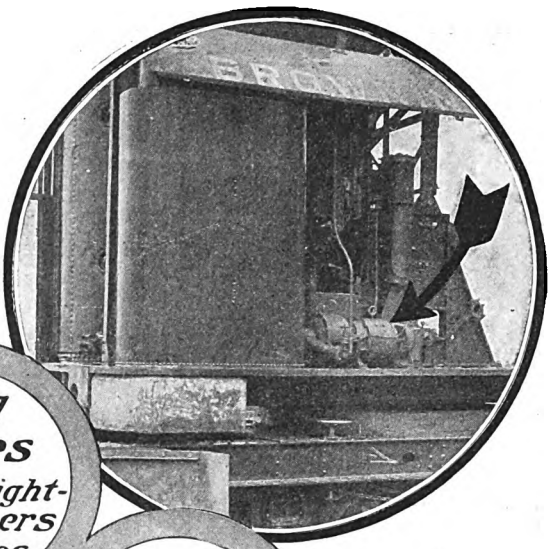

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Locomotive Crane Magnet Work.

Coal Mines
Utility Lighting; Miners Houses.

Metal Mines
Utility Lighting Miners Houses

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Lighting Roundhouses; Flood Lighting on wrecking trains.

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—The picture below shows the *complete* unit, ready for steam connections
—Being light and compact, it is specially desirable for portable use.
—Much simpler foundations than required for reciprocating engines.

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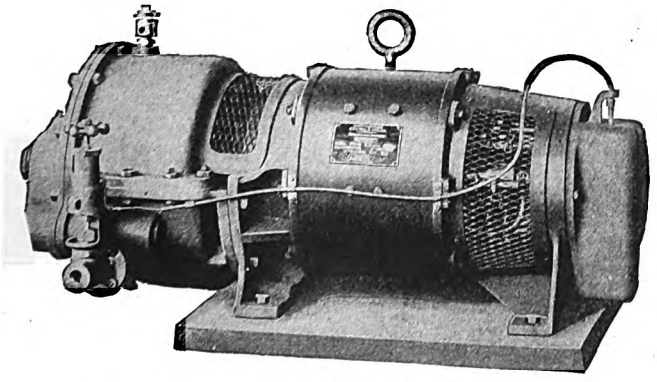

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Direct Current
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—So designed that the replacement of a part can readily be made in the field.
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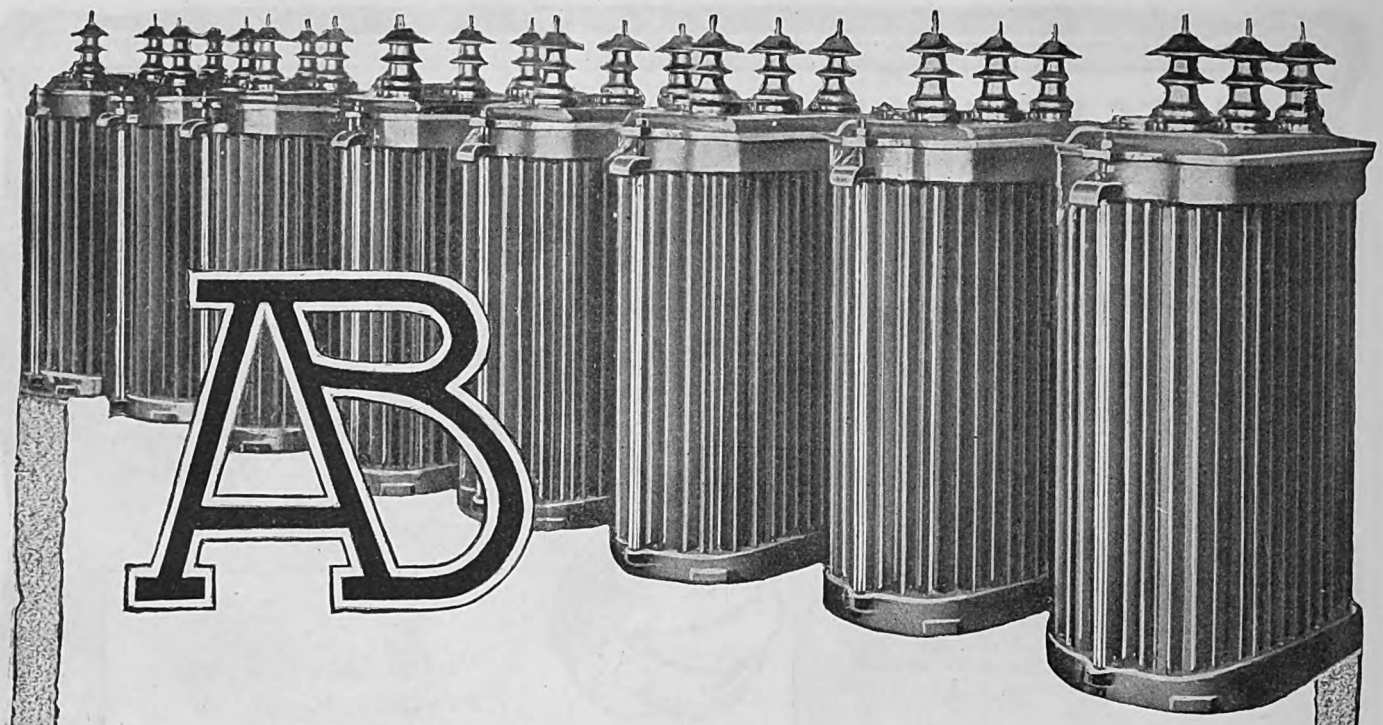

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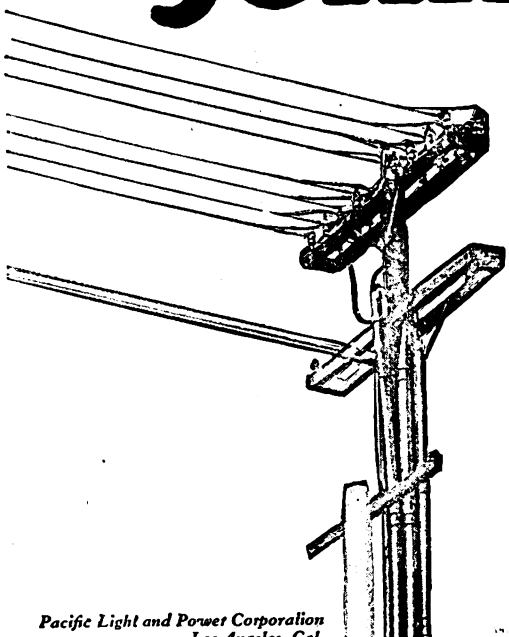

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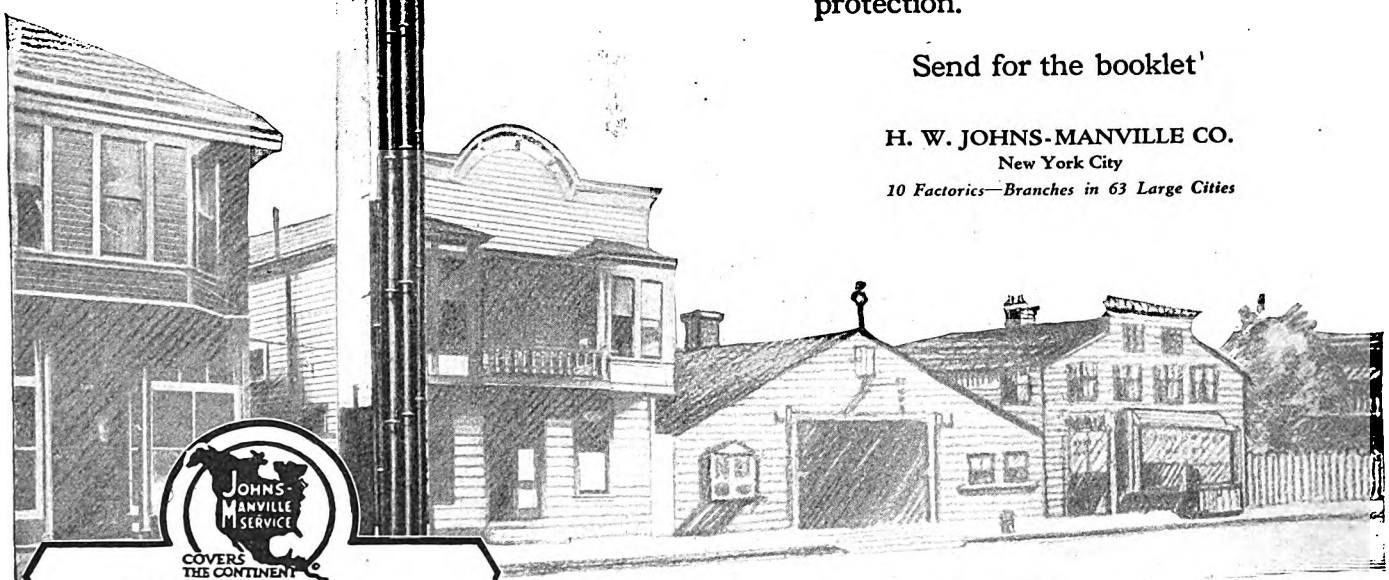

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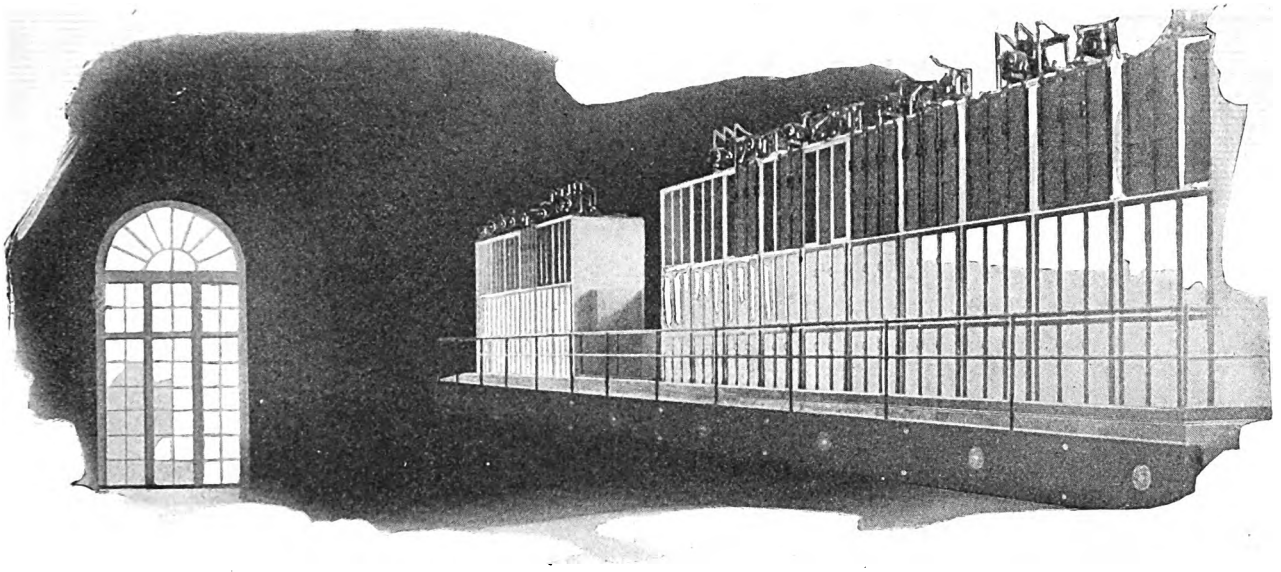

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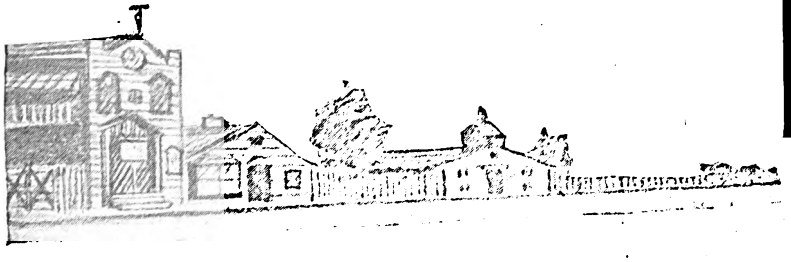

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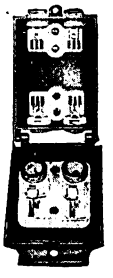

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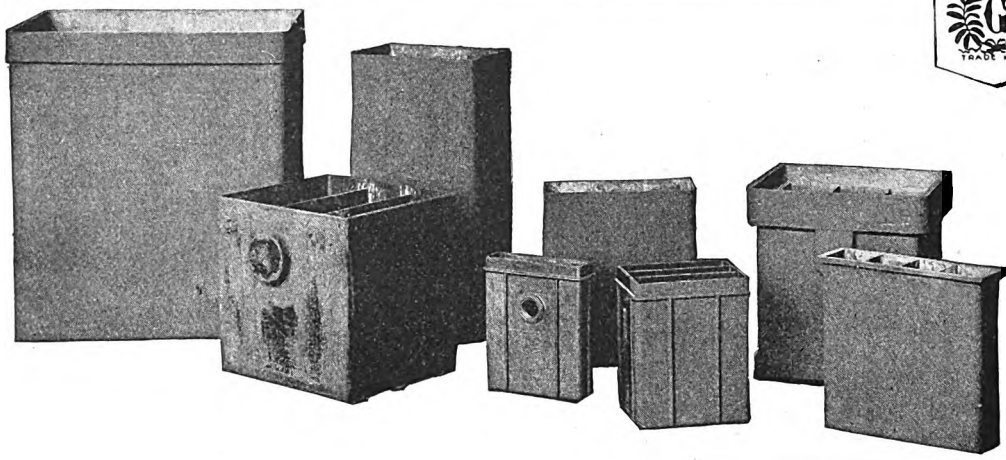
GOODRICH BATTERY JARS —



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Sometimes we ourselves, are amazed at the severe service tests which Goodrich Hard Rubber Battery Jars survive.

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We have never known a jar to crack or to become porous, and we are much pleased with their wearing qualities.

Yours very truly,
Name on request.

Goodrich make Battery Jars for every purpose. Let us know your wants; undoubtedly we can satisfy you as well as our customer mentioned above.

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The City of Goodrich—AKRON, OHIO

GOODRICH
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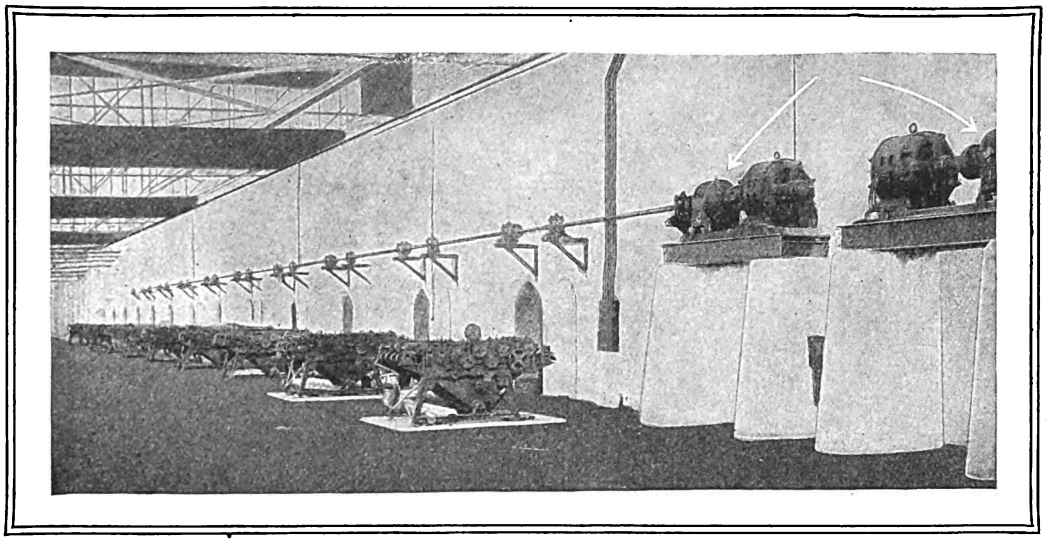

In tin plate mills
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Wherever the line shafts must run constantly—

YOU must have dependability in mechanical power transmission. Even before you have considered the reasonable initial cost and the final economy of Turbo-Gear you can be entirely assured of constant, dependable service. Study its design, its construction, the material put into it, how it is made to close limits. Then you will see that the efficiency of 98% plus is not only possible but inevitable. Its maintenance cost is less than any other drive made. Bulletin 101 supports these claims. Send today for your copy.

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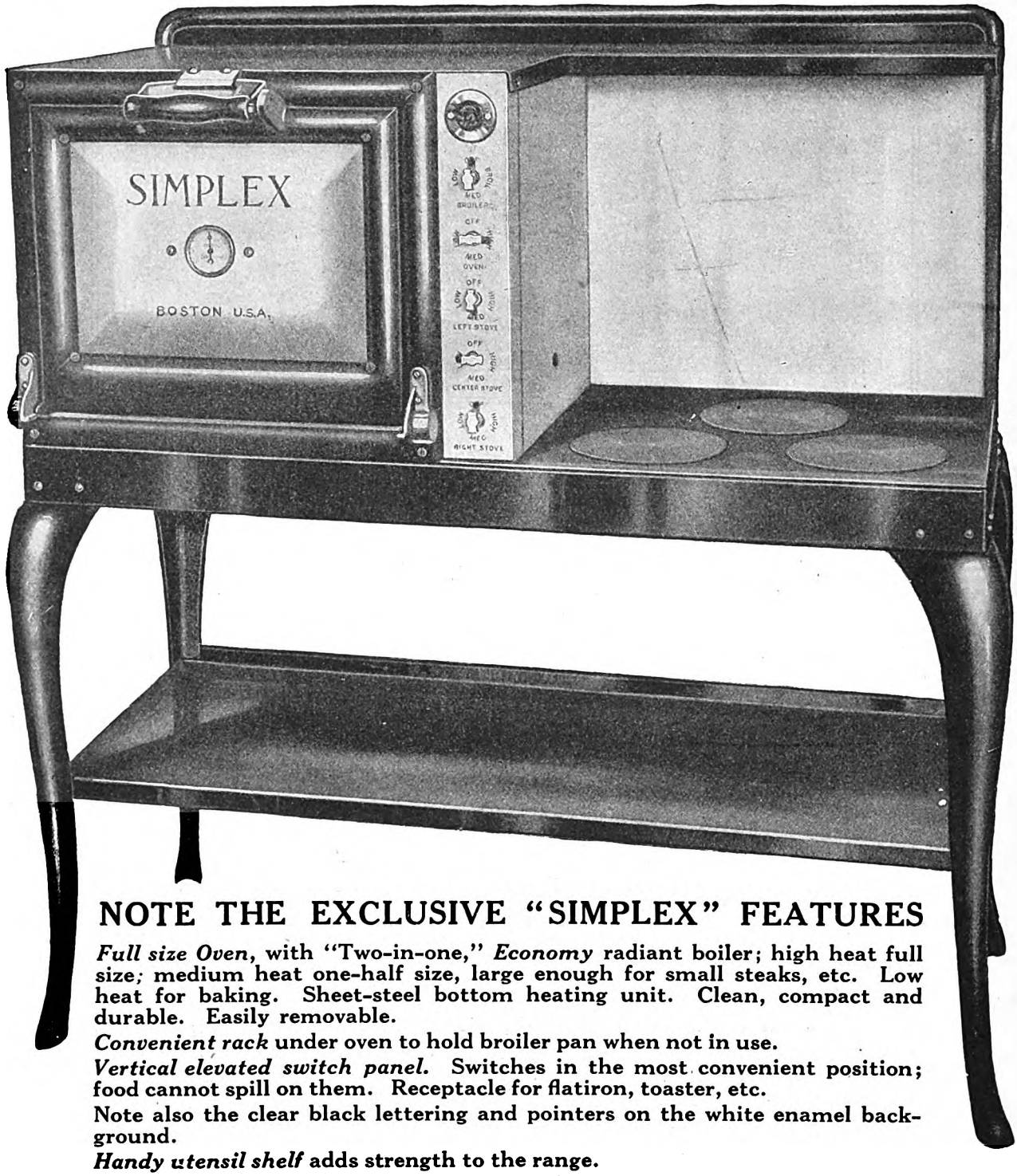

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Galvan ite	Thermol ite
Hedl ite	Ug ite
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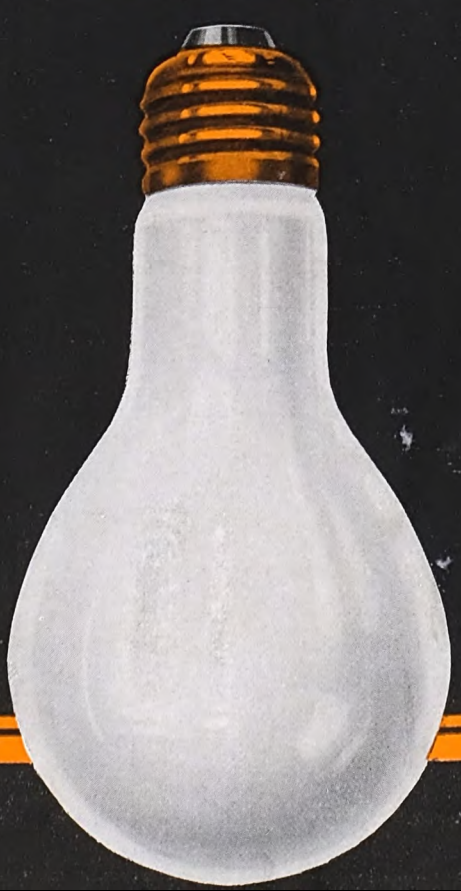

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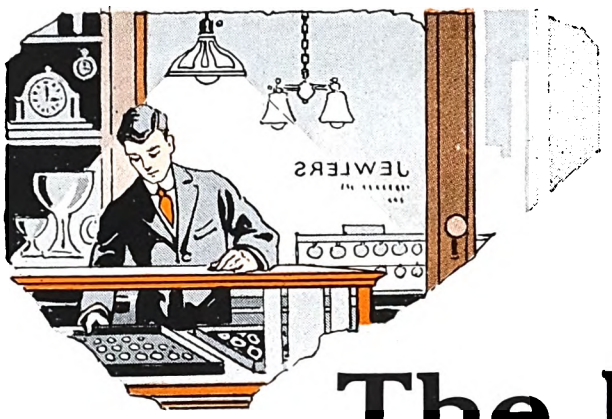

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Powerful and penetrating as is the light of the regular MAZDA lamp, there are many situations—particularly in home, office and store lighting and in other places—where it is impossible to shade the light and where consequently glare becomes a decided objection. Here the WESTINGHOUSE MAZDA C-4 lamp renders its best service.

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Sales Offices and Warehouses Throughout the Country
For Canada—Canadian Westinghouse Co., Ltd., Hamilton, Ont.

WESTINGHOUSE MAZDA LAMPS

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77-20
77-20
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Can You Remember This Number?
77-20

It is the number of the receptacle that should be used in every home and office. The C-H 77-20 Duplex Receptacle provides

Two Outlets in the Space Required for One

This double outlet receptacle fits the same standard outlet box used for a single outlet receptacle, and the wiring is the same also.

You provide double convenience for electrical appliances of all kinds. When installing receptacles, why not install double ones,—77-20's.

Sold by Electrical Jobbers and Dealers, all over

MADE BY

The Cutler-Hammer Mfg. Co.

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NATIONAL MAZDA

THE WAY TO BETTER LIGHT

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.

A NEW ARRIVAL IN THE MAZDA FAMILY

The National MAZDA C-4 Lamp

Thousands of homes are waiting to welcome this newcomer, for it represents the most important development in home lighting since the very first MAZDA lamp came to show *the way to better light.*

The National MAZDA C-4 lamp is of gas-filled construction, with a tipless bulb of white glass which conceals the filament, and softens and diffuses the light. It is made in the 50-watt size only.

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NATIONAL LAMP WORKS
of General Electric Company
Nela Park, Cleveland, Ohio

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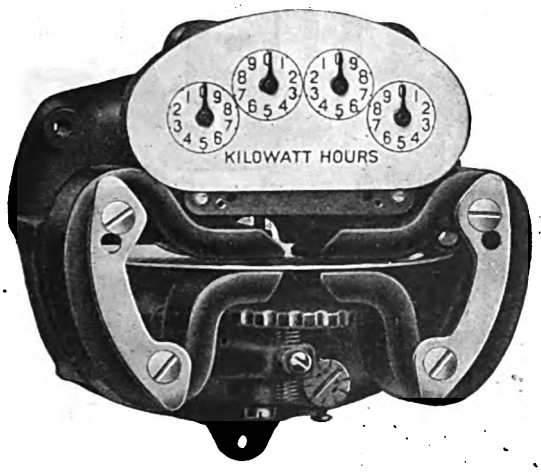

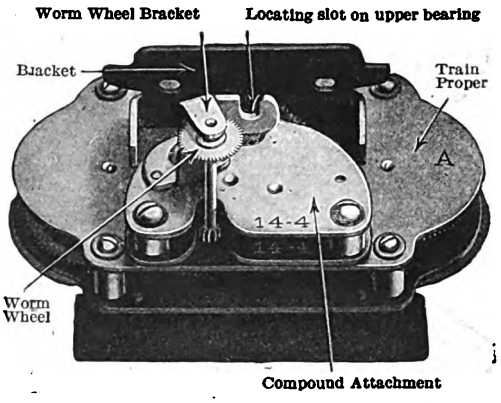

Sangamo Meter Trains Are Built Right

THE recording train of a Watthour meter *must* be built right or meter accuracy is impossible. The recording trains of Sangamo meters *are* built right. Friction in the train is reduced to a minimum through accurate meshing of gears and pinions scientifically cut one tooth at a time like all high-grade gears. Corrosion of parts is avoided by using nickel plated brass throughout. In fact the Type "H" meter will show no difference in speed on a very light load whether recording train is on or off.

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New Orleans, La., Electric Appliance Co.
New Orleans, La., Federal Sign System (Electric).
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The same careful design which insures accurate performance of the train is carried out in all other parts of Type "H." Our nearest agents will be glad to give you details. Write today for bulletin No. 46.

BUILT LIKE A WATCH

Sangamo Electric Company
Springfield, Illinois

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(Continued)

San Francisco, Calif., Sangamo Elec. Co.
Seattle, Wash., Burton R. Stare Co.
Spokane, Wash., Nixon-Kimmel Co.
St. Joseph, Mo., American Electric Co.
Montreal, Sangamo Electric Co. of Canada, Ltd.
Toronto, Sangamo Electric Co. of Canada, Ltd.

Sangamo Products:

A. C. Rotating Standards.
A. C. Service and Switchboard type Watthour Meters.
Automatic Switches Double Acting.
D. C. Service and Switchboard type Watthour Meters.
D. C. Service and Switchboard type Ampere Meters.
Distant Dial Mechanisms.
Instrument Transformers.
Minimum size type Ampere hour Meters.
Reverse Current Time Limit Relays.
Shunts and Resistance Boxes.
Shunt Trip Circuit Breakers.

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On the Job long after ordinary Fuses are scrapped

When you buy a renewable fuse you buy it with the idea that it is going to give *lasting* service. That's the reason you bought the renewable type. You expect it to renew—to live up to its name—to stand the gaff a long time in spite of many blow-outs.

And a fuse that doesn't give you full measure of service in this respect is not renewable in the true sense.

"Union" Renewable Fuse

stands more blow-outs than any other fuse. We are not boasting about it, but merely stating a fact. This is true for several reasons. Here are two:

First: The fusing element does not explode like a hand grenade, straining or burning the tube.

Second: The cap screws onto a *metal ferrule,* which is screwed and riveted to the tube—not onto threaded *fibre* which must inevitably wear and weaken, due to frequent renewals and heat. This metal ferrule also eliminates danger of the fibre tube swelling so the cap can't be removed.

When assembled, the cap, ferrule and tube form a single, rigid, substantial unit—mechanically correct in construction and built for long wear.

"Union" Renewable Fuses comply with standard Underwriters' requirements for cartridge enclosed fuses in rating and short circuit performance. And both the ferrule and knife-blade types of "Union" Renewable Links are interchangeable *with all makes* of standard renewable fuses.

It makes no difference what renewable fuse you have been using, "Union" Renewable Fuses positively will cut your fuse maintenance cost. Sold by dealers in electrical supplies.

Write for booklet.

Chicago Fuse Mfg Co.

Oldest and largest manufacturers of Fuses, Electrical Protecting Materials and Conduit Fittings.

Chicago, New York

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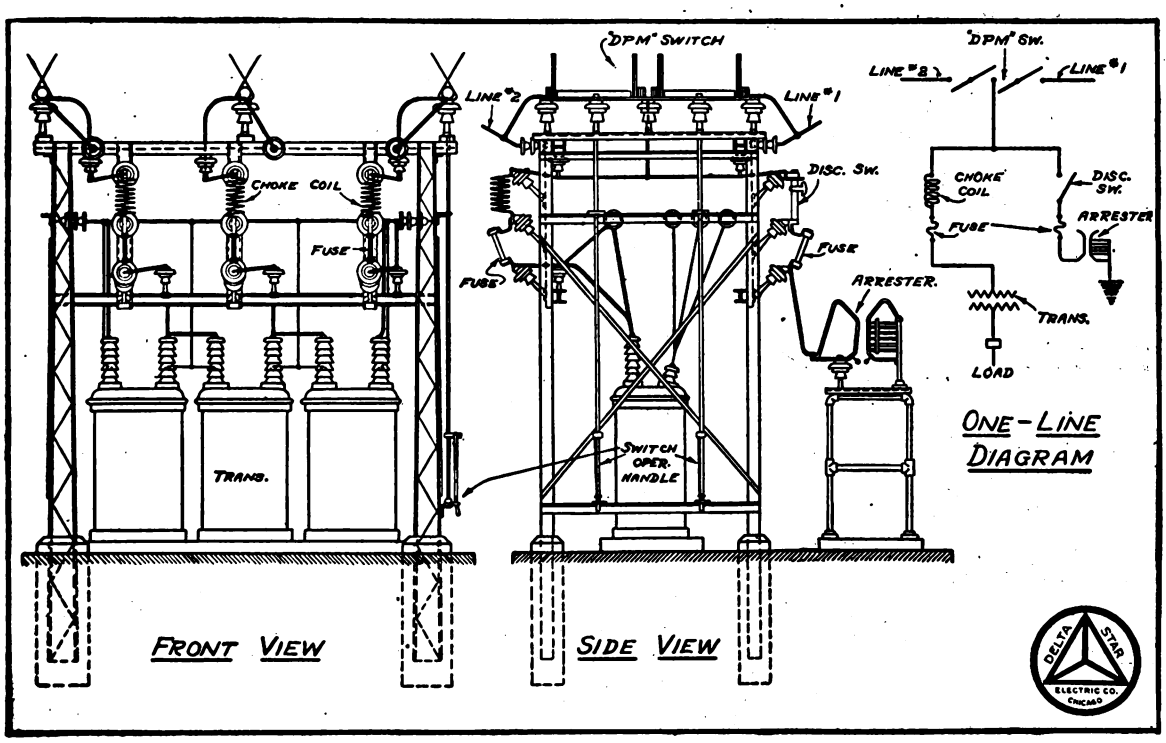
HIGH TENSION EQUIPMENT

You Will Appreciate DELTA-STAR Service



THERE are many users of DELTA-STAR substation equipment who can tell you that DELTA-STAR SERVICE has accomplished a real saving to them—a saving in *first cost* of equipment as well as a *saving* in *cost of upkeep* and alterations due to station growth.

It is a frequent occurrence for a central station or industrial plant to send in a one line diagram showing the supposed requirements for their substation and asking for an estimate on specified equipment. DELTA-STAR engineers have gone over this very carefully and many times have suggested changes which call for less equipment—changes which will give the customer a better substation at less cost than if we had followed the customer's original suggestions.

DELTA-STAR engineers, through years of experience with high tension distribution problems, are competent to advise you as to your requirements. Delta-Star is selling not only Unit Type equipment—*it is also selling permanent substation satisfaction.*

Send us a one line diagram which will outline your requirements. We shall be glad to submit a drawing similar to that shown above —without obligation to you.

Ask for Delta-Star Bulletins.

Delta-Star Electric Company

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Boston, Mass., 76 Pearl St.
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Syracuse, N. Y., City Bank Bldg.

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Pittsburgh, Pa., Union Arcade

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT TYPE INTERCHANGEABLE PARTS

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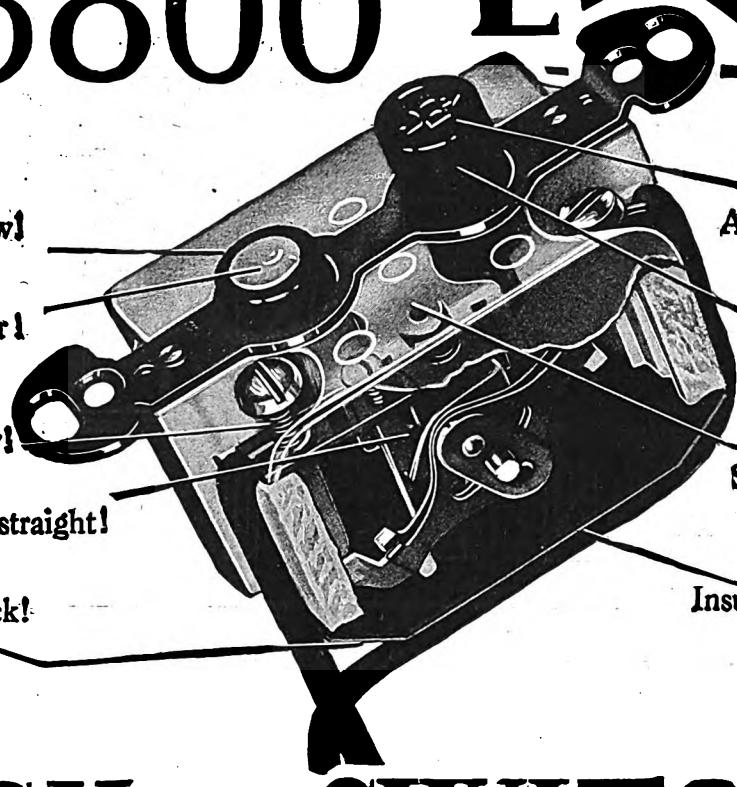
ARROW

6800 LINE



PUSH SWITCHES

Will Last a Lifetime—are Quiet in Operation—have a Smooth Action—give Consistent Satisfaction and Have Everything a Good Switch should have. They sell at a low list but have no superior at any price.

Manufactured by

THE ARROW ELECTRIC CO.

HARTFORD, CONNECTICUT

Chicago New York Boston San Francisco Syracuse

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A Hundred Thousand! Nine Million!! Fourteen Million!!!

One Hundred Thousand Farm Lighting Plants—Nine Million Homes wired but for the most part in need of rewiring and refixturing—Fourteen Million Homes Unwired, to say nothing of new building and the opportunities in industrial work of every kind!

There will be a big demand for electrical supplies—the Electrical Jobber is ready to meet it.

Careful selection of stocks—warehouses located right next to the greatest activities in development—familiarity with the needs of the territory covered assure you of reliable material, large assortments, quick deliveries.

Concentrate on the Jobber for the supplies you will need to hold up your end of the Big Business that is coming your way.

Electrical Supply Jobbers Association

Office of the Secretary:

411 South Clinton Street, CHICAGO

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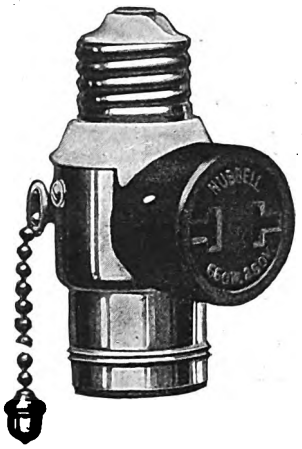
Easily the best!

HUBBELL



No. 3190
For temporary or permanent use in any socket

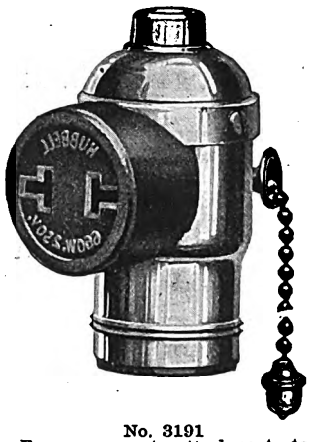
Nos. 3190 and 3191

PULL SOCKET CURRENT TAPS

Combine Pull Socket convenience with Current Tap service. No. 3190 screws into any standard socket—No. 3191 for permanent attachment to the fixture.

Independent control of the lamp while drawing current from side outlet to operate Fan, Vacuum Cleaner or other electrical appliance. Lamp hangs always in correct vertical position and threaded shell takes any standard shadeholder.

Dealers: Here are devices worthy in every way to bear the Hubbell name and trade-mark. They offer great possibilities for counter trade, and while without doubt the best Current Taps for your customers to use, they are by the same token—the best for you to sell. Your Jobber can supply you. Write us for literature.



No. 3191
For permanent attachment to the fixture

HARVEY HUBBELL, Inc.

Bridgeport, Connecticut

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San Francisco
Atlanta
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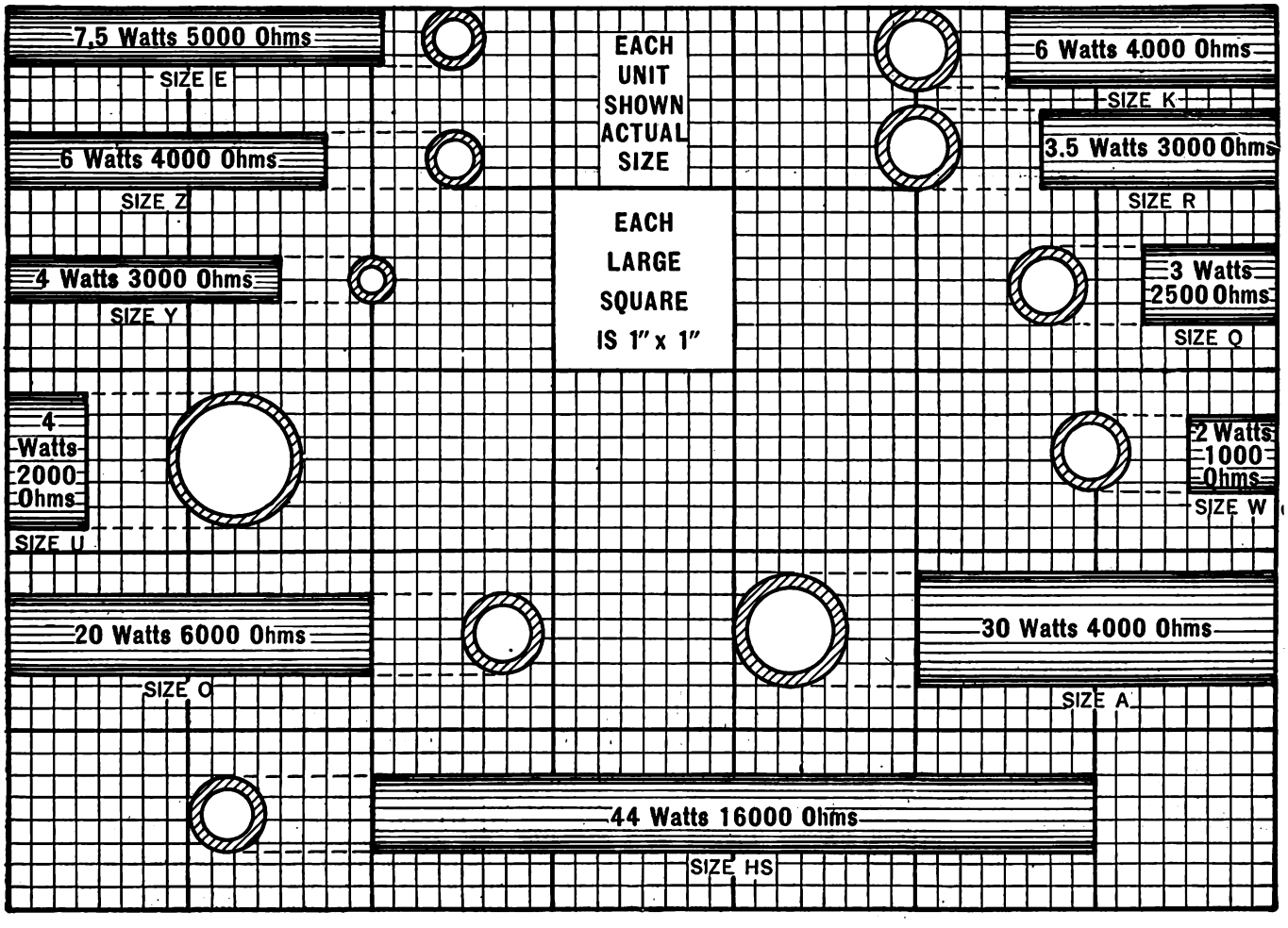
A Few "Vitrohm" Resistor Units

Do you want one—FREE?



If none of these units meet your requirements, tell us your problem—the experience of our engineering staff is at your disposal.

Ward Leonard Electric Company

Mount Vernon, New York

Westburg Engineering Co.—Chicago
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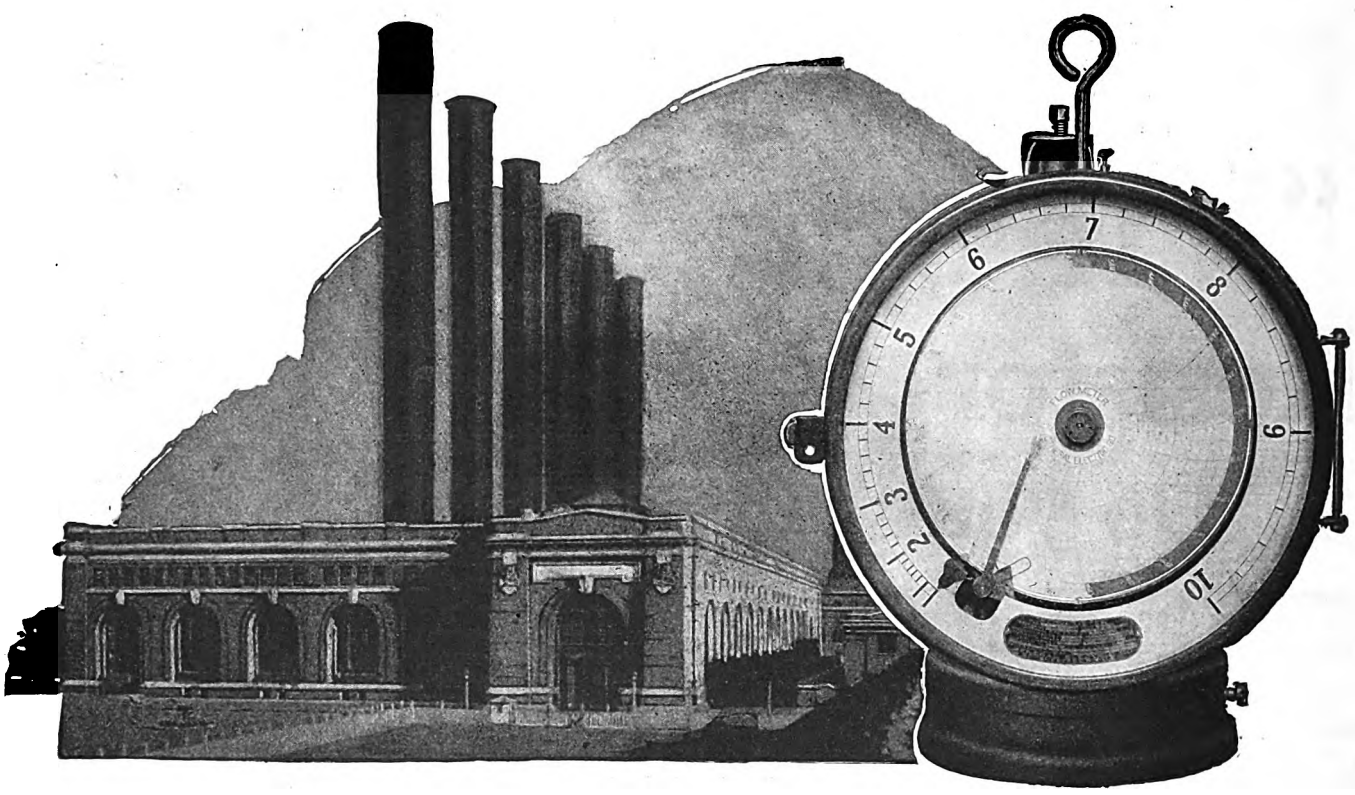

Do you know exactly what your coal pile is doing for you?

This country no longer tolerates guesswork in power plants. The successful superintendent of an efficient plant does not guess — he knows. That's why the plant is efficient and the superintendent successful. He knows how much coal is burned, how much water is evaporated, how each boiler unit is steaming and how much steam is taken by the different departments and processes.

Much of this data must be based on the measurement of feed water and steam and in obtaining this information no meters are more accurate and continually reliable than

G-E Flow Meters

There are several types of G-E Flow Meters. Our Flow Meter Specialists will assist you in determining the best Flow Meter Equipment for your plant.

Write for the Booklet "A Guide to Boiler Economy" and Bulletin 46501-*B.*

General Electric Company

General Office Schenectady, N.Y.

34C-9

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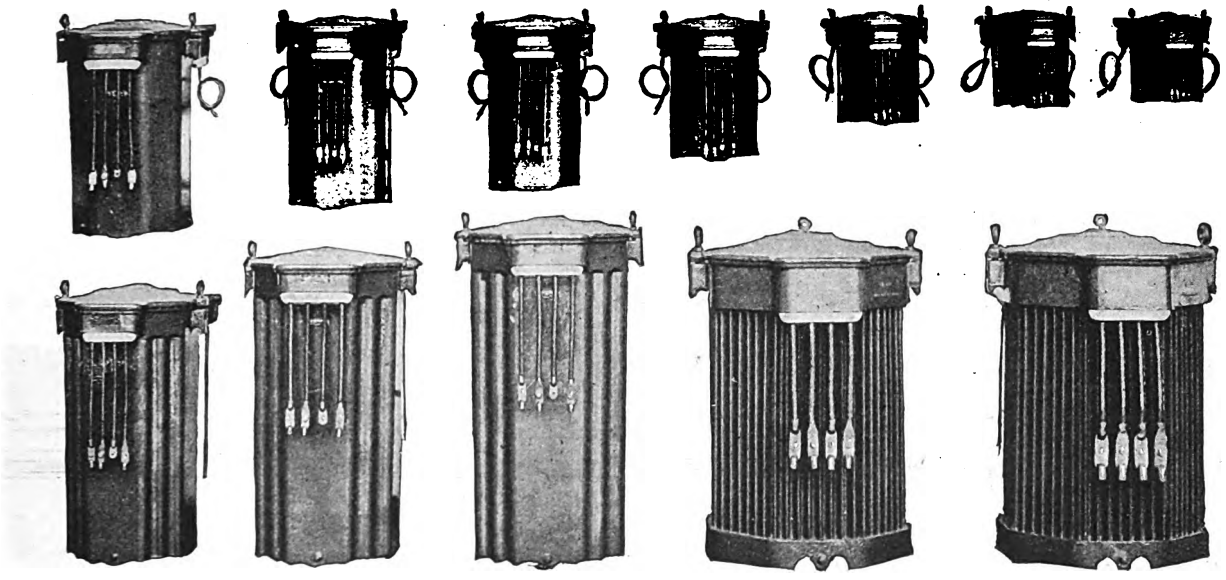
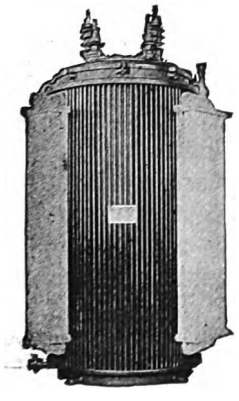
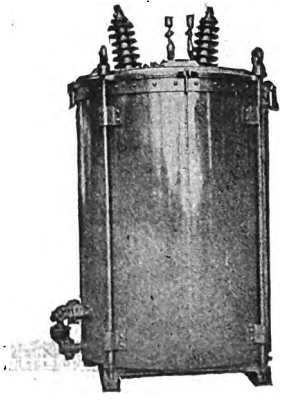


Transformers of Standardized Ratings Save in Many Ways



The use of standard transformers means economy, better service and conservation of man-power. G-E transformers are available in all of the standard ratings recommended by the National Electric Light Association.

Our nearest office will be glad to co-operate with you in the application of these standard transformers to your system.



TYPE H—THE STANDARD OF QUALITY

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General Office Schenectady, N.Y.

33A-5

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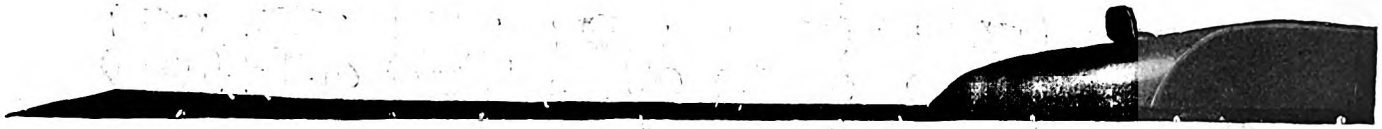
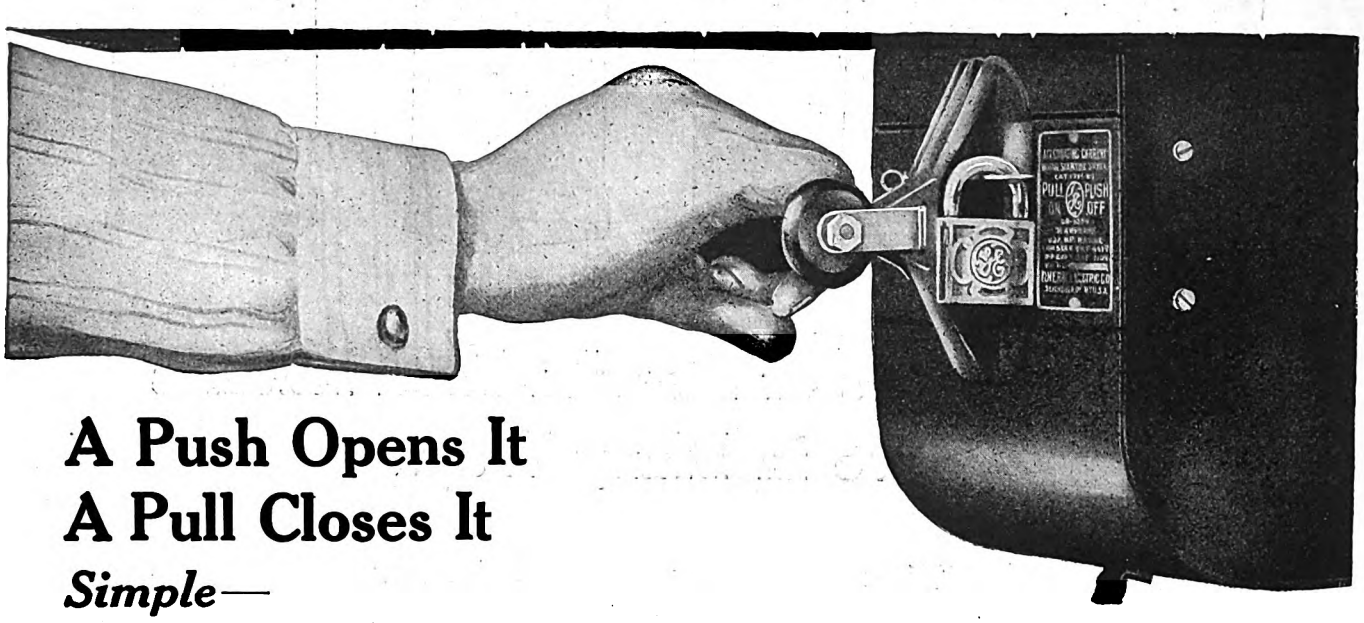
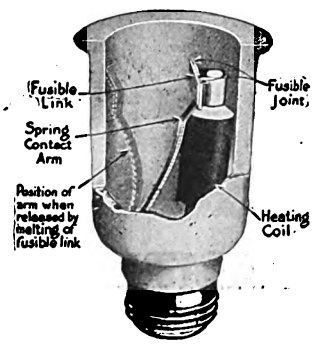


There are many inexpensive "Safety" Starting Switches, but there's just one that also provides Time Limit Overload Protection—the CR 1038.



A Push Opens It
A Pull Closes It

Simple—
Safe—
Sure—



Simple starting and economical protection for small A-C motors up to 5 hp. are combined in the CR 1038 Motor Starting Switch.

The momentary high-starting current or overloads for short periods will not injure the motor, but will blow any ordinary fuse of a size that would safeguard the motor against prolonged overload.

The time lag feature of the protective plugs furnished with CR 1038 switches assures, not only protection, but continuity of service in spite of brief overloads.

The safety features of the CR 1038 are also unique—an accidental push opens the switch—cover cannot open if switch is closed—switch may be locked open when not in use.

The fusible link is the only supply part needed.

The link costs about as much as a postage stamp.

Approved by Underwriters—thousands in use—more thousands on the way.

Can be purchased from G-E Agents.

General Electric Company

General Office Schenectady, N.Y.

43A-36

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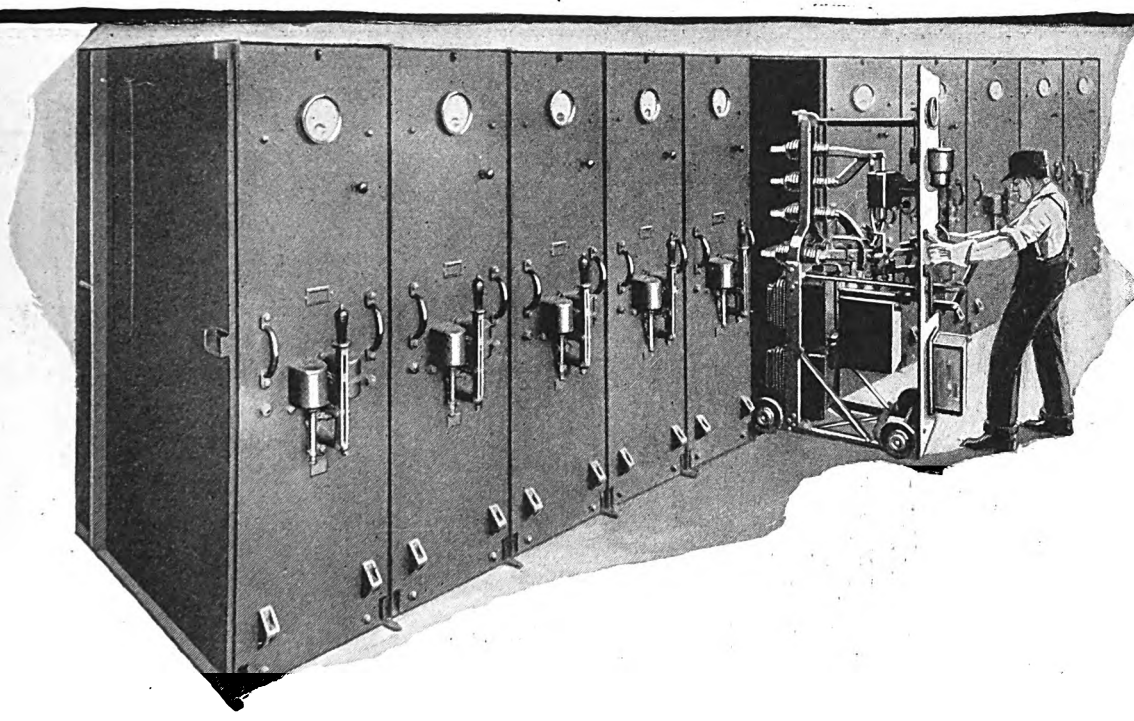
A switchboard that will prevent little troubles becoming great losses is worth building and standardizing



How much is uninterrupted operation worth to you?

The profit of many operations and processes depends on their being continuous. Interruptions dislocate schedules, disorganize departmental operations and start other difficulties.

To prevent interruptions, originating at the switchboard, the remedy is to use G-E Truck Switchboard Units. They reduce the probability of interruptions to the minimum. If an interruption does occur, substitution of a spare truck of the proper capacity makes it possible to maintain service which, in most cases, can be regarded as practically continuous.

These movable trucks, as illustrated, carry all the instruments, switching and protective devices. By mounting this equipment on a truck, which can be withdrawn only when this apparatus is dead, electrically, inspection is easy and safe. Complete enclosure of all live current-carrying parts within the steel compartment affords personal safety at all times and reduces fire risk.

Consult the G-E Switchboard Specialist in your vicinity. Write our nearest office.

54-19

G-E Truck Type Switchboard Units

General Electric Company

General Office Schenectady, N.Y.

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The same far-reaching publicity that has popularized MAZDA Lamps is being consistently applied to G-E Motors

Advertising That Moves Your Stock

The two-color illustration above will compel attention to the G-E Motor advertising in the Saturday Evening Post of June 28th and Good Housekeeping for July.

It is a *washing machine* advertisement. It will move *all* washing machines —particularly G-E motored washing machines.

All G-E advertising is designed to move *all* your stock, to keep it moving, to quicken your turn-over.

This advertising assistance—together with quick-action dealer helps and tie-in window displays—makes happy business men of dealers who sell products "equipped with General Electric motors."

★ G-E motors 55 B-18

—from the Tiniest to the Mightiest

GENERAL ELECTRIC COMPANY

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The New Milk-white tipless MAZDA C-4 Lamp

ANOTHER epoch-making attainment for MAZDA Service! This milk-white *tipless* gas-filled Mazda C-4 lamp is the culmination of years of endeavor to produce mellow, glareless, efficient, white light and to remove the tip. One size only—50 watt,110 to 125 volts.

The outstanding characteristics of this lamp make it *the* lamp for nearly all but industrial lighting. Without change of equipment, Mazda C-4 lamps may be substituted for standard, clear Mazda B lamps of 40, 50, or 60 watts.

The efficiency of the Mazda C-4 lamp is somewhat higher than that of the 50-watt clear Mazda B lamp.

Orders for Edison Mazda C-4 lamps will be acceptable after July 1, 1919.

EDISON MAZDA

53-47

EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY

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Incorporated 1901. Established and maintained by the National Board of Fire Underwriters. For service—not profit.
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8 Merrimack Street, Lowell, Mass.

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Get YOUR wants into the SEARCHLIGHT 0084

Superheaters for Stationary Plants.
The Elesco Superheater will increase your plant economy because it is produced for your own plant.
Write for Bulletin DT-1. It contains valuable data.
LOCOMOTIVE SUPERHEATER CO.
30 Church St., New York City

PORCELAIN INSULATORS
THAT STAND ALL TESTS
THE PREMIER OF SUSPENSION UNITS
DIELECTRIC STRENGTH HIGH WITH LOW WORKING STRESS
JEFFERY-DEWITT INSULATOR CO. HUNTINGTON, W. VA.
ARE NOT AFFECTED BY CHANGES OF TEMPERATURE
SEND FOR CATALOGUE

PRESTIGE will be added to your name by its appearance here each issue.
The cost is nominal—well worth it.
Write for particulars

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GREGORY ELECTRIC CO.

CHICAGO, ILLINOIS

America's Headquarters for Second-Hand Electrical Machinery

If all people knew how thoroughly we overhaul the machines we sell, and how practically "equal to new" they are, the only time they would order a new machine would be when we do not have the machine desired in stock. Send for our "Monthly Bargain Sheet" showing complete stock on hand (revised monthly), with the lowest net prices.

3-PHASE, 60-CYCLE GENERATORS

KW.		Speed
1 25	Gen. Electric, 240 v.	1800
1 50	Allis-Chalmers, 240 or 480 v.	1200
1 75	Westinghouse, 240 or 480 v.	1200
1 75	Gen. Elec. ATB rev. field, 2300 volt	900
1 90	Electric Machinery revolving field, 2300 volt	1200
1 100	Western Elec revolving field, 2300 volt	600
1 125	Allis-Chalmers, 240 or 480 v.	900
1 125	Electric Machinery Co. revolv. field, 440 volt	720
1 150	Westinghouse, revolving field, 1100 or 220 volt	900
1 150	Westinghouse, rev. field, 2500 volt, direct connected to Harrisburg-Fleming Horiz. self-oil side-crank engine	257

220-VOLT D. C. GENERATORS

KW.		Speed
1 2	Sprague-Lundell	1250
1 15	Garwood (C. & C.), MP, comp, 125-250 v., 3-wire, double commutator, D. C. DeLaval single stage non-condensing turbine	2000
1 15	Peerless, MP	1200
1 20	Sprague, direct-connected to DeLaval single-stage steam turbine, for 150 lb. steam pressure	2000
1 25	Northern	1050
1 25	Fairbanks-Morse	725
1 35	Allis-Chalmers	725
1 35	Western Elec., to Chuse engine	209
1 40	Sprague, 125-250 v., 3-wire	1050
1 50	C. & C.	640
1 55	Ft. Wayne, 125-250 v., 3-wire	950
1 56¼	Northern, type L	500
2 62½	Allis-Chalmers	450
1 75	Morgan-Gardner	725
1 100	Allis-Chalmers	850
1 100	Westinghouse	650
1 110	Crocker-Wheeler	720
2 125	Allis-Chalmers	850
2 150	Ft. Wayne, interpole	650
1 150	Morgan-Gardner	550
1 225	Crocker-Wheeler, 6-pole	450
1 225	Northern, 8-pole	360

125-VOLT D. C. GENERATORS

KW.		Speed
1 3	Triumph, Sturtevant vertical steam engine	400
1 3¾	Westinghouse	1600
1 4	Crocker-Wheeler	1500
1 6½	Fairbanks-Morse	1700
1 7½	Fairbanks-Morse	1650
1 8½	Roth	1500
1 9	Northern	1300
1 9	Fairbanks-Morse	1100
1 10	Westinghouse	1600
1 12½	Westinghouse, type SK interpole, with fly wheel pulley for gas engine operation	1350
1 12½	Northern, interpole	1300
1 12½	Triumph	1100
1 15	Hobart	1450
1 15	National	1150
1 17½	National	1350
1 17½	Triumph	850
1 21½	Milwaukee	725
1 25	Northern	1000
1 25	Gen. Elec.	825
1 40	Gen. Elec., direct-connected Ideal, horizontal engine	300
1 50	Crocker-Wheeler	450
1 50	Gen. Elec., direct-connected to Erie-Ball horizontal engine	280
1 65	Crocker-Wheeler	625
1 100	National, 6-pole, type MB, 4000 light	615
1 100	Westinghouse, MP, 4000 light, direct-connected to 11x18x13 in. Harrisburg tandem-compound engine	275

110-125-VOLT MOTORS

H.P.		Speed
1 2	Gen. Elec.	1650
1 2	Western Elec.	1225
1 2	Akron	1100
2 2	Roth	1100
1 2	Sprague-Lundell, series full load speed.	1025
2 2½	Watson	980
1 2½	Sterling	750
4 2½	Van Dorn & Dutton portable electric drills, taking Morse taper-shank drills up to 2 in.	300
1 3	Fairbanks-Morse	1650
1 3	Western Elec.	1150
1 3	Roth	1150
1 3	Northern	1125
4 3	Gen. Elec.	1100
1 3	Watson	1050
1 3½	Lincoln	1350
1 3½	Sprague-Lundell, 6-pole, comp., printing-press motor, with C-H Bull, 4140 Carpenter type comp. reversible printing-press controller, for both armature and field control	168
1 4½	Crocker-Wheeler, variable speed	580-1160
1 5	Western Elec.	1675
1 5	Northern	1650
2 5	Gen. Elec., interpole	1650
1 5	Roth	1100
1 5	Gen. Elec.	1000
1 5	Ft. Wayne	975
1 5	Westinghouse	975
2 5	Western Elec. comp., totally encl. hoist-motors, new, with Ward-Leonard reversible panel-type controllers	900
2 5	Westinghouse	820
1 5½	Gen. Elec.	1750
2 6	Western Elec.	1000
1 6	General Elec., variable speed	460-2600
1 7	Sprague	235
1 7½	Roth	1550
1 7½	Allis-Chalmers	1440
1 7½	Gen. Elec.	1400
2 7½	Fairbanks-Morse	1325
1 7½	M. & O.	1250
1 7½	Barriett	1000
1 7½	Western Elec.	540
1 7½	Triumph, MP	260
1 10	Roth	1300
1 10	Fairbanks-Morse	1300
1 10	Gen. Elec., interpole	1150
1 10	Watson	1050
1 10	Fairbanks-Morse, interpole	900
2 10	Ideal, MP, comp., elevator motors	900
1 10	Western Elec.	575
1 12	Western Elec.	950
1 12	Sprague-Lundell	850
1 13	Jenney	1050
1 15	Allis-Chalmers	1390
1 20	Westinghouse	1700
1 20	Triumph	675
1 30	Gen. Elec.	675
1 75	Crocker-Wheeler	550

220-250-VOLT MOTORS

H.P.		Speed
1 1/3	Westinghouse	1725
1 3/8	U. S. Elec. Tool Co. portable electric drill, taking taper-shank drills up to ⅞ in.	200
1 1/2	Western Elec.	1725
1 1/2	Westinghouse, full load speed	700
1 3/4	Westinghouse	1500
1 1	Roth	2100
1 1	Crocker-Wheeler	1600
8 1	Western Elec.	1300
1 1	Western Elec., "Yankee" twist-drill grinder	1300
2 1	Gen. Elec.	1275
1 1	Northern	1250
1 1	Watson	1200
5 1	Western Elec.	1150
1 1	Jenney, MP, double-reduction, back-geared	1700-40
1 1½	Westinghouse, type SK, comp, interpole	900
1 2	Gen. Elec., comp., interpole	1700
1 2	Fairbanks-Morse	1650
1 2	Gen. Elec., comp., back-geared	1100-275

220-VOLT MOTORS

H.P.		Speed
1 2½	Ft. Wayne	1400
2 2½	Thompson-Ryan, interpole	1225
1 2½	Milwaukee	1025
1 2½	Gen. Elec., type CE, variable speed	1050-2100
1 2½	Crocker-Wheeler	875
3 2½	Allis-Chalmers, variable speed	490-650
1 3	Western Elec.	1950
1 3	Allis-Chalmers	1875
1 3	Westinghouse	1800
1 3	Gen. Elec.	1650
2 3	Gen. Elec.	1650
1 3	Watson	1650
1 3	Holtzer-Cabot	1600
2 3	Bartz-Wygand & Brown	1525
3 3	Westinghouse	1500
1 3	Crocker-Wheeler	1437
2 3	Fairbanks-Morse	1350
1 3	Watson, MP	1200
1 3	Gen. Elec.	1050
1 3	Thompson-Ryan, interpole	730
1 3½	Gen. Elec.	750
1 3½	Westinghouse, type SK, comp., interpole, variable speed	375-1500
1 5	Crocker-Wheeler	1850
1 5	Jenney	1750
1 5	Fairbanks-Morse	1700
1 5	Peerless	1425
1 5	Gen. Elec.	1100
1 5	Westinghouse,	975
1 5	Gibbs	935
2 5	Crocker-Wheeler	900
1 5¼	Westinghouse	1500
1 6	Bartz-Wygand & Brown	1475
1 6	Willey	1275
1 6	Fairbanks-Morse	1100
1 6	Browning	600
1 7	Westinghouse	950
1 7½	Westinghouse	1800
1 7½	Colonial	1575
1 7½	Watson	1350
1 7½	Browning	875
2 7½	Crocker-Wheeler	875
1 7½	Sprague-Lundell, comp., printing-press motor	140
1 10	Robbins & Myers	2100
1 10	Allis-Chalmers	900
1 10	Cincinnati	900
2 10	Holtzer-Cabot	900
1 10	Fisher	850
3 10	Fairbanks-Morse	750
1 10	Crocker-Wheeler, variable speed	720-1200
1 10	Gen. Elec.	650
1 12	Western Elec.	1200
1 15	Ft. Wayne	1250
1 15	Peerless	975
1 15	Gen. Elec., interpole	925
1 15	Western Elec.	880
1 15	Jenney	850
1 15	National	725
1 15	Gen. Elec.	690
1 15	Triumph	520
1 15	Northern	400
3 17	Crocker-Wheeler, variable speed	700-1400
1 20	Jenney	1000
1 20	Jantz & Leist	900
1 20	Crocker-Wheeler	700
1 20	Northern	675
1 20	Western Elec.	675
1 20	Lincoln	540
1 25	Crocker-Wheeler	750
1 25	Allis-Chalmers	750
1 25	Gen. Elec.	550
2 25	Westinghouse, railway type, series, crane or hoisting	500
1 25	Westinghouse	400
1 30	Northern	900
1 30	Fairbanks-Morse	650
1 30	Westinghouse	600
1 30	Westinghouse, type SK, comp., interpole	600
1 30	Westinghouse	575
1 35	Westinghouse, railway type, series, crane or hoisting motor	550
1 40	Northern	550
1 40	Westinghouse	500
1 45	Allis-Chalmers	650
1 50	Westinghouse	550
6 50	Westinghouse	525
1 65	C & C	525
1 75	Western Elec.	500
1 75	Northern	450
1 75	Northern	400
4 75	Allis-Chalmers	325
1 100	Morgan-Gardner	650
3 150	Allis-Chalmers	650

220-VOLT MOTORS (Continued)

H.P.		Speed
1 200	Ft. Wayne, G, 6-pole, comp., interpole	500
1 200	Ft. Wayne, comp. interpole	500

500-VOLT

H.P.		Speed
1 1/4	Roth, totally enclosed, shunt	1250
1 1/2	Westinghouse, type R, shunt	1375
1 1	Gen. Elec., type CQ	1400
1 1	Gen. Elec., type CA	1300
1 1	Fairbanks-Morse, MP	1300
1 1½	Commercial	1700
1 1½	Fairbanks-Morse, MP	1700
1 2	Commercial	1100
1 3	Crocker-Wheeler, form L	1900
1 3	Jenney, MP	1725
1 5	Ft. Wayne, type MP	1500
1 6	Western Elec., old style bipolar, type GI	1100
1 7½	Gen. Elec., type CE	1650
1 15	Ft. Wayne, MP, type EL	1450
1 15	Northern, MP, vertical, on tripod	460
1 15	Northern, MP, type B	460
1 20	Jenney, MP, comp.	1250

LOW VOLTAGE GENERATORS

Capacity		Speed
1	11½ ampere Roth, 65 volt, shunt	2400
1 25	ampere Western Elec., 30 volt, shunt	1750
2 25	ampere Western Elec., 42 volt, shunt	1750
2 30	amp. Northern, shunt, 35 volt	2000
1 40	ampere Colonial, MP, shunt, 30 v.	1500
1 50	ampere Sterling, MP, shunt, 60 v.	1500
1 58.3	amp. Fairbanks - Morse (3½ KW), type CP, comp., interpole, 60 v.	1850
1 60	ampere Browning, MP, shunt, 25 volt (or 30 amperes, 50 volts), double commutator generator	2000
1 65	ampere Western Elec., shunt, 8½ volt.	1750
1 100	amp. Western Elec., 30 volt, MP, shunt.	1200
1 170	amp. Allis-Chalmers, 30 volt, shunt, d. c. generator direct-connected to 7½ H. P., 220 v., MP, d. c. motor, with starter (dynamotor)	1200
1 180	amp. Phoenix, MP, comp., 6 v., type P, form A	1500

LOW VOLTAGE MOTORS

H.P.		Speed
3 1/8	Western Elec., comp., 32 volt	1725
1 1/6	Western Elec., comp., 32 volt	1725
7 1/4	Western Elec., 32 volt.	1725
1 1/4	Western Elec., comp., 32 volt, new	1140

MISCELLANEOUS

2 150	KW. Gen. Elec., rotary converters, 3-phase, 25 cycle, 372 v. a. c. to 600 v. 250 amp. d. c.; each with 3-60 KW. type H 25 cycle 6600-375 v. oil-cooled indoor type transformers; also both a. c. and d. c. control panels with instruments	750
1 150	KW. Morgan-Gardner, 6-pole, 220 v., compound, d. c. generator, direct coupled by insulated flexible coupling on wooden sub-base to 250 H. P. Westinghouse, type CX, 220 or 440 volt, 3-phase, 60 cycle induction motor, with rheostat for generator and oil starting compensator for motor	580

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MACHINERY IN STOCK FOR IMMEDIATE SHIPMENT

250 Volt Direct Current, Direct Connected Units

1—150-kw. Thompson Ryan compound wound Generator, 200-r.p.m., direct connected to 15 and 25 x 18 horizontal tandem compound McEwen automatic engine
1—125-kw. Westinghouse, 8-pole, compound wound Generator, 280-r.p.m., direct connected to 14 and 24 x 14 Westinghouse compound engine
2—60-kw. Crocker-Wheeler, 275-r.p.m. Generators direct connected to 13x12 Buffalo Forge Engine.
1—37½-kw. Westinghouse, 320-r.p.m., compound wound Generator, direct connected to 10 and 18 x 10 Westinghouse engine

125 Volt Direct Current, Direct Connected Units

1—62½-kw. Westinghouse, 329-r.p.m. Generator direct connected to 10 and 18 x 10 Westinghouse engine
1—60-kw. G. E. 118/120-v., 6-pole, compound wound Generator, 280-r.p.m., direct connected to 12½ x 14 Watertown horizontal right-hand engine
1—50-kw. Western Electric, 125-v., 6-pole, compound Generator, direct connected to 10 x 11 Russell engine
1—35-kw. Westinghouse, 310-r.p.m. Generator direct connected to 11 x 10 Ames engine
1—30-kw. Sturtevant, 125-v., 6-pole Generator 325-r.p.m., direct connected to 9 x 9 Sturtevant engine
1—30-kw. Westinghouse, 110-v., 6-pole Generator, 325-r.p.m., direct connected to 10 x 12 Harrisburg horizontal engine
1—30-kw. Western Electric, 115/125-v., 6-pole, compound wound Generator, Erie Ball center crank engine

250 Volt Generators

1—300-kw. Sprague Lundell, 470-r.p.m 3 bearing
3—250-kw. Westinghouse, 450-r.p.m. 3 bearing
1—150-kw. Westinghouse, 550-r.p.m.
1—150-kw. National, 575-r.p.m.

Gas or Gasoline Unit

1—5-kw., G. E. 3-wire, 125/250-v. Generator, 750-r.p.m., direct connected to G. E., 4-cylinder gas engine, all complete
1—5-kw. General Electric, 125-v., 750-r.p.m. Generator, direct connected to 4-cylinder gas engine

125 Volt D. C. Generators

2—150-kw. Westinghouse, 475-r.p.m.
1—100-kw. General Electric, type MP, 650-r.p.m.
1—50-kw. General Electric, CL, 600-r.p.m.
1—45-kw. C. & C., type SL, 920-r.p.m.
1—45-kw. General Electric, MP, 975-r.p.m.
1—40-kw. Wood, 1000-r.p.m.
1—25-kw. Crocker-Wheeler, 875-r.p.m.
1—25-kw. General Electric, 1100-r.p.m.
1—22-kw. Lincoln, 775-r.p.m.
1—18½-kw. American Engine Co., 1050-r.p.m.
1—18-kw. Bullock, 1400-r.p.m.
1—15-kw. Western Electric, 1010-r.p.m.

125 Volt D. C. Motors

1—90-hp. General Electric, 500-r.p.m.
1—60-hp. Holtzer Cabot, 615-r.p.m.
1—50-hp. Sprague, 540-r.p.m.
1—30-hp. Fisher, 600-r.p.m.
1—25-hp. General Electric, 580-r.p.m.
1—25-hp. Peerless, 710-r.p.m.
1—25-hp. Crocker-Wheeler, 1025-r.p.m.
1—25-hp. General Electric, 650-r.p.m.
1—20-hp. Western Electric, 900-r.p.m.
1—20-hp. General Electric, 1600-r.p.m.
2—20-hp. General Electric, 925-r.p.m.
4—20-hp. General Electric, 1040-r.p.m.
1—15-hp. General Electric, 1000-r.p.m.
2—15-hp. General Electric, 690-r.p.m.
1—10-hp. General Electric, 115-v., 1250-r.p.m.
1—10-hp. General Electric, 115-v., 1100-r.p.m.
1—10-hp. Crocker-Wheeler, 115-v., 1000r.p.m.
1—10-hp. General Electric, 115-v., 650-r.p.m.

Also stock of Motors in smaller sizes.

550 Volt Turbo Unit

1—15-kw. Diehl, 2500-r.p.m. Generator and 27-hp. 500 v. Terry Turbine, 75-lb. steam pressure

250 Volt D. C. Motors

2—20-hp. Northern, 950-r.p.m.

500 Volt Motors

1—200-hp. Westinghouse, 500-r.p.m.
1—50-hp. General Electric, 900-r.p.m.
1—40-hp. Westinghouse, 660-r.p.m.
1—15-hp. General Electric, 1200-r.p.m.

Rotary Converters

1—500-kw. Westinghouse Rotary Converter 6 phase, 600-v. D.C. 430-v. A.C., 600-r.p.m.
1—300-kw. Westinghouse, 3-ph., 60-cy., 370-v. A.C., 575-v., D.C., 600-r.p.m.
1—150-kw. Westinghouse, 2- or 3-ph., 60-cy., 185-v. A.C., 250-v., D.C., 720-r.p.m., with direct connected starting motor on end of shaft

NOTE—Above rotaries can be furnished with transformers suitable for any high voltage

Pumps

1—14-in. Worthington Volute type Centrifugal Pump, direct connected to 11 x 12 Blake vertical engine
2—8-in. Worthington Volute Centrifugal Vertical Pumps, 10-in. suction, 8-in. discharge, direct connected to and operated by two 15-hp. Westinghouse, 3-ph., 60-cy., 220-v., 485-r.p.m. vertical motors

Condensers

2—2000-sq.ft. Wheeler Surface Condensers
1— 9 x 12 x 10-in. Worthington Jet
1—12 x 16 x 18-in Blake Jet Condenser

Engines

1—14 x 20 in. Russell, 200-r.p.m.
1—13 x 12-in. Armington & Sims, 250-r.p.m.

Boilers

4—400 hp. Lyons Boilers, 150-lb. pressure
2—300-hp. Heine Boilers, 175-lb. pressure
12—264-hp. B. & W. and A. & T. Water Tube Boilers

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A. C. UNITS

7500-kva. Westinghouse-Parsons, $80,000
2—1250-kw. Westinghouse-Parsons, 2300-volt, $17,000.
2—1250-kw. Westinghouse Parsons, 11,000-volt, $17,000.
750-kw. G. E., with Erie City Lentz cr. compound Engine, $13,000.
600-kw. G. E., with Rice-Sargent Engine, $10,000.
450-kw. G. E., with Allis Corliss C.C. Engine, $8500
400-kva. Westinghouse with Erie Ball, 4 valve engine, $12,000.
240-kva. Westinghouse, with Harrisburg Engine, $47,500.
130-kw. Wghse., with Russell, 4-valve engine, $3000
125-kw. G. E., with Harrisburg, 4-valve engine, $3750.
100-kva. Fairbanks, with Lycoming engine, $2350.
100-kva. Westinghouse, with Ames Engine, $2500
2—100-kva. Wghse., with Ballwood tandem engine, $1750.
50-kva. Westinghouse, with Erie Ball Engine, $1500.

BELTED A. C. ALTERNATORS

Kw.	Generator	Speed	Price
200	G. E.	900	$1500
200	Allis-Chalmers	900	1400
150	Elec. Mchy.	720	1000
120	Westinghouse	900	900
115	Allis-Chalmers	900	900
100	W. E.	600	800
20	Wagner	1200	400

ENGINES

Cylinder	Make	Type	Price
15 x 14	Ideal	Auto	$350
14 x 24	Murray	Throttling	200
13½ x 15	Taylor	Auto	200
10 x 12	Ames	Auto	175

GAS AND OIL ENGINES

Hp.	Make	Gas or Oil	Price
125	Wghse.	Gas or gasoline	$1200
20	Nash	Gas	350
18	Metz & Weiss	Oil	400
7	Priestman	Oil	100
5	Fairbanks	Gas	75

60-CY. A. C. MOTORS

Hp.	Make	Phase	Volt	Speed	Price
20	G. E.	3	550	1200	275
3—5	Wghse.	3	550	1700	80
5	Richmond	2	220	1200	85
3	Wghse.	2	220	1700	65

250-VOLT D. C. UNITS

Kw.	Generator	Engine	Price
500	C. W.	Tandem	$6500
350	G. E.	Rice & Sar	6500
130	W. E.	Buckeye	2750
2—150	G. E.	Ball	3000
150	Wghse.	Wghse. gas	6000
100	G. E.	Ridgway	3000
100	Ridgway	Ridgway	3000
75	Ridgway	Ridgway	2000
75	G. E.	Harrisburg	2000
75	G. E., 3-wire	Skinner	2500
62½	G. E., 3-wire	Skinner	2000
62½	G. E.	Ames	1650
50	Allis-Chalmers	Chand. Tay.	1250
50	C. W.	Frost	1000
40	Ridgway	Ridgway	1100
35	Northern	Ide	1200
30	Sprague	Harrisburg	1000
30	W. E.	Union I. W.	650
25	G. E.	Ames	850

125-VOLT D. C. UNITS

Kw.	Generator	Engine	Price
150	Wghse.	Ball Wood	$5500
100	Ridgway	Ridgway	$2000
75	G. E.	Harrisburg	1750
75	Ridgway	Ridgway	1750
75	G. E.	Bruce McB. gas	2500
65	Garwood	Harrisburg	1200
50	C. W.	Ames	1000
35	G. E.	G. E. Marine	1500
20	Northern	Ideal	750
15	Cr.	A. & S.	450
15	Sprague	Ames	550

250-VOLT BELTED GENERATORS AND MOTORS

Hp.	Make	Speed	Price
300	G. E.	425	$2200
200	G. E.	210	1500
200	James Clark	395	1250
100	Roth	850	750
65	G. E. type C. L. B.	575	575
60	National	875	450
50	Wghse.	825	500
50	Lincoln	775	450
40	Milwaukee	650	350
30	G. E.	1050	325
30	Wghse.	975	325
25	Lincoln	1250	275
25	G. E. Series	800	225
22	Burke	1100	225
15	Wghse.	1150	225
15	Northern	1300	200
13½	Allis-Chalmers	1175	200
10	Wghse.	750	200
10	G. E.	650	225
10	Akron	1000	175
8½	W. E.	1100	140
7½	G. E.	800	150
7½	G. E. series	900	175

125-VOLT BELTED GENERATORS AND MOTORS

Hp.	Make	Speed	Price
100	Northern	600	$750
60	Northern	725	475
50	Triumph	825	350
45	Sprague	750	325
40	Phoenix	625	300
30	G. E.	1025	275
30	Electron	900	225
25	Triumph	1125	200
22½	Bullock	975	250
20	Onondaga	1100	150
20	Three Rivers	725	200
15	Lincoln	875	175
12½	Fairbanks-M.	825	175
10	Diehl	1300	150
8	W. E.	1225	140
8	Wghse.	1525	140
8	C. W.	1375	140
7½	Al. Chal.	1350	125
5	Browning	1380	120
2	Northern	600/800	75
2	Wghse.	1800	50
2	G. E.	500/1500	75
1	R. & M.	1750	40

BOILERS

HP.	Make	Pressure
2-500	B. & W.	200
2-500	Heine	175
4-400	B. & W.	180
4-267	B. & W.	200
6-250	Heine	160

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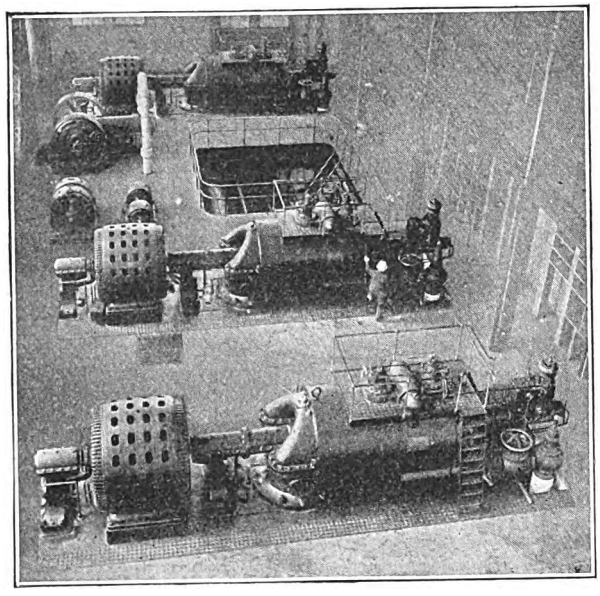


A.C. Turbine Generator Sets

3—2000-kva., 3-phase, 60-cycle, 6600/4000-volt, 1200-r.p.m. Westinghouse-Parsons Horizontal Turbines and Generators, complete with switchboards, exciters and Alberger 8000-sq. ft. surface condenser, with auxiliary pumps. Stirling Boilers are also available. Complete plant equipment can be shipped immediately.

Motor Generator Sets

2—500-kw. Synchronous Motor-Generator Sets, each consisting of:

1—700-kva., Type ATI, G. E. Syn. Motor, 3-phase, 60-cycle, 2300-volt, mounted on a common base and direct connected to

2—250-kw., 3-wire, D.C. Generators, 125-volt each generator, or 250-volt with series connection.

4—Complete Engine Generator Sets, each unit consisting of a

60-kw., 120-volt, direct current Ft. Wayne Wood System Generator, direct connected to a Chandler & Taylor horizontal 13 x 13 slide valve steam engine, operating at 240 r.p.m. on 100 lb. steam pressure.

Included with the above sets are:

4—Generator Panels, with the usual meter equipment and circuit breakers and switches on them. All four units are in first class condition and are available for immediate delivery. These outfits are subject to inspection.

DRILLS

3—Type H D.C. 110 v. Cincinnati Electrical Tool Co., portable heavy duty DRILLS, capacity in steel 1¼ in., taper socket No. 4 speed 120 R.P.M.

MOTORS

3-Ph., 60-Cy., 220-Volt and 440-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	1	G. E.	K.	600/1800	U. Stock
1	2	Howell	S.C.	1800	New Stock
1	3	Howell	S.C.	1800	New Stock
1	3	Triumph	S.C.	1800	Used Stock
1	5	A.C.	AN.	1200	New Stock
2	7½	Howell	S.C.	1200	Used Stock
3	7½	Wh.	C.S.	1800	New Stock
1	7½	Wh.	H.F.	1200	Used Stock
1	15	Wag.	Elev.	1200	Used Stock
1	20	Wh.	C.W.	1200	New Stock
4	20	A.C.	ANY	1200	New Stock
7	20	F.-M.	KBV.	1200	New Stock
1	20	G.E.	M.	600	Used Stock
1	25	Wh.	C.S.	1200	New Stock
2	50	A.C.	AN.	720	New Stock
2	75	A.C.	AN.	900	New Stock
1	75	Wh.	C.-W.	900	New Stock
1	100	Wh.	C.S.	900	New Stock
1	100	Wh.	C.W.	720	New Stock
4	150	Wh.	C.W.	720	New Stock
2	150	Wh.	C.W.	600	New Stock
1	150	Wh.	C.W.	900	New Stock
5	200	Wh.	C.W.	720	New Stock
4	200	Wh.	C.W.	600	New Stock

Our stock includes a large number of Auto-Starters and Resistance Starter, for squirrel cage Motors. Also Drum Type and Face Plate Type for Slip Ring Motors.

3-Ph., 60-Cy., 550-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
6	15	Wh.	C.S.	1800	New Stock
1	75	G. E.	M.	514	Used Stock
1	75	Wh.	C.W.	900	New Stock
1	150	Wh.	H.F.	600	Used Stock
1	150	W. E.	M.	600	New Stock
3	150	Wh.	C.W.	600	New Stock
2	200	Wh.	C.W.	600	New Stock
1	200	W. E. M. 3 Brg.		600	New Stock

3-Ph., 60-Cy., 2200-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	75	A. C.	ANY	720	New Stock
2	75	Wh.	C.W.	900	New Stock
1	75	G. E.	M.	514	Used Stock
1	100	Wh.	C.W.	900	New Stock
1	150	Wh.	H.F.	600	Used Stock
1	150	W. E.	M.	600	New Stock
2	150	Wh.	C.W.	600	New Stock
3	150	Wh.	C.W.	720	New Stock
1	200	W. E. M. 3 Brg.		600	New Stock
2	200	Wh.	C.W.	600	New Stock

3-Ph., 25-Cy., 550-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	30	A.C.	A.N.	750	Used Stock

3-Ph., 25-Cy., 220- and 440-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail
1	1	Westg.	CSA	750	New Stock
1	2	Wh.	C.S.	1500	Used Stock
3	2	A.-C.	A.N.	750	New Stock
1	3½	Burke	C.S.	1500	Used Stock
1	5	W. E.	K.	750	New Stock
3	5	A.-C.	A.N.	750	New Stock
1	7½	A.-C.	A.N.	750	New Stock
1	7½	G. E.	M	750	Used Stock
4	10	A.-C.	A.N.	750	New Stock
1	15	W. E.	K.	750	New Stock
1	15	A.C.	AN	1500	Used Stock
2	20	W. E.	K.	750	New Stock
3	30	W. E.	K.	750	New Stock
3	30	A.-C.	A.N.	750	New Stock
4	40	W. E.	K.T.	750	New Stock
3	40	A.-C.	A.N.	750	New Stock
5	50	W. E.	K.	750	New Stock
4	50	A.-C.	A.N.	750	New Stock
2	75	Wh.	C.S.	750	New Stock
1	75	W.E.	K.	1500	New Stock
1	100	W.E.	K.	1500	New Stock
1	150	A.-C.	ANY	500	New Stock
1	150	W. E.	K.	750	New Stock
2	150	W. E.	M.	750	New Stock
2	150	W. E.	M.	500	New Stock

1—200-hp., 3-phase, 25-cycle, 440-volt, 500-r.p.m., used Westinghouse, Type "C" sq. Cage Motor, complete with pulley, rails and starter.

2-Ph., 60-Cy., 220-Volt Motors

No.	Hp.	Make	Type	R.p.m.	Avail.
1	2	G.E.	K.Q.	1200	Used Stock
1	10	W.	H.F.	1200	Used Stock

Single-Phase, 60-Cy. Motors

No.	Hp.	Make	Type	Volts	R.P.M.	Avail.
1	¼	W.H.	A.R.	110-220	1800	N 7-15
1	½	W.H.	A.R.	110-220	1200	N S-W
1	1	W.H.	A.R.	110-220	1800	N 5-30
1	2	Wag.	B.A.	110-220	1200	U Stk.
1	2	W.H.	A.R.	110-220	1800	N 7-15
1	2	W.H.	A.R.	110-220	1200	N 5-15
1	3	W.H.	A.R.	110 220	1200	N 7-15
1	5	W.H.	A.R.	110-220	1800	N 7 30
1	5	W.H.	A.R.	110-220	1200	N 6-15
1	5	Wag.	B.A.	110-220	900	U Stk.
1	5	Wag	Elev.	220	900	U Stk.
1	7½	Wag.	B.A.	110-220	1200	U S-R

110-Volt D.C. Motors

No.	Hp.	Make	Type	Fld.	R.p.m	Avail.
22	1/16	R & M		Sh	900	U Stk
1	1	Wh.	R	Sh.	1800	U Stk
1	1½	Diehl	G	Sh	1180	U Stk
1	15	R. & M.		Cpd.	1050	U Stk
1	40	Wh.	M	Sh.	950	U Stk
1	60	Wh.	S.A.	Sh.	1000	U Stk

220-Volt, D.C. Motors

	H.P.	Make	Type	Fld.	rpm.	Avail
1	¼	W.H.		Sh.	1140	U St.
1	2	New Eng. E.		Sh.	800	U St.
1	3	Triumph		Sh.	1000	U St.
1	3	W.H.	S.	Sh.	1800	U St.
1	3	W.H.	S.	Sh.	2000	U St
1	7½	G.E. Var. Spd.		Cpd.	450/900	U St.
1	7½	G.E.	C.A.	Sh.	1525	U St.
1	10	W.H.	N	Sh.	1250	U St.
1	20	Ft. Wayne B-1		El. Cpd.	820	U St.
1	25	G.E.	C.L.	Sh.	675	U St.

Belted D.C. Generators

No.	Kw.	Make	Type	Vlt.	Rpm.	Avail.
1	1.8	F.-M.	T.R.	110	2350	U Stock
1	10	Wh. S.	Cpd.	250	1325	U Stock

Chain Drives

Link Belt Silent Chain Drive

1—Flanged Steel Pinion, 4.987-in. diam., 25 teeth, ½-in. pitch, 1⅞-in. bore, ½ x ½-in. K. S. tapered to ½-in.

1—Flanged C. I. Wheel, 11.942-in. diam., 60 tee.th, ½-in. pitch, 1⅞-in. bore, ½ x ½-in K. S., tapered to ½ in., CL to CL of drive, 16 in.

This Chain Drive is complete and has never been used. It is in our stock due to change in the plans of the job for which it was ordered.

D.C. Turbine Generator Sets, 125-Volts

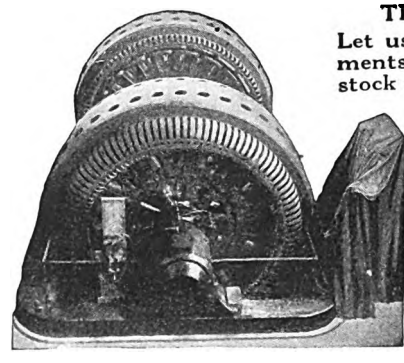
Pinion and Gear

1—Spur Gear 1½ D.P., 2.0944-in. C.P., 6-in. face, 56 teeth, 37-33. in. P.D., 4/-in. bore, 1½-in. x ½-in. keyway, complete with Shaft and Bearing for bolting to pedestal foundation.

1—Pinion 1½ D.P., 2. 944-in. C.P., 6-in. face, 23 teeth. 15.33-in. P.D., 4½-in. bore, 1½-in. x ½-in. keyway. Gear ratio 2.4 to 1. 125 hp. at 514 r.p.m.

TRANSFORMERS

Let us know your requirements as we have a large stock available.



FREQUENCY CHANGER SET

25-60 Cycles 4000 Kva. capacity complete and available for early delivery.

Meeting the Emergency Is Standard Practice

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BARGAINS!—STOCK SHIPMENT

Alternating Current Motors
All New, 3-Phase, 60-Cycle

No.	Hp.	R.p.m	Volts	Type	Make
7	3	1800	220 or 440	AN	Allis Chal.
1	3	1200	220 or 440	AN	Allis-Chal.
11	5	1800	220 or 440	AN	Allis Chal.
10	5	1200	220 or 440	AN	Allis-Chal.
4	7½	1800	220 or 440	AN	Allis-Chal.
3	7½	1200	220 or 440	AN	Allis-Chal.
3	7½	900	220 or 440	AN	Allis-Chal
11	10	1800	220 or 440	AN	Allis-Chal.
13	10	1200	220 or 440	AN	Allis Chal.
3	10	900	220 or 440	AN	Allis-Chal.
1	15	1800	220 or 440	AN	Allis-Chal.
4	15	1200	220 or 440	AN	Allis-Chal.
6	15	900	220 or 440	AN	Allis-Chal.
1	20	1800	220 or 440	AN	Allis-Chal.
4	20	1200	220 or 440	AN	Allis-Chal.
3	20	900	220 or 440	AN	Allis-Chal.
1	25	1800	220 or 440	AN	Allis Chal.
3	25	1200	220 or 440	AN	Allis-Chal.
1	25	900	220 or 440	AN	Allis-Chal.
9	30	1200	220 or 440	AN	Allis-Chal.
6	30	900	220 or 440	AN	Allis-Chal.
3	40	1200	220 or 440	AN	Allis-Chal.
2	50	1200	220 or 440	AN	Allis Chal.
5	40	900	220 or 440	AN	Allis-Chal.
6	50	900	220 or 440	AN	Allis Chal
1	75	1750	220 or 440	CS	Westghse.
1	75	1200	220 or 440	AN	Allis-Chal.
1	75	900	220 or 440	CS	Westghse.
1	75	900	220 or 440	AN	Allis Chal.
2	75	720	220 or 440	AN	Allis-Chal.
6	100	900	220 or 440	AN	Allis-Chal.
1	100	720	2200	AN	Allis-Chal.
3	100	720	220 or 440	AN	Allis-Chal.
1	100	900	2200	AN	Allis Chal.
1	150	900	2200	AN	Allis-Chal.
3	150	900	220 or 440	AN	Allis-Chal.
1	150	720	2200	AN	Allis-Chal.
2	150	720	220 or 440	AN	Allis-Chal.
1	200	720	220 or 440	AN	Allis-Chal

Alternating Current Motors
Slip Ring, 3-Phase, 60-Cycle

No	Hp.	R.p.m.	Volts	Type	Make
3	30	900	220 or 440	ANY	Allis Chal.
2	50	900	220 or 440	ANY	Allis-Chal.
4	75	900	220 or 440	ANY	Allis-Chal.
2	75	720	220 or 440	ANY	Allis-Chal.
3	100	900	220 or 440	ANY	Allis Chal.
2	100	720	220 or 440	ANY	Allis-Chal.
2	150	900	220 or 440	ANY	Allis-Chal.
3	150	720	220 or 440	ANY	Allis-Chal.
1	150	900	2200	ANY	Allis-Chal.
1	150	720	2200	ANY	Allis Chal.
3	200	720	2200	ANY	Allis-Chal.

All of the above Slip Ring Motors, complete with drum controllers

Direct Current Motors
All Rebuilt, 230 to 250 Volts

No	Hp.	R.p.m.	Wdg.	Type	Make
1	¼	975	Sh.		Westghse.
1	1	750	Series	D	Mech. App.
1	1	1100	Sh	CA	G. E.
1	2	1000	Sh	MP	Fidelity
4	2½	700/900	Sh	S	Westghse.
2	3	1100	Sh	MP	Fidelity
2	3	580/1160	sh	SA	Westghse.
2	5	1100	Sh	MP	Fidelity
1	5	1750	Sh	MP	Fidelity
1	5	1100	Sh	SK	Westghse.
1	6	750/1500	Sh	SK	Westghse.
10	7½	500/1500	Sh.	SK	Westghse.
1	7½	850	Sh	SK	Westghse
		With controllers used 3 months			
5	8½	900/1800	Sh.	SK	Westghse.
1	10	1150	Sh	SK	Westghse.
1	10	850	Sh	SK	Westghse.
2	10	900	Sh	MP	Fidelity
3	11½	500/1500	Sh.	SK	Westghse.
1	13	875	Sh	S	Westghse.
1	15	690	Sh	CE	G. E.
1	15	500/1500	Sh	SA	Westghse.
1	15	750	Sh.	MP	Milwaukee
1	17½	585	Sh.	A-14	Gibbs
1	20	900	Sh.	MP	Hobart
1	20	650	Sh.	MP	Milwaukee
1	20	600	Sh.	MP	W. E.
1	20	800	Sh.	MT	Imperial
1	40	575	CP	MP	Milwaukee
1	50	525	Sh.	MP	Northern
1	50	625	Sh.	A-40	Milwaukee
1	55	575	Cp.	MP	Western Elec
1	75	850	Cp.	MP	Milwaukee
2	135	750	Cp.	SK	Westghse.

Direct Current Engine Generator Sets
All Rebuilt, 230 to 250 Volts

1—15-kw., 230-volt, 750-r.p.m., sh. wd. Milwaukee Generator, belted to 1—28-hp., 250-r.p.m. Champion Gas engine complete.

1—20-kw., 230-volt, 700-r.p.m., sh. wd. Northern Electric Generator, belted to 1—28-hp. Struthers Wells gas engine.

1—37½-kw., 650-r.p.m., sh.wd. Northern Generator complete, belted to 1—Ball steam engine, complete with all accessories.

1—37½Kw., 700-r.p.m. sh.wd. Milwaukee generator complete belted to Ball steam engine complete with all accessories.

1—100-kw., 250-volt, 650-r.p.m., cp.wd., Type M Westinghouse Generator, belted to Lord Howler 220-r.p.m. steam engine complete.

1—100-kw., 860-r.p.m., 240-volt, D.C., Type SK Westinghouse Generator (used 3 months), belted to Lord Howler steam engine, complete.

1—100-kw., 860-r.p.m., 240-volt, D.C., Type SK Westinghouse Generator (used 3 months), belted to 3-cylinder, 125-hp. Westinghouse vertical gas engine, complete.

Locomotive

1—7-ton 250 VDC. Morgan-Gardner 42-in. gage Haulage Locomotive.

"AMERICA'S BARGAIN HOUSE"

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DUQUESNE ELECTRIC & MANUFACTURING COMPANY
NEW AND REBUILT ELECTRICAL EQUIPMENT
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Reliable—POWER PLANT MACHINERY

MOTORS—ALTERNATING CURRENT
3-Phase, 60-Cycle, Slip Ring Type

No.	Hp.		Make	Volt	R.p.m.	Form
1	10	New	Gen. Elec.	440	1200	M
1	15	New	Gen. Elec.	440	1200	M
1	25	New	Gen. Elec.	440	1200	M
1	30	New	Gen. Elec.	440	900	M
1	40	New	Gen. Elec.	440	1200	M
1	40	New	Gen. Elec.	440	900	M
1	50	New	Gen. Elec.	440	900	M
1	50	New	Allis-Chal.	440	900	ANY
1	75	New	Gen. Elec.	440	900	M
2	100	New	Gen. Elec.	440	900	M
2	150	New	Gen. Elec.	440	600	M
1	200	Used	Allis-Chal.	440	600	ANY

MOTORS—ALTERNATING CURRENT
3-Phase, 60-Cycle Squirrel Cage

No.	Hp.		Make	Volt	R.p.m.	Type
3	2	New	Gen. Elec.	220	1800	K.T.
6	3	New	Gen. Elec.	220	1800	K.T.
4	3	New	Gen. Elec.	220	1200	K.T.
24	5	New	Gen. Elec.	220	1800	K.T.
10	5	New	Gen. Elec.	220	1200	K.T.
8	7½	New	Gen. Elec.	220	1800	K.T.
6	7½	New	Gen Elec.	220	900	K.T.
5	10	New	Gen. Elec.	220	1200	K.T.
8	15	New	Gen. Elec.	220	1200	K.T.
1	20	New	Gen. Elec.	220	1200	K.T.
5	20	New	Gen. Elec.	220	1200	K.T.
4	20	New	Gen. Elec.	220	900	K.T.
5	25	New	Gen. Elec.	220	1200	K.T.
4	25	New	Gen. Elec.	220	900	K.T.
3	25	New	A.-C.	220	580	
4	30	New	Gen. Elec.	220	1200	K.T.
4	30	New	Gen. Elec.	220	900	K.T.
5	40	New	Gen Elec.	220	1200	K.T.
2	40	New	Gen. Elec.	220	900	K.T.
3	50	New	Gen. Elec.	220	900	K.T.
3	75	New	Gen. Elec.	220	900	K.T.
2	100	New	Gen. Elec.	220	900	K.T.
1	150	Used	Westghse.	2200	720	C.C.L.

(Any of the above 220-volt Motors can be furnished suitable for 440 volts)

STEAM ENGINES

1—300-hp., 20 x 42 Hamilton Corliss.
1—250-hp., 18 x 36 Hamilton Corliss.
1—125-hp., 14 x 28 Filer & Stowell.
1—150-hp., 15 x 14, Ideal Automatic.
1— 90-hp., 14 x 18 Houston, Stanwood & Gamble
1— 50-hp., 12 x 16 Industrial
1— 50-hp., 11 x 14 Brownell.
1— 35-hp., 10 x 15 Erie.
1— 30-hp., 10 x 12 Chandler & Taylor.
1— 25-hp., 8 x 12 Houston, Stanwood & Gamble
1— 12-hp., 7 x 10 Atlas.
1— 4-hp., 4 x 5 Clark, Vertical.

BOILERS

2—502-hp. Sterling, 200-lb. pressure
2—400-hp. Sterling, 160-lb. pressure
1—330-hp. Heine, 180-lb. pressure.
2—250-hp Sterling, 150-lb. pressure.
8—150-hp., 72 x 18, high pressure, return tubular.
1—125-hp., 72 x 16, high pressure, return tubular.
1—100-hp., 66 x 16, return tubular.
1— 80-hp., 60 x 16, high pressure, return tubular.
1— 70-hp., 54 x 16, return tubular.
1— 60-hp. Firebox or Locomotive Type, on skids.
1— 60-hp , 54 x 14, high pressure, return tubular.
1— 35-hp., Firebox or Locomotive Type, on skids
1— 25-hp., 42 x 7½ ft. vertical.
1— 20-hp., 36 x 90, vertical.
1— 10-hp., 30 x 7½ ft., vertical.

ALTERNATING CURRENT GENERATORS
Belted and Direct Connected

3—1250-kw. Westingnouse-Parsons, 3-phase, 60-cycle, 11,000-2300-volt Turbo Generator Sets (without condensers).
1—360-kw., 3-phase, 60-cycle, 480-volt General Electric Generator, direct connected to a 24 x 25 Fleming-Harrisburg Corliss Engine.
1—250-kw. Westinghouse, 3-phase, 60-cycle, 2300-volt, 450-r.p.m., belted Alternator.
2—125-kva. Kerr-Burke, 3-phase, 60-cycle, 480-vo.t, 3600-r.p.m. Turbo Generator Sets, with jet condensers.
1—100-kw. General Electric, 3-phase, 60-cycle, 2300-volt Turbo Generator Set with condenser.
1—90-kva. Electric Machinery Company, 3-phase, 60-cycle 2200-volt, 1200-r.p.m., revolving field Alternator.
1—85-kw. Allis-Chalmers, single phase, 60-cycle, 2200-volt, 900-r.p.m., revolving field Alternator.
1—75-kw. Westinghouse, 3-phase, 60-cycle, 440-volt, 720-r.p.m., belted Alternator.
2—75-kva. Burke, 3-phase, 60-cycle, 2300-volt, Alternator, with direct connected exciters, each direct connected to a 13 x 15 Skinner automatic, self-oiling Engine, with high-grade switchboard and instruments for controlling.

DIRECT CURRENT MOTORS

No.	Hp.	Make	Volt	R.p.m.
1	50	Rebuilt Fairbanks-M.	250	900
1	50	Rebuilt Allis-Chalmers	250	1050
1	30	Rebuilt Northern	220	600
1	25	Rebuilt Fisher	250	500
2	20	New General Electric	230	1150
2	15	New General Electric	230	1150
4	10	New General Electric	230	1150
1	7½	Interpole	220	550-1100
5	5	New General Electric	220	1150

DIRECT CURRENT GENERATORS
Belted and Direct Connected

1—5-kw. Allis-Chalmers, 125-volt, 1350-r.p.m., compound wound Generators.
1—10-kw. Commercial, 120-volt, 1000-r.p.m., compound wound Generator.
1—25-kw. Triumph, 120-volt, 1000-r.p.m., compound wound Generator.
1—40-kw. Fairbanks-Morse, 220-volt, 900-r.p.m., compound wound Generator.
1—35-kw., 250-volt, 300-r.p.m. Crocker-Wheeler Generator, direct connected to a 10 x 10 Ames Automatic Engine.
1—50-kw. General Electric, 125-volt, compound wound Generator direct connected to an 11 x 14 Buckeye Automatic Engine.
1—75-kw. Ft. Wayne, 250-volt, compound wound Generator, direct connected to a 13 x 16 Russell Automatic Engine.
1—150-kw. Crocker-Wheeler, 275-volt, compound wound Generator, direct connected to a 16 x 16 Phoenix Automatic Engine.
2—175-kw. Thompson-Ryan, 250-volt, compound wound Generator, each direct connected to a 19 x 20 McEwen Automatic Engine.

MOTOR GENERATOR SETS

1—100-kw. General Electric, 250-volt Generator, direct connected to a 3-phase, 60-cycle, 2300-volt Synchronous Motor, with switchboard and instruments for controlling.
1—100-kw. Westinghouse Set, as above.
1—New 150-kw. General Electric, 275-volt 1200-r.p.m., compound wound, direct current Generator, mounted on same base with and direct connected to a 225-kva., type ATI General Electric, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Motor, with a 2-panel switchboard and instruments for starting and controlling.
1—300-kw. General Electric, 550-volt, 720-r.p.m., direct current Generator, with direct connected exciter mounted on same base with and direct connected to a 430-hp. General Electric, 3-phase 60-cycle, 2300-volt Synchronous Motor.
2—New 500-kw. General Electric, 575-volt, 514-r.p.m., direct current Generators, mounted on same base with and direct connected to t 720-hp., 3-phase, 60-cycle, 6600-13,200-vola Synchronous Motor.

THE RANDLE MACHINERY COMPANY *Established 34 Years*
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INDEPENDENT ELECTRIC MACHINERY CO.

CENTRAL STREET and GOODRICH PLACE, KANSAS CITY, MO.

SEE THE INDEPENDENT FIRST

25-CYCLE, 3-PHASE, 220-440 VOLT MOTORS

No.	H.P.	Name	Speed
1	1	Westinghouse	680
1	1	Richmond	1420
1	1	General Electric	1500
1	2	General Electric	1500
2	3	Ideal	1400
3	3	Robbins & Myers (New)	1400
5	3	General Electric	1500
2	5	Ideal	1450
1	5	Robbins & Myers (New)	1400
1	5	Western Electric	1420
1	5	General Electric	750
1	5	Westinghouse	Var.
2	7½	Robbins & Myers (New)	1400
2	7½	General Electric	1500
3	15	General Electric	1500
1	15	Ideal	1430
1	15	Robbins & Myers (New)	720
3	15	Burke	750
1	25	Burke	750
1	40	Westinghouse	710
1	50	General Electric	750

60-CYCLE, 3-PHASE, 220-VOLT MOTORS

No.	H.P.	Name	Speed
1	½	Fairbanks-Morse	1200
1	1	General Electric	Var.
12	1	Robbins-Myers—New	1750
4	1	Robbins-Myers—New	1150
1	1	General Electric	Var
3	2	Robbins & Myers (New)	1750
14	2	Robbins-Myers	1750
5	2	Robbins-Myers	1150
1	5	Northern	1150
22	3	Robbins & Myers (New)	1750
10	3	Robbins & Myers (New)	1150
32	5	Robbins & Myers (New)	1750
10	5	Robbins & Myers (New)	1150
3	5	Crocker-Wheeler (New)	1750
1	5	Wagner (New)	1140
1	5	Robbins-Myers—New—Elevator type	1200
1	5	Fairbanks-Morse	1800
1	7½	Robbins & Myers (New)	1150
1	7½	Allis Chalmers	1150
1	7½	Ideal	1720
9	7½	Robbins & Myers (New)	1750
1	7½	Ideal	1800
2	7½	Robbins & Myers (New)	850
1	10	Wagner (New)	1140
6	10	Robbins & Myers (New)	1150
5	10	Robbins & Myers (New)	1750
2	10	Robbins & Myers (New)	850
5	15	Robbins & Myers (New)	1750
2	15	Robbins & Myers (New)	1150
2	15	Robbins & Myers (New)	850
1	15	General Electric	1740
4	20	Robbins & Myers (New)	1150
2	20	Robbins & Myers (New)	1750
1	20	Robbins & Myers	850
1	20	Westinghouse—sl. rg.	800
2	25	Robbins & Myers (New)	1750
1	25	Robbins & Myers (New)	1150
2	25	Robbins & Myers (New)	850
1	25	Lincoln	2200 V.—1200
3	30	Robbins & Myers (New)	1150
1	30	Robbins & Myers (New)	840
1	30	West. El., Slp.rg.	2200 V.— 350
2	35	Wagner	1730
1	35	General Electric	2200 V.—1150
1	40	Allis Ch., Sq. Cg.	2200 V.— 865
1	40	Allis-Chalmers—New—S.R.	860
1	50	Allis-Chalmers—New—S.R.	690
1	50	Westing., Slp rg.	2200 V.— 725
1	50	Allis Ch., Sq. Cg.	2200 V.— 865
1	50	Allis Chalmers Slip Ring	865
1	50	Allis Ch., Slp. rg.	2200 V.— 865
1	50	Wagner	850
1	75	General Electric—Sl. Rg.	900
1	75	Allis-Ch., Slp. rg. 2200V— 865	
2	100	Allis Chalmers (slip ring) 2200V	865
1	100	General Electric—2200 V.	695
1	125	Allis-Chalmers	1800
1	200	Allis-Chalmers	580
1	200	Ideal	600

220 VOLT D.C. MOTORS

No.	Hp.	Name	Speed
2	5	Robbins & Myers	1400
1	5	Reliance	1750
1	7	Holtzer-Cabot	1200
1	5	Robbins-Myers (back geared)	900

No.	H.P.	Name	Speed
3	7½	General Electric	815
2	7½	Northern	1650
5	10	Crocker-Wheeler	825
1	10	Northern	825
1	10	American Engine Co.	1140
1	12½	Robbins & Myers	850
1	15	Electric Mchy. Co.	1050
1	15	General Electric (Crane)	600
1	15	Northern	535
1	20	Crocker-Wheeler	775
3	30	General Electric (Vertical)	1500
1	110	Crocker-Wheeler	560

110-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	35	W. E.	775
1	50	G. E.	1150
1	50	Westinghouse	850
1	50	Eddy	800
1	75	W. E., engine type	275

220-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	12½	Fairbanks-Morse, 3-wire	1450
1	17½	Triumph	1200
1	60	Commercial	700
1	60	Westinghouse	850
1	75	Northern	700
1	80	Thompson-Ryan	600
1	225	Crocker-Wheeler	450

DIRECT CONNECTED SETS

1—30-kw., 220-volt, 300-r.p.m. Akron generator direct connected to 10 x 10 Buffalo Forge Co. engine, complete.

1—50-kw., 125-volt, 280-r.p.m. General Electric generator, direct connected to 11 x 12 G. E. Marine steam engine, complete.

1—75-kw., 220-volt, 275-r.p.m. Crocker-Wheeler generator, direct connected to a 15 x 16 Harrisburg-Fleming steam engine with balancer set.

1—100 kw., 220 volt, 250 r.p.m. Crocker Wheeler generator, direct connected to a 10 x 16 x 14 simple compound horizontal Ball engine.

1—100-kw., 220-volt, 260-r.p.m. General Electric Generator, direct connected to 15 x 21 Ball self-contained automatic engine.

ALTERNATORS

1—50 kva., 2200 volt, 60 cycle, 3 phase, 1200 r.p.m. Westinghouse alternator, complete.

1—62½ kw., 2200 volt, 60 cycle, 3 phase, 300 r.p.m. Bullock alternator, direct connected to an Almes steam engine, all complete.

1—75 kva., 2300 volt, 60 cycle, 1 phase, 900 r.p.m. General Electric alternator complete.

1—80 kva., 2300 volt, 60 cycle, 3 phase, 225 r.p.m. Ft. Wayne alternator, direct connected to 110 hp. Buckeye Producer Gas Engine, complete.

1—85 kva., 2300 volt, 60 cycle, 3 phase, 277 r.p.m. Allis Chalmers alternator direct connected to an Erie City steam engine, 12 x 12, all complete.

1—100 kva., 2300 volt, 60 cycle, 3 phase, 277 r.p.m. Westinghouse alternator, direct connected to 125 hp Erie engine.

1—150 kva., 2300 volt, 60 cycle, 3 phase 200 r.p.m. General Electric alternator, direct connected to a 14½ x 24 x 18 Mansfield automatic steam engine, complete.

1—150 kva., 2300 volt, 60 cycle, 3 phase, 720 r.p.m. Electric Machinery, alternator, complete with exciter.

"HONESTLY REBUILT" ELECTRICAL MACHINERY

You can purchase our product with the same assurance that you would buy New Electrical Machinery. For all practical purposes it is just as good.

SPECIAL OFFERINGS

3—100-kva. Westinghouse, 1-phase, 60-cycle Transformers, 13,200-12,600-12,000-volt primary 465-445-437-423-volt, sec. rebuilt by Westinghouse. Price $1000 for all.

3—75-kw. General Electric, 1-phase, 60-cycle, Type H-RR Transformers, 2300-2185-2070-volt prim. 370-185-volt, sec. for 200-kw., 600-volt, D.C. rotary. Price for all $900.

200-hp., 3-phase, 60-cycle, 440-volt Westinghouse CCL, 1140-r.p.m. Motor, with starting panel. price $1000.

200-hp., 3-phase, 60-cycle, 440-volt Westinghouse CCL, 900-r.p.m. Motor with starter. Price $1250.

175-hp., 3-phase, 60-cycle, 2300-volt Allis-Chalmers 860-r.p.m., Slip Ring Motor, with Cutler-Hammer, drum controller, resistance and G.E. Oil Circuit Breaker. Price $1350.

6—132-hp., 3-phase, 60-cycle, 2300-volt General Electric, type 1, form L Wound Rotor Motors. Price $1200 each.

2—100-hp., 3-phase, 60-cycle, 220-volt Allis-Chalmers, AN 1750-r.p.m. Motors. Price $575 each.

2—75-hp., 3-phase, 60-cycle, 220-volt Westinghouse, CCL, 685-r.p.m. Motors, complete. Price $750 each.

150-kw., 250-volt, D.C. C & C Elec. & Mfg. Co., type MPL, 6-pole compound wound, 500-r.p.m. Generator, complete with switchboard. Price $1250.

125-kw., 250-volt, D.C. Westinghouse, 6-pole, compound wound, 580-r.p.m. Generator, complete with switchboard. Price $1400.

2—75-kw., 250-volt, D.C. Crocker-Wheeler, 200-r.p.m. Generators, direct connected to Alberger Gas Engines. Price $4000.

25-kw., 250-volt, D.C., Crocker-Wheeler Generator, 300-r.p.m., direct connected to Alberger Gas Engine, with switchboard. Price $1000.

35-kw., 125-volt, D.C. General Electric-Curtis Turbo Generator, 3600-r.p.m., 125-lb. ST. Price $1000.

MOTOR GENERATOR SET

250-kw., 125/250-volt, D.C. Allis-Chalmers 2-phase, 25-cycle, 2300-volt Synchronous speed 750.

200-kw., 250-volt, D.C. General Electric, 3-phase, 25-cycle, 2300-volt Synchronous, speed 750.

2—200-kw., 250-volt, D.C. Allis-Chalmers, 3-phase, 25-cycle, 2300-volt, 750-r.p.m. Rotarys, with transformers.

200-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 2300-volt, 900-r.p.m. Synchronous Set.

3—150-kw., 250-volt, D.C. General Electric 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

100-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

100-kw., 600-volt, D.C. General Electric, 3-phase, 60-cycle, 2300-volt Rotary, with transformers.

100-kw., 500-volt, D.C. Allis-Chalmers, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

75-kw., 250 volt, D.C. Crocker-Wheeler, 3-phase, 60-cycle, 2300-volt, 720-r.p.m. Induction Set.

75-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 900-r.p.m. Synchronous Set.

50-kw., 250-volt, D.C. General Electric, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Synchronous Set.

25-kw. 220-volt, D.C. General Electric, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Induction Set.

10-kw., 250-volt, D.C. Watson, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Induction Set.

7½-kw., 220-volt, D.C. Western Electric, 3-phase, 60-cycle, 220-volt, 1800-r.p.m. Induction Set.

7½-kw., 125-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Induction Set.

2—2½-kva., 1-phase, 60-cycle, 110-volt Crocker-Wheeler, 125-volt, D.C., 1800-r.p.m. Motor Generators.

2—2½-kw., 125-volt, D.C. Crocker-Wheeler, 500-volt, D.C., 1800-r.p.m. Motor Generators.

½-kw., 125-volt, D.C. General Electric, 1-phase, 60-cycle, 220-volt, 1800-r.p.m. Motor Generator.

25-amp., 8-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1700-r.p.m. Induction Set.

25-amp., 28-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1700-r.p.m., Induction Set.

10-kw., 60-volt, D.C. Northern, 125-volt, D.C., 835-r.p.m. Booster Set.

3-PHASE, 25-CYCLE MOTORS

Hp.	Make	Type	Speed
3	Westinghouse	CS	1400
15	General Electric	I.M., 2300-volt Slip Ring	750
20	Allis-Chalmers	AN	750
2—35	Allis-Chalmers	ANY 2300-volt Slip Ring	720
35	General Electric	IK	500
35	Westinghouse	CS	720
37	General Electric	"ITC" Slip Ring	685
3—52	General Electric	"ITC" Slip Ring	685

ALTERNATING CURRENT GENERATORS

30-kva., 3-phase, 60-cycle, 220-volt Burke, speed 1200-r.p.m.

30-kva., 3-phase, 25-cycle, 220-volt Westinghouse, speed 750-r.p.m.

50-kva., 2-phase, 60-cycle, 240-volt Burke, speed 1200-r.p.m.

50-kva., 3-phase, 60-cycle, 220-volt Burke, speed 1200-r.p.m.

50-kva., 3-phase, 60-cycle, 2300-volt, General Electric, speed 1200-r.p.m.

100-kva., 3-phase, 60-cycle, 220-volt Westinghouse, speed 900-r.p.m.

250-kw., 3-phase, 60-cycle, 220-volt Westinghouse speed 450-r.p.m.

350-kva., 3-phase, 25-cycle, 2300-volt Allis-Chalmers, direct connected to Harrisburg Fleming Steam Engine.

220-250-VOLT, D.C. GENERATORS

Kw.	West		
15	Westinghouse	S	900
25	Crocker-Wheeler	CCM	300
42½	Sprague	SB	725
50	Crocker-Wheeler	Engine	275
75	Westinghouse	S	725
85	Westinghouse	S	725
100	General Electric	Engine	725
100	Triumph	MP	650
125	Westinghouse	MP	580
150	C & C Electric	MP6	500
200	Westinghouse	MP6	500
200	General Electric	Engine	200

SPECIAL NOTICE

Our large and varied stock of A.C. and D.C. Motors will be sold this month at greatly reduced prices.

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IN STOCK FOR PROMPT SHIPMENT

TURBO-GENERATOR UNITS—60 Cycle

10,000 Kw. Westinghouse Parsons Horizontal Turbo-Generator Unit, 3 Phase, 60 Cycle, 13800 Volts, 1800 r.p.m. Can be reconnected to any other standard voltage. ABSOLUTELY NEW. Suitable surface condenser and condenser auxiliaries. Send for full details and specifications.
1—1250 Kva. Westinghouse-Parsons horizontal turbo-unit, 3 phase, 2300 volts, r.p.m., with LeBlanc jet type condenser and turbine driven pumps.
1—750 KW. General Electric-Curtis horiz. turbo-unit, 3 phase, 2300 volts, 3600 r.p.m. mixed pressure with C. H. Wheeler surface condenser vacuum and circulating pumps etc.,
2— 625 Kva. Westinghouse-Parsons horiz. turbo-units, 3 phase, 440 volts, 3600 r.p.m.
1—550 KW. Gen. Elec.-Curtis vertical, non-condensing turbo-unit, 3 phase, 4600 or 2300 volts, 1800 r.p.m.
1—500 KW. Allis-Chalmers horizontal turbo-unit, 3 phase, 480 volts, 3600 r.p.m., with Allis-Chalmers jet condenser and necessary pumps.
1—500 Kw. Gen. Elec.-Curtis vertical turbo-unit, 3 phase, 4000-2300 volts, 1800 r.p.m., with Wheeler Cond. & Eng'g Co. jet condenser and necessary pumps.
1—500 Kw. General Electric-Curtis horizontal turbo unit, 3 phase, 2300 volts, 3600 r.p.m., 4 stage, condensing, complete withcondenser, pumps and switchboard equipment.

TURBO-GENERATOR UNIT—25 Cycle

1—6500 Kw. Allis-Chalmers horizontal turbo unit, 3 phase, 6600 volts, 4 pole, 750 r.p.m.

ROTARY CONVERTERS—60 Cycle

3—500 Kw. Westg., 6 phase, 60 cycle, commutating pole, 250 volts D.C., 2000 amps. D.C., 177 volts A.C., 6 pole, 1200 r.p.m. With each rotary are three 183 Kva. Westg. type, SKR, single phase, OI SC transformers, 6900 volts delta high tension. 15% inherent reactance also A.C. and D.C. panels, complete with necessary instruments.
THE ABOVE UNITS ARE ABSOLUTELY NEW.
1—400 Kw. Gen. Elec., type HC, form P, 6 ph., 60 cy., 8 pole, 600 volts D.C., 667 amps. D.C., 430 volts A.C., 900 r.p.m., with switchboard and necessary instruments.
1—150 Kw. Westg., 6 ph., 60 cy., 250 volts D.C., 600 amps. D.C., 177 volts A.C., 6 pole commutating pole, 1200 r.p.m. Transformer: 165 Kva. West., 3 ph., 6900 volts prim., OI SC. 15% inherent reactance; also A.C. and D.C. panels with necessary instruments.
THE ABOVE UNIT IS ABSOLUTELY NEW.

ROTARY CONVERTERS—25 Cycle

1—1500 Kw. General Elec., type HC, form N, 6 ph., 25 cy., 14 pole, 250 volts D.C., 5700 amps. D.C., 214 r.p.m., with electrically operated and controlled field rheostat, automatic overload and speed limit device.
1—300 Kw. National, type RT, 3 ph., 25 cy., 550 volts D.C., 545 amps. D.C., 330 volts A.C., 526 amps. A.C., 6 pole, 500 r.p.m.
1—250 Kw. Elec., type TC, form A, 3 ph., 25 cy., 4 pole, 550 volts D.C., 455 amps. D.C., 350 volts A.C., 750 r.p.m.; also A.C. and D.C. panels complete with instruments.

We shall be glad to mail complete list of Electrical, Steam and Hydraulic Machinery upon request.

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READY FOR IMMEDIATE DELIVERY

ALTERNATING CURRENT DIRECT CONNECTED SET

1—145 Kva., 3-phase, 60-cycle, 220/440 volt, Westinghouse, revolving field generator, 257 r.p.m., direct connected on one shaft to 18 x 16 Erie Ball engine, complete with switchboard and exciter.

ALTERNATING CURRENT BELTED GENERATORS

1—450 Kw., 3 phase, 60 cycle, 2200 volt, 400 r.p.m., General Electric, type ATB.
1—300 Kva., 3 phase, 60 cycle, 2300 volt, 164 r.p.m., General Electric, type ATB.
1—200 Kw., 3 phase, 60 cycle, 1150 volt, 600 r.p.m., General Electric, type ATB.
1—300 Kw., 3 phase, 40 cycle, 600 volt, 600 r.p.m., General Electric, type ATB.
1—150 Kw., 3 phase, 40 cycle, 550 volt, 300 r.p.m., General Electric, type ATB.
1—75 Kw., 3 phase, 60 cycle, 220 volt, 720 r.p.m., revolving armature Westinghouse generator.

LARGE ALTERNATING CURRENT MOTORS

1—1000 HP., synchronous motor, 2 phase, 60 cycle, 2300 volt, 300 r.p.m., General Electric, type AQB.
1—450 HP., 3 phase, 40 cycle, 550 volt, 400 r.p.m., type LM, General Electric.
1—225 HP., 550 volt, 3 phase, 60 cycle, 514 r.p.m., form L, General Electric motor.
1—175 HP., General Electric, 3 phase, 60 cycle, 550 volt, 600 r.p.m., type M motor.
1—150 HP., Western Electric, 3 phase, 60 cycle, 550 volt, 720 r.p.m., type M motor.
1—100 HP., Western Electric, 3 phase, 60 cycle, 550 volt, 720 r.p.m., type M motor.
1—75 HP., Westinghouse, 3 phase, 60 cycle, 550 volt, 690 r.p.m., type CW new motor.
1—50 HP., Western Electric, 3 phase, 60 cycle, 550 volt, 1200 r.p.m., type MT motor.
1—50 HP., General Electric, 3 phase, 60 cycle, 550 volt, 1200 r.p.m., type KT motor.
2—150 HP., 575 r.p.m., General Electric, 3 phase, 60 cycle, 2200 volt, type M motors.
1—100 HP., Western Electric, 3 phase, 60 cycle, 720 r.p.m., form M motor, 2200 volt.
1—100 HP., Western Electric, 3 phase, 60 cycle, 440 volt, 720 r.p.m., type M.
1—75 HP., Western Electric 3 phase, 60 cycle, 440 volt, 720 r.p.m., type M.
1—50 HP., Western Electric 3 phase, 60 cycle, 440 volt, 1200 r.p.m., type M.
1—150 HP., Westinghouse, 3 phase, 60 cycle, 385 r.p.m., 220 volt, type CW.
1—75 HP., General Electric, 3 phase, 60 cycle, 220 volt, type K, 900 r.p.m.
1—75 HP., General Electric, 3 phase 60 cycle 220 volt, 720 r.p.m., type K.
1—75 HP., General Electric, 3 phase, 60 cycle, 220 volt, 720 r.p.m., type M.

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230 VOLTS D. C. MOTORS

Qu.	H.P.	Speed	Make
*1	130	500	Westg.
1	40	1150	Jantz-Leist
1	30	900	Fairbanks-M.
1	25	850	Peerless
1	20	600	Jantz-Leist
1	20	630	Triumph
1	20	750	Jantz-Leist
1	20	800	Imperial
2	20	955	Peerless
1	20	1150	Peerless
1	20	1200	Jantz-Leist
1	15	1000	Akron
2	15	1020	Peerless
1	15	1200	G. E.
1	15	1300	G. E.
1	10	585	Peerless
1	10	1325	Peerless
1	7½	700	O'Donnell
1	7½	1400	Lincoln
1	7½	1500	Phoenix
1	6	550/1100	Peerless
1	5	700	Lincoln
1	3½	1100	G. E.
1	3	1750	Sprague
1	2½	490/650	Allis-Chalmers
1	2	750	Westinghouse
1	1	1275	Westg.
1	1	1650	Bissell
1	1	1700	G.E.

110 VOLT D. C. MOTORS

1	15	650	Sprague
1	10	300/1000	Jantz-Leist
1	10	1750	Colburn
1	6	560	Card
1	3	600	Lincoln

GENERATORS

Qu.	Kw.	Speed	Volts	Make
1	10	800	110	Sprague
1	30	1150	250	Crocker-W.
*1	40	975	125	Akron
*1	60	810	125	Triumph
1	75	700	250	G. E.
*1	100	600	250	Westg.
1	100	700	250	G. E.

MOTOR GENERATOR SETS

100-kw., 250-volt, 600-r.p.m., USED Westinghouse, D.C. Generator, with field rheostat, flexibly coupled to 150-hp., 440-volt, 3-phase, 60-cycle, 720-r.p.m., USED Western Electric motor, with starting compensator.

75-kw., 250-volt, 700-r.p.m., USED General Electric, D.C. Generator, with field rheostat, flexibly coupled to 150-hp., 440-volt, 3-phase, 60-cycle, 720-r.p.m., USED Western Electric motor, with starting compensator.

30-kw., 250-volt, 1150-r.p.m., USED Crocker-Wheeler, D.C. Generator flexibly coupled to 40-hp., 220- or 440-volt, 3-phase, 60-cycle, 1165-r.p.m., NEW General Electric motor with starting compensator

10-kw. 110-volt, 865-r.p.m., USED Sprague, D.C. Generator, with switchboard, flexibly coupled to 15-hp., 220- or 440-volt, 3-phase, 60-cycle, 865-r.p.m., NEW General Electric motor, with starting compensator.

3-PHASE 60-CYCLE MOTORS

H.P.	Speed	Make	Volts 220	440
150	720	Western		1
*75	450	G. E.		2
35	900	Western	1	
30	1150	Westg.	1 slip ring	
20	1730	Wagner	1	
20	1800	G. E.	1	
20	1800	Lincoln	1	
15	1150	Allis-C.		1
15	1720	Wagner		1
10	1800	G. E.	1	
7½	900	G. E.	1	
7½	1800	G. E.	1	
7½	1800	Western	1	

*Detroit stock.

ALTERNATORS

150-kva., 220-volt, 3-phase, 60-cycle, 900-r.p.m., USED Westinghouse, A.C. Alternator, with pulley, rails, field rheostat and exciter.

30-kva., 220-volt, 3-phase, 60-cycle, 1200-r.p.m., USED Burke, A.C. Alternator, with pulley rails, field rheostat and exciter.

*Detroit stock.

We maintain a large and up-to-date repair shop and can give you prompt service. Our night telephone numbers are: Marlo 234-M, Eddy 6001-R. Being jobbers for Electrical supplies, we solicit your inquiries.

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FIRST NATIONAL BANK BLDG. ELECTRIC AND STEAM MACHINERY CINCINNATI, OHIO U.S.A.

A-1 POWER APPARATUS--IMMEDIATE DELIVERY

BOILERS

4—350-hp. Stirling, Class N, No. 16, butt joint, triple riveted, 190 lb., Foster superheaters, complete plant.
1—500-hp. B. & W., steel header, butt joint, 185 lb., B. & W. stoker.
1—400-hp. Stirling, butt joint, complete with superheater and stack, 160 lb.
10—500-hp. B. & W., steel header, 160 lb., oil furnaces.
3—500-hp. B. & W., steel header, 200 lb.
3—250-hp. Heine, 125-150-lb., hand fired.
1—600-hp. B. & W., 115 150-lb.
1—500-hp. B. & W., 115 150-lb.
1—400-hp. B. & W., 122-160-lb.
4—250-hp. B. & W., 150-lb.
2—150-hp. Lynne, 150-lb. allowance, vertical water tube.

D. C. UNITS

1—400-kw. Bullock, 230-volt, direct connected to Allis-Chalmers, cross compound, heavy duty Corliss engine.
1—300-kw. General Electric, 250-volt, M.P. 10, direct connected at 100 rev., tandem compound, heavy duty Corliss engine.
1—300-kw. Western Electric, 240-volt, direct connected at 180 rev., to Williams valve vertical cross compound engine.
1—250-kw. Western Electric, 250-volt, M.P.8, direct connected at 180 rev., Ideal tandem compound engine.
1—200-kw. Crocker-Wheeler, 250-volt, direct connected to left hand, heavy duty Corliss engine.
1—200-kw. Crocker-Wheeler, 125-volt, M.P.8, direct connected at 150 rev., 18 x 32 Corliss engine, practically new.
2—150-kw. Bullock, 250-volt, M.P.6, direct connected to Ames left hand automatic engines.
1—150-kw. Western Electric, 220-volt, direct connected at 225 rev. to Ideal Simple Automatic engine.

A. C. UNITS

1—1000-kw. General Electric, A.T.B. Alternator, 2300-volt, 120 rev., with vertical Rice & Sargeant engine.
1—600 kw. General Electric, A.T.B. alternator. 2300 volt. 150 rev. with vertical Rice & Sargeant engine.
2—600-kw. General Electric, H. D. Alternator, 60-cycle, 3-phase, 2300-volt, with cross compound Rie & Sargeant engines.
1—500-kw. Fort Wayne, R. F. Alternator, 60-cycle 3-phase, 2300-volt, 120-rev., with heavy duty Hamilton Corliss engine.
1—240-kw. Stanley R. F. Alternator, 2300-volt, 125-rev., with Buckeye automatic engine.
1—170-kw. Fort Wayne, R. F. Alternator, with compound Russell engine.
1—150-kw. General Electric, A.T.B. Alternator, 225-rev., with Ideal tandem engine.

A.C., D.C. UNITS

3—800-kw. General Electric, 25-cycle, 3-phase, A.T.B. Alternators, 370-400-volt, with cross compound Hamilton Corliss engines.
1—625-kva. Crocker-Wheeler Revolving Field Engine Type Alternator, 60-cycle, 3-phase, 220-440-volt, 225-rev., no engine.
2—300-kw. Westinghouse R.F. Engine Type Alternators, 25-cycle, 3-phase, 400 volt, with cross compound Hamilton Corliss engines.

TURBINES

1—15,000-kw. General Electric Horizontal Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt.
2—10,000-kw. Allis-Chalmers-Parsons Turbo-Alternator Unit, 25-cycle, 3-phase, 6600-volt, 1500-r.p.m.
1—9300-kva. Westinghouse-Parsons Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt, with jet condenser.
1—5000-kva. General Electric Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt, 1200-r.p.m.
1—3750-kva. Westinghouse-Parsons Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2300-volt, with jet condenser.
1—2000-kw. Westinghouse-Parsons Condensing Turbo-Alternator Unit, 60-cycle, 3-phase, 2400-volt, 1200-r.p.m.
2—2000-kw. General Electric Turbo Generator Units, 60-cycle, 3-phase, 2300-volt, 3600-r.p.m., direct connected to Curtis steam turbines for 150- b. steam pressure.
1—1500-kw. Westinghouse-Parsons Horizontal Condensing Turbo Alternator, 60-cycle, 3-phase, 440-2300-4400-volt, complete with condenser.
2—1500-kw. Allis-Chalmers Condensing Turbo Alternator Units, 60-cycle, 3-phase, 6600-volt, with surface condensers.
2—750-kw. General Electric, Type A.T.B., 60-cycle, 3-phase, 2300-volt Generator, direct connected to Form B, non-condensing Curtis 160- b. steam pressure Turbine.
1—300-kw. Westinghouse-Parsons Condensing Turbo Alternator Unit, 60-cycle, 3-phase, 2300-volt.

FREQUENCY CHANGERS

1—1000-kw. Westinghouse, 60-cylce, 3-phase, 2300-volt to 30-cycle, 6600-volt.
1—500-kw. General Electric, 60-cycle, 3-phase, 2300-4000-volt Alternator, with 700-hp., 25-cycle, 13000-volt motor.
1—500-kw. General Electric, 60-cycle, 3-phase, 2300-4100-volt Alternator, with 800-hp., 25-cycle, 9000-volt motor.
1—500-kw. General Electric, 60-cycle, 3-phase, 2300-4000-volt Generator, with 25-cycle, 3-phase, 2300-4000-volt motor.

BELTED D.C. UNITS

2—400-kw. Westinghouse, belted M.P.6, 3 bearing 250-volt, 375-r.p.m.
150-200-250-300-kw. belted Multipolar Generators, with and without Corliss and automatic engines for belted drive.
Heavy Duty Corliss, automatic and four-valve Engines, ranging in size from 100 to 5000-hp. capacity.

A. C. MOTORS

1—1200-hp. General Electric, 25-cycle, 3-phase, 2200-volt, 250-r.p.m. Induction Motor; shaft extension both ends.
1—1200-hp. General Electric, 60-cycle, 3-phase, 2300-volt, 2—60-r.p.m. Synchronous damper wound Motor, with starting device. No bearings or pulley.
1—250-hp. Burke, 60-cycle, 2-phase, 2300-volt, Synchronous Slip Ring Motor, with twin, 24-in. Platt Iron Works Pump; 20 million G.P.D., 45-ft. head.
5—240-hp. General Electric, 25-cycle, 3-phase, 6600-volt, 500-r.p.m. Synchronous Motors.

SHOVEL

1—45-ton Steam Shovel, Class 2, car length 30 ft.; width 9 ft.; will dump 22 ft. from center of mast each way 1¾ cu.yd. capacity.

COMPLETE PLANTS BOUGHT and SOLD

WE HAVE FOR IMMEDIATE DELIVERY

3-Phase, 220-440-Volt

2—500-hp. Allis-Chalmers, mill type, 900-r.p.m.
2—200-hp. Crocker-Wheeler, 117Q.
2—125-hp. Crocker-Wheeler, 125 AQ, 690-r.p.m
1—100-hp. General Electric, E-10, 720-r.p.m.
3—100-hp. Westinghouse, 870-r.p.m.
3—100-hp. Crocker-Wheeler, 35 R, 1750-r.p.m.
2— 75-hp. Lincoln, C-14, 1800-r.p.m.
1— 60-hp. Burke, I-M, 1800-r.p.m.
2— 75-hp. Crocker-Wheeler, 125-Q, 575-r.p.m.
1— 60-hp. Crocker-Wheeler, 123 AQ, 680-r.p.m.
2— 50-hp. Westinghouse, CCL, 720-r.p.m.
3— 50-hp. Allis-Chalmers, 3K, 690-r.p.m.
2— 50-hp. Crocker-Wheeler, 122Q, 665-r.p.m.
4— 50-hp. Crocker-Wheeler, 121Q, 1160-r.p.m.
2— 50-hp. Fairbanks-Morse, BB, 1200-r.p.m.
4— 50-hp. Fairbanks-Morse, 16A, 720-r.p.m.
3— 40-hp. General Electric, KT, 1800-r.p.m.
2— 40-hp. Crocker-Wheeler, 121Q, 865-r.p.m
3— 40-hp. Crocker-Wheeler, 122Q, 685-r.p.m.
2— 35-hp. Westinghouse CL, 870-r.p.m.
4— 35-hp. Crocker Wheeler, 120Q, 850-r.p.m.
3— 30-hp. Westinghouse, C, 1160-r.p.m.
5— 30-hp. Fairbanks-Morse, 12B, 1200-r.p.m.
6— 25-hp. Crocker-Wheeler, 118Q, 1150-r.p.m.
2— 25-hp. Crocker-Wheeler, 119Q, 850-r.p.m.
20— 25-hp. Fairbanks-Morse, 12A, 1200-r.p.m.
4— 20-hp. Fairbanks-Morse, 12B, 900-r.p.m.
3— 20-hp. Crocker-Wheeler, 117Q, 1140 r.p.m.
3— 20-hp. Crocker-Wheeler, 116Q, 1739-r.p.m.
5— 15-hp. Westinghouse HF, 690-r.p.m.
4— 15-hp. Western Electric, L-10, 665-r.p.m.
4— 15-hp. General Electric, K, 900-r.p.m.
12— 15-hp. Crocker-Wheeler, 116Q, 1130-r.p.m.
3— 15-hp. Fairbanks-Morse, 10-C, 100-r.p.m.
3— 15-hp. Wagner, BW, 1140-r.p.m.
3— 20-hp. Westinghouse, CS, 1160-r'p.m.
2— 25-hp. General Electric, I, 900-r.p.m.
30— 10-hp. Crocker-Wheeler, 115Q, 1130-r.p.m.
7— 10-hp. Fairbanks-Morse, 10 B, 1200-r.p.m.
3— 10-hp. Allis-Chalmers, 3K, 1730-r.p.m.
14— 7½-hp. Westinghouse, CS, elevator, 980-r.p.m.
3— 7½-hp. Crocker-Wheeler, 117-Q, 560-r.p.m.
2— 11-hp. Westinghouse CI, elevator, 1135-r.p.m.
15— 5-hp. Crocker Wheeler, 105Q, 680-r.p.m.
10— 5-hp. Crocker-Wheeler, 113Q, 1140-r.p.m.
5— 5-hp. Westinghouse CS, 1735-r.p.m.
4— 3-hp. Crocker-Wheeler, 109Q, 1140-r.p.m.
3— 3-hp. Crocker-Wheeler, 114AQ, 690-r.p.m.
15— 3-hp. Crocker-Wheeler, 111Q, 1130-r.p.m.
5— 2-hp. Crocker-Wheeler, 111Q, 835-r.p.m.
8— 1-hp. General Electric, KT, 1800-r.p.m.
5— 1-hp. Crocker-Wheeler, 104Q, 1710-r.p.m.

General Electric, Westinghouse, Fairbanks-Morse and Crocker-Wheeler

2-Phase, 220-440 Volt

4— 1-hp., 1200-r.p.m.
3— 1-hp., 1700-r.p.m.
2— 1-hp., 900-r.p.m.
4— 2-hp., 850-r.p.m.
5— 2-hp., 1730-r.p.m.
6— 3-hp., 850-r.p.m.
5— 3-hp., 1160-r.p.m.
5— 3-hp., 1730-r.p.m.
7— 7-hp., 1130-r.p.m.
5— 7-hp., 1720-r.p.m.
4—10-hp., 1130-r.p.m.
3—15-hp., 1130-r.p.m.
6— 15-hp., 850-r.p.m.
3— 20-hp., 1200-r.p.m.
5— 25-hp., 1150-r.p.m.
4— 25-hp., 850 r.p.m.
6— 35-hp., 900-r.p.m.
5— 40-hp., 1160-r.p.m.
10— 50-hp., 900-r.p.m.
7— 75-hp., 1160-r.p.m.
8—100-hp., 720-r.p.m.
5—125-hp., 705-r.p.m.
6—200-hp., 580-r.p.m.
5—200-hp., 870-r.p.m.

Single-Phase, 110-220 Volt

5— ¼-hp. Westinghouse, 850-r.p.m.
3— ½-hp. Ideal, 1165-r.p.m.
4— 1 -hp. Century, 1165-r.p.m.
5— 2 -hp. Century, 1750-r.p.m.
4— 2 -hp. Westinghouse, 1700-r.p.m.
3— 3 -hp. Westinghouse, 1720-r.p.m.
6— 3 -hp. Century, 1165-r.p.m.
5— 3½-hp. Century, 1165-r.p.m.
3— 7½-hp. Westinghouse, 1720-r.p.m.
2—10 -hp. Wagner, 1720-r.p.m.

D.C., 220 and 440 Volt

50-hp. Crocker-Wheeler, 450-r.p.m., Type CCM
50-hp. Westinghouse, 750-r.p.m., type S.K.
40-hp. C. & C. Interpole, 955-r.p.m.
30-hp. Reliance, 730-r.p.m.
30-hp. Reliance, 1700-r.p.m.
25-hp. Westinghouse, 825-r.p.m., type S.K.
20-hp. Reliance, 1700-r.p.m., type R.G.
20-hp. General Electric, 1150-r.p.m.
15-hp. Westinghouse, 1100-r.p.m., type SK
15-hp. General Electric, 1700-r.p.m., type R.G.
15-hp. Westinghouse, 1700-r.p.m.
10-hp. Westinghouse, 850-r.p.m., type S.K.
10-hp. Genera lElectric, 1700-r.p.m., type R. C.
10-hp. General Electric, 1150-r.p.m., type R.G.
10-hp. Westinghouse, 1150-r.p.m., type SK
7½-hp. Westinghouse, 850-r.p.m., type S.K.
7½-hp. General Electric, 1150-r.p.m., type R.G.
7½-hp. Westinghouse, 1700-r.p.m., type S.K.
5-hp. Westinghouse, 1800-r.p.m., type S.K.
5-hp. Westinghouse, 1200-r.p.m., type S.K.
5-hp. General Electric, 1150-r.p.m., type R.G.
5-hp. General Electric, 850-r.p.m., type S.K.
3-hp. Westinghouse, 1725-r.p.m., type G.D.
3-hp. General Electric, 1150-r.p.m., type R.G.
2-hp. Westinghouse, 1725-r.p.m., type G.D.
2-hp. Westinghouse, 1180-r.p.m., type GD

D.C., 500-Volt

1—5-hp. Crocker-Wheeler, series, with controller for hoist, 1340-r.p.m.
1— 7½-hp. General Electric, type CVC, Interpole, 825-r.p.m.
1—10-hp. Westinghouse, type S, 1200-r.p.m.
1—15-hp. Westinghouse, type M, 1050-r.p.m.
1— 8-hp. Westinghouse, type S, 900-r.p.m.

Direct-Connected Units 110-Volt, D. C.

1—30-kw. Western Electric, with Buckeye steam engine.
1—35-kw. Fairbanks-Morse, with Fairbanks-Morse 2-cyclinder vertical gas engine.
1—50-kw. American Ball Generator and Steam Engine.
1—9-kw. Westinghouse, with 2-cylinder, vertical Bruce MacBeth.

250-Volt

2—175-kw. Ridgway Dynamo & Engine Co. Generator and Steam Engine.
2—225-kw. Westinghouse Generators, with Koerting gas engines.
Also have a number of **Turbo Generator Units,** from 300-kva. to 3000-kva., 480- and 2300-volt, 3-phase, 60-cycle; direct connected two- and three-phase generators with reciprocating steam and gas engines.
Gas Engines, 5000-hp. in various sizes to 750-hp.
Boilers, 30,000-hp. in various sizes to 612-hp.
Air Compressors, large assortment, sizes to 2500-cu.ft.

W. A. CARRELI & CO 211-213-215 Second Avenue, Pittsburgh, Pa.

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FIRST-CLASS USED EQUIPMENT

Immediate Release

1—2000-2500-kw. G. E., 1800 r.p.m., 150-lb. pressure, 3-ph., 60-cy., 2300-volt horizontal **Steam Turbo Generator**—6000 sq.ft. C. H. Wheeler surface condenser, with engine driven aux.

2—500-hp. **Porcupine Boilers,** Mass. std., 160-lb. pressure, 6 years old. Universal chain grate, steel casing, individual stacks.

1—2000-hp. "Hoppes" open type **Feed Water Heater.**

1—2000-hp. "National" closed type **Feed Water Heater.**

1—200 GPM 3-in. Jeansville-Terry cent. D. S. **Pump.**

1—9-in. x 6-in. x 12-in. duplex, outside, center packed **Blake Pump.**

1—20-kw. G. E., 900 r.p.m., 2300-volt, motor driven, 125-volt **Exciter.**

1—**G. E. Tirrell Regulator,** 2886-TA-125-F-6, mounted on 16 x 31 x 1½ inches, black slate.

Greenfield Electric Light & Power Co.
Greenfield, Mass.

For Sale—Immediate Delivery

f.o.b. cars Baltimore, Md.

STEAM ENGINES

2—125-hp. 13 x 13 Harrisburg.
1—215 hp. 14 x 16 Ames.
1—210-hp. 16 x 14 Ball.

MOTOR GENERATOR

1—Synchronous Motor Generator Set consisting of 700 hp. Synchronous Motor, Type ATI, 25-cycle, 13,000-volt, 750 r.p.m., Form C, and 1 A. C. 500-kw., Type ATB, 60-cycle, 4000-volt, and direct current exciter type M.P., 125-volt. Three units mounted on one shaft with two bearings.

PUMPS

1—Simplex 3½-in. x 6-in. motor driven reciprocating pump with extended base with Westinghouse ½-hp. Type C 1200 r.p.m. Motor C. D. 1200 r.p.m. Motor.
1—Hill 2-in. Double suction Centrifugal Pump, with extended base. Capacity 75 G.P.M. against 125-ft. head.

NEW WESTINGHOUSE TRANSFORMERS

6—100-kva. Type S.C., 13,200-v. H.T., with 4—2½ H.T. Taps, 460 v., L. T. Single-phase, 25-cycle.
3—200-kva. Type S.C., 13,200-v. H. T., 2—5% Taps, 1-phase, 25-cycle, 460-230-v. L. T.
3—833-kva. O. I. S. C., 13,200-v. H. T., 4—2½% Taps, 1-phase, 25-cycle, L. T., 440 volts.

MISCELLANEOUS

1—New York Air Brake Compressor No. 2145 for 90 lb. pressure. Compressor end double action 7 in. x 9 in. delivering approximately 40 C. F. Air at 60 lb. pressure.
1—Patterson Automatic Steam damper regulator complete with brackets and weights.
2—160-hp. Terry Turbines, direct connected to No. 10 Sturtevant blowers.

Purchasing Agent
Consolidated Gas, Elec. Light and Power Co.
Baltimore, Md.

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500-VOLT DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	Speed
1	7½	General Electric—NEW	BGR	850
1	7½	Westinghouse	SK	850
3	7½	Westinghouse	SK	1150
1	7½	Westinghouse	SK	1750
8	7½	General Electric—2 compd.	RC	900
4	7½	General Electric	RC	1300
7	7½	General Electric	CVC	1125
1	7½	General Electric	CVC	1685
1	10	Westinghouse	SA	435/1300
2	10	Westinghouse	SK	1200
1	10	Westinghouse	SK	850
1	10	Westinghouse	SK	1300
1	10	Westinghouse		1250
1	10	Allis-Chalmers		900
4	10	General Electric	RC	900
1	10	General Electric	RC	1800
1	10	General Electric	CVC	1500
1	15	General Electric	RC	1250
2	15	General Electric	CVC	1350
1	15	Westinghouse	SK	825
3	15	Westinghouse	SK	1100
4	15	Westinghouse	SK	1700
1	20	Westinghouse	SK	1100
1	20	Westinghouse	SK	1700
1	20	General Electric	CLA	690
5	25	Crocker-Wheeler—compd.	CCM	780
6	25	Westinghouse	S	950
3	25	General Electric	DLC	875
1	25	General Electric	CVC	1700
1	30	Westinghouse	SK	1700
1	30	Westinghouse	R	
2	30	General Electric		1250
2	30	General Electric	RC	1250
2	35	General Electric	MP	600
1	35	General Electric	DLC	825
4	35	General Electric		850
3	35	Crocker-Wheeler—compd.	CCM	730
4	40	Westinghouse	SK	600
3	40	General Electric	RLC	600/1200
2	40	General Electric	RLC	1200
5	48-80	Westinghouse	SK	550/800
4	50	Westinghouse	SK	750
1	50	General Electric	DLC	750
1	50	Westinghouse	SK	975
2	50	Westinghouse	SA	550
2	65	Westinghouse—compd.	SA	825
3	70	General Electric	RLC	1100
1	75	Bullock		825
1	75	Westinghouse	SK	850
1	80	Westinghouse	SA	600/900
4	90	General Electric		1025
1	100	Westinghouse	S	685
1	105	General Electric	CLB	700
1	115	General Electric	DLC	975
2	150	General Electric—series, crane or hoist	GE-211	700

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"The Machinery House of the East"

FRANK TOOMEY, Inc.

1876 **1876**

DIRECT-CURRENT MOTORS
220-250 VOLTS

165-hp. Crocker-Wheeler, type CCM, Interpole, 670 r.p.m.
90-hp. Westinghouse, type M, 650 r.p.m.
50-hp. Westinghouse, type M, 675 r.p.m.
45-hp. Diehl Interpole 600 r.p.m.
40-hp. Allis-Chalmers 550 r.p.m.
25-hp. Westinghouse type SK Interpole 950 r.p.m
25-hp. Bullock 775 r.p.m.
15-hp. General Electric, type CE, 1200 r.p.m.
15-hp. Bullock, 1300 r.p.m.
15-hp. Peerless, 1150 r.p.m.
10-hp. Allis-Chalmers, 1300 r.p.m.
7½-hp. Crocker-Wheeler 1100 r.p.m.
7½-hp. General Electric, 1600 r.p.m.

DIRECT-CURRENT MOTORS
110-125 VOLTS

50-hp. Bullock, 850 r.p.m.
32-hp. Crocker-Wheeler, type CCM, 1000 r.p.m.
30-hp. Kinetic, 1100 r.p.m.
25-hp. Crocker-Wheeler, type CCM, 750 r.p.m.
20-hp. General Electric, type CQ, 925 r.p.m.
20-hp. General Electric, type CQ 1150 r.p.m.
15-hp. Crocker-Wheeler, type CCM, 800 r.p.m.
15-hp. Bullock, 1350 r.p.m.
2—10-hp. General Electric type RC, Interpole, 850 r.p.m.
4—10-hp. Crocker-Wheeler, type CCM, 825 r.p.m.
7½-hp. Crocker-Wheeler, 1100 r.p.m.
7½-hp. General Electric, type CE, 1800 r.p.m.

Large stock of Alternating and Direct Current Motors. Immediate shipment.

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We have or may have

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Partial list of 2-ph. motors, 220-volt, 60-cycles, squirrel cage Wagner motors.

SLIP RING, VARIABLE SPEED

Qu.	HP.	RPM.	Make
2	3	850	Wagner
1	5	1140	"
1	5	1720	"
1	7½	1720	"
1	10	850	"
2	15	850	"
3	11	850	West. 3 ph.
2	11	600	"
2	15	845	"
2	15	600	"

G. E., 3 ph., 1200 RPM		
Qu.	HP.	
2	35	Form L
2	30	" L
2	30	" B
2	20	" L
1	25	" B
1	50	Wagner

HAROLD R. WILSON MACHINERY CO.

Electric and Steam Machinery Second Hand

Federal Reserve Bank Building, ST. LOUIS, MO.

DIRECT CONNECTED D.C. UNITS 125-250 VOLTS

Kw.	Make	Volts	Poles	Sp.	Make Engine
2—500	Burke	250	..	150	22&38x27 Erie Ball, 4 Va.
500	C. W.	250	16	125	22&38x36 Ironton Corliss
400	Allis	250	..	....	Allis Corliss Cross Compound
300	G. E.	250	10	100	16&32x36 Corliss T. C.
300	Westge.	550	..	125	22x36 Corliss
300	C. W.	250	..	150	20x42 Corliss
300	G. E.	250	8	185	20&34x18 B. & W., 4-valve
250	Westge.	250	8	180	19 and 32x20 Ideal
2—175	McEwen	250	..	200	19x20 McEwen
160	G. E.	250	..	230	14 and 26 x 16 Harrisburg
3—150	Allis	250	..	....	16x24 3-cyl. Diesel Oil
150	Westge.	250	..	200	20x24 Erie Ball
125	G. E.	250	6	250	10 and 20x15 Automatic
3—100	Goughnour	250	..	265	14x15 Skinner
100	T. R.	250	..	....	McEwen Simple
75	Westge.	250	..	250	11x12 Westge. Gas Eng.
75	G. E.	230	..	2400	Curtiss Turbine
75	Westge.	250	..	270	14x14 Payne Automatic
75	W. E.	250	6	275	14 x 13 Chuse Automatic
50	G. E.	125-250	..	300	16 x 14 Harrisburg

ENGINES—BOILERS—A.C. & D.C. MOTORS, GENERATORS
This is only a partial list

IMMEDIATE DELIVERY

MOTORS

1—300 hp. Crocker-Wheeler 3 ph., 2300-v. 60-cy. 600 r.p.m. Slip-ring type motor only.
3—75 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
1—75 hp. General Electric, 2 ph., 220-v. 60-cy. 900 r.p.m. Slip-ring type complete.
4—50 hp. Fairbanks-Morse, 3 ph., 220-v. 60-cy. 900 r.p.m.
4—50 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
1—35 hp. General Electric, 220-v. Direct Current, 560 r.p.m.
1—30 hp. Triumph, 2 ph., 220-v. 60-cy. 1140 r.p.m.
4—25 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
3—25 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
2—25 hp. Fairbanks-Morse, 3 ph., 220-v. 60-cy. 900 r.p.m.
1—20 hp. General Electric, 3 ph., 550-v. 60-cy. 900 r.p.m.
1—20 hp. General Electric, 3 ph., 220-v. 60-cy. 1200 r.p.m.
3—20 hp. General Electric, 2 ph., 220-v. 60-cy. 1200 r.p.m.
5—20 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
5—15 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
2—15 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1800 r.p.m.
1—15 hp. Westinghouse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
2—15 hp. General Electric, 2 ph., 220-v. 60-cy. 1200 r.p.m.
1—15 hp. Sturtevant Direct Current, 125-v. 150/450 r.p.m. (shunt interpole).
1—15 hp. Fairbanks-Morse, 3 ph., 220-v. 60-cy. 900 r.p.m. (slip-ring).
1—15 hp. Fairbanks-Morse, DC, 230-v. 1100 r.p.m.
4—10 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 900 r.p.m.
4—10 hp. Fairbanks-Morse, 2 ph., 220-v. 60-cy. 1200 r.p.m.
Single Phase Wagner motors, 5 to 20 hp. type BA in stock.

GENERATORS

1—100 Kw., G. E. 125-v. DC direct connected to a Ball & Wood engine, complete with switchboard.
1—75 Kw., Crocker-Wheeler AC Generator, 2 phase, 220 volt, 60 cycle, 900 r.p.m. with direct connected exciter, complete with switchboard.
1—60 Kw. Stanley 2 ph., 60-cy. 900 r.p.m. with exciter and switchboard.
1—50 Kw., Western Electric generator 120-v. DC 265 r.p.m. 6-pole compound direct connected to an Ideal centercrank Harrisburg engine, complete with switchboard.
2—30 Kw., Westinghouse 125-v. DC direct connected to an American Ball engine complete with switchboard.
1—25 Kw., Crocker-Wheeler 125-v. DC direct connected to an American-Ball engine complete with switchboard.

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BROWN-HUNKELE CORPORATION, 12-24-26 Mechanic Street, Newark, N. J.

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GENERATORS AND MOTORS

1—125 Kva. Allis-Chalmers Generator, 2400 V., 3 P., 60 C., direct connected to Brownell Auto. Engine, complete with Switchboard.
1—150 Kw. Triumph, 250 V. D.C. Generator, direct connected to 16 in. x 21 in. Chuse Corliss Valve Engine.
1—150 H.P. Fairbanks, Morse, 440 V., 3 P., 60 C.
1— 20 H.P. Crocker-Wheeler, 220 V., 3 P., 60 C.
1— 20 H.P. G.E., 220 V., 3 P., 60 C.
1— 20 H.P. Fairbanks, Morse, 220 V., 3 P., 60 C.
1—200 H.P. Crocker-Wheeler, 150 V. D.C.
1— 10 H.P. Crocker-Wheeler, 115 V. D.C.
1— 10 H.P. Western Electric, 110 V. D.C.
1— 5 H.P. Triumph, 110 V. D.C.
2— 5 H.P. Bullock, 120 V. D.C.

CONVERTERS AND TRANSFORMERS

1—300 K.W. G.E. Rotary Converter, 25 C., 600 V.
3—110 K.W. G.E. Transformers, 25 C., 13,200 to 185 V. Oil Cooled.
3—200 K.W. Westinghouse Transformers, 25 C., 11,500 to 440 V. Oil Cooled complete with panel board and all instruments.
1—Complete set of Lightning Arresters.
3—10 K.W. Kuhlman Transformers, 25 C., 440 to 110 V. Oil Cooled.

COPPER WIRE

10,000 ft. 400,000 C.M. Stranded Bare Copper Wire.
50,000 ft. 350,000 C.M. Stranded Bare Copper Wire.
10,000 ft. of No. 4-0 Grooved Copper Trolley Wire.
15,000 ft. of No. 6 Rubber Covered Copper Wire.
10,000 ft. of No. 4 Rubber Covered Copper Wire.
10,000 ft. of No. 0 Rubber Covered Stranded Copper Wire.
10,000 ft. of No. 0 Weatherproof Stranded Copper Wire.

COMPRESSORS

2—310 ft. Capacity 12 in. x 12 in. Bury Single Cyl. Belt Driven Air Compressors, 100 lb. pressure.
2—250 ft. Cap. 14 in. x 9 in. x 8 in. Bury Compound Air Cyl. Belt Driven Air Compressors, 100 lb. pressure.
1—450 ft. Cap. 16¼ in. x 10¼ in. x 12 in. Ingersoll Compound Air Cyl., Belt Driven Air Compressor, 100 lb. pressure.
1—350 ft. Cap. 14 in. x 14 in. x 16 in. Chicago Pneumatic Steam Driven Compressor, 100 lb. pressure.

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1—50-hp., 3-phase, 60-cyc., 2200-v., 900 r.p.m.
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1—100-hp., 3-phase, 60-cyc., 220/440-v., 900 r.p.m.
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2—25 H. P. Burke, 900 R. P. M.
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1— 25 HP., 2-phase, 220 volt, Fairbanks-Morse, 900 RPM, slip ring.
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1	Westinghouse	15	CS	2	220	1200	60	Good
2	Westinghouse	25	CS	2	220	1200	60	New
1	Wagner	25	BR	2	220	1140	60	Good slip rg.
1	Allis-Chalmers	30	3K	2	220	860	60	Good
1	Crocker-Wheeler	7½	114Q	3	220	1130	60	New slip rg.
1	Crocker-Wheeler	10	114Q	3	220	1710	60	New slip rg.
1	Allis-Chalmers.....	10	B	3	220	1200	60	Good slip rg.
2	Westinghouse	15	KT	3	220	1200	60	New
1	Crocker-Wheeler	15	118Q	3	220	675	60	New
1	Crocker-Wheeler	15	KT	3	220	900	60	Good
1	Westinghouse	20	CS	3	220	900	60	Good
1	Westinghouse	20	CS	3	220	1200	60	Good
1	Crocker-Wheeler	20	116Q	3	440	1720	60	New
1	General Electric	20	I	3	220	1200	60	Good
1	Western Electric	20	KT	3	220	900	60	New
1	Crocker-Wheeler	25	25R	3	440	720	25	New
1	Westinghouse	25	CS	3	220	1160	60	New
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25	860	9
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30	860	3
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40	1170	4
40	870	5
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With Complete Storage Battery Plant

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speed 1200 r.p.m., complete with extended sliding base, and out board, pedestal bearing, pulley 14 in. diameter, with 18-in. phase, sterling compensator.

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Generator to deliver full rated load at 300 r.p.m. Full load everage 220 volts. Set to be used in 25% unbalanced compensator or 220/110 volts, three wire system.

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Plant shipped new from factory September, 1911. Not run since July, 1917. Is in good order and ready for immediate service.

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FOR SALE

GENERATING UNIT

Nash two cylinder vertical gasoline or fuel Engine, direct connected to 12½ kw., D.C. Generator, almost new.

NATHAN KLEIN & CO.
208 Center St., New York

PROMPT DELIVERY

VERTICAL ALTERNATORS AND EXCITER

2—650-kva., 150-r.p.m., 48-pole, 2400-volt, 156 amperes, 60-cycle, 3-phase, vertical type Generators, complete with bases, shafts, steady bearing and field rheostats.

1—50-kw., 450-r.p.m., 125-volt, vertical type exciter, complete with base, shaft, thrust bearing above and steady bearing below, and field rheostat.

For details and very attractive prices, write us.

The F. Bissell Company, Toledo, Ohio, U. S. A.

BRAND NEW

ROTARY CONVERTER

60 kva. 60-cycle, 3-phase, 230-volts.
Very low price.

NATHAN KLEIN & CO.
Howard & Centre Sts., New York City.

Quality Machinery
Never causes failures or regrets
We buy and sell only
The Best
What are your requirements
Geare & Co. Engineers

"Opportunity" Advertising:

Think
"SEARCHLIGHT"
First!

0099

FOR SALE

2—12 x 12 x 10-in. E. H. Flange Tee, F. & D.
1—12-in. E. H. Flange Tee, F. & D.
3—12 x 12 x 8-in. E. H. Flange Tee, F. & D.
1—12 x 12 x 4-in. E. H. Flange Tee, F. & D.
5—12 x 12 x 6-in. E. H. Flange Tee, F. & D.
2— 8 x 8 x 8-in. E. H. Flange Tee, F. & D.
1—10 x 8 x 8-in. E. H. Flange Tee, F. & D.
1—4½ x 4½ x 4½-in. E. H. Flange Tee, F. & D.
1—12 x 12 x 7 x 7 Cross, F. & D.
1—12 x 12 x 4½ x 4½ Cross, F. & D.
1—10-in. Ell E. H., F. & D.
1— 6-in. Ell, E. H., F. & D.
1— 8-in. Ell, E. H., F. & D., long sweep.
2— 8-in. Ell, E. H., F. & D.
1— 7-in. Ell, E. H., F. & D.
2—12-in., 45 deg. Ell E. H., F. & D.
1—4 x 3 x 2½ Tee, E. H., F. & D.
1—3 x 3 x 3 Tee, E. H., F. & D.
1—7-in. Ell, with 2½-in. screw outlet.
2—8-in. Facer, 12¾ in. long, F. & D.
2—8-in. Facer, 12 in. long, F. & D.
1—10 x 8 x 8-in. Tee, E. H., F. & D., 31½ in. long, face to face.
1—7-in. Gate Valve, Chapman Rising Stem.
2—4½-in. Gate Valve, Crane Rising Stem.
1—7 -in. Gate Valve, Non-rising Stem.
2—12-in. Gate Valve, Crane Rising Stem.
1—7 -in. Gate Valve, Crane Rising Stem.
1—6 -in. Gate Valve, Crane Rising Stem.
1—12-in. Gate Valve, with by-pass Crane.
1—12 x 12 x 7 Tee E. H., F. & D. Crane.

Indiana Railways & Light Co.
Kokomo, Ind.

WANTED

Engine & Turbo Generator Units—D.C. & A.C.
(All Sizes; Any Voltage)
Boilers—H.R.T. & Water Tube.

FOR SALE

500—220/440 A.C., 3/25 Cycle (all sizes).
200—110/220 D.C. & A.C. (all sizes).
Engine & Turbo Generator Sets—A.C. & D.C. (all sizes).
Boilers—H.R.T. & Water Tube—all sizes.

Correspondence solicited.

JOHN A. STEWART ELECTRIC CO.
208 So. LaSalle St., Chicago, Ill.

A. C. GENERATING UNITS

200 KW. 2200-v., 3-ph., 60-cy., Westinghouse direct connected to 17½ and 21½ Buckeye engine with exciter and board.

160 K.V.A. 440-v., 60-cy., 3-ph., Crocker-Wheeler direct connected to 17 x 16 Straight Line engine with board.

500 Motors and Generators

all sizes and voltages, fully guaranteed.

GREAT SAVINGS IN PRICES

WICKES MACHINERY CO.
Jersey City, N. J.

FOR SALE

100-Hp., 2-Phase, 60-Cycle, 220-Volt

514-r.p.m. Burke Squirrel Cage

MOTOR

with extended shaft for third bearing. G-E Compensator Starter, no base rails, pulley or 3d bearing. New, never used. *Immediate delivery.*

The Philadelphia Rubber Works Co.
Akron, Ohio

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MACHINERY

WANTED

MISCELLANEOUS

WANTED TO BUY

HORIZONTAL TURBO GENERATORS

2—500 KW. 1—750 KW. and 1—1000 or 1500 KW.

100 to 150 lb. steam pressure, 3-ph. 60-cy. either 2200 or 440 volt. Wire price including complete specifications together with list of switchboard and auxilaries.

W. C. McCREERY
63 Horton Street, Seattle, Washington

WANTED

One Direct Connected Engine Drive Alternator Set 1100-volts, 2-phase, 60-cycle, 100-Kw. to 200-Kw. capacity. Also One 250-volt direct current Engine Set direct connected.

HENRY P. THOMPSON
Mercantile Library Bldg., Cincinnati, Ohio

Wanted for Immediate Delivery

One Rotary Converter or Synchronous Motor Generator

with necessary transformers.

13,200 volts, 3 phase, 60 cycle, for 550-600 volt D. C.

Rockingham County Light and Power Co.
Portsmouth, N. H.

WANTED

MOTORS

One 100 H.P., 230-volt, 500 to 600 RPM, direct current, compound wound motor.

Also, one 40 to 50 H.P., 230-volt, 600 to 900 RPM motor.

THE JOS. L. SKELDON ENGR. CO.
Toledo, Ohio

Turn Your Motors Into Cash

WANTED

Electric Motors
Electric Exhaust Fans

We are ready to purchase in any quantities Electric Motors ¼ to 100 H. P., A. C. and D. C. 110-220-550 Volt. Wall, Desk, Oscillating, Exhaust and Ceiling Fans.

LEATHER BELTING

Mail list with prices, if interested will mail check.

MONARCH ELECTRIC MOTOR CO.
166 Centre St., Cor. Canal St. **New York City**
Franklin: 1240, 6232, 6233

Engine Generator Units Wanted

Complete, either alternating or direct current.

Let me know what you have available as to capacity and voltage.

C. H. MOHR, 3817 Ashburton Ave., Baltimore, Md.

WANTED

250-H.P.

Westinghouse Motor

3 Phase, 25 Cycle, 2200 Volt, 240 R.P.M., in first-class condition.

C. P. WILSON SO.
709 Lunsden Bldg., Toronto, Canada.

QUICK ACTION SPOT CASH PAID
for
electric motors, machinery or entire plants.
Any amount.
NATHAN KLEIN & CO.
Howard & Centre Sts., New York City

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Get Your Wants into the Searchlight

ADVERTISING RATES

Ads Set in Uniform Style

(Solid, in one paragraph, without display.)

THREE CENTS A WORD, minimum charge 50 cents an insertion, payable in advance, less 10 per cent. if one payment is made in advance for four continuous insertions—for advertisements under:

Positions Wanted	Vacation Work Wanted
Evening Work Wanted	Salesman Wants Connections

FIVE CENTS A WORD, minimum char e $1.50 an insertion, for advertisement under:

Agencies Wanted	Positions Vacant
Agents Wanted	Partner Wanted
Business Opportunities	Representations Wanted
Desk Room for Rent	Salesmen Wanted
Educational	Patents for Sale
Employment Agencies	Plants for Sale
Desk Room Wanted	Sub-Contracts Wanted
Foreign Business	Work Wanted

Miscellaneous for Sale, for Rent or Want Ads.

THIRTY CENTS A LINE, minimum five lines, for all undisplayed advertisements set with a paragraph for each item or tabulated.

THREE DOLLARS AND SIXTY CENTS AN INCH for advertisements for bids (Official Proposals).

Ads Set i n Display Type

(Individual space, within border rules.)

Space for these advertisements is sold by the inch. Each page contains 30 inches. The rate per inch is based on the *total* number of inches to be used—that is, the number of inches the advertisement is to occupy multiplied by the number of insertions it is to receive. For instance, a 2-inch advertisement in 2 issues earns the 4-inch rate of $3.90 an inch. A 1-inch space for 4 issues, or a 4-inch space in one issue, also earn the 4-inch rate.

SCHEDULE OF RATES

1 to 3 in.,	$4.00 an in.	15 to 26 in.,	$3.70 an in.
4 to 7 in.,	3.90 an in.	27 to 49 in.,	3.60 an in.
8 to 14 in.,	3.80 an in.	50 to 99 in.,	3.50 an in.

Rates for larger space furnished on request.

For quick and satisfactory results tell the reader everything that he will want to know.

INFORMATION

ALLOW FIVE WORDS for the address, if replies are to a box number in care of any of our offices There is no extra charge for forwarding replies.

IN REPLYING TO ADS, do not enclose origin a testimonials or anything that you may want returned. State your experience and qualification in as concise and neat a manner as possible and enclose copies of your testimonials.

BE CAREFUL TO PUT ON ENVELOPE, when answering any "blind" ad, the box number in the ad, the name of the paper, and also the local address of office to which reply is sent:

36th St., at 10th Ave.,	New York
935 Real Estate Trust Bldg.,	Philadelphia
657 Lead er-News Bldg.,	Cleveland
1570 Old Colony Bldg.,	Chicago
501 Rialto Bldg.,	San Francisco

WHEN ADVERTISING MACHINERY, use your own name and address—or a local address of some kind—so that the readers can wire direct and get quick replies. We advise also that you state in your advertisement the present location of plant that is offered for sale, or point of delivery provided you are in the market for equipment.

TO SIGN YOUR NAME and address to your advertisement begets the confidence of the reader and facilitates receiving replies. You can, however, obviate delay in receiving answers by signing your ad. only with initials (your own or others), care of your home, your office or a post-office box number in your city.

FOR SALE

Magnet Wire, Volt Meter and Arc Lamps

Magnet wire, No. 18, No. 38 and No. 39; resistance wire, No. 38 and 39, 100 arc lamps, D.C., and volt meters and ammeters for sale at half price. Walsh's Sons & Co., Newark, N. J.

Motors—Sell Cheap

Two 20 HP. 25 cycle Westinghouse; four 10 and two 15 HP. 60 cylinder Robbins & Myers. All complete with starting compensators, pulleys and rails. H. W. Wiswell, 122 N. 7th St., St. Louis, Mo.

Vertical Motors For Sale

2 G. E., 50 hp., 1800 r.p.m., 440 volt, 60 cycle, 3 phase, vertical, Form K motors, each with no-voltage release starting compensator and overload relay. Practically new. Also large stock motors and generators. Write for stock list. V. M. Nussbaum & Co., Ft. Wayne, Ind.

Generators For Sale

Two C. & C. generators, type SL, 1.8 kw., 60 volts, 30 amps., 1750 r.p.m. Complete with rheostat pulley and base; one new, one used four weeks. Make offer. D. J. Carter, 6 Wilson St., Bridgeport, Conn.

Get your Wants into the Searchlight

MISCELLANEOUS

Electricians

Send $1.50 for 16 blue prints of Motor Windings, 10 A. C. Single, two and three-phase, and 6 D. O. or set of 20 A. C., 6 D. C. and 6 Rotary Converter Drawings for $2.25. Connecting and Winding made easy. Superior Electric Co., Lock Box, 1372, Pittsburgh, Pa.

PATENT ATTORNEYS

Patents, Trademarks, Copyrights—If you have an invention write for our Free Illustrated Guide Book, "How to Obtain a Patent." Send model or sketch and description for our free opinion of its patentable nature. Highest references. Prompt service. Reasonable terms.

VICTOR J. EVANS & CO.
845 Ninth St., N. W., Washington, D. C.

Business Opportunities

Capital—Partners—Plants—Shops—Properties—Industrial Sites

Combination Electric Light and Ice Plant

For sale in one of the healthiest sections of South Carolina; equipment in best of condition and urgent demand for all the ice we can produce. Can arrange terms and give possession at once. Come and see it in operation. Boyd Utilities Plant, Johnston, S. C.

Electrical Household Appliances

An organization capable of nationally distributing electrical household appliances is in a position to contract for the entire output of a plant now manufacturing or in a position to manufacture electric clothes washers or dish washers. Would consider aiding in the manufacture of any meritorious machine that is now partially developed. BO-989, Elec. World.

Electric Light and Ice Plant

For sale, in county seat town; liberal franchise; street lighting, city pumping, six smaller towns within radius of 15 miles. A real opportunity for party having a little capital. Address Box 282, Edina, Mo.

A Manufacturer of Electrical Appliances

Wishes to secure the services of a man capable of developing for the market an electric household clothes washer or dish washer. BO-990, Elec. World.

BUILDING

(Steel Frame)

132 ft. x 100 ft.—24 ft. to eaves. Roof consists of two trusses—50-ft. span each. Used as a power house and machine shop during construction of East River Tunnel.

In Excellent Condition
Plan of building can be furnished

BOOTH & FLINN, Ltd.
17 Battery Place, New York

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POSITIONS VACANT

EMPLOYMENT

POSITIONS WANTED

OFFICIAL PROPOSALS

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C. June 2, 1919.—Sealed proposals will be opened in this office at 3 p. m., July 1, 1919, for supplying to the various Federal Buildings, Marine Hospitals, and Quarantine Stations under the control of the Treasury Department, portable desk lamps during the fiscal year ending June 30, 1920, in accordance with the drawing and specifications, copies of which may be had at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

TREASURY DEPARTMENT, Supervising Architect's Office, Washington, D. C., June 19, 1919. Sealed proposals will be opened in this office at 3 p.m., July 16, 1919, for furnishing and installing lighting fixtures in the South Building, Hygienic Laboratory, U. S. Public Health Service, Washington, D. C., in accordance with drawings and specifications, copies of which may be had at this office. Proposals are desired only from those qualified to produce work of the highest grade, both artistically and mechanically, and the right is reserved to refuse to send the drawings and specification to or to receive proposals from any one who, in the opinion of the Supervising Architect, is not so qualified. Jas. A. Wetmore, Acting Supervising Architect.

POSITIONS VACANT

A DIESEL engine electric station engineer wanted who can operate engines in parallel and handle the switchboard. Steady job. Address Atlantic Light & Power Co., Coeymans, N. Y.

AN established electrical manufacturing company wants electrical technical graduates with steel mill experience for sales work. Selling experience not necessary. P-718, Elec. World, Leader-News Bldg., Cleveland.

AAE IS EVERYWHERE!

AMERICAN ASSOCIATION OF ENGINEERS
ADVANCE-CO-OPERATE
JOIN NOW
A.A.E.
NATIONAL HEADQUARTERS 28 S. LA SALLE ST., CHICAGO, ILL.

WRITE FOR BLANKS TODAY!

NAME .....
STREET .....
CITY .....
STATE .....

POSITIONS VACANT

A MUNICIPAL electric light plant desires a chief engineer at their power plant. Generating equipment consisting of 1 750 kilowatt turbine condensing, 1 400 k.v.a. alternator driven by Cross compound engine, non-condensing and 1 200 k.v.a. alternator driven by single cylinder engine. Correspondence confidential. P-981, Elec. World.

ARMATURE winder wanted for Western Kentucky coal field; one with experience on Sullivan short-wall machine armatures preferred. P-3, Elec. World.

BUSINESS manager and secretary wanted to represent a live Contractors' Association with qualifications as an organizer. A man with electrical experience preferred. State references, salary expected and qualifications in first letter. Address Secretary, 41 East Jefferson Avenue, Detroit, Michigan.

DRAFTSMEN wanted for the Panama Canal—1 electrical draftsman experienced in underground power distribution and building illumination; $168 to $179 month; 2 hull draftsmen, $168 to $231 month; 1 draftsman capable of handling municipal engineering work, $189 month; must be thoroughly experienced in special lines above indicated; American citizens under 50 years of age, in good health. Free steamship transportation from New York or New Orleans, salary beginning date of sailing. Write Chief of Office, The Panama Canal, Washington, D. C.

ELECTRICAL draftsman wanted by a California public utility corporation. Should be experienced in power house and substation design. Chance of advancement for right man. State age, experience and salary. P-912, Elec. World, Rialto Bldg., San Francisco.

ENGINEER familiar with the design and application of fractional horse power motors, both A.C. and D.C. Opportunity to develop with a rapidly growing business. In replying, give experience. P-995, Elec. World, Phil.

ENGINEER experienced in the design of induction motors. Permanent position for man able to do independent work. Please state training and experience. P-996, Elec. World, Phil.

ENGINEER experienced in the design of transformers. Permanent position for man who can qualify. State age, training, experience and salary expected. P-998, Elec. World, Phila.

EXPERIENCED electrical draftsman wanted, one who has had some mechanical experience preferred; state experience and salary expected in first letter. Electric Machinery Company, Minneapolis, Minn.

EXPERIENCED electrical draftsmen wanted for designing of high tension substations and power plants. Draftsmen must be capable of preparing bills of material and cost estimates for station designs. State age, experience and salary desired. P-960, Elec. World, Chicago.

POSITIONS VACANT

EXPERIENCED designing engineers, competent to do original design work on direct current motors and generators of small and medium sizes. In replying, state education, experience and salary expected. P-997, Elec. World, Phila.

HIGH-GRADE, experienced, new business solicitor wanted; capable of figuring requirements of small power jobs. Good salary, permanent position and opportunity for advancement in operating department. Give experience, record, salary desired, married or unmarried. Address Box 313, Cedar Rapids, Iowa.

METER tester; outside tester on single and polyphase meters. Within 50 miles of Chicago. State age, experience and salary wanted. P-993, Elec. World, Chicago.

POSITION open as chief draftsman for man having had experience on electrical measuring and protective apparatus. Unusual opportunity for advancement for the right party. Address P-987, Elec. World.

TECHNICAL graduates in E. E. wanted, recent and prospective. A few men will be employed at attractive rates by manufacturer of motors and generators located in Middle West. Send your application promptly, stating previous record and when you desire to start work. P-961, Elec. World, Chicago.

STEADY job; foreman electrician, all around for motor repairs A. C. and D. C. Good pay to cracker-jack man. P-986, Elec. World.

METER tester and repairman wanted. Good salary for the right kind of a man. References required. State experience. Box 373, Evansville, Ind.

EMPLOYMENT AGENCIES

Employment Service

The undersigned provides a confidential service designed to locate openings through correspondence for men earning not less than $2,500 and up to $25,000; all lines. Not an employment agency, but a constructive, initiative service, covering individual negotiations. Established 1910. Complete privacy assured; present connections in no way jeopardized. Send name and address only for explanatory details. R. W. Bixby, 310 Lockwood Bldg., Buffalo, New York.

EMPLOYERS

Send us your inquiries for men of technical training and experience. We are obtaining employment for soldiers, sailors and marines released from the service.
Re-Employment Bureau of New York City for Soldiers, Sailors and Marines, 505 Pearl Street, north of Municipal Building, Professional Section. Worth 9250.

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POSITIONS WANTED

AMERICAN electrical engineer, 12 years' experience, mainly designing industrial plant installations. Moderate salary. PW-917, Elec. World.

AM desirous of connecting with electrical manufacturer or lighting company; age, 27; technical graduate; seven years' practical experience in electrical manufacturing, testing and new development work. Would consider position as salesman or representative. Recently discharged officer U. S. Air Service. Salary expected, $160 to $200 per month. PW-927, Elec. World.

CHIEF electrician open for position; 12 years construction, operation, maintenance; armature and field winding; storage battery work; honorable discharge U. S. Army. PW-11, Elec. World, Chicago.

COMBUSTION engineer, technically trained, ten years' experience in the burning of anthracite and bituminous coals in large power plants. Qualified to experiment with new methods of burning coal. PW-991, Elec. World.

ELECTRICAL engineer, ten years' experience; induction motor design 5 to 5000 H.P.; will design lines of motors or take charge of department. PW-870, Elec. World.

ELECTRICAL engineer; just the man you want invites your correspondence; six years' shop, installation, construction, maintenance, planning; one year coal mine electrification. French, Spanish, Domestic or foreign service; now first lieutenant commanding engineer horse and motor transport, A. E. F. Free about July 1st. PW-733, Elec. World.

Your Advancement

is largely in your own hands—it is doubtful if any one else is worrying over it.

Better positions are constantly being secured through small advertisements in the "Positions Wanted" columns.

60 CENTS FOR 20 WORDS

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad. and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
935 Real Estate Trust Bldg., Phila.
657 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
501 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

POSITIONS WANTED

DRAFTSMAN desires permanent position; has I. C. S. training and 10 years' experience. PW-918, Elec. World.

ELECTRICAL ENGINEER technically trained university man, desires responsible engineering position. Has had six years' extensive and varied laboratory experience in the development and testing of small electrical apparatus, the design of electromagnetic windings and of circuits. Thoroughly familiar with telephone and telegraph engineering, central officer and equipment; possesses broad general knowledge of electrical engineering subjects, including radiotelegraphy. Location near New York preferred. Your correspondence is invited. PW-945, Elec. World.

ELECTRICAL and mechanical engineer, with executive ability, desires position as manager, electrical engineer or superintendent of light and power company; 14 years' experience, office, design, construction and operation, steam and electric plants, refrigeration, general supervision light and power properties. Technical graduate, married, age 34, honest, honorable, capable, best references. Salary, $2400. PW-951, Elec. World, Chicago.

ELECTRICAL engineer and superintendent, technical graduate, 7 years' experience, recently released from army, desires position as electrical engineer of industrial plant, or central station distribution engineer. Broad experience in design, construction and operation of substations and electrical equipment for mills and mines. Formerly electrical superintendent of plant employing over 100 electricians. Salary, $3000. PW-992, Elec. World, Phila.

ELECTRICAL engineer, just the man you want, invites your correspondence; six years shop, installation, construction, maintenance, planning; one year coal mine electrification; French, Spanish; domestic or foreign service; now first lieutenant commanding engineer horse and motor transport, A. E. F.; free about July 1. PW-999, Elec. World.

ELECTRICAL construction and maintenance man; ten years' experience A.C. and D.C., desires change. South American work preferred. Best reference furnished. PW-10, Elec. World.

ELECTRICAL construction superintendent open for position; twelve years' experience on power and substations; railroad electrifications; industrial installations including steel mills and chemical plants and underground cable systems. Age, 33 years. PW-965, Elec. World, Phil.

POSITIONS WANTED

ELECTRICAL and mechanical engineer open for engagement; extensive experience covering consulting, power plant design, steam and electric substations, high tension design, factory management, waterworks design; highest references. PW-966, Elec. World.

ELECTRICAL engineer, army officer, leaving service. Seven years' experience, testing, appraisal, engineering and purchasing. PW-970, Elec. World, Philadelphia.

ELECTRICAL engineer; technical graduate; seven years with the General Electric Company, laboratory, test, design, construction foreman. Power plant and substation design, installation and operation. Minimum salary, $200. PW-953, Elec. World, Leader-News Bldg., Cleveland.

ELECTRICIAN, 29 years old, with 15 years' experience, construction and repairs, both as workman and contractor-dealer, enlisted and honorably discharged; desires position with lighting company or as traveling salesman with supply house, preferably west. PW-943, Elec. World, Chicago.

ENGINEER wishes a change; small light plant or mill preferred; correspondence solicited. PW-969, Elec. World, Chicago.

EXECUTIVE position desired; 12 years' general central station experience—motors, wiring, arc lamp, trouble, drafting, collection, meter, office and sales departments; 2 years' assistant to manager; married; 31 years of age; located, but desire change; best of employers' references. PW-972, Elec. World.

EXPERIMENTAL and development engineer, technical graduate, with 15 years' experience, competent to direct such work including design and manufacture. Also five years sales and management. Specialties telegraph, telephone, fog signals, submarine cable and automobile lines. PW-905, Elec. World.

FIRE prevention engineer; electrical engineer, technical graduate; 28; available August 1st; several years' experience design, manufacture, and installation protective devices; thoroughly familiar with commercial phases protection business; desires position of responsibility and prospects. Minimum salary, $2500. At present with A. E. F. PW-979, Elec. World.

GRADUATE electrical engineer; thoroughly trained by one of the larger companies with five years' industrial experience and two years' field service as captain engineers U. S. A.; will soon be available for engagement. Detailed information of training and experience and highest references will be furnished upon request. PW-13, Elec. World.

GRADUATE electrical engineer, 29, seven years' experience in the sale, purchase, application and operation of power machinery, seeks position as electrical engineer in progressive manufactory. Foreign service will be considered. PW-12, Elec. World.

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POSITIONS WANTED

MAJOR of engineers, U. S. Army, with valuable connections and knowledge of government procedure, now holding administrative position in War Department, desires similar position with going concern. Salary $600. PW-984, Elec. World, Philadelphia.

MANAGER'S assistant and purchasing agent, or general superintendent of construction of interior, underground and overhead installation of electrical holding and operating company or municipal properties; have electrical education and 13 years' experience; economical manager and business builder. Past President of Electrical Association. PW-4, Elec. World, Chicago.

MANAGER, 12 years' experience in central station service. Particularly successful in building up run-down property and maintaining friendly relations with public. Married; 36 years old; best of references. PW-994, Elec. World.

METER and test engineer, technical graduate, 32, married; now employed; desires change. New England states preferred. References. PW-913, Elec. World.

OFFICER, 18 months in research, air service, wishes position, New England preferred. Previous experience in electrical engineering, physics and manufacturing. PW-1, Elec. World.

OPERATING engineer; 15 years' experience steam, electric and internal combustion engine plants; University graduate; age, 34; ex-soldier. PW-971, Elec. World, Chicago.

OPERATING position, hydro-electric preferred. Technical trainiing, 7 years' operating of stations and large substations all types. Age 30, married. Can speak Italian. Would work on new project. PW-944, Elec. World, Chicago.

POSITIONS WANTED

PATENT engineer; electrical engineer; technical graduate; 28; several years' experience analysis and digest scientific papers with view preparing patent forms and claims; specially capable in analysis telephonic and telegraphic circuits; available August 1st; now with A. E. F.; minimum salary, $2500. PW-978, Elec. World.

SALES manager or industrial power salesman; twelve years' central experience; seven years as industrial power salesman for large company; isolated plant analysis; good record; personality; technical graduate; age, 37; married; salary, $2400. PW-988, Elec. World.

SUPERINTENDENT of electric light and power plant, or waterworks, in medium-sized city, or chief electrician in an industrial plant; age, 35; 16 years' experience, practical and technically competent with both steam and hydro-electric plants, would consider taking charge of installing new plant and running same afterward; am desirous of a steady position; employed, but desire change; can furnish references as to character and ability, available on short notice; least salary to start, $1800. J. M. C., 1816 14th St., Superior, Wis.

TECHNICAL graduate (2-year course), wishes position with power company. Overseas service. Honorably discharged. Varied experience. Available within thirty days. PW-2, Elec. World.

TECHNICAL graduate (I. C. S.), seven years' practical experience along maintenance and operation of A.C. and D.C. apparatus, including two years G. E. test of E. R. equipment, and nine months' switchboard operation, seeks position along testing, maintenance, or operation, with manufacturing or operating company; A-1 reference; single; 28; nationality, Slovak; Western states preferred. Salary, $100. Address PW-7, Elec. World.

TURBINE engineer and switchboard operator desires change; long experience. PW-8, Elec. World, Phila.

POSITIONS WANTED

UNIVERSITY graduate in electrical engineering; 5 years' experience; 30; married; desires permanent position along line of electrical research, testing or experimental work. Location preferably Ohio or adjacent territory. Salary to start secondary to securing right connection. Details of experience and references furnished on request. PW-9, Elec. World, Leader-News Bldg., Cleveland.

EXTRA WORK WANTED

Special Investigations or computations
Civil or electrical interfering with your executive duties undertaken in spare time, by engineer of broad experience and excellent conections. EW-975, Elec. World.

EDUCATIONAL

ELECTRICAL ENGINEERING—Practical one-year trade course; also two-year electrical engineering course. Comprehensive training in mathematics, mechanics, applied electricity and drafting, including actual installation, operation, testing and repair of electrical machinery and testing of steam and gas engines. New buildings and equipment. Send for catalog. Detroit Institute of Technology, Detroit Mich.

BLISS ELECTRICAL SCHOOL, Washington, D. C., again open to civilians. Condensed Course in Electrical Engineering. Complete in one year. For men of character, ambition, limited time. Principles and application of electricity. Mathematics, Steam and Gas Engines, Mechanical Drawing, Shop Work. Construction, installation, testing. Fireproof dormotories, dining hall, laboratories. 27th year opens October 1st. Catalog.

Selling Opportunities

Salesmen — Agents — Representatives

SALESMEN WANTED

Salesman of Ability and Experience Wanted
To handle line of high-grade flashlights and batteries; assistant sales manager; excellent position for the right man; experience and references required. AS-14, Elec. World.

SALESMAN AVAILABLE

Electrical and Mechanical Sales Engineer
Recently severed connections government work with manufacturer war material, desires connection, salary or commission manufacturer of high-class material. Eastern territory preferred. AS-973, Elec. World, Phil.

AGENTS WANTED

Manufacturers Agencies Wanted
Demand increasing rapidly. If you are interested in responsible, reliable and experienced representation on the Pacific Coast, write Room 812, Hobart Building, San Francisco, Calif.

In Replying to "Blind" Ads

be careful to put on envelope the key number in the ad and also local address of office to which reply is sent.

10th Ave. at 36th St., New York.
935 Real Estate Trust Bldg., Phila.
657 Leader-News Bldg., Cleveland.
1570 Old Colony Bldg., Chicago.
501 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

AGENCIES AVAILABLE

Do You Want Representation in Manchuria?
Advertisers are invited to communicate with Messrs. Fukuaho Company, Dairen, Manchuria, who are interested in all kinds of machine tools, engineering requirements and railway materials. If not already represented in Manchuria Fukusho Company invite correspondence with this end in view. Advertisers are requested to forward catalogues, prices and terms offered.

Get your copy in early—

Owing to the holiday next week, the forms for the Searchlight Section of the

July 5th Issue

of

ELECTRICAL WORLD

will close for press at 10 A. M., Tuesday, July 1.

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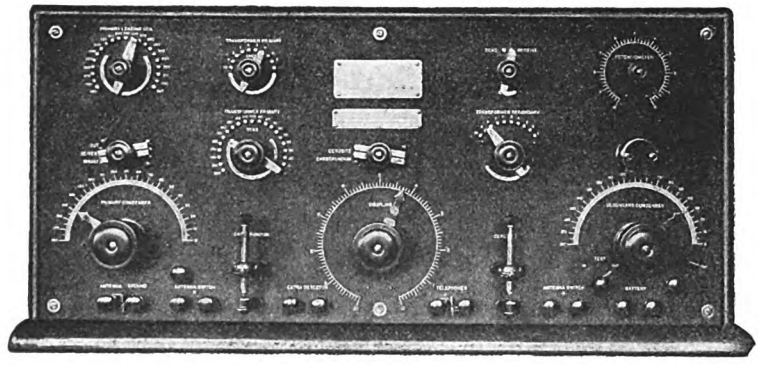
BAKELITE

REG. U. S. PAT. OFF.



From a bushing to a panelboard—

and for mechanical as well as electrical parts—the qualities peculiar to Bakelite make it the dependable and economical moulding material.

BAKELITE *combines* high heat resistance with great mechanical and dielectric strength.

BAKELITE is steam, oil, water and age-proof, chemically inert, odorless and tasteless.

BAKELITE will not shrink, swell, warp or split after being moulded.

BAKELITE takes a smooth, lustrous finish from the mould and needs no buffing to present an attractive appearance.

BAKELITE moulds to such an exact impression, no finishing hand work is necessary.

BAKELITE can be moulded with metal inserts incorporated in the process—thus eliminating a second operation.

BAKELITE would prove a decided manufacturing economy in half a hundred ways because of these half a dozen reasons. How about using **BAKELITE** in your product?

The GENERAL BAKELITE COMPANY, 2 Rector Street, New York, welcomes inquiries from manufacturers and maintains a research laboratory for the working out of new applications.

2041-B

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What Would You Think of a Manufacturer—

—who wrote to you with a lead pencil—"We are saving much money because we do not use typewriters and telephones"? You might as well wonder whether his merchandise was as much out of date as his business methods.

You kinow that modern time- and labor-saving appliances are not added expenses, but that they have superseded slower and more costly processes.

The concern which uses your business paper to tell you its business story is simply using a modern piece of selling machinery to make it easier for you to buy intelligently with the least waste of your time and theirs.

For the right kind of advertising shortens the distance between human minds just as certainly as the railroad shortens the distance between places. It is still possible to walk from New York to Chicago, and it is still possible for a business to get along without advertising, BUT—

—bear in mind that the seller who does not advertise does NOT save the cost of advertising, for it costs more to do the work of advertising by other means. Consistent advertisers are progressive merchandisers, and it pays to do business with them.

You are invited to consult us freely about Business Papers or Business Paper Advertising.

THE ASSOCIATED BUSINESS PAPERS INC.

The International Association of Trade and Technical Papers

Headquarters, 220 West 42nd Street, New York

LIST OF MEMBERS

Each has subscribed to and is maintaining the highest standards of practice in their editorial and advertising service.

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American Funeral Director
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American Paint and Oil Dealer
American Printer
American School Board Journal
Architectural Record
Automobile Dealer and Repairer
Automotive Industries
Boot and Shoe Recorder
Brick and Clay Record
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Canadian Grocer
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Coal Age
Coal Trade Journal
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Electrical Record
Electrical Review
Electrical World
Embalmers' Monthly
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Furniture Manufacturer & Artisan
Furniture Merchants' Trade Journal
Gas Age
Gas Record
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National Petroleum News
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Power Boating
Power Plant Engineering
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Shoe Findings
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Southern Engineer
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Sporting Goods Dealer
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Textile World Journal
Timberman
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Rome-Wire

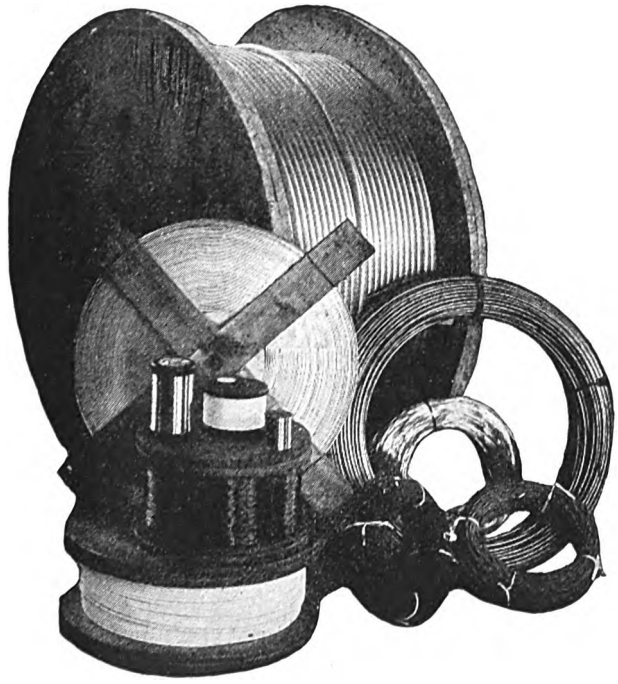
Rome Service Starts at the Wire Bar

FROM the time the wire bar goes into the billet furnace, every step in the progress of the wire to its finished state is under the observation and direct supervision of a capable expert whose duty it is to see that the Rome Standard is maintained.

Superior methods, special machines, close cooperation and rigid adherence to promises, make ROME SERVICE possible, and produce electrical wires and cables that are dependable in every detail.

NOW is a good time to test our assertion that the Rome trade-mark is a sign of efficient conductors.

Rome
Wire Company
Rome, N. Y.



All Operations from Wire Bar to Finished Product in this Plant.

Rome-Wire

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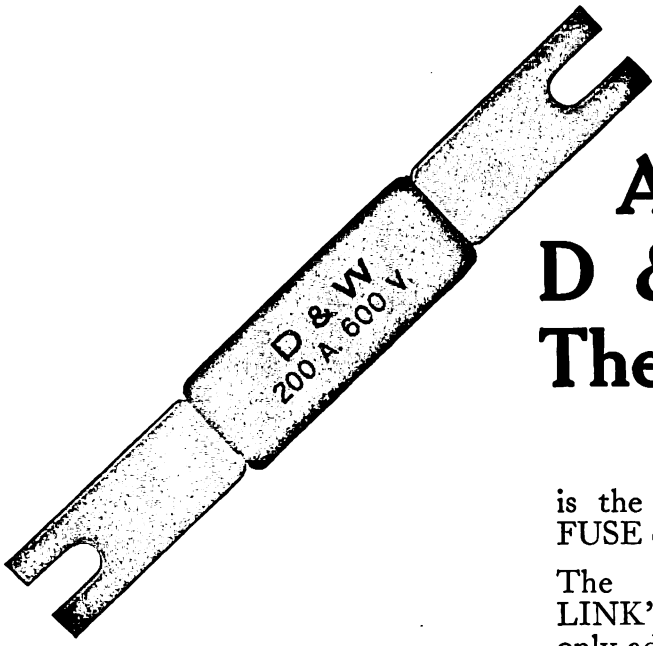


Another New D & W Feature The Expulsion Link

is the greatest advance in RENEWABLE FUSE design yet produced.

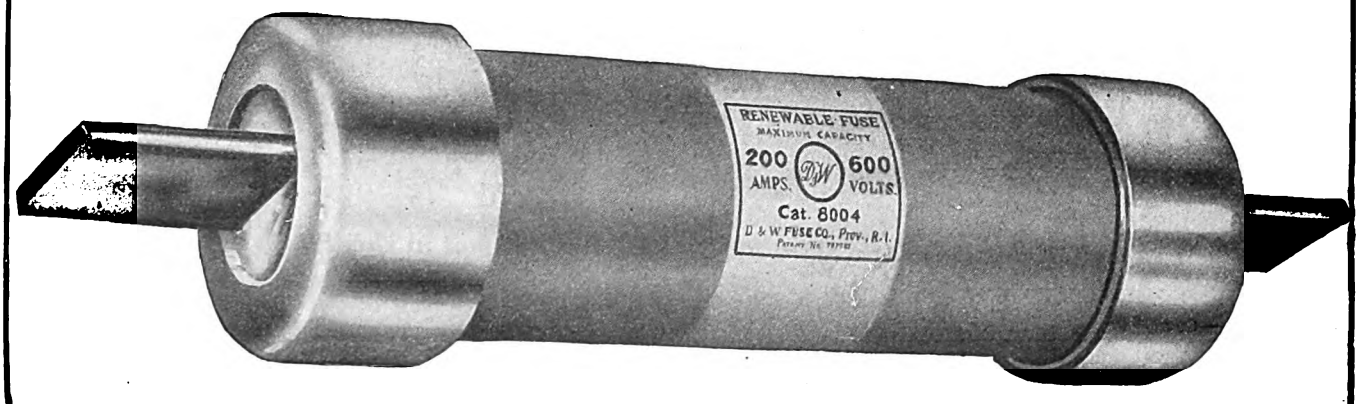
The new "JACKETED EXPULSION LINK" for knife blade type D. & W. fuses not only adds to the life of the shell but positively quenches the arc inside the "jacket" and the gases generated forcibly expel the fused metal at each end.

This disrupts the arc, prevents charring of tube and insures quick opening of the circuit. The threaded sleeves on the shell ends insure long life. The few parts make for simplicity—prevent cross threading and destroying of the threads as with threaded fibre which may also shrink or warp.

All steel parts of D. & W. RENEWABLE FUSES are oxidized, preventing adhesion of molten metal and insuring greater and more positive contact and carrying capacity.

Send for bulletins on "EXPULSION LINKS" and keep abreast of the times.

D & W Fuse Company
Providence R.I.
U.S.A.



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THE output of Hoovers is the largest in the world. We are increasing it daily. Our 1920 plans embrace double the number of Hoovers which the most diligent efforts will produce this year. Popularity sets a fast pace—but we are constantly "covering more ground" with buildings to provide the necessary capacity to keep up.

The Hoover Suction Sweeper Co.

World's oldest, largest and most successful electric cleaner makers

North Canton, Ohio Hamilton Ont., Canada

The HOOVER

ELECTRIC SUCTION SWEEPER

It *Beats*...as it Sweeps as it Cleans

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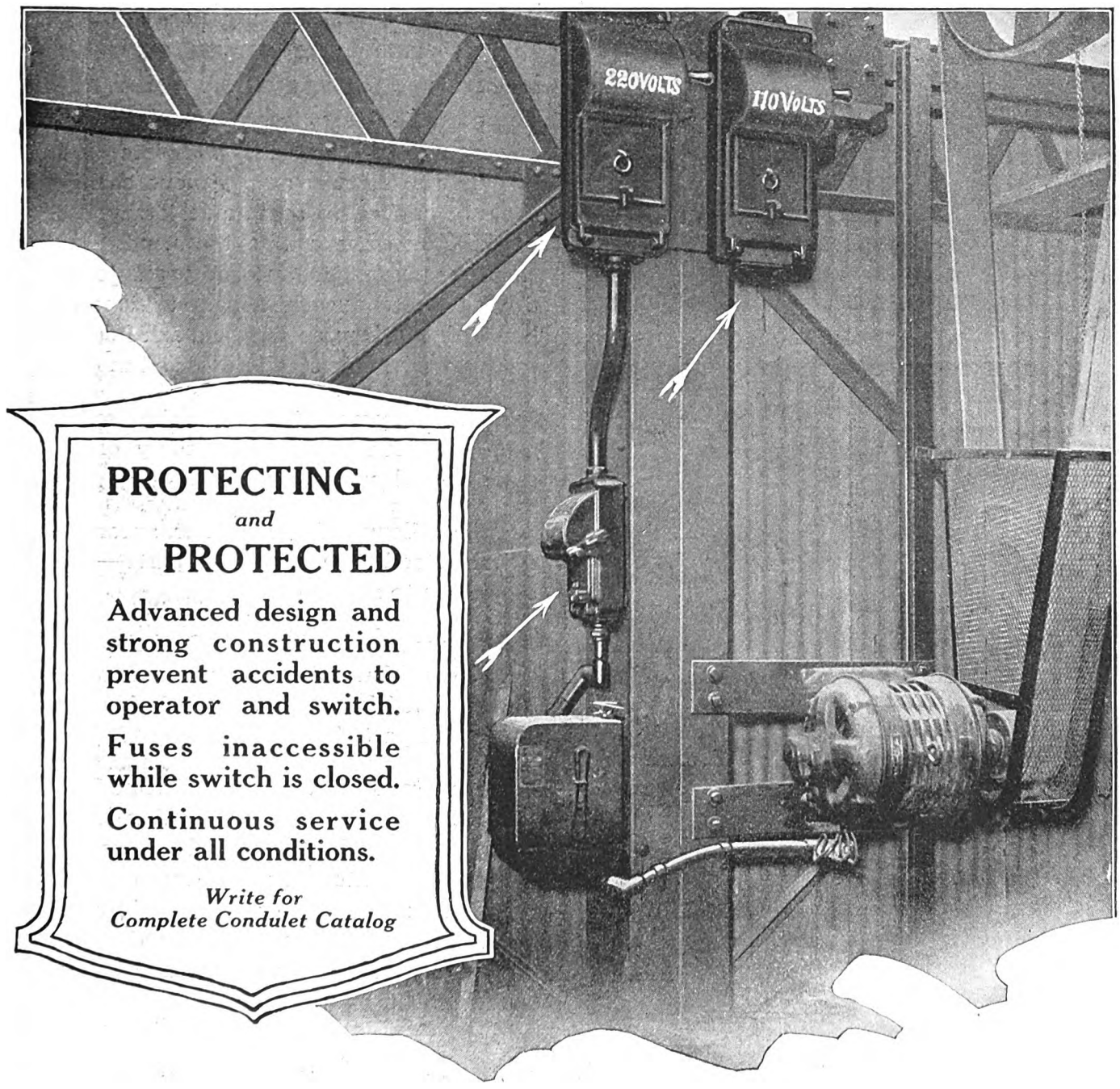
SAFETY LINE-SWITCH CONDULETS



PROTECTING
and
PROTECTED

Advanced design and strong construction prevent accidents to operator and switch.

Fuses inaccessible while switch is closed.

Continuous service under all conditions.

Write for Complete Condulet Catalog

CROUSE-HINDS COMPANY
SYRACUSE, N.Y., U.S.A.

NEW YORK BOSTON CHICAGO

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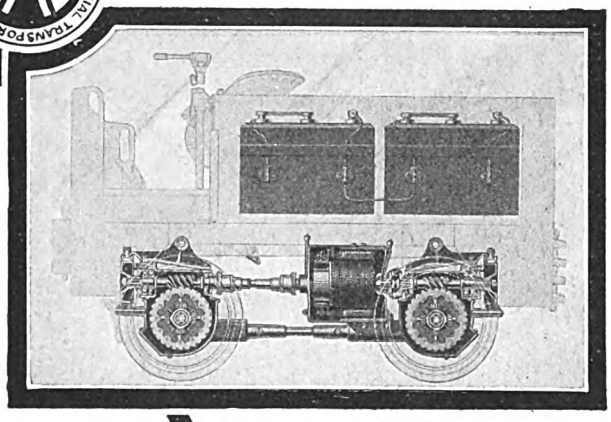
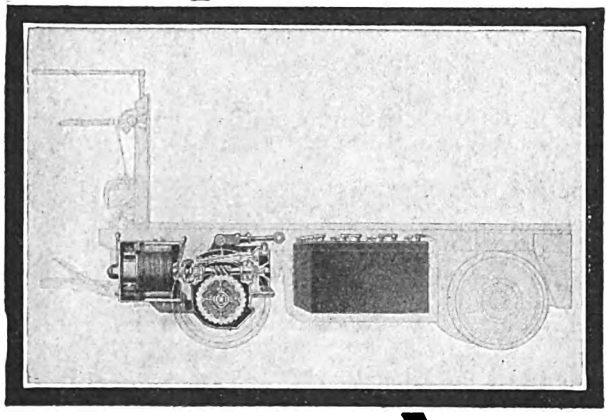
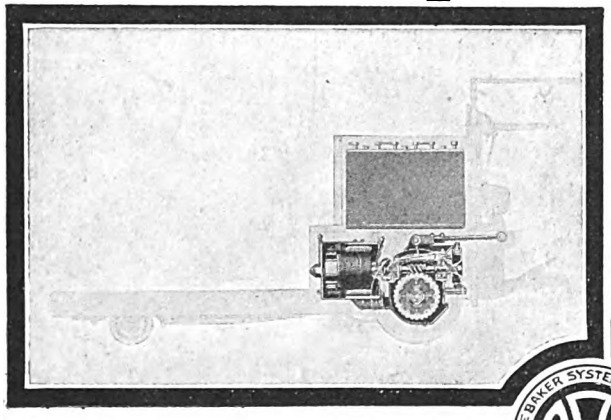
INTER-STANDARDIZATION

WHAT IT IS







WHEN Baker engineers commenced the design of Baker Electric Industrial Trucks and Tractors they first developed a power axle—a rugged, complete unit that in its entirety and without changes could be applied to any model or type of truck. The same wheels, the same differential, the same motor, universal joints, driving shafts, worm and gear, steering knuckles, bearings, springs, and axle housing casting were made standard for all models.

After the power axle came the trailing axle—constructed almost entirely of the standardized power axle parts.

Then followed the controller, automatic switch, steering and braking parts—each applicable to all models.

This has resulted in 98% of all the vital parts being identical—or inter-standardized—on all models and has reduced the total number of parts for all models by 70%.

Inter-Standardization is distinctly a Baker feature and its incorporation in the design of industrial trucks and tractors was no simple matter. It required the best effort of some of the foremost engineers in the industry, but the result is well worth the difficulties encountered and Baker users benefit.

The BAKER
CLEVELAND, OHIO

The BAKER of INDUSTRIAL

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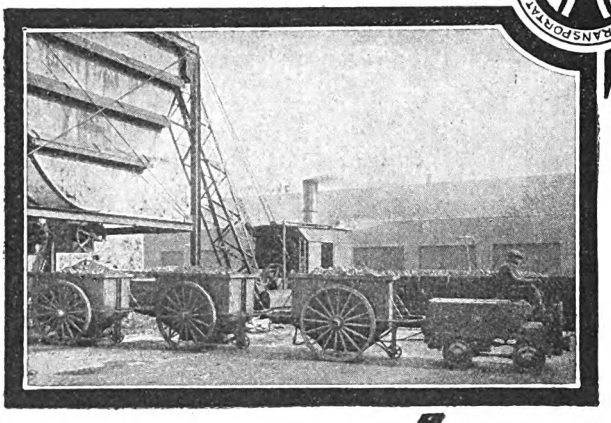
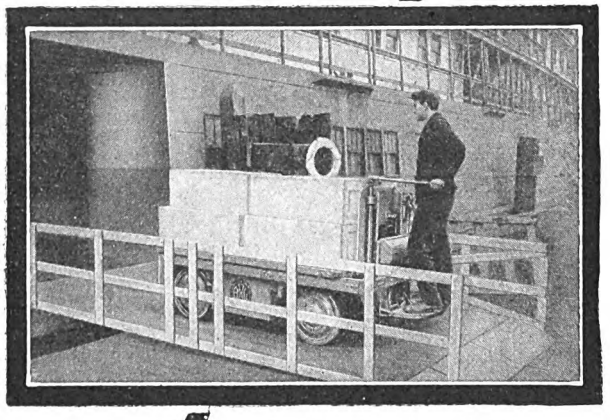
INTER-STANDARDIZATION

WHAT IT MEANS TO YOU

BAKER Industrial Trucks and Tractors are of more rugged construction. They are built of higher grade and better machined parts than any other make. But the 70% reduction in the number of parts manufactured cuts down costs and Baker Trucks and Tractors sell for no more than others.



Operators of fleets of Baker Trucks find them easy to maintain. All parts are accessible and alike on all models. The maintenance crew find their work greatly simplified and a reserve part for one model will fit all other models. In emergencies complete units may be transferred from one truck to another.



This idea—conceived and applied by Baker engineers—has contributed to the success of Baker Trucks and Tractors. It has made possible the marketing of a better truck at a reasonable price and has reduced maintenance costs and troubles to a minimum.

R&L COMPANY
ORIGINATORS OF

SYSTEM TRANSPORTATION

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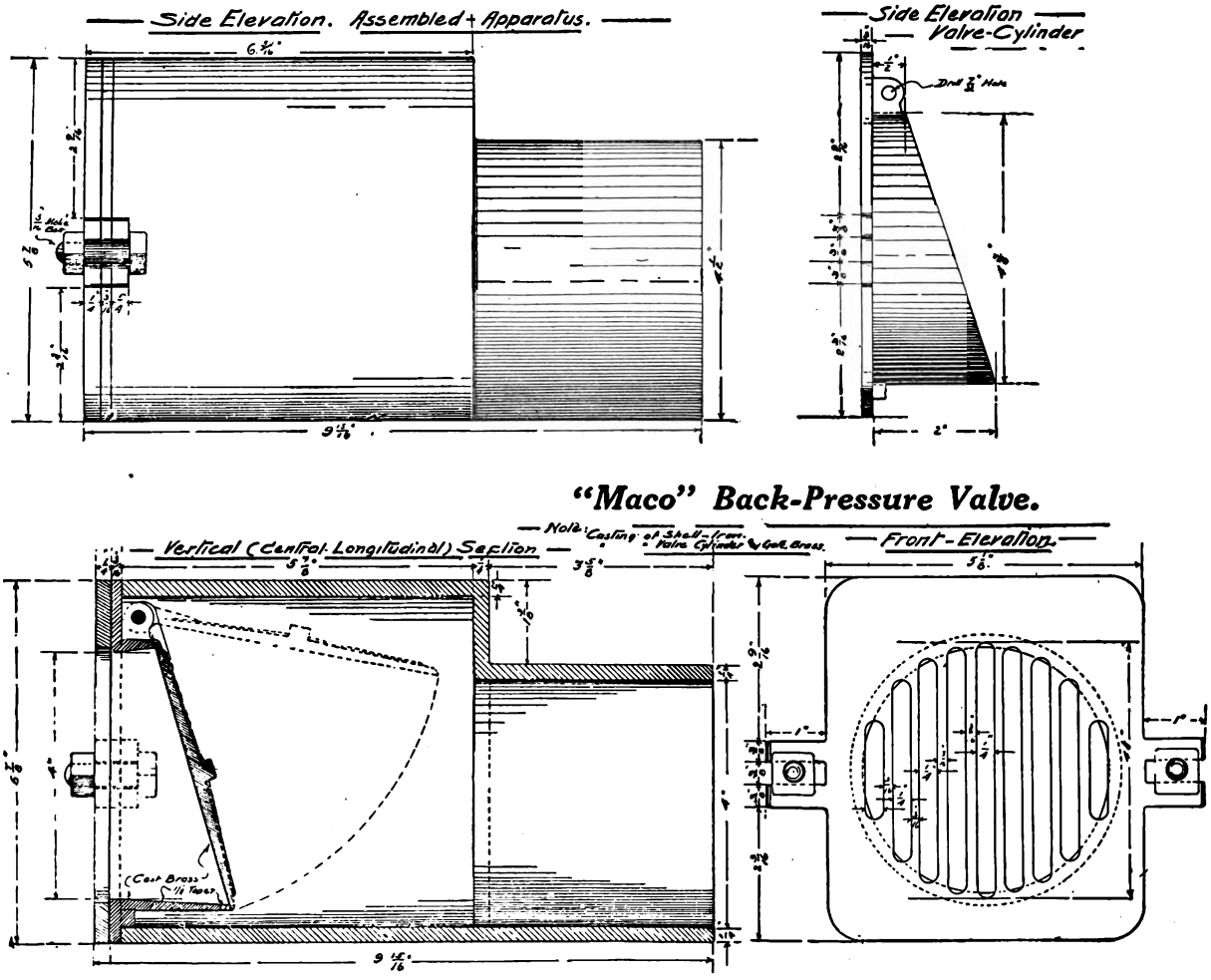
Keep Your



Detail Drawing of "Maco" Back-Pressure Valve with dimensions.

THE "Maco" Back-Pressure Valve will positively keep your manholes free from water and dirt to the height it is placed in the wall.

The depth of sewer regulates the height in wall the valve must be installed. Place as near the floor of manhole as possible.

W. F. CUMMINGS, INC.,

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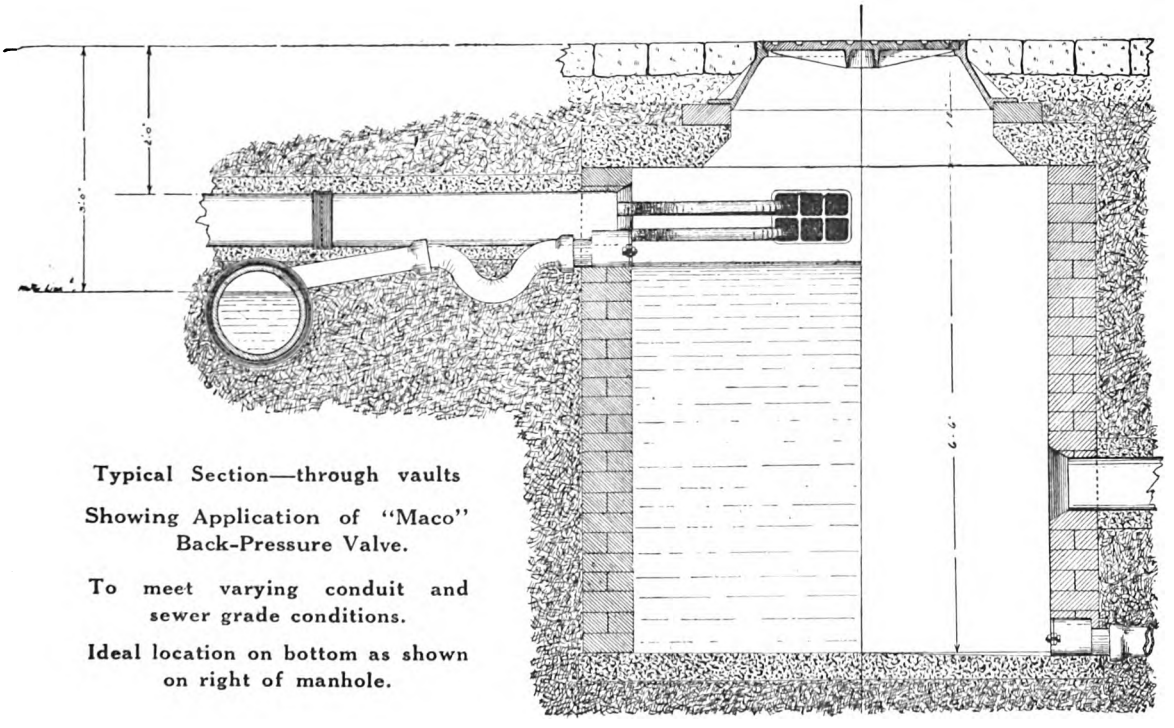
Manholes Dry



Typical Section—through vaults

Showing Application of "Maco" Back-Pressure Valve.

To meet varying conduit and sewer grade conditions.

Ideal location on bottom as shown on right of manhole.

The "Maco" Back-Pressure Valve will positively prevent sewer water backing up into manholes and flooding your conduit system.

The valve gate is readily removable should the sewer tile become clogged.

The "Maco" Back-Pressure Valve has been installed in approximately 1500 manholes in Chicago and elsewhere.

Place "Maco" Back-Pressure Valves in your Underground System and forget Mud and Water and Leaky Cables. Price $6.00 net F. O. B. Chicago.

Let us send one today subject to approval.

330 So. Paulina St., Chicago, Ill.

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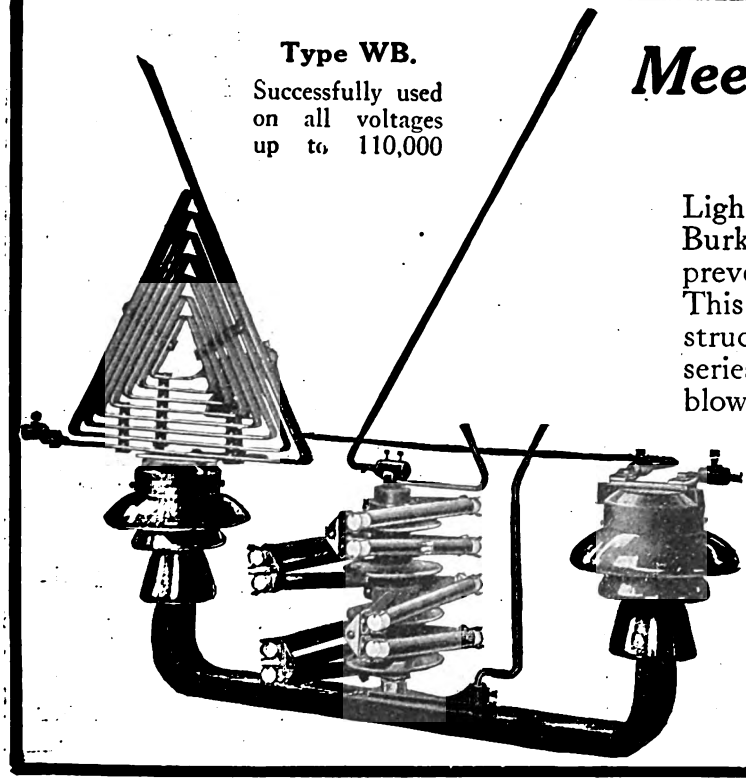
The BURKE ARRESTER

THE HORN GAP ARRESTER WITH THE TRIANGULAR CHOKE COIL



Type WB.
Successfully used on all voltages up to 110,000

Meets Most Exacting Needs

Lightning seeks a path to ground. The Burke Arrester provides a direct path and prevents surges passing the discharge gap. This is due to the triangular choke coil construction with its sharp turns, its sensitive series horn gap, its quick-acting magnetic blowout and its straight line discharge path.

Write for Bulletin.

Type WB, as well as WBR (for larger transmission systems) are pictured and described in an interesting bulletin, sent on request.

Railway and Industrial Engineering Company

Sales Office Pittsburgh

Plant Greensburg, Pa.

Announcing

A New Emergency Power Plant

MEDIUM and high speed Sterling gasoline engines (which have held world's marine records for eight years) have been adapted for driving centrifugal pumps and electric generators. They are being used by many prominent pump manufacturers, coupled to Underwriters' fire pumps, and are installed in townships, villages, municipalities, department stores and manufacturing plants for fire protection. They are also utilized for emergency generator drives. The motors are admirable for either pump or generator operation, as they develop rated power at 800, 1000, 1200 and 1400 R.P.M. The construction is in 4, 6 and 8-cylinder units, 10 to 300 H.P.

Numerous units are employed in the United States and Canada. They are equipped for instantaneous starting for any emergency and will always furnish dependable power until the emergency will have passed.

Catalog on Request

STERLING ENGINE CO. *Dept. C-2* **BUFFALO, N.Y.**

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SOME OF OUR MANUFACTURED PRODUCTS

ANNUNCIATORS
House
Hotel
Hospital
Elevator
Marine
Wood or Metal
All Styles of
Drops and Resets

BELLS
Iron Box
Wood Box
Fire-Alarm
Skeleton
Vibrating
Single Stroke
Weatherproof
Electro-Mechanical

BUZZERS
Iron Box
Wood Box

PUSHES
Wood
Metal
Desk
Door
Pear
Floor
Marine
Multiple
Table Clamp
All Finishes

OSTRANDER

Electrical Supplies and Specialties

Sockets

QUALITY PLUS SAFETY
KEY
KEYLESS
PULL CHAIN

Highly Systematized Manufacture. Specialization of designers for the various articles we market, discriminating selection of materials and years of manufacture, enable us to keep OSTRANDER PRODUCTS supreme in their field, invincible in SERVICE.

SOCKETS
Key
Keyless
Pull Chain
All Finishes

FIRE ALARMS
Cabinets
Boxes
Systems for Current or Storage Battery

SHADES
Metal Shades of All Descriptions

LETTER BOXES
of All Descriptions

FLOOR BOXES

SPEAKING TUBE
Tin Tube
Flexible Tube
Whistles
Elbows
Collars
Roses

BURGLAR ALARMS
Door Springs
Window Springs
Transom Springs

TANK ALARMS

THE OSTRANDER PRODUCTION is on a firm, smooth running basis which assures adequate supply for the big demands which are sure to be made for our equipment.

371 Broadway, New York

BROOKLYN PHILADELPHIA CHICAGO BALTIMORE SAN FRANCISCO ST. LOUIS DETROIT

CHIEF OSHKOSH TRADE MARK

Play Safe with Your Construction Tools

For forty years, contractors and public service corporations have regarded the OSHKOSH brand on a construction tool as the same guarantee as "Sterling" on silver. America's big concerns, as a rule, will use no others. There must be a reason for this and the tools themselves in the hands of your workmen will show you what that reason is.

An Oshkosh-Equipped Crew Earns More

From a peavey to a huge concrete-road builder, the OSHKOSH line will furnish you with equipment that will show results in dollars and cents in your profits or dividends. An OSHKOSH catalog kept handy is a big help. And there's an OSHKOSH supply house near you, ready to give you service that will surprise you.

Write for that catalog TODAY.

Oshkosh Manufacturing Company

336 Wood Street, Oshkosh, Wis.

Oshkosh Construction Tools are carried in stock by all leading jobbers including—
Western Electric Company, Chicago, Ill., and All Branches.
Dillon Supply Company, Raleigh, N. C.
Kellogg Switchboard & Supply Co., Adams & Aberdeen Streets, Chicago, Ill.
Richards & Conover Hardware Co., Kansas City, Mo.

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Fir Cross Arms and Locust Pins

In Stock for Prompt Shipment

Also a large and complete line of Malleable and Steel Brackets, Pole Line Hardware, Street and Commercial Lighting Fixtures, Tape, Etc.

Ask for Prices

Philadelphia Electrical & Manufacturing Co.
1228-36 North 31st Street, Philadelphia, Pa.

Reserve Space Now!

For the Chicago

Electrical Trades Exposition

Coliseum, Chicago, October 11-25, 1919

THE FIRST CHICAGO ELECTRICAL SHOW SINCE 1911.
A LARGE AMOUNT OF SPACE ALREADY CONTRACTED FOR
MANY DESIRABLE SPACES MAY STILL BE HAD

DIAGRAMS OF SPACE CONTRACT FORMS ALL PARTICULARS
MAY BE OBTAINED FROM

ELECTRICAL TRADES EXPOSITION COMPANY
E. W. LLOYD, Manager
72 West Adams Street, Chicago, Illinois

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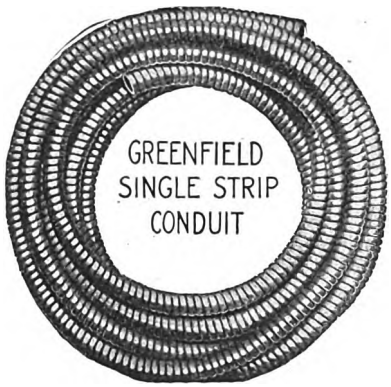
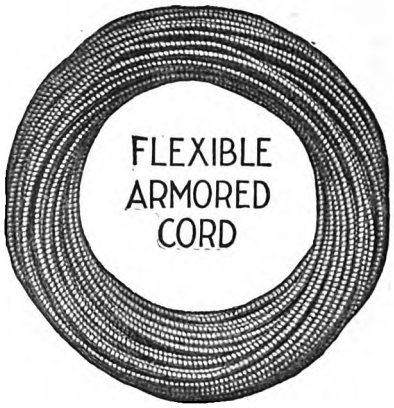


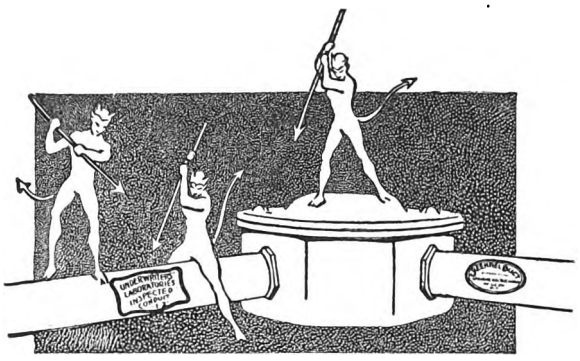
Steel Armored Cable

Flexible - Conduit - Rigid



SPRAGUE

A Complete Line of Stamped Steel Boxes, Covers and Fittings



Interchangeable with Boxes and Covers of other manufacture

Resists the Elements

SPRAGUE ELECTRIC WORKS

OF GENERAL ELECTRIC COMPANY

Main Offices: 527-531 West 34th Street, New York City

BRANCH OFFICES IN PRINCIPAL CITIES

TRADE MARK

Hazard

RUBBER INSULATED

WIRES & CABLES

Represent the Square Deal between maker and user They stand for safety and economy in the transmission of electric current under practically all conditions of service.

Submarine Cables—Steel Taped Cables
Power Cables—Underground Cables
Circular Loom Cables—Code Wire

HAZARD MFG CO WILKES-BARRE PA

NEW YORK 533 CANAL ST PITTSBURGH 1ST NAT'L BANK BLDG CHICAGO 552 W ADAMS ST

MAKERS OF QUALITY WIRE ROPE SINCE 1848

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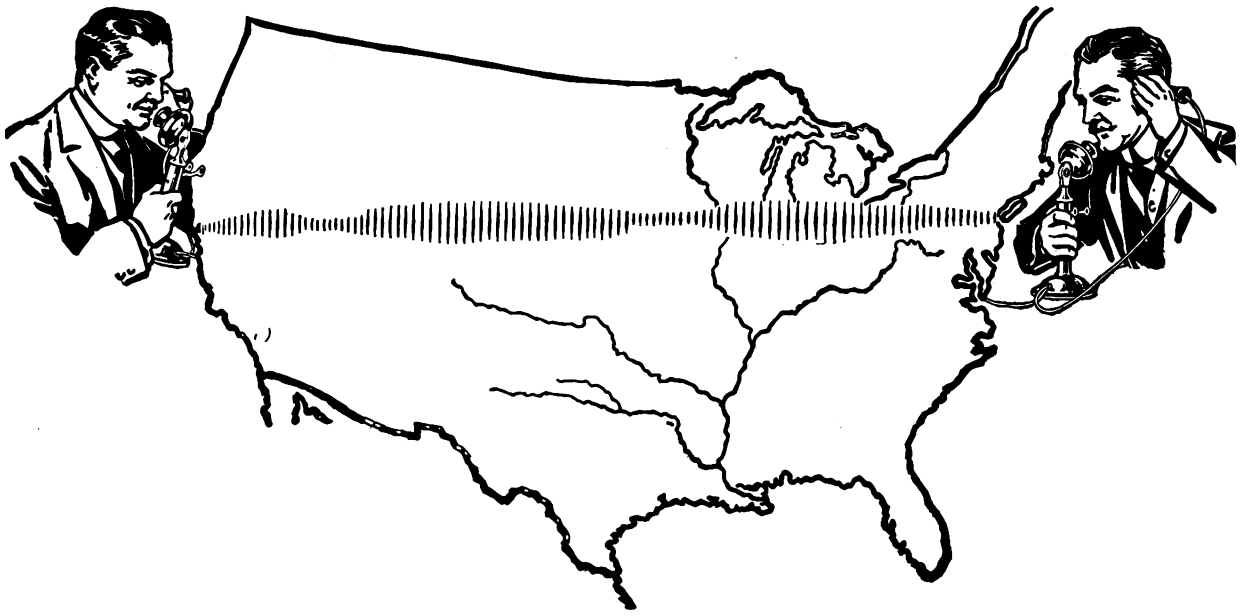
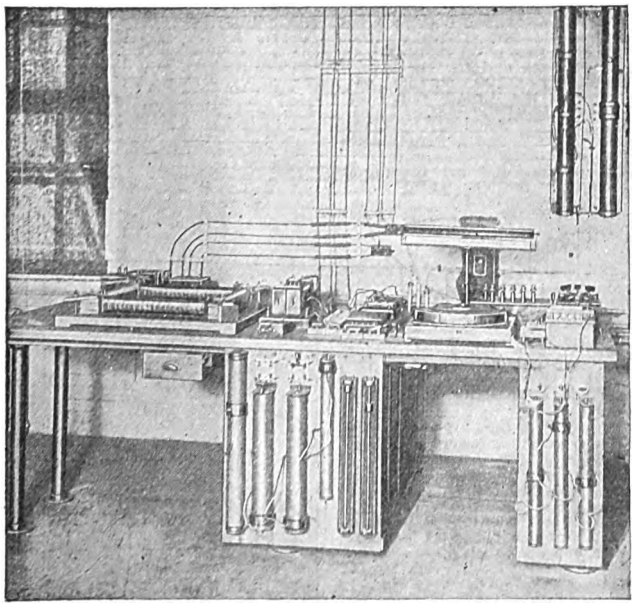


It takes only one-fifteenth of a second for the electrical impulse which reproduces the voice to span the continent from New York to San Francisco, 3400 miles, over the transcontinental line of the Bell System. Communication between important points over the long distance lines of the Bell System is practically instantaneous.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

MAGNETIC TESTS
OF IRON AND STEEL



Magnetic Testing Equipment

The iron and steel entering into the manufacture of electrical apparatus must contain certain properties and characteristics which must be definitely known.

The E. T. L. is completely equipped to make test for Hysteresis, Permeability, Energy Loss, or any special tests for manufacturers or others not having facilities for such work and who require an accurate, certified report on their products which will be accepted by experts without further question.

Electrical Testing Laboratories
80th Street and East End Avenue, New York City

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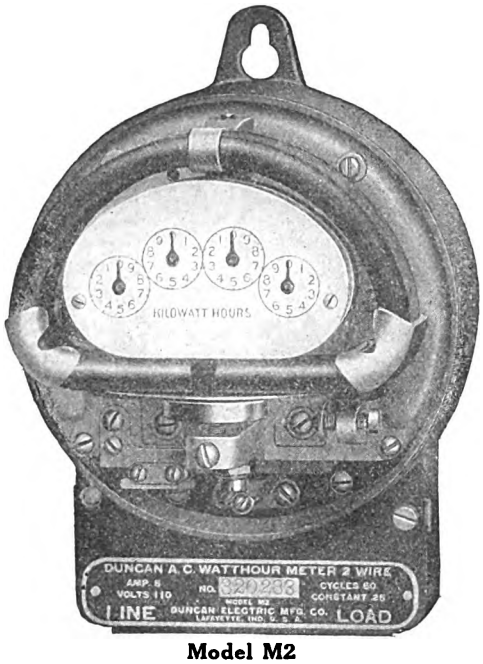


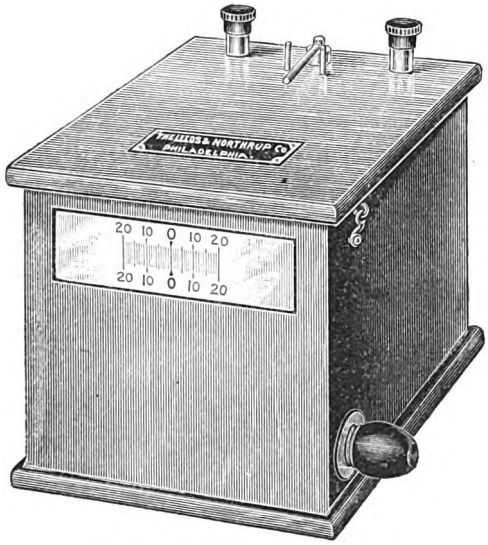
Model M2

25 Years Ago

The first Duncan A.C. watt-hour meter of 25 years ago was heralded by the central station fraternity as a much needed device on account of its accuracy and dependability, and the users of that time yet give substantial proof of its merits by having thousands of them in use unto this day. Each new type of Duncan meter that has been brought out during the intervening years has been a masterpiece in the art, and now the Model M2 is conceded to be the acme of all that is worth while among present day meters.

DUNCAN ELECTRIC MFG. CO., LAFAYETTE, IND.

Portable Lamp and Scale Galvanometer



A suspension type d'Arsonval Galvanometer with Lamp and Scale—all in a single unit. About twenty times as sensitive as the best portable pointer instrument. Rugged as the ordinary voltmeter. We use it in many of the "working set-ups" in our own laboratory, and find it extremely popular there.

Bulletin 242 describes it—
let us send it to you.

LEEDS & NORTHRUP COMPANY
Electrical Measuring Instruments
4903 Stenton Ave., Philadelphia, Pa.

Steel Poles
For Every Pole Purpose

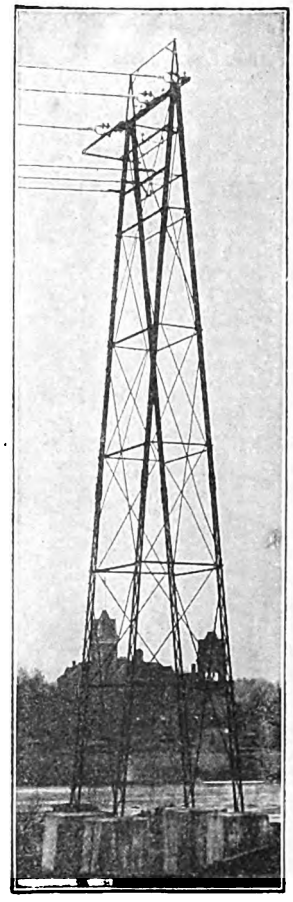
Cut shows Bates Steel Towers in use by Consolidated Water Power & Paper Co., Grand Rapids, Wis. This structure is 70 ft. high and acts as dead end for six heavy conductors on 1000 ft. span. It evidences the broad range of adaptability of Bates Steel Poles. Our slogan "STEEL POLES FOR EVERY POLE PURPOSE" is most fitting and appropriate. Bates Steel Poles are becoming universally popular world wide. Repeat orders testify their general suitability for every Pole purpose.

Telegraph
Telephone
Power Transmission
Electric Trolley Lines
Electric Lighting, Etc.

Highest class and most up-to-date steel pole equipment in the world. Our STEEL POLE TREATISE tells the story. Ask for it.

About 2,000 tons of steel constantly on hand; immediate shipments and lowest prices.

Tubular Steel Poles cost 50% more than Bates Steel Poles, yet Bates Poles are 100% stronger—will last 100% longer, cover a much broader range of adaptability and are much more artistic than Tubular Poles. Ask us to verify these facts.



Bates Expanded Steel Truss Company
208 So. La Salle St.
Chicago, Ill., U. S. A.

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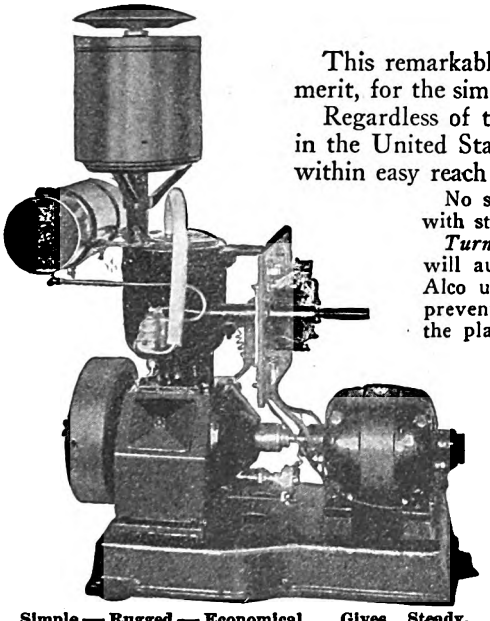
The Alco 110-Volt Full Automatic
Farm Lighting and Power Plant
No Batteries in Lighting Circuit



Simple — Rugged — Economical. Gives Steady, White Light. The current is supplied direct from a generator specially designed and made for us by the General Electric Co. There are no storage batteries in lighting circuit to get out of order or to recharge. Consumes fuel only while lights or power are actually used.

This remarkable plant has won a leading place in the World's market on its own merit, for the simple reason that the public wants a non-battery plant.

Regardless of the ALCO being the only *automatic* farm lighting and power plant in the United States of its kind, it is sold at a very reasonable price, which places it within easy reach of your buyers.

No special wiring necessary and no special fixtures required. Connect the Alco with standard 110-Volt wiring. The economy of this is obvious.

Turn on the lamp a block away, if you will, and the plant in the farm cellar will automatically start—*when you turn off the last light* the plant stops. The Alco uses fuel according to the number of lights burning, the electric governor preventing wastage. And the light at great distance is as clear as the light over the plant itself.

A Big Seller For Dealers

The Alco 110-Volt full automatic lighting and power plant is bound to become the "Ford" of the farm lighting field in point of sales; and the broad gauged men who join with us now are of the type who know a money-making proposition when they see it.

Territory is going fast, and if you want to get in on the ground floor, act now. The market for the Alco is ripe as a golden plum. Do you intend to let the other fellow beat you to the profits, or will you write or wire now—before you turn another page to find out if your territory is open.

Remember, the Alco is free from any expensive, bothersome storage batteries in the lighting current, and will supply real light, or it will furnish power to operate motors up to ¾ hp.

Send for descriptive folder today, and specify exact territory wanted

Automatic Light Company, Inc.
Exclusive Builders of Automatic Electric Generating Sets
Federal Building Suite 3 Ludington, Michigan

Alco
AUTOMATIC LIGHT CO. INC.

Full Cash Value
For Good Used Equipment

No man with a true knowledge of present-day conditions thinks of sacrificing good used equipment at "junk" prices. Nor is it necessary.

Buyers have come to appreciate that so-called "second-hand equipment in serviceable condition—whether out-grown or otherwise released by one establishment—can still give good service in another.

Old-time prejudice practically disappeared under pressure of war conditions. Thousands of new buyers were created and present high prices of new machinery continue to make a favorable market for used equipment.

If you have anything to sell Central Stations, Industrial Power Plants or other big users of Electrical Power Equipment, advertise it in the

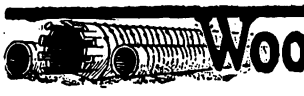
SEARCHLIGHT SECTION
OF ELECTRICAL WORLD
The "Opportunity" Center of the Electrical Industry

Whether you want to buy or sell

Think "SEARCHLIGHT" First!

0090

CONTINENTAL
WOOD STAVE PIPE



—is received by engineers with marked favor everywhere. Many of the largest Irrigation Projects, Power Companies and Municipalities are served by this pipe—it is giving service in all parts of the world.

Our Engineering Staff is maintained for your convenience.

Continental Pipe Mfg. Co.

General Office:
Seattle, U. S. A.
Eastern Office:
Woolworth Bldg.
New York City

Successor to
Pacific Coast Pipe Co., Seattle
Portland Wood Pipe Co., Portland
Washington Pipe & Foundry Co., Tacoma
National Tank & Pipe Co. (Pipe Dept. Only), Portland

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JUST WHAT YOU NEED

A Complete and Permanent Insulating Material

10,000 Volts to 100,000 Volts

(Durable—Practically Waterproof)

The Lasting Qualities of

BAKELITE DILECTO

make it a most desirable material, much superior to hard rubber or other brittle compounds.

It can be drilled, tapped or machined like metal and has a wonderful dielectric strength.

If you use insulation, you need BAKELITE-DILECTO.

Details and prices on request.

CONTINENTAL

Ask us *for Data*

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Newark, Del.

Pittsburgh Office 316 Fourth Ave. New York Office 233 Broadway Chicago 322 S. Michigan Ave.
San Francisco Office, 525 Market St.
Los Angeles Office, 411 S. Main St.

SARP

In the Far East the treatment for the bite of a snake or sarp is to take a number of wheat cakes moulded in the shape of a serpent.

These are fed to the patient one by one.

As he consumes them he sits in front of his house and repeats, "I am not going to die—I am not going to die."

They do this *wishing* for results, instead of taking a shot of the good old American remedy for snake-bite.

And in much the same way you'll see an operator over here put some cheap-mix carbon brushes on a machine and hope for commutation—and hope—and hope.

—instead of putting on the old reliable prescribed Morganite and GETTING it.

There are always two ways to do a thing—and everybody knows it—and yet very little more than 50 per cent. do it right.

The Morgan Crucible Company

Main Office and Factory:
519 W. 38th St., New York City

DISTRICT AGENTS:
Lewis & Roth, 13th and Wood Sts., Philadelphia
Electrical Engineering & Mfg. Co.
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150 Steuart St., San Francisco, Calif.
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Railway & Power Engineering Corporation, Ltd., 137 Eastern Avenue, Toronto, Ontario, Canada.

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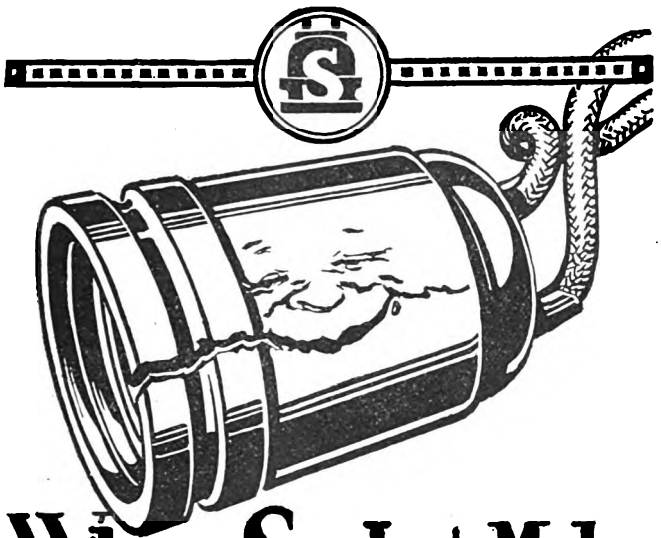


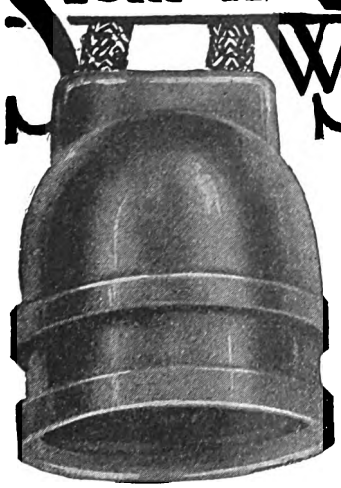
When Sockets Make A Funny Crack—

t isn't quite so funny, not if you have to take them back and **thereby lose good money.**

Weatherproof sockets that split up one side and down the other make a fine opening for trouble.

Avoid loss of money on replacements by using sockets you won't have to replace.

Siemon Seamless WEATHERPROOF SOCKETS



THE jackets are molded in *one piece* and cannot split in two. They are *seamless* in making—crackproof in service.

The lamp base is secured in *solid porcelain* that firmly embeds the *solid brass center contact.* The wires are held in a water-tight grip of the composition jacket. Water cannot leak in—current can't leak out.

SOLID BUSHINGS FOR SOLID SERVICE

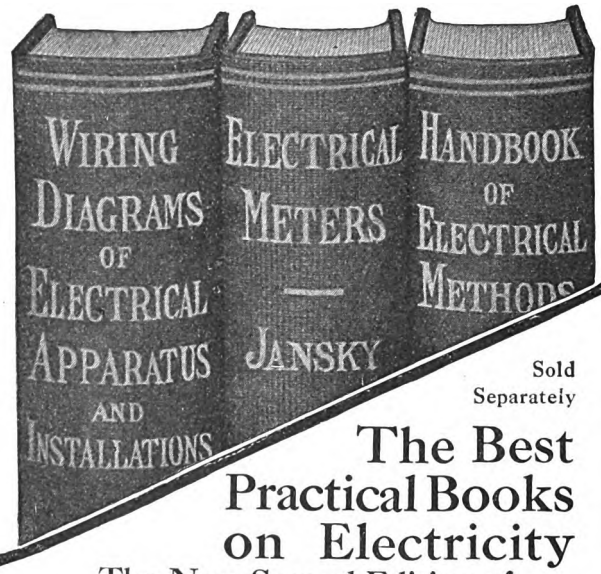
SIEMON Bushings have *continuous* threads that continually hold. They never stick going in—never break coming out, because they have no rough spots to chip, crack or bind on the socket threads.

Siemon Hard Rubber Corporation

BRIDGEPORT CONNECTICUT

USE THESE BOOKS for 10 days FREE

and see for yourself before you purchase them how useful they are



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The Best Practical Books on Electricity

The New Second Edition of *Jansky*—Electrical Meters

By C. M. Jansky, Assoc. Prof. of Electrical Engineering, University of Wisconsin.

370 *pages, 6 x 9, 273 illustrations,* $3.00 *net, postpaid.*

The first edition of Jansky's Electrical Meters received such wide distribution that a second edition was necessary. This new edition has been completely revised and 60 pages of new material added. Recent developments in meter design are covered and a new chapter on "Instrument Transformers" and instrument errors is included.

This volume covers testing and types in general use, in a most thorough and business-like manner. It brings to the average worker that information which has been inaccessible heretofore. Free use has been made of typical illustrations and graphic diagrams.

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252 *pages, 6 x 9, 439 illustrations,* $2.00 *net, postpaid.*

A collection of 439 circuit diagrams taken from actual practice. They cover both simple and complex connections.

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Modern ways of solving every-day problems—as practical men have solved them.

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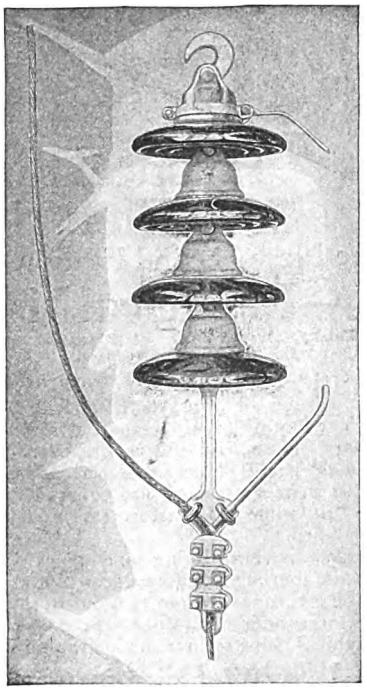
VICTOR
SUSPENSION TYPE
INSULATORS
FOR
END STRAINS



Arcing Horns Increase Protection

VICTOR suspension Type Insulators installed in strain positions and with arcing horns, increase the protection to your lines many-fold and help to maintain the continuity of service which is essential to many manufacturing processes.

The Locke Insulator Mfg. Co.
Victor, N. Y.

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Dear Boss:

Have you considered, boss, that July 1st opens up a mighty serious problem for you and me—and the rest of the steady, sober, serious temperate workers of America?

How often you've heard of the chap who is "a wizard when he lets booze alone"—of the man who is a "whirlwind when sober"—who is "the finest fellow in the world when he's off the stuff."

We've all known about them—but they never offered us serious competition before because they were always soused. We simply got by because we stayed sober.

Do you realize that a flood of such genius goes on the market right now?

How can we stand up against the sudden lurch forward they'll give this old planet?

About the only thing they won't improve on is Nichrome because that's 20 years ahead now. Never mind, boss, the thirst is yet to come.

Nyc Chrome

DRIVER-HARRIS COMPANY

MAIN OFFICE AND WORKS
HARRISON, N.J.

WESTERN OFFICE AND DEPOT
CHICAGO
80 So. JEFFERSON ST.

CANADIAN WORKS
WALKERVILLE, ONT.
CANADA

BRITISH WORKS
MANCHESTER
ENGLAND

Hasten Recovery with

AMBRINE

THE NEW FIRST AID

This war-proven wax dressing for burns, scalds and all surface wounds is becoming the most useful first-aid in Industrial Plants.

Injuries are made comfortable. Scars are eliminated. Functional disability is reduced. Compensation is saved.

Complete equipments are now available in several sizes—$47.50—$17.50—$7.50. Anyone can apply it.

Can you afford to be without Ambrine?

Ambrine Laboratories
Room 1903
347 Madison Ave.
New York City

Ambrine Laboratories,
347 Madison Avenue,
New York.

Gentlemen:—
Send complete AMBRINE Emergency Case, including 3 lbs. AMBRINE and descriptive literature
Check enclosed for .....

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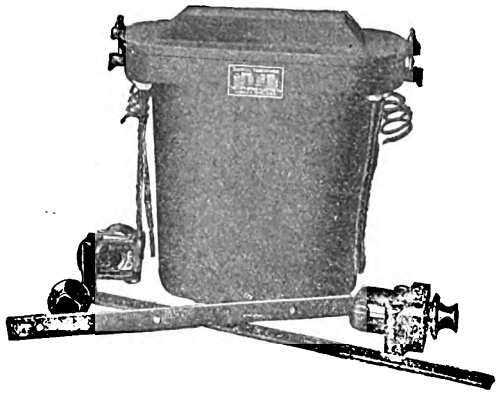


We Will Ship You a

PEERLESS TRANSFORMER

on Approval

and let you test it in your own factory, in any way you choose, and if it's not just as we represent and is not entirely satisfactory—just return it at our expense.

If PEERLESS transformers were not so carefully built and every detail of their manufacture supervised by men who have a direct financial interest in the firm, we might hesitate to make such an offer.

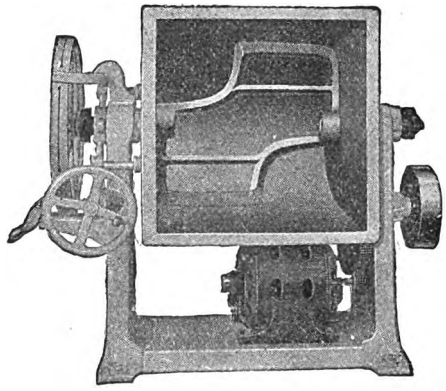
Experience as well as rigid tests has demonstrated that in quality and performance they are all that the name implies—PEERLESS.

Send for data and prices.

The Enterprise Electric Co.
Warren, Ohio

Century

Repulsion Start Induction Single Phase Motors



7½ H. P. Motor Geared for Dough Mixer

Are popular because they are dependable.

Their high starting torque makes them particularly desirable for operating direct and gear connected apparatus.

1/10 to 40 H.P.

They Keep-A-Running

Century Electric Company
St. Louis, Mo.
Sales Offices in Principal Cities

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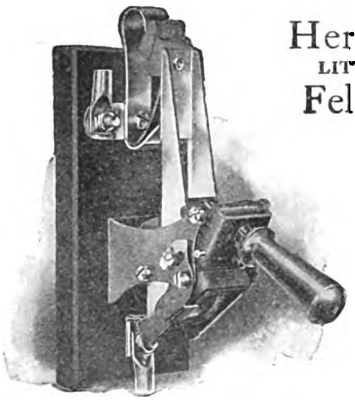
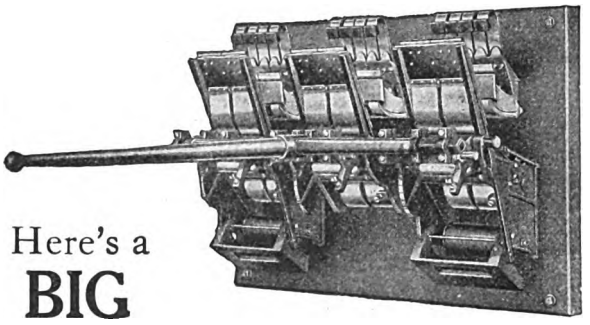


Here's a LITTLE Fellow

and



Here's a BIG One

ROLLER-SMITH BUILDS BOTH KINDS

Above is a cut showing the smallest breaker we make, a 3-ampere, 250-volt, single pole, plain overload, Industrial type circuit breaker.

It is described in our *new* Bulletin No. 520, which is of interest to all users of Circuit Breakers.

As a contrast to the little one, we show above a cut of a 4000-ampere, 250-volt, 3-pole, rigid arm, combined overload and under-voltage, Standard type circuit breaker with removable pole type handle.

It's a big one but we build them bigger than that!

If you need ANY kind of a circuit breaker, consult with our nearest office.

ROLLER-SMITH CO., 233 Broadway, New York, N.Y.

Works: **Bethlehem, Pa.**

CHICAGO: Monadnock Block **DETROIT: Majestic Bldg.** **CLEVELAND: Williamson Bldg.**

BALTIMORE, Builders Exchange.
BOSTON, 141 Milk St.
BUFFALO, 716 Ellicott Sq.
DENVER, 1633 Tremont St.
PHILADELPHIA, 903 Drexel Bldg.

ROLLER SMITH

Union Arcade Bldg., PITTSBURGH
Railway Exchange Bldg., ST. LOUIS
609 McIntyre Bldg., SALT LAKE CITY
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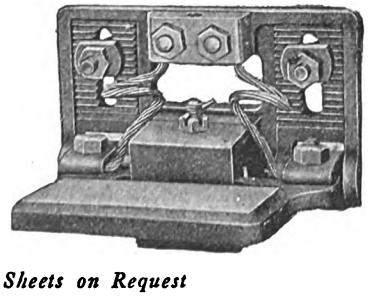
Contact Rail Material

Insulators, Shoes and Standards

A broad line of either under-running or over-running contact rail material for light or heavy shipyard or industrial cranes, industrial haulage systems and electric railways



Data Sheets on Request

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Manufacturer of Railway Material and Electrical Supplies

NEW YORK PHILADELPHIA CHICAGO
50 Church St. 17th and Cambria Sts. Monadnock Bldg.

Canadian Distributors: Lyman Tube & Supply Co., Montreal, Toronto, Winnipeg.

"3-in-1" Draft Gauge

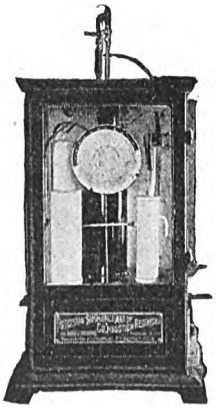
Accuracy Reliability Ruggedness Durability Service

These are the points to consider when buying boiler efficiency instruments.

"Precision" instruments excel in the first four points to a very marked degree.

Our service department thoroughly and promptly takes care of the last point.

Write for Catalog.



CO_2 Recorder

Precision Instrument Co.

Detroit, Michigan

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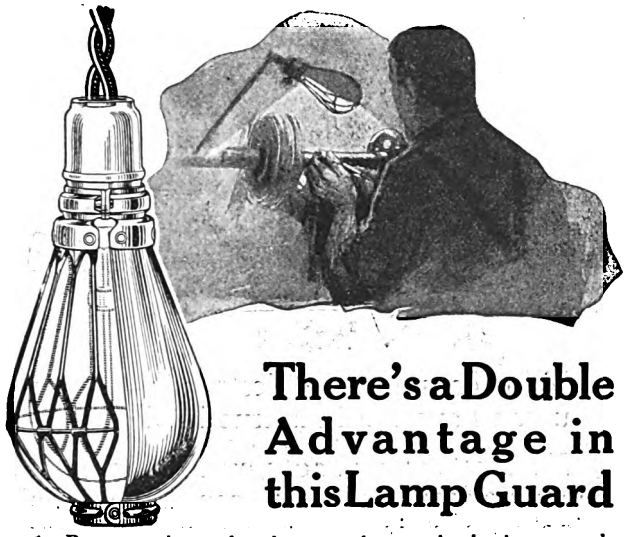

There's a Double Advantage in this Lamp Guard

1—Prevents lamp breakage and unauthorized removal; eliminates fire hazard; prevents injuries to employes due to flying glass.

2—Keeps the glaring light rays out of the workmen's eyes; concentrates the light on the place or work to be illuminated.

FLEXCO-LOK REFLECTOR GUARD

not only protects the lamp but it prevents eye strain by keeping direct light rays *on the work.*

Flexco-Lok Reflector Guards are made of expanded steel, well-coated with tin. Easy to adjust. Made in sizes to protect up to and including 60 Watt Mazda and 75 Watt, Type C, Nitrogen lamps.

Write to-day for prices and full information.

FLEXIBLE STEEL LACING CO.

Also Manufacturers of Alligator Steel Lacing

Dept. RG20, 522 S. Clinton St., Chicago, Ill.

Reg. U. S. Pat. Off.

This trade-mark — always in red — on every Hygrade lamp and carton — is another way of saying "O K Quality Dept.

Praise for the Quality Department

The Quality Department sets a very high standard for Hygrade Lamps and then sees to it that every lamp lives up to that standard.

No lamp can leave the Hygrade factory until it has the approval of the Quality Department. This careful inspection is one of the reasons why, from the beginning, Hygrade Lamps have been so persistently well made.

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

FIELD COILS SOLENOIDS ELECTRO MAGNETS MAGNET WIRE

THE ACME WIRE COMPANY

NEW HAVEN CONNECTICUT

DUDLO

MAGNET WIRE
MAGNET WIRE PRODUCTS

Highest quality and good service.

WINDINGS

Ignition
Wireless
X-Ray
Magnet
Field
Telephone
Meter Coils
Transformer Coils

All coils made according to specifications and guaranteed to be satisfactory.

MAGNET WIRE

Plain enameled copper wire
Single cotton enameled wire
Single silk enameled wire
Single or double cotton magnet wire
Single or double silk magnet wire

We carry large stocks on hand, and can make prompt deliveries of the best grade wire.

Dudlo Manufacturing Co.
Fort Wayne, Ind.

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The Lamp of Quality

If it is a WHITELITE it is a lamp of quality. Quality is our watchword, and we stand by it.

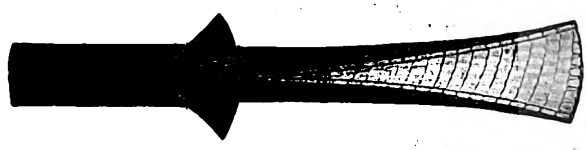
We stand back of our lamp, from the time it leaves our factory till the last hour of its allotted service.

Ask us for prices and discounts.

NITROGEN WHITELITE LAMPS

Whitelite Electric Co.
368-70 Broome Street, New York City
Licensed under General Electric Co.'s Patents

"LOOMFLEX"
Flexible Conduit



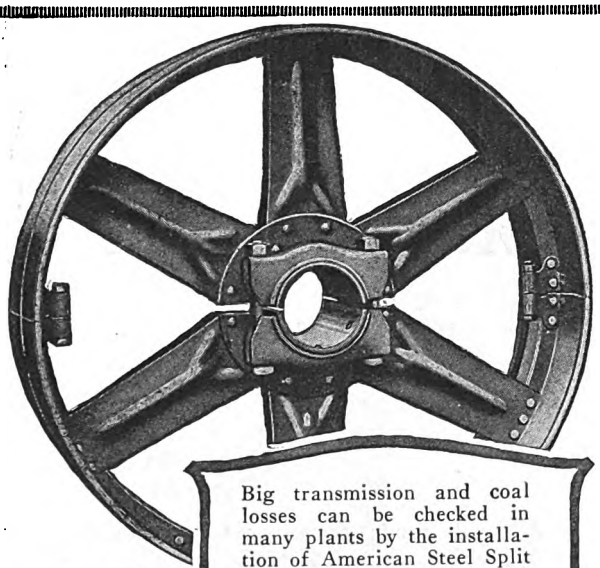
Why consider the destructible when you can have the indestructible?

No matter how badly crushed, twisted or kinked, "Loomflex" can always be pinched back into shape and used. Easy to fish—all sizes are slightly oversized and there are no seams to break loose. The roller-bearing construction of the interior allows the wire to slide through with a minimum of friction.

Write for samples.

American Circular Loom Co.
90 West St., New York
Boston Los Angeles Seattle
Chicago San Francisco Toronto

AMERICAN CIRCULAR LOOM CO. TRADE MARK



Big transmission and coal losses can be checked in many plants by the installation of American Steel Split Pulleys. They combine maximum strength with light weight, and are guaranteed for minimum belt slip, minimum air resistance, double belt service.

AMERICAN STEEL SPLIT PULLEYS

"American" Pulleys are quickly and easily installed. There's no troublesome key way to be cut, no set screw needed. Over four million sold.

Our 37-page book, "Getting maximum Pulley Efficiency," is full of valuable transmission data.

The American Pulley Company
Philadelphia, Pa.

When you order a transformer from us you can be sure that it will be delivered *on time* and that when you get it it will be *RIGHT*—right in *efficiency*—right in *reliability*—right in *price.*

KUHLMAN ELECTRIC COMPANY
Bay City, Mich.

SEARCHLIGHT SERVICE
SECURES SATISFACTORY SITUATIONS SALES

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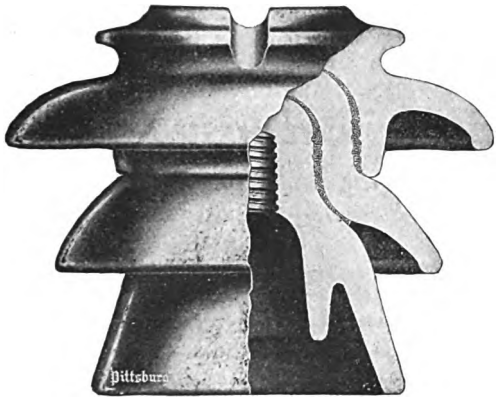
"PITTSBURG INSULATORS"



Export No. 371 for 45,000 Volts will give you a line where you will not be troubled with interruptions.

The Pittsburg High Voltage Insulator Co.

Main Office and Factory, Derry, Penna.
Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., Sole Agent for United States.
Canadian General Electric Company, Toronto, Canada, Sole Agent for Dominion of Canada.
Harmon S. Salt, 114 Liberty Street, New York, Export Agent.

Aluminum Company of America

Manufacturers of

ALUMINUM

Electrical Conductors

All-Aluminum and Steel Reinforced

for

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Railway and Industrial Feeders
Signal Circuits
Railway Catenary Construction
Bus Bars

also

Ingots—Rods—Rivets—Extruded Shapes
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also

Aluminum Solders and Flux
Flux and Wire for Autogenous Welding

GENERAL SALES OFFICE
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Latin America: Aluminum Co. of South America, Pittsburgh, Pa.
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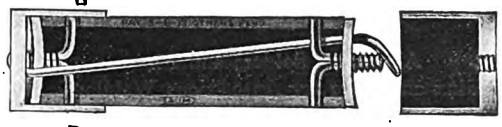

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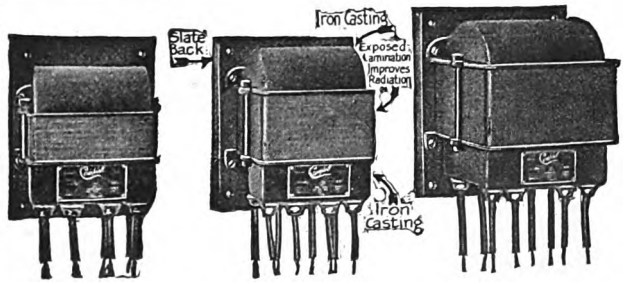

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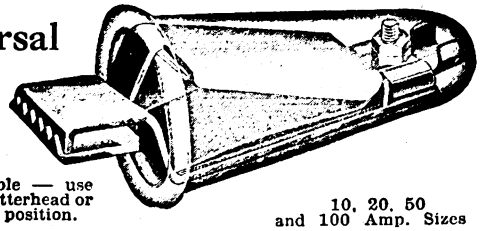

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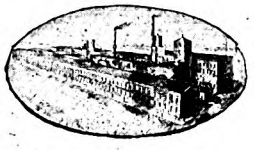

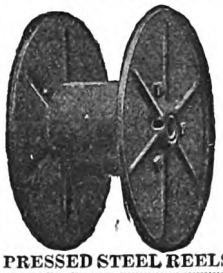

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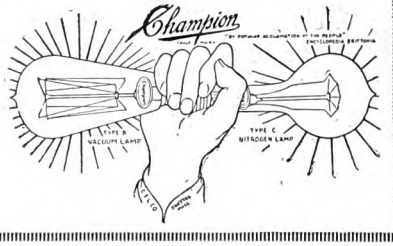

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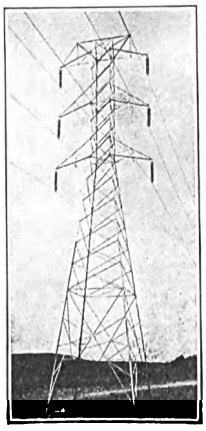

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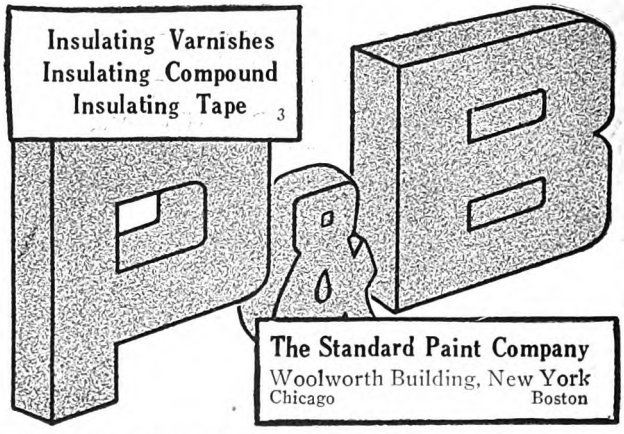

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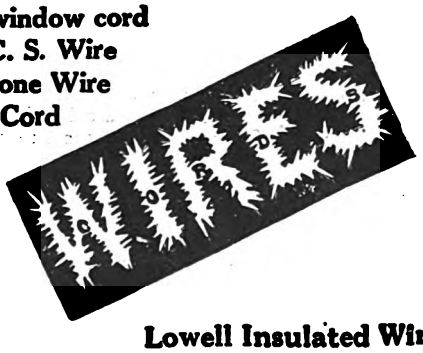

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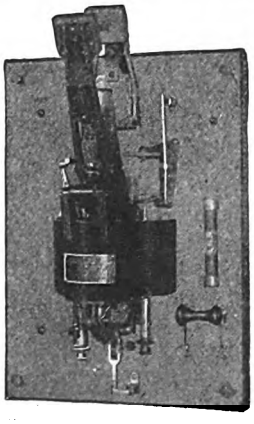

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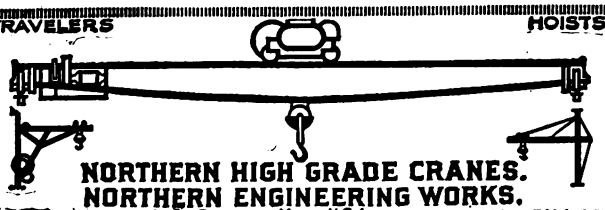

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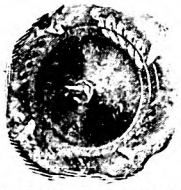

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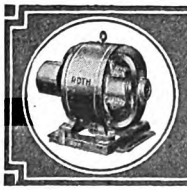

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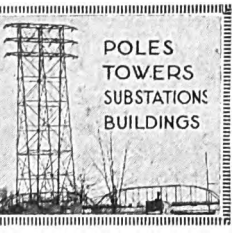

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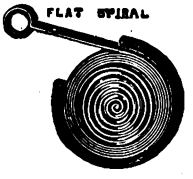

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Use "Three-E" Products for their built-in *quality* and *superior design*. We are specialists in High Tension Equipment.
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for controlling liquid level in tanks, sumps, receivers, etc.
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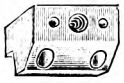
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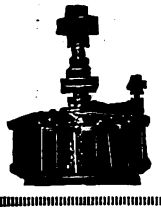
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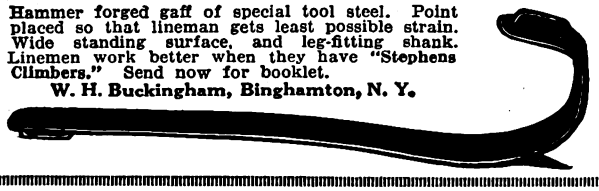

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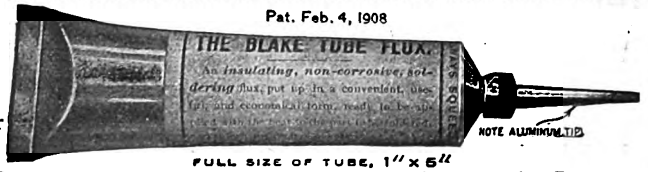

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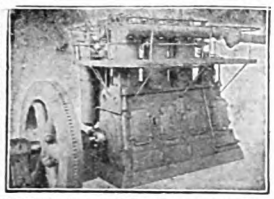

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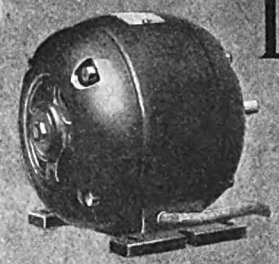
DOMESTIC SMALL MOTORS



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"What does the term Quality applied to Small Motors Mean?"

"It means a motor designed for the particular application on which it is used, a Motor of superior design constructed of the highest grade materials and the best workmanship.

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Built on the 40°C Basis with overload capacity

Type TR

Polyphase Induction Type

Requires No Auxiliary Starting Apparatus

¶IT automatically controls the starting current within predetermined limits. ¶IT eliminates the "personal equation" of the operator. ¶IT has a starting torque three and one-half times that of the ordinary motor started thru an auto-transformer. ¶IT has efficiency and other operating characteristics, as high as the best designs of other types. ¶IT has in the rotor windings no open circuit or disruptive discharge voltage. ¶IT can be operated from any convenient point, no matter how far distant. ¶IT is Simple—Reliable—Durable—Efficient, the four requisites of SATISFACTORY SERVICE. ¶IT is built on the 40 degree C basis with overload capacity.

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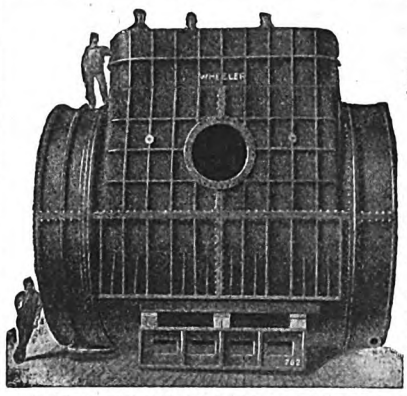

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Bulletin 112-A tells all about our condensers, pumps, cooling towers, etc.

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MOTORS

Furnish DEPENDABLE Power

St. Louis Motors are made in Three-Phase, Two-Phase and Split Single Phase, Squirrel Cage Induction Type. Polyphase may be had in twelve sizes, from one-half to twenty h.p.; Single Phase in ten sizes, from one-eighth to two h.p.

These motors are absolutely dependable; have high efficiency, low maintenance cost, ideal performance characteristics and economical price. Send for Our Catalog No. 5.

We urge you to investigate if you are seeking the BEST motor value that the market affords.

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High Grade Motor and Generator Brushes

For Central Station Units

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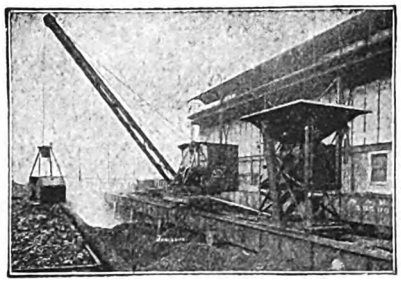

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A most logical combination for Central Station and Power House. The Cranes and Buckets operate with highest efficiency and the Crushers give a superior grade of Stoker coal with a minimum of "fines" and dust. The many in use have paid big dividends on the investments.

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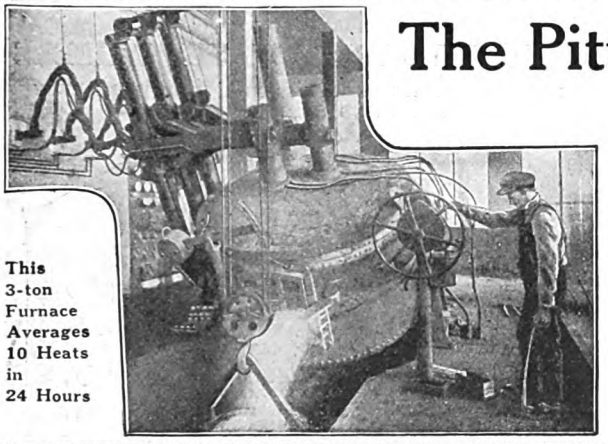

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These furnaces effect large economies over other steel making methods in steel foundries.

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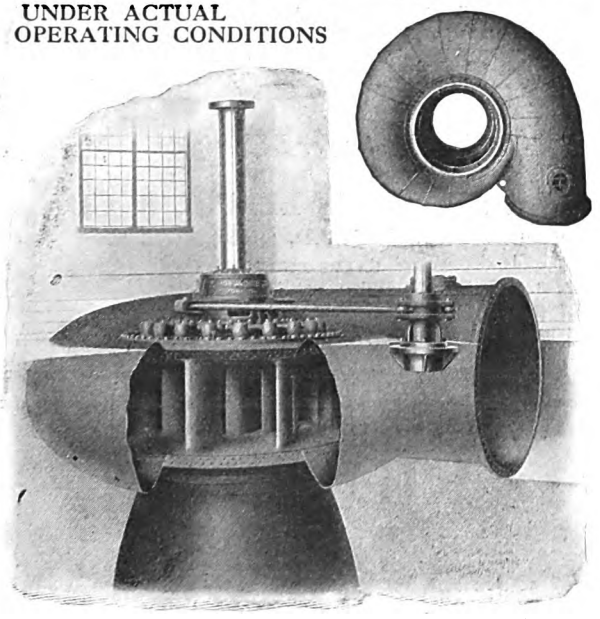
UNDER ACTUAL OPERATING CONDITIONS



The accompanying illustration shows a single, vertical shaft wicket gate SMITH HYDRAULIC TURBINE in a plate steel scroll case with all gate operating mechanism on the outside. This unit is in successful operation under 60 ft. head developing 3,000 brake horse power at 240 revolutions. After installation it was tested by disinterested engineers and established the above performance record under actual operating conditions.

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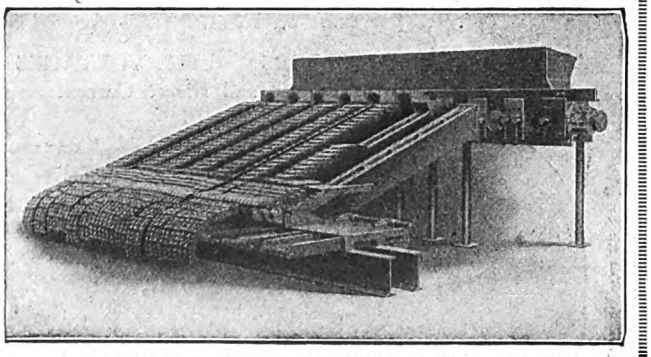

Perspective view of nine-retort stoker partially assembled

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Each line of grates of the RILEY STOKER extends the entire length of the furnace. By changing the travel on one or more sections (with conveniently located stroke adjusters) it is therefore possible to level, thin or thicken the fuel bed as required.

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Our Catalog E-6 makes it self-evident why operators are enthusiastic over RILEY-STOKERS. Copy on request.

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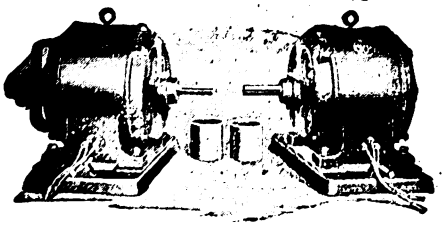

Direct motor drive simplified. Dimensions identical in both A.C. and D.C. motors of same hp. rating permitting use of standardized motor mountings. Write for Bulletins.

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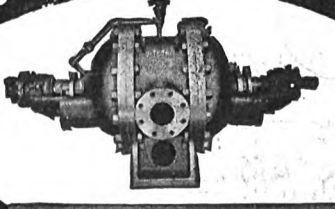

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MADE BY MANISTEE
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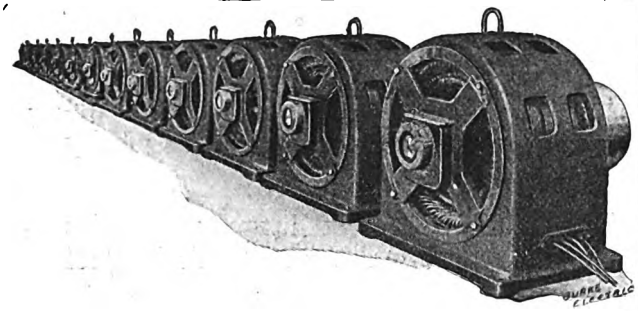

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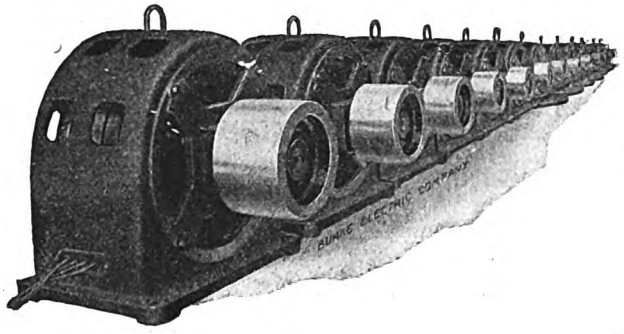

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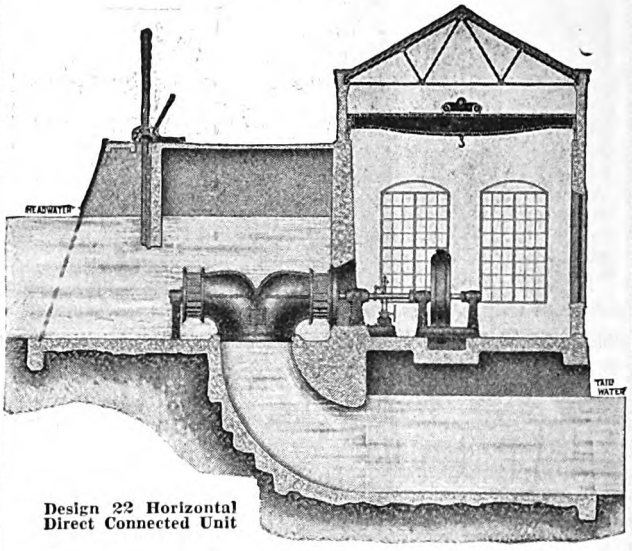

Design 22 Horizontal Direct Connected Unit

Write for Bulletin 54

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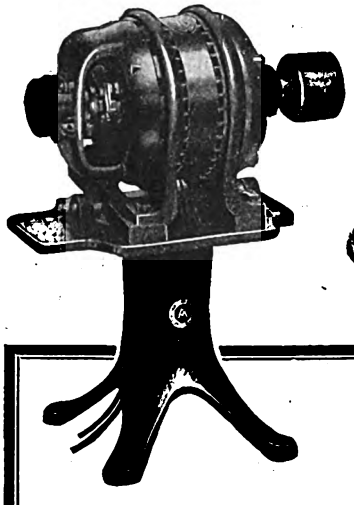

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—for Your Friction Drive Job Presses

Here are some of the operating advantages of "AK" Job Press Drive that have made enthusiastic users everywhere its best advertisement.

Predetermined Set Speeds, Push Button Control. Made for A.C.—any cycle—1/20 to 6 HP.

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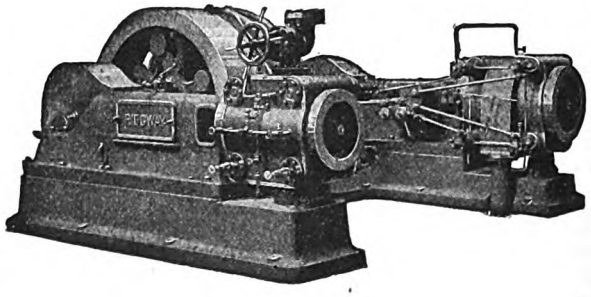

Are made as a single piece of machinery—
Not "hooked together"—
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But Actually Made as a *Unit.*
That's why they run so silently, so smoothly and so economically.

Get the RIDGWAY Bulletins

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"LOPULCO" produces
An ideal labor condition in your boiler room.

"LOPULCO" produces
More steam per pound of coal than any other method of firing.

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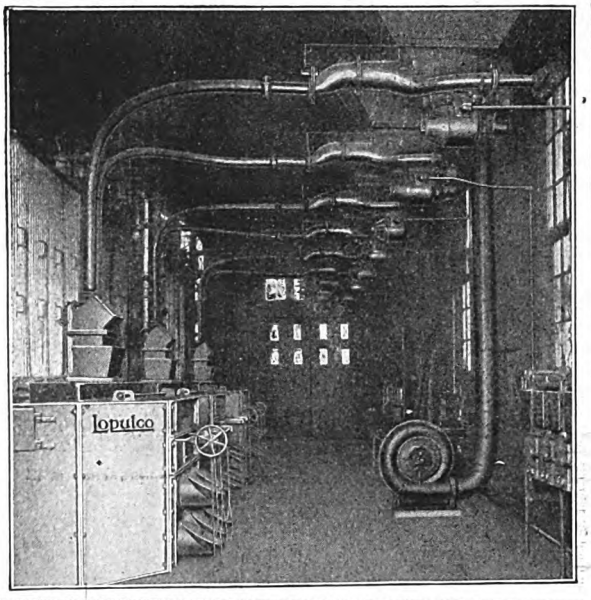
RESULTS



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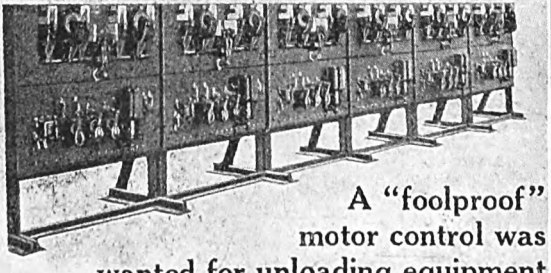
built to meet the requirements of a good specification



A "foolproof" motor control was wanted for unloading equipment

The case was that of a ship loading and unloading device installed on an important pier.

It was necessary that this apparatus should be handled by rough and careless "dock wallopers." Consequently a motor control equipment was required that would be practically foolproof—an equipment, in fact, that would enable the owners to forget the human element altogether.

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—so they put it up to SUNDH

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Combustion efficiency the Fireman when

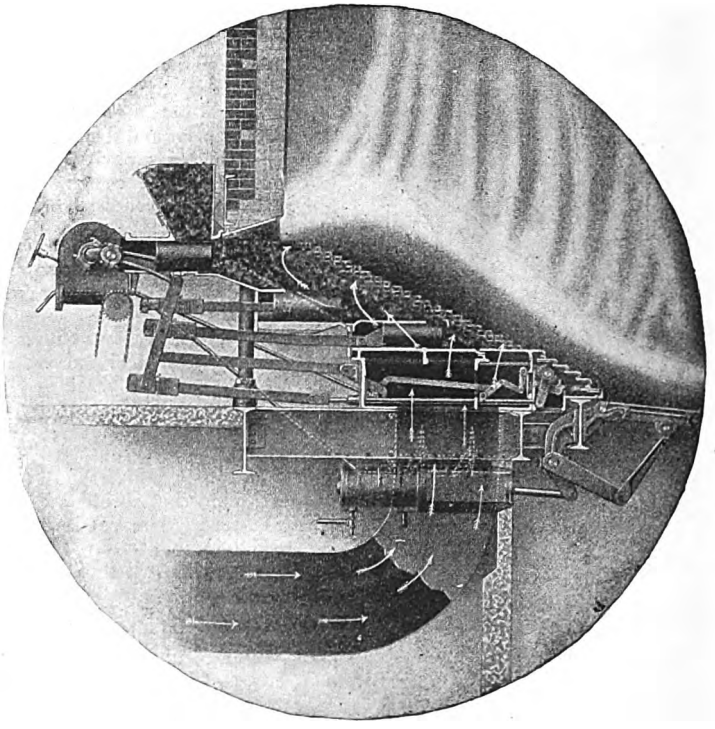
To obtain the best commercial combustion of bituminous coal requires a low distillation temperature, thorough mixture of the combustibles and oxygen, and rapid preparation of the combustible hydrocarbons for burning.

In practical work the results obtained depend upon the load, the furnace, the chimney and the fireman. With a good fireman and a bad combination of other conditions, it is possible to obtain fairly good results, but with a poor fireman, no matter how favorable other conditions may be, the results will gradually gravitate to the fireman's standard. Therefore the fireman is the most important factor in heat generation.

From article in POWER

Is Your Plant Handicapped THIS Way?

Or is THIS the standard by which you get results? Think it over!



The TAYLOR System of Efficient Boiler Firing

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does not depend upon you are using

The Taylor Stoker

Here it is anew—the old, old story.

"The Fireman is the most important factor in heat generation"—everything gravitates to *his* standard and you stand helpless in spite of the best equipment.

Sad—but true—*until you eliminate the shovel-swinging "fireman."*

By eliminating the "fireman" from the boiler room we mean exactly the same thing as eliminating the man who used to swing the old-fashioned scythe from agriculture, or the "man with the hoe" from construction work.

For instance, where would agriculture be now if we worked with the small scythe and the horse-plow instead of with the mighty gang-plow and the reaping-machine?

Where would construction be if contractors let their men mix concrete with hoes and rakes instead of the power-driven concrete-mixer?

These industries still employ thousands of men—but they get better results by keeping up to the *standard of the machine* rather than down to the "man-power" standard.

And by making it EASIER for their men to do *better,* more intelligent, more interesting, less slave-like work, they get better COOPERATION.

When YOU eliminate the "fireman" (the man who handles the primitive shovel, slicebar and rake), and give this man the TAYLOR STOKER to work with,—you will accomplish the results we speak of. You will make him equal to *five or more men.* And one point more. The Taylor Stoker, having forced draft, is not dependent on *the chimney,* either.

American Engineering Company

Philadelphia

Foreign Licensee: Babcock & Wilcox, Ltd., Oriel House, Farringdon St., London, England

The Taylor Stoker

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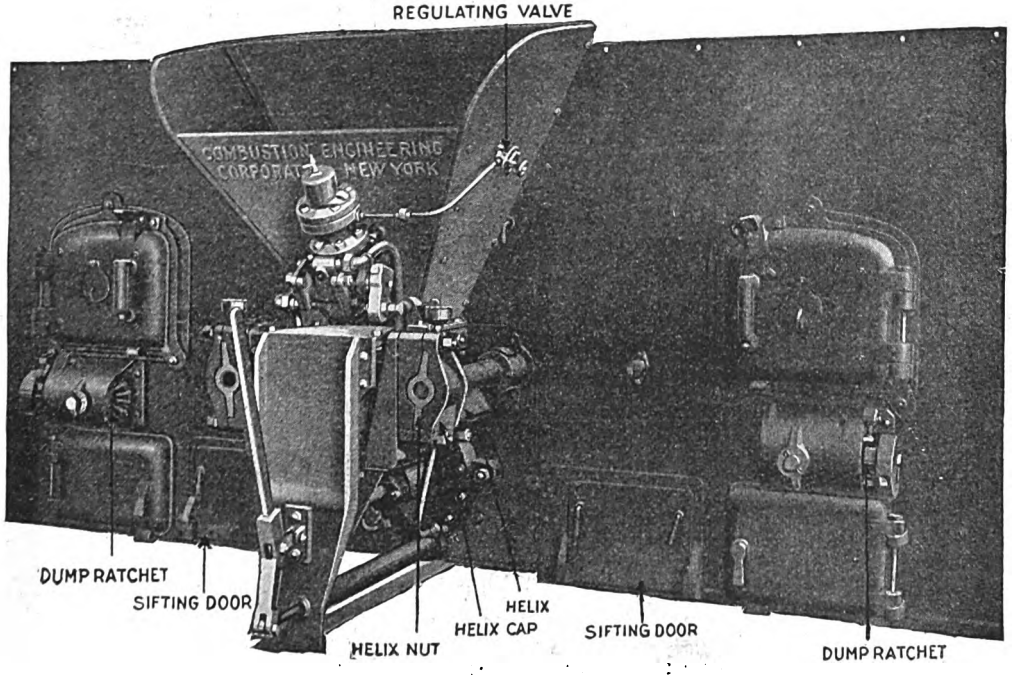
tern Coals

TYPE "E" STOKERS

in this plant carry the light, heat and power loads



COMBUSTION ENGINEERING CORPORATION

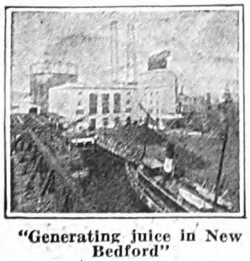
11 Broadway, New York City

Owners and Manufacturers of

Type "E" Stokers—for Bituminous Coal The Grieve Grate—Hand-Firing

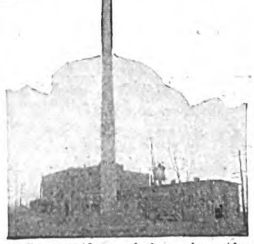
Coxe Stokers—Anthracite Coal and Coke Breeze

PHILADELPHIA, PA. PITTSBURGH, PA. MINNEAPOLIS, MINN. BIRMINGHAM, ALA.
HAZLETON, PA. BOSTON, MASS. CHICAGO, ILL. SEATTLE, WASH. SALT LAKE CITY, UTAH
ALBANY, N. Y. OMAHA, NEB. TAYLOR ENGINEERING CO., VANCOUVER, B. C.


"Generating juice in New Bedford"

"Generating juice in the Backwoods"

"Generating juice in Iowa"


"Generating juice in the Buckeye State"

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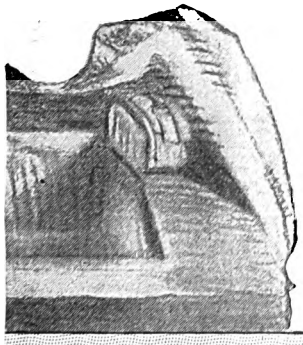
Even when they shaved Worthington helped

"SHOES shined and faces shaved"—if any one phrase from the orders of the day will be remembered, that is it.

With the American soldier the morning shave was a habit, even under fire, so Worthington's part in making razor blades at once assumes a peculiar importance.

And while Worthington compressors and vacuum pumps in South Boston were helping to make razor blades, other Worthington equipment was playing its part in factories making soap, steel mirrors, brushes, and indeed practically everything that went into the recruit kit.

It is significant of Worthington's ability to meet emergencies that, although the eight Worthington factories were all delivering unprecedented quantities of war materials, it was still possible for them to supply the wants of those industries essential to everyday life.



WORTHINGTON PUMP AND MACHINERY CORPORATION
Executive Offices: 115 Broadway, New York City
Branch Offices in 24 Large Cities

OIL & GAS ENGINES—MINING MACHINERY

WORTHINGTON

Snow-Holly Works
Buffalo, N. Y.
Laidlaw Works
Cincinnati, Ohio
Power & Mining Works
Cudahy, Wis.
Gas Engine Works
Cudahy, Wis.

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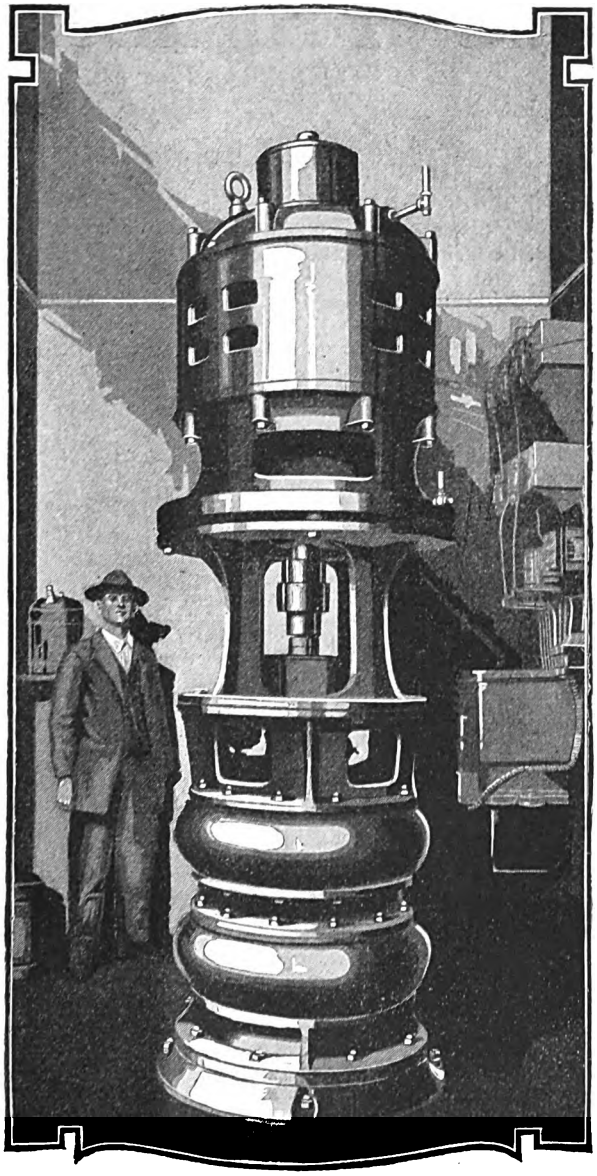
MIDWEST
Dependable Power

Midwest Engine Company Products

Midwest—Diesel Engines
Midwest—Hvid Oil Engines
Midwest—Parsons Turbines (*Reaction Type*)
Midwest—Wait Turbines (*Impulse Type*)
Midwest—Hill Centrifugal and Reciprocating Pumps and Auxiliaries
Werkspoor Diesel—American Licensees



THERE is a Midwest pumping equipment to meet every condition—and in each case that equipment guarantees maximum dependability with minimum maintenance expense.

For instance, if you need equipment for deep-well pumping, where it is necessary to pump against high pressure after the water is brought to the surface, you will be interested in the equipment shown here—one of eight Midwest pumps of this type doing service for the city of Canton, Ohio.

Each of these units consists of an 8-inch, 2 stage surface pump in combination with a No. 10 Axial deep-well pump, with a capacity of 1000 g. p. m. against 100 pounds pressure in the mains.

The records of the city of Canton show that with practically no maintenance cost these pumps have given continuous satisfactory service.

Bring your own pumping problems to our engineering department, or see our representatives in all large cities.

New York Office—111 Broadway
New Orleans Office—617 Maison-Blanche Building

MIDWEST
ENGINE COMPANY
INDIANAPOLIS, U. S. A.

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Which is the Worse "Profiteer"

The man who refuses to *sell* on a fair basis and holds out for a higher price in a "seller's market"?

Or the man who refuses to *buy* on a fair basis and holds out for a lower price in a "buyer's market"?

Both trade on the necessities of others.

Both take advantage of conditions to speculate at the "other fellow's" expense. Don't be a "buying profiteer."

If you need anything and it is offered to you at a fair price, present market conditions considered, *buy it.*

Unreasonable prices can not be successfully maintained but waiting for prices to fall below costs of production can result only in general loss to all

Keep business going. Carry on. If everybody keeps busy and gives the other fellow a fair deal everybody will make their turnover and the process of adjustment from war conditions to peace conditions will be so gradual that we will never feel a single bump.

Let's Go!

National Prosperity Campaign, Commodore Hotel, New York *Electrical World*

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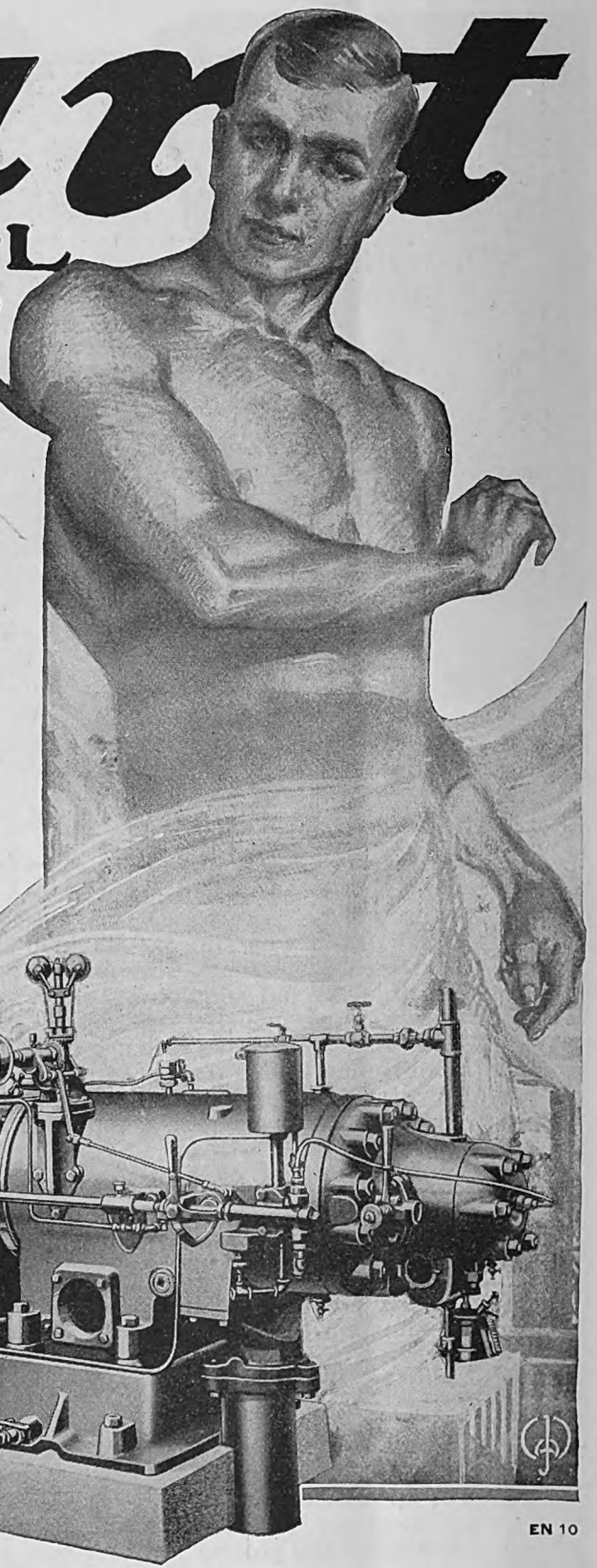
Giant
SEMI-DIESEL OIL ENGINES

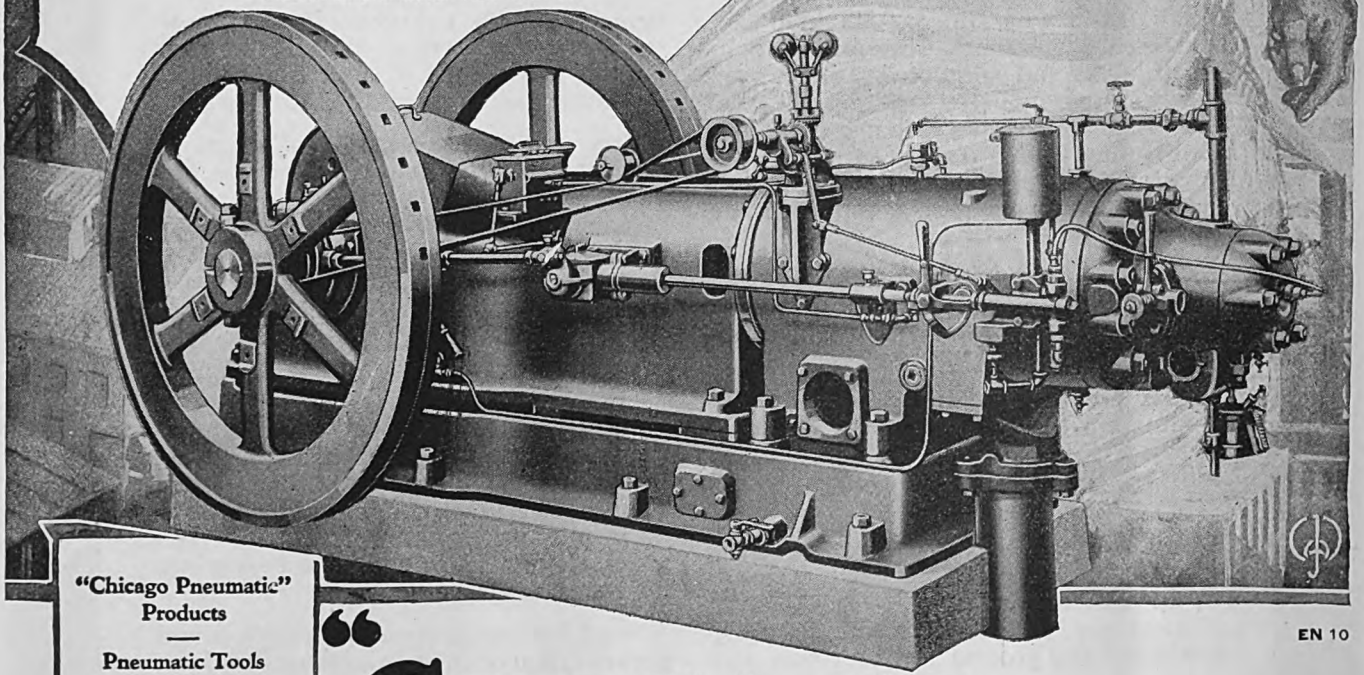


POWER costs of one-half cent per horse power hour are common amongst users of Giant Semi-Diesel Fuel Oil Engines. The economy and dependability of this prime mover for general purposes are proven facts.

Records are available showing the performance of Giant Engines under service conditions similar to yours. Put your individual power problem, without obligation on your part, before our experienced engineers. Your present power costs may be such that a Giant Engine will pay for itself within a short time—and then pay dividends on the investment.

Giant Oil Engines utilize the lower grades of cheap fuel oils, are built in capacities from 12 to 160 horse power, both single and duplex types. Ask for Bulletin 34-W.

Chicago Pneumatic Tool Company
1087 Fisher Building, Chicago, Illinois
Branches all over the world



EN 10

"Chicago Pneumatic" Products

Pneumatic Tools
Electric Drills
Air Compressors
Oil, Gas and Steam Engines
Vacuum Pumps
Rock Drills

"CHICAGO PNEUMATIC"

Depend upon that name

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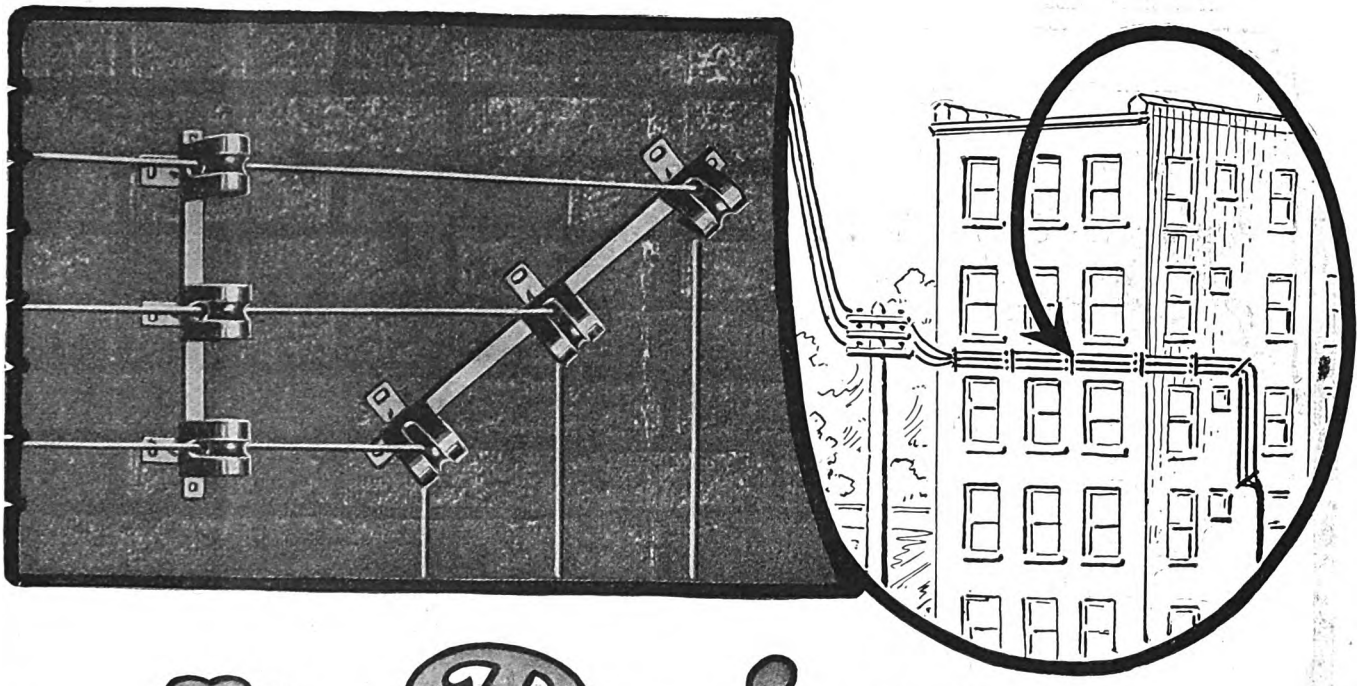
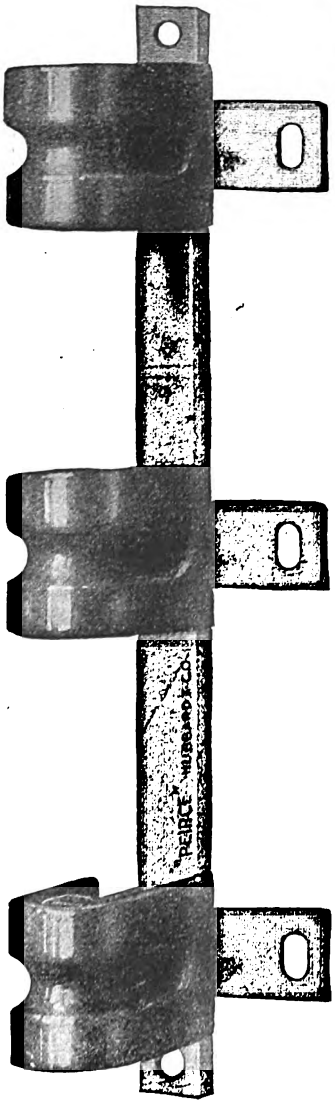


The Peirce WIREHOLDER



Why do we call it a "Wireholder?"

Because it will hold your wires—just as it comes to you without any extras.

When you use house brackets, you must buy insulators and tie wires to use with them.

But the **Peirce Wireholder** *is a complete article.*

It comes with insulators assembled on it, and the insulators are designed to eliminate tie wires. The line wires are merely threaded through the holes.

The complete wireholder costs you about the same as the incomplete bracket.

You save the cost of

3 D. G. D. P. insulators	$ .17
3 Tie Wires	.13
Labor of assembling	.01
Labor of tying in	.02
	$ .33

and you get a more dependable job and a neater one. See your Jobber. He carries the **Wireholder** in six styles.

HUBBARD & COMPANY
PITTSBURGH, PA.

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Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

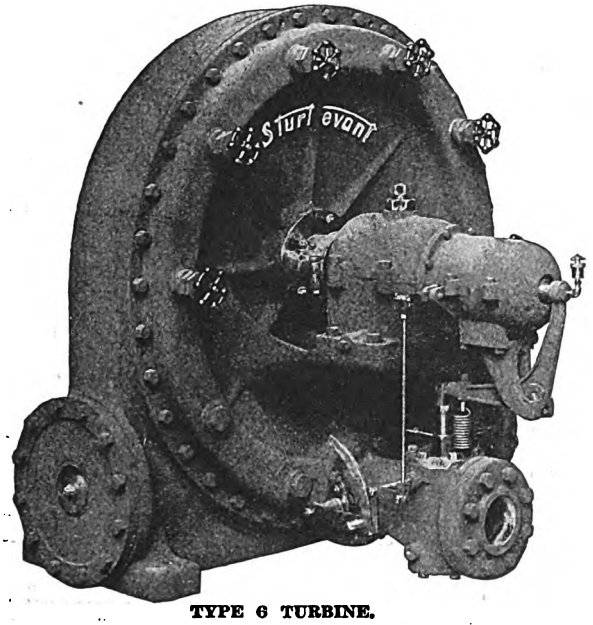
"APPROVED"

was written by the U. S. Navy and Emergency Fleet Corporation :: :: on the :: ::

Sturtevant (REG. U.S. PAT. OFF.) Steam Turbine

This without an alteration in our operating principle, allowing this department to produce on a quantity basis,

97% for the Government



TYPE 6 TURBINE.

This product of twelve years' development and research, embodies the Sturtevant quality of engineering practice. The solid rotor, integral nozzle and re-directing buckets give that simplicity and ruggedness that mean reliability.

Designed to operate Sturtevant fans and blowers, this turbine is equally efficient for driving pumps and generators.

Our new Turbine Catalog is now ready for distribution. Ask for No. 256-E.

B. F. STURTEVANT COMPANY

Hyde Park, Boston, Mass.

And all Principal Cities.

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

Sturtevant (REG. U.S. PAT. OFF.) FANS AND BLOWERS

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16 GOULDS PUMPS

in the Minnequa Coke Plant of the Colorado Fuel & Iron Co.

A striking illustration of the great popularity of Goulds Pumps with large industrial organizations is the pumping equipment of the Minnequa Works of the Colorado Fuel & Iron Co. at Pueblo. Sixteen "Goulds" are operated for various purposes.

Three Fig. 1128, size 12 x 12, Triplex Pumps pump tar over ovens; a Fig. 1694, size 8 x 10 Triplex pumps tar to cars; three Fig. 1694, size 7 x 10, Triplex pump liquor to tanks and stills; two Fig. 3030, Centrifugals size 5 S, lift water to tank; three Fig. 3011, Centrifugals, size 2, pump lime water to tanks; and three Fig. 3030, size 6 S, and two Fig. 3030, size 5 S, recirculate water over cooler towers and gas coolers.

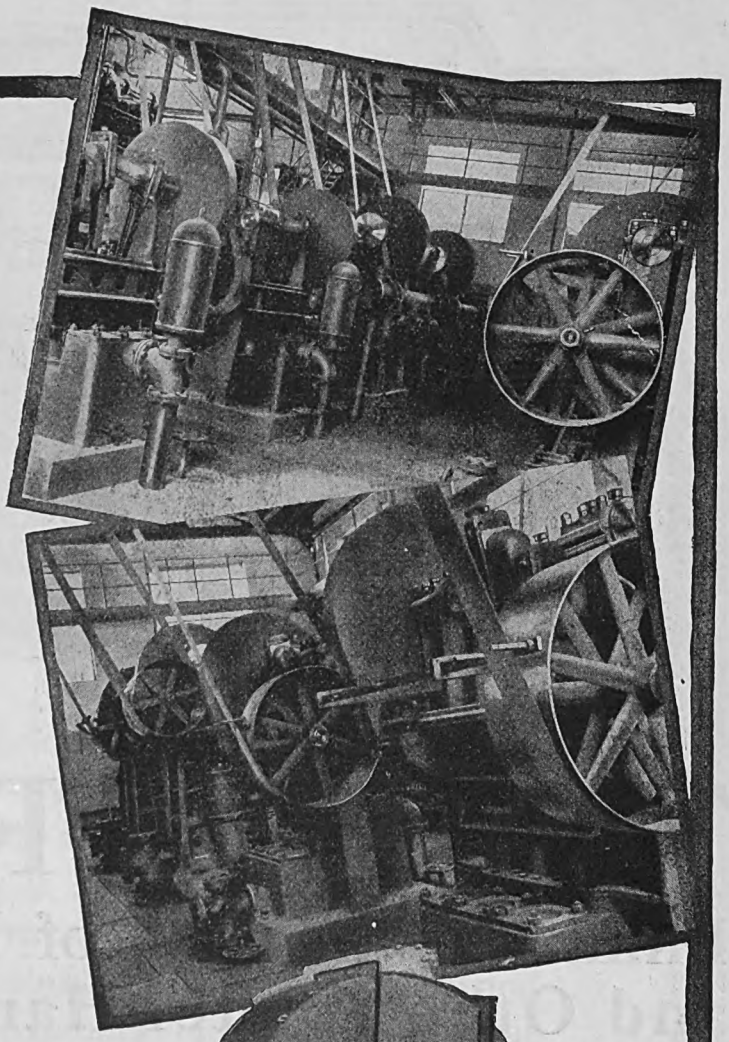
Goulds Pumps are built in many types and sizes—there is a Goulds Pump of remarkable efficiency for every pumping purpose.

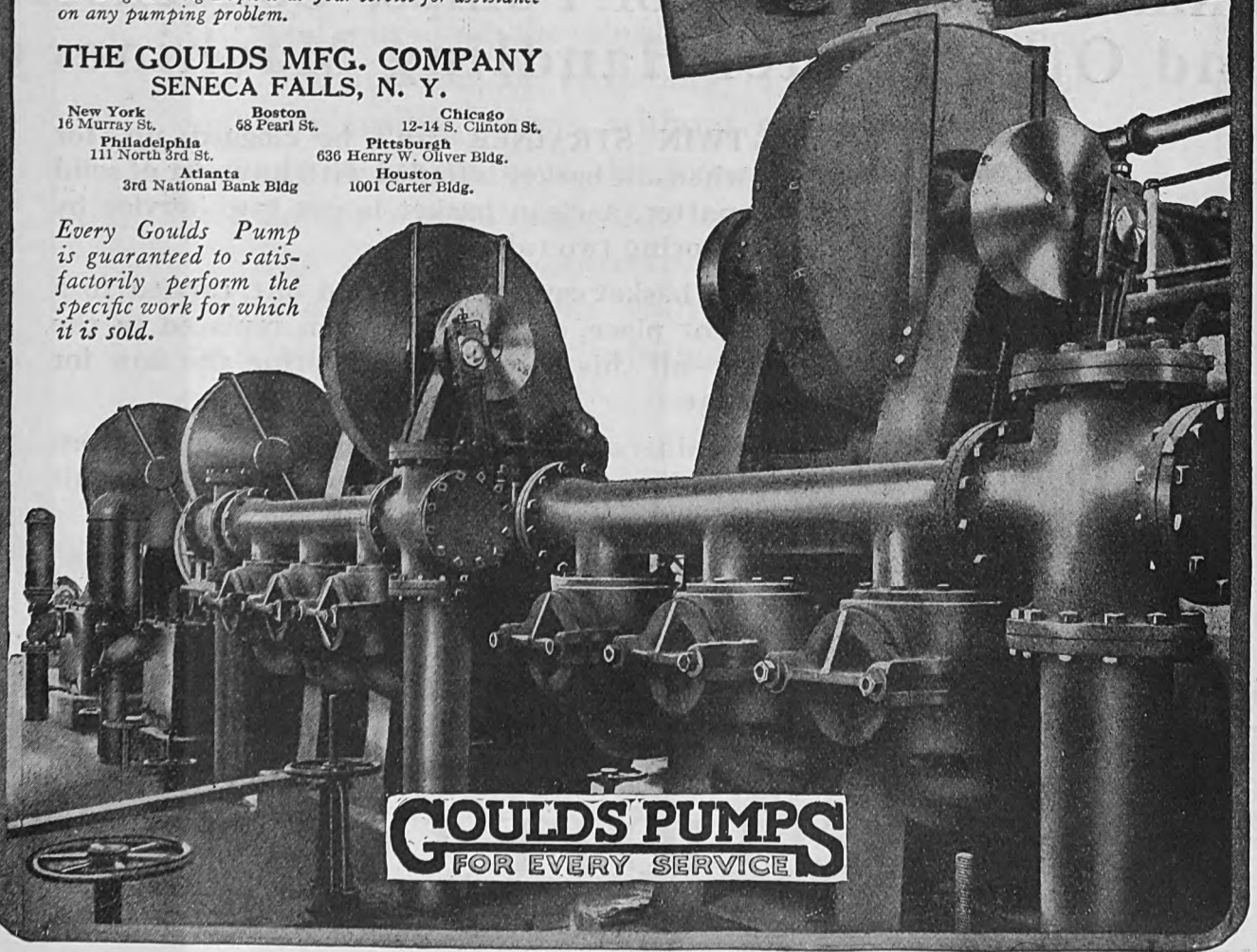
Our Engineering Dept. is at your service for assistance on any pumping problem.

THE GOULDS MFG. COMPANY
SENECA FALLS, N. Y.

New York 16 Murray St.
Boston 68 Pearl St.
Chicago 12-14 S. Clinton St.
Philadelphia 111 North 3rd St.
Pittsburgh 636 Henry W. Oliver Bldg.
Atlanta 3rd National Bank Bldg
Houston 1001 Carter Bldg.

Every Goulds Pump is guaranteed to satisfactorily perform the specific work for which it is sold.





GOULDS PUMPS
FOR EVERY SERVICE

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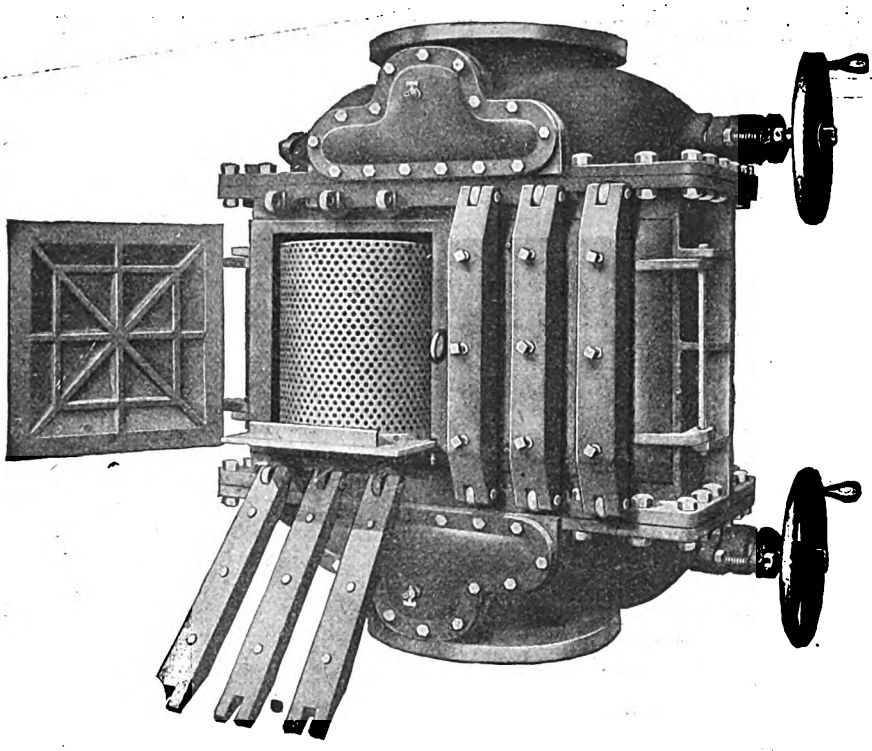

TWIN STRAINERS

Eliminate Clogging of Pumps, Condensers and Other Water-Handling Machinery

A TWIN STRAINER can't be clogged up, for when one basket is fouled with any sort of solid matter, a clean basket is cut into service by simply moving two valves.

The dirty basket can then be lifted out, carried to a convenient place, cleaned, and then replaced in the Strainer—all this without interrupting the flow for an instant.

Twin Strainers are furnished in sizes ranging from 1 in. to 42 in. with perforations in the baskets to suit the service.

They can be installed in any position—horizontal or vertical.

Full particulars in Bulletin "A" which will be sent on request.

ELLIOTT PRODUCTS
Condensers
Air Ejectors
Twin Strainers
Twin Filters
Feed Water Heaters
Steam Separators
Receiver Separators
Blow-Off Valves
Oil Filters
Steam Traps

ELLIOTT COMPANY
442 *Fifth Avenue, Pittsburgh, Pa.*

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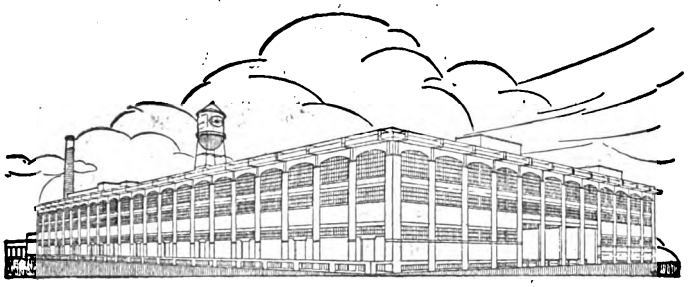

AMERICAN CAN CO., FACTORY, MAYWOOD, ILL.

INVESTIGATE BEFORE YOU INVEST

No matter how efficient in its own business, no organization can dispense with competent advice on its plant extensions, any more than a lawyer can dispense with a doctor when he is sick or a doctor dispense with a lawyer when he sues a client for his bill.

And pursuing the simile further, merely hiring any organization of engineers or contractors that makes plausible claims, without scrutinizing its credentials of ability, is as dangerous as hiring a lawyer or a doctor without regard to his record.

The Thompson-Starrett Company is not only competent to undertake your plant extensions, but its advice is constantly solicited and followed in the investigative stages of construction problems, by organizations which want specialized advice before they commit themselves to a contract.

Our Advice is as Good as Our Service

THOMPSON-STARRETT COMPANY
INDUSTRIAL CONSTRUCTION
NEW YORK
CHICAGO **PITTSBURGH**

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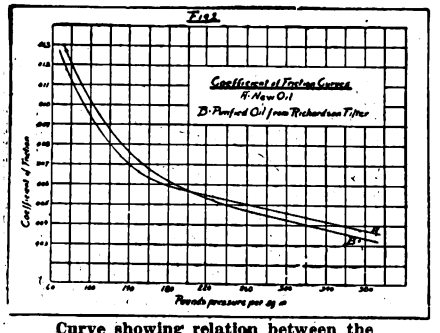
Filtered Oil From An R-P Automatic Oil Circulating And Filtering System As Good As New Oil!

The tests described herewith were made by Cornell University on samples of oil taken from the R-P Automatic Oil Circulating and Filtering System in the McAlpin Hotel, New York. The oil tested has been in continuous service for **more than a year.**

Coefficient of Friction

A series of friction tests were made on a Thurston Railroad Lubricant Tester. The testing machine was run at a constant speed of about 360 R.P.M. and the load applied in increments of 75 pounds pressure per square inch. Readings of the coefficient of friction were made at ten minute intervals. The results are shown in the curves opposite (Fig.1.)

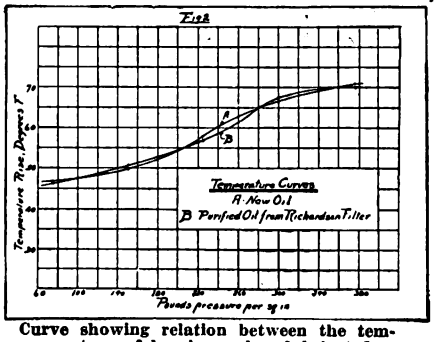


Curve showing relation between the coefficient of friction of new and filtered oil

Temperature

The curves shown in Fig. 2 are the ones that will probably prove the most interesting to the operating engineer. It will be noted that the two curves in Fig. 6 are practically superimposed and in no case is the variation more than a few degrees, giving ample proof that the lubricating quality of the oil is practically unimpaired.

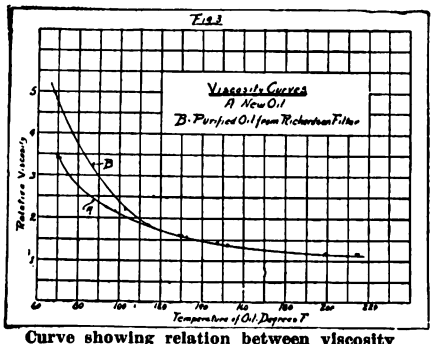
Readings of the temperature of the bearing were made at ten-minute intervals. The results of these tests are shown in the curves in Fig. 2. Fig. 2 shows the rise in temperature, that is, the difference between the temperature of the bearing and of the room.



Curve showing relation between the temperature of bearings when lubricated with new and filtered oil

Viscosity

Tests of the new and filtered oil were also made in an Olsen viscosimeter. The results of these tests are shown in Fig. 3. From the data it is evident that oil gains in specific gravity through constant use. This is what one would naturally expect inasmuch as the oil in passing through the bearings had had some of its more volatile constituents driven off. The viscosity curves also show that as oil is used over and over again in an oiling system, it actually gains in body, provided a filter is used which thoroughly removes entrained water.



Curve showing relation between viscosity of new and filtered oil

Sample "A"—New Oil
Color—medium red, translucent.
Flash point 410 degrees (open cup).
Burning point—460 degrees F. (open cup).
Specific gravity at 60 degrees F. water as 1-.895.

Laboratory Tests of New and Filtered Oil

Sample "B"—Purified Oil from Peterson Filter
Color—very dark red, opaque.
Flash point—410 degrees F. (open cup).
Burning point—440 degrees F. (open cup).
Specific gravity at 60 degrees F. water as 1-.903.

In hundreds of plants, R-P Automatic Oil Circulating and Filtering Systems are making remarkable savings. Every engineer should be thoroughly familiar with Bulletin M-25, which describes their application in detail. Drop a postal for your copy today.

THE RICHARDSON-PHENIX CO.
LUBRICATION ENGINEERS AND MANUFACTURERS
WORKS-127 RESERVOIR AVE. MILWAUKEE, WIS.

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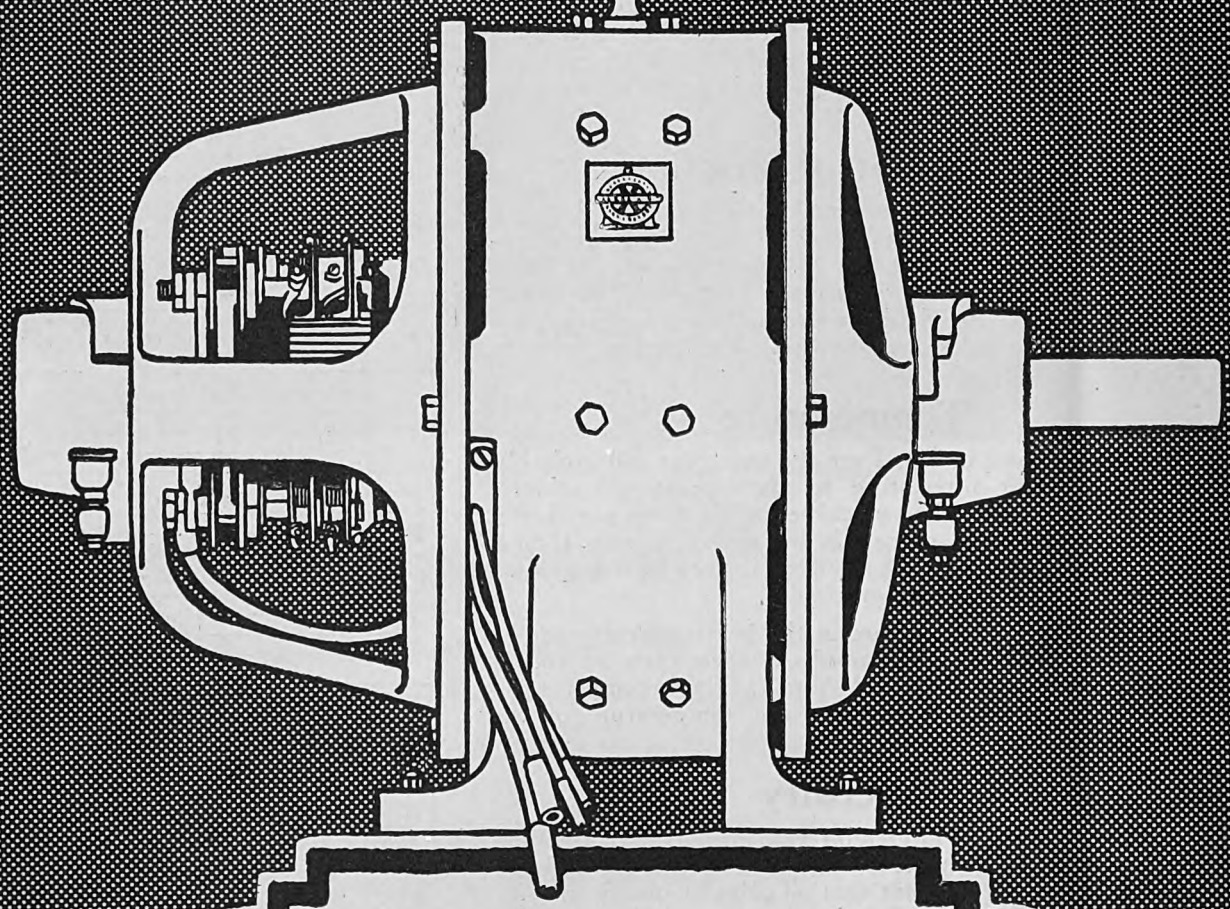
Type T Heavy Duty
RELIANCE MOTORS
Direct Current



Extra Quality and Extra Quantity

The 35 electrical engineers who co-operated with us in the design of Type T motors have under their care installations of 300 to 3000 motors. From years of experience in their repair shops they have learned where extra quality and strength would mean better motor service.

It was such experience that guided us in the building of a motor that would stay on the job longer and be in the repair shop less. The story of how better material and more of it is used in buiding Type T motors is told in Bulletin 2014 with 39 illustrations.

Reliance Electric & Engineering Co.

1046 Ivanhoe Road, Cleveland, O.

Branches: Boston, New York, Philadelphia, Pittsburgh, Chicago

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WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used by the Electrical Industry with Names of Manufacturers and Distributors

Air Compressors.
Allis-Chalmers Mfg. Co.
General Electric Co.
Hartford Machine Screw Co.
Worthington Pump & Machy. Corpn.

Air Washers and Coolers.
Spray Engrg. Co.

Aluminum.
Aluminum Co. of America.

Ammeters, Voltmeters.
(See Instruments, Electrical).

Anchors, Guy.
Crouse-Hinds Co.
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Arches, Boiler
Green Engineering Co.

Armature Repair Machinery
Electric Service Supplies Co.

Asbestos Lumber
Johns-Manville Co., H. W.

Batteries, Dry Cell.
Manhattan Elec'l Supply Co.
Western Elec. Co.

Batteries, Storage.
Edison Storage Battery Co.
Electric Storage Battery Co.

Battery Charging Apparatus.
Cutler-Hammer Mfg. Co.
General Elec. Co.
St. Louis Elec'l Wks.
Weshe Electric Co., B. A.

Bearings, Ball.
Norma Co. of America.

Belt Fasteners
Flexible Steel Lacing Co.

Belt Lacing
Flexible Steel Lacing Co

Belting, Leather
Ladew Co., E. R.

Blowers, Electric
Sturtevant Co., B. F.

Blowers, Steam Driven.
Green Fuel Economizer Co.
Terry Steam Turbine Co.

Boilers, Steam.
Babcock & Wilcox Co.
Bigelow Co.
Edge Moor Iron Co.

Bolts, Expansion.
Hubbard & Co.

Bond Testers.
Roller-Smith Co.

Books, Technical.
McGraw-Hill Company, Inc.

Boosters.
Crocker-Wheeler Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Triumph Electric Co.
Weshe. Elec. Co., B. A.
Westinghouse Elec. & Mfg. Co.

Boxes, Fuse.
Crouse-Hinds Co.
General Electric Co.
Johns-Mannville Co., H. W.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.

Boxes, Junction and Outlet.
Chicago Fuse Mfg. Co.
Crouse-Hinds Co.
D. & W. Fuse Co.
General Electric Co.
National Metal Molding Co.
Sprague Electric Works.

Boxes, Meter and Service.
Crouse-Hinds Co.
General Elec. Co.
Johns-Mannville Co., H. W.
Metropolitan Eng'g Co.

Brackets and Pins, Metal.
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Pittsburgh Transformer Co.

Brushes, Dynamo.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
National Carbon Co.
United States Graphite Co.

Buckets, Clamshell
Blaw-Knox Co.

Buckets, Excavating, Motor Driven.
Blaw-Knox Co.
Hayward Co.

Buildings, Steel.
Blaw-Knox Co.
Delta Star Elec. Co.
Milliken Bros. Mfg. Co.

Bus Bar Supports
Delta Star Electric Co.

Bushings.
Crouse-Hinds Co.
National Fibre & Insulation Co.
National Metal Molding Co.
Siemon Hard Rubber Corp.

Cabinets, Panel Board
Crouse-Hinds Co.

Cable End Bells
Electrical Engineers Equipment Co.

Cable Racks.
Hubbard & Co.
Metropolitan Eng'g Co.

Cabling Machinery.
American Ins. Machinery Co.
New England Butt Co.

Carbon Brushes.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
National Carbon Co.
United States Graphite Co.

Cars, Coal & Ash Handling.
Easton Car & Const. Co.

Castings
Triumph Electric Co.

Castings, Die.
Acme Die Casting Corp.
Doehler Die-Casting Co.
Precision Castings Co.

Chains, Silent Driving
Morse Chain Co.

Chains, Silent Power Transmission
Morse Chain Co.

Circuit Breakers.
Automatic Reclosing Circuit Breaker Co.
Condit Elec. Mfg. Co.
Cutter Co.
General Electric Co.
Industrial Controller Co.
Palmer Elec. & Mfg. Co.
Roller-Smith Co.
Sangamo Elec. Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Clamps, Cable Supporting.
Matthews & Bro., Inc., W. N.

Clamps, Ground Connections.
Condit Elec. Mfg. Co.
General Electric Co.

Clamps, Guy.
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Clamps, Insulator.
Electrical Engineers Equipment Co.

Cleats.
Blake Signal & Mfg. Co.
Imperial Porcelain Works.
National Metal Molding Co.

Climbers, Linemen's
Buckingham, W. H.

Clips, Cable
Condit Elec. Mfg. Co.
Hubbard & Co.

Clips, Testing
Mueller & Co., R. S.

Clusters
Hubbell, Inc., Harvey

Clutches, Magnetic.
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery.
Blaw-Knox Co.
Green Engineering Co.
Hayward Co.
Northern Engineering Works
Pulverized Fuel Equipment Corp.

Coil Winding Tools
Electric Service Supplies Co.

Coils
Coto-Coil Co.
Dudlo Mfg. Co.

Coils, Armature, Field
D & W Fuse Co.
Independent Lamp & Wire Co.

Coils, Choke.
Delta Star Elec. Co.
General Electric Co.

Commutator Stones
Ideal Commutator Dresser Co.

Commutators.
Cameron Electric Mfg. Co.

Compounds, Commutator.
McLennan Co., K.

Condensers.
Elliott Company
Griscom-Russell Co.
Manistee Iron Works
Wheeler Condenser & Eng. Co.
Worthington Pump & Machy. Corpn.

Conduit Bends.
Fibre Conduit Co.

Conduit Fittings.
Crouse-Hinds Co.
Fibre Conduit Co.
Sprague Electric Works.

Conduits, Interior.
American Circular Loom Co.
National Metal Molding Co.
Sprague Electric Works.

Conduits, Underground (Fibre)
Fibre Conduit Co.
Johns-Mannville Co., H. W.

Connectors, Solderless.
Westinghouse Elec. & Mfg. Co.

Connectors and Terminals.
Electrical Engineers Equipment Co.
Sherman Mfg. Co., H. B.
Westinghouse Elec. & Mfg. Co.

Contact Rail Material
Electric Service Supplies Co.

Contracting Engineers
Thompson-Starrett Co.

Controllers, Motor.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Conveying Machinery (Coal, Ashes, Etc.)
American Bridge Co.
Green Engineering Co.

Cooling Ponds, Spray.
Spray Engrg. Co.

Cord Adjusters.
American Vul. Fibre Co.
National Fibre & Insulation Co.

Cord, Arc Lamp.
Samson Cordage Works.

Cord, Flexible.
Belden Mfg. Co.
Lowell Insulated Wire Co.
Rome Wire Co.

Cord, Trolley.
Samson Cordage Works.

Couplings, Flexible.
Smith-Serrell Co., Inc.

Crane Motors.
Sprague Electric Works.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
American Bridge Co.
Maris Bros.
Northern Engineering Works

Cross Arms.
American Bridge Co.
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Western Electric Co.

Cutouts.
D & W Fuse Co.
Condit Elec. Mfg. Co.
General Elec. Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g. Co.

Dealers' Machinery
(See Searchlight Section and Second-Hand Apparatus.)

Draft, Mechanical.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Drills, Brick.
Hubbard & Co.

Dynamos and Motors.
Allis-Chalmers Mfg. Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Domestic Electric Co.
Electric Machinery Co.
Emerson Electric Mfg. Co.
General Electric Co.
Gregory Electric Co.
Howell Elec. Motors Co.
Kimble Electric Co.
Mechanical Appliance Co.
Northwestern Electric Co.
Peerless Electric Co.
Reliance Elec. & Eng'g. Co.
Ridgway Dynamo & Engine Co.
Robbins & Myers Co.
Roth Bros. & Co.
Sprague Electric Works.
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Wesche Electric Co., B. A.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Ebony Asbestos Wood (Switchboard Material)
Johns-Manville Co., H. W.

Economizers, Fuel.
Green Fuel Economizer Co.
Sturtevant Co., B. F.

Electromagnets
Acme Wire Co.
Coto-Coil Co.
Elec. Controller & Mfg. Co.
Ohio Elec. & Controller Co.
Ward Leonard Elec. Co.

Emergency Outfit (for Burns, etc.)
Ambrine Laboratories

Engineers, Consulting and Contracting.
(See also Directory of Engineers.)

Engines, Gas and Gasoline.
Allis-Chalmers Mfg. Co.
Sterling Engine Co.
Worthington Pump & Machy. Corpn.

Engines, Oil.
Chicago Pneumatic Tool Co.
McIntosh & Seymour Corp.
Midwest Engine Co.
Worthington Pump & Machy. Corpn.

Engines, Steam.
Allis-Chalmers Mfg. Co.
Ridgway Dynamo & Eng. Co.

Evaporators, Water
Griscom-Russell Co.

Excavating Machinery, Motor-Driven.
Hayward Co.

Experimental Apparatus.
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.

Fan Motors.
Adams, Bagnall Elec. Co.
Century Elec. Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
General Elec. Co.
Gilbert Co., A. C.
Peerless Electric Co.
Robbins & Myers Co.
Sprague Electric Works.
Western Elec. Co.

Fans (Exhaust and Ventilating)
Adams, Bagnall Elec. Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Elec. Co.
General Elec. Co.
Green Fuel Economizer Co.
Kimble Elec. Co.
Mechanical Appliance Co.
Robbins & Myers Co.
Sprague Electric Works.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.

Fans, Turbine Driven.
Terry Steam Turbine Co.

Fault Finders, Cable.
Elliott Co.
Matthews & Bro., Inc., W. N.

Feed Water Heaters
Elliott Co.
Griscom-Russell Co.

Fibre.
American Vul. Fibre Co.
Continental Fibre Co.
Fibre Conduit Co.
National Fibre & Insulation Co.

Filters, Oil.
Elliott Company
Richardsor-Phenix Co

Filters, Water
Blackburn-Smith Corp
Elliott Company
Griscom-Russell Co.
Scaife & Sons, W. B.

Financial
Coal & Iron National Bank.
Rollins & Sons, E. H.

Fire Extinguishers
Johns-Mannville Co., H. W.

First Aid Cabinets
Ambrine Laboratories

Fixture Holders, Adjustable.
Matthews & Bro., Inc., W. N.

Fixtures, Electric and Gas.
Adams Bagnell Elec. Co.

Fixtures, Street Lighting
Campbell Electric Co.
Philadelphia Elec. & Mfg. Co.

Flooring, Grating
Irving Iron Works Co.

Flooring, Metallic
Irving Iron Works Co.

Friction Tape and Cloths
Johns-Manville Co., H. W.

Furnace Equipment, Water Cooled
Blaw-Knox Co.

Furnaces, Electric.
Pittsburgh Furnace Co.

Furnaces, Pulverized Coal
Pulverized Fuel Equipment Corp.

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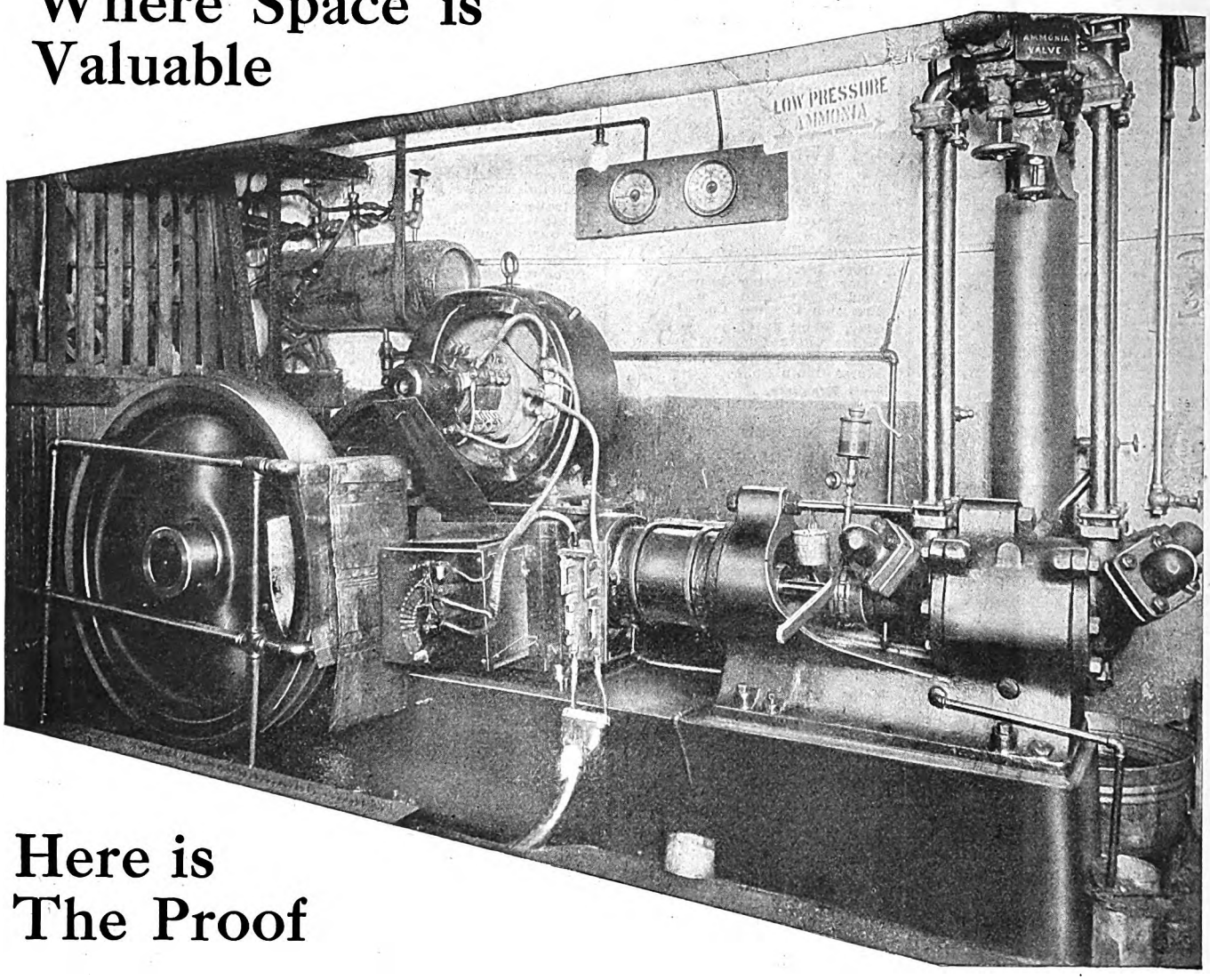
"OVER THE TOP"

A PEERLESS DRIVE

Where Space is Valuable



Here is The Proof

This problem of lack of space was solved by mounting this 25 hp. PEERLESS multipolar motor *directly on top* of the pump, this is proof of the ability of PEERLESS motors to meet any requirement, however unusual. The inbuilt quality, rugged construction and the perfectly balanced armature combine to make a highly efficient drive, free from all vibration and occupying no additional floor space, which, as in this case, is often a valuable consideration.

It is in unusual applications such as this one that PEERLESS motors have earned their distinction and firmly established their reputation for efficiency, adaptability and economy of operation under all conditions.

It has been our constant aim to maintain PEERLESS products at the highest degree of electrical and mechanical perfection humanly possible and render that "PEERLESS SERVICE" which the purchaser pays for and has a right to expect.

Let us help *you* solve your motor problems.

Bulletins promptly on request.

The Peerless Electric Co.

Warren, Ohio

REPRESENTATIVES

New York—C. O. Hall—147 W. 35th St.
Phila.—Walter L. Veit—The Bourse Bldg.
Toledo—The F. Bissell Co.
Chicago—The Electrical Machinery Sales Co.—327 So. La Salle St.
Minneapolis—The Electrical Machinery Sales Co.—Plymouth Bldg.
New Orleans—The Electric Appliance Co.
Los Angeles—The Garland Affolter Co.
San Francisco—The Garland Affolter Co.
Seattle—The Garland Affolter Co.
St. Louis—L. M. Sperry—917 Pine St.

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WHAT AND WHERE TO BUY

Fuses.
Condit Elec. Mfg. Co.
D. & W. Fuse Co.
Daum, A. F.
Delta Star Elec. Co.
Economy Fuse & Mfg. Co.
General Electric Co.
Johns-Mannville Co., H. W.
Metropolitan Eng'g. Co.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Western Elec. Co.

Fuses, Refillable.
Chicago Fuse Mfg. Co.
Daum, A. F.
Economy Fuse & Mfg. Co.

Galvanizing, Custom Work
Cattie, Jos. P. and Bros.

Gauges, Air
Precision Instrument Co.

Gauges, Recording.
Bristol Co.
Foxboro Co., The.
Precision Instrument Co.

Gearing, Silent Flexible
Morse Chain Co.

Gears.
General Elec. Co.

Gears, Herringbone.
Poole Eng'g. & Mach. Co.

Gears, Reduction.
Poole Eng'g. & Mach. Co.

Generating Sets
Automatic Light Co.

Generating Sets, Engine and Turbine
Sturtevant Co., B. F.
Universal Motor Co.

Globes, Shades, etc.
Adams Bagnall Elec. Co.

Gratings
Irving Iron Wks. Co.

Grating, Flooring
Irving Iron Wks. Co.

Grease Extractors
Blackburn-Smith Corp.
Elliott Company

Ground Rods
Page Steel & Wire Co.

Grounds, Etc.
Paragon Electric Co.

Guards, Incandescent Lamp.
Flexible Steel Lacing Co.
Hubbell, Inc., Harvey
Matthews & Bro., Inc., W. N.

Hack Saws, Rotary
Barnes & Irving, Inc.

Hair Driers.
Shelton Elec. Co.

Hangers, Cable
Condit Elec. Mfg. Co.
Hubbard & Co.

Hardening, Case Hardening and Tempering
Edison Lamp Works

Head Gates
American Bridge Co.

Headlights, Acid and Incadescent
Crouse-Hinds Co.

Heating Devices, Electric.
General Electric Co.
Simplex Electric Heating Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Heating and Ventilating Systems
Sturtevant Co., B. F.

Hoists, Electrical and Steam.
Allis-Chalmers Mfg. Co.
Northern Engineering Wks.
Sprague Electric Works.

Indicators, Sight Flow.
Richardson-Phenix Co.

Indicators, Speed.
Biddle, James G.
Roller-Smith Co.

Industrial Railways and Cars
Easton Car & Const. Co.

Instrument Transformers.
General Elec. Co.
Weston Electrical Instrument Co.

Instruments, Electrical.
Graphic.
Biddle, James G.
Bristol, Co.
General Electric Co.
Sangamo Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Indicating.
General Electric Co.
Precision Instrument Co.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.
Integrating.
Biddle, James G.
Duncan Elec. Mfg. Co.
General Electric Co.
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Repairing and Testing.
Illinois Testing Laboratories
Scientific and Testing.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Metropolitan Eng'g. Co.
Weston Elec. Instrument Co.

Insulating Machinery.
American Ins. Machinery Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
Imperial Porcelain Works.
Jeffery-Dewitt Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Pittsburg H. V. Ins. Co.
Compounds, Paints and Varnishes
Garfield Mfg. Co.
General Bakelite Co.
Mitchell-Rand Mfg. Co.
Redmanol Chemical Products Co.
Standard Paint Co.
Fibre.
Amer. Vulcanized Fibre Co.
Continental Fibre Co.
Lava.
American Lava Co.
Steward Mfg. Co., D. M.
Mica.
Munsell & Co., Engene.
Silk.
Ryle & Co., Wm.
Slate
Mitchell-Rand Mfg. Co.
New York Insulated Wire Co.
Okonite Co., The

Insulating Paper.
Johns-Mannville Co., H. W.
National Fibre & Insulation Co.

Insulator Pins.
Hubbard & Co.

Insulators.
China, Porcelain and Composition.
Imperial Porcelain Works.
Jeffery-Dewitt Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Peru Electric Co.
Pittsburg High Volt Ins. Co.
Glass
Brookfield Glass Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.

Insulators
Delta Star Electric Co.

Irons, Electric
Simplex Electric Heating Co.

Lamp Guards.
Flexible Steel Lacing Co.
Hubbell, Inc., Harvey.
Matthews & Bros., Inc., W. N.

Lamp Replacers.
Matthews & Bro., Inc., W. N.

Lamps, Arc.
Adams, Bagnall Elec. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Flaming Arc.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent.
Boston Economy Lamp Div.
Chicago Elec. Lamp Co.
Consolidated Elec. Lamp Co.
Edison Lamp Works
General Electric Co.
Hygrade Lamp Co.
Independent Lamp & Wire Co.
National Lamp Works
Western Elec. Co.
Westinghouse Lamp Co.
Whitelite Elec. Co.

Lamps, Miniature.
General Electric Co.
Miniature Incandes. Lamp Corp.

Lava.
(See Insulating Material, Lava.)

Lightning Arresters.
Delta Star Elec. Co.
Electric Service Supplies Co.
Electrical Engineers Equipment Co.
General Electric Co.
Hubbard & Co.
Lewis & Roth Corp.
Railway & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Lighting Fixtures, Industrial
Philadelphia Elec. & Mfg. Co.

Lighting Plants, Isolated Type
Automatic Light Co.

Line Material.
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Electric Service Supplies Co.
General Electric Co.
Hubbard & Co.
Johns-Manville Co., H. W.
Philadelphia Elec. & Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Linemen's Shields.
Matthews & Bro., Inc., W. N.

Linemen's Tools.
(See Tools, Linemen.)

Lubricating Oils.
Texas Company

Lubrication Engineers.
Richardson-Phenix Co.

Lubricators.
Richardson-Phenix Co.

Machines, Armature Notching.
Ferracute Machine Co.

Magnanin
Barker & Co., Inc.

Magnet Wire.
Acme Wire Co.
American Brass Co.
American Electrical Works.
American Steel & Wire Co.
Ansonia Elec. Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D & W Fuse Co.
Hazard Mfg. Co.
Independent Lamp & Wire Co.
Massachusetts Elec. Mfg. Co.
Page Steel & Wire Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Western Elec. Co.

Magnets.
Acme Wire Co.
Coto-Coil Co.
Cutler-Hammer Mfg. Co.
Dudlo Mfg. Co.

Magnets, Lifting.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Ohio Elec. & Controller Co.

Mechanical Stokers.
Amer. Engrg. Co.
Combustion Engineering Corp.
Riley Stoker Co., Ltd., Sanford.
Underfeed Stoker Co.

Metal Work, Drawn and Stamped.
Patten-MacGuyer Co.
Risdon Tool & Mach. Co.

Meter Testers
States Company, The

Meters, Electric (See Instruments)

Meters, Flow.
General Elec. Co.
Spray Engineering Co.

Meters, Hot Water
Worthington Pump & Machy. Corpn.

Mica.
Ford Mica Co.
Munsell & Co., Eugene.

Mining Machinery.
Allis-Chalmers Mfg. Co.
Worthington Pump & Machy. Corpn.

Molded Insulation.
Garfield Mfg. Co.
General Bakelite Co.
Johns-Mannville Co., H. W.
Northern Industrial Chemical Co.
Redmanol Chemical Products Co

Molded Parts.
Belden Mfg. Co.

Molding, Metal.
National Metal Molding Co.

Motors.
(See Dynamos & Motors.)

Nozzles, Spray.
Spray Engineering Co.

Oils, Lubricating
Texas Company

Oil, Transformer.
Texas Company

Oilers, Telescope.
Richardson-Phenix Co.

Oiling Systems, Cutting.
Richardson-Phenix Co.

Oiling Systems, Hydro-electric.
Richardson-Phenix Co.

Oiling Systems, Sight Feed.
Richardson-Phenix Co.

Oiling Systems, Steam Turbine
Richardson-Phenix Co.

Oiling Systems, Turbine.
Richardson-Phenix Co.

Packing
Johns-Manville Co., H. W.
Leeds & Northrup Co.

Panel Boards.
Adams Bagnall Elec. Co.
Crouse-Hinds Co.
General Electric Co.
Westinghouse Elec. & Mfg Co.

Panels, Switchboard.
General Electric Co.
Packard Elec. Co.

Penstocks
Blaw-Knox Co.

Photometric Apparatus.
Elec'l Testing Laboratories.
Leeds & Northrup Co.

Pipe Fittings.
Richardson-Phenix Co.

Pipe, Wood
Continental Pipe Mfg. Co.

Plate Work
Blaw-Knox Co.

Platinum
Baker & Co., Inc.

Plugs.
Condit Elec. Mfg. Co.
Crouse-Hinds Co.
Cutler-Hammer Mfg. Co.
Delta-Star Elec. Co.
General Electric Co.
Hubbell, Inc., Harvey.
National Metal Molding Co.

Pole Erectors.
American Bridge Co.
Matthews & Bro., Inc., W. N.

Pole Line Hardware.
Hubbard & Co.
Western Elec. Co.

Poles, Brackets and Pins.
Page & Hill Co.
Western Elec. Co.

Poles, Reinforcing.
Hubbard & Co.

Poles, Steel.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw-Knox Co.
Milliken Bros.

Poles, Ties (Wood)
Carney & Co., B. J.
Valentine-Clark Co.

Porcelain. (See Insulating Material, China and Porcelain.)

Potentiometers.
Biddle, James G.
General Electric Co.

Potheads.
Okonite Co., The.

Presses, Cutting
Ferracute Machine Co.

Projectors, Floodlighting
Crouse-Hinds Co.
Electric Service Supplies Co.

Protective Devices.
Condit Elec. Mfg. Co.
Crouse-Hinds Co.
General Electric Co.
Metropolitan Engineering Co.
Schweitzer & Conrad, Inc.

Pulleys
Amer. Pulley Co.

Pulverized Fuel Equipment
Pulverized Fuel Equipment Corp

Pumps, Air.
Wheeler Condenser & Eng. Co.
Worthington Pump & Machy. Corpn.

Pumps, Centrifugal.
Allis-Chalmers Mfg. Co.
Goulds Mfg. Co.
Manistee Iron Works
Midwest Engine Co.
Manistee Iron Works
Terry Steam Turbine Co.
Worthington Pump & Machy. Corpn.

Pumps, Deep Well
Worthington Pump & Machy. Corpn.

Pumps, Electric Garage
Hartford Machine Screw Co.

Pumps, House Service
Goulds Mfg. Co.
Midwest Engine Co.
Worthington Pump & Machy. Corpn.

Pumps, Hydraulic
Worthington Pump & Machy. Corpn.

Pumps, Motor Driven
Goulds Mfg. Co.
Worthington Pump & Machy. Corpn.

Pumps, Oil.
Goulds Mfg. Co.
Richardson-Phenix Co.
Worthington Pump & Machy. Corpn.

Pumps, Power
Worthington Pump & Machy. Corpn.

Pumps, Steam Driven.
Allis-Chalmers Mfg. Co.
Midwest Engine Co.
Terry Steam Turbine Co.
Worthington Pump & Machy. Corpn.

Pumps, Turbine Driven
Terry Steam Turbine Co.

Pumps, Vacuum
Terry Steam Turbine Co.
Worthington Pump & Machy. Corpn.

Pumps, Water Works
Goulds Mfg. Co.

Pyrometers.
Bristol Co., The.
Leeds & Northrup Co.

Rail Bonds.
American Steel & Wire Co.
Condit Mfg. Co.

Ranges, Elec.
General Electric Co.
Simplex Electric Heating Co.

Receptacles. (See Sockets and Receptacles.)

Rectifiers.
General Electric Co.

Reflectors
Adams Bagnall Elec. Co.

Repairing.
See Searchlight Section.
Cleveland Armature Wks.
Commonwealth Edison Co.
Denton Engr. & Constr. Co.
Elec. Motor & Repair Co.
Nelson, I. R.

Resistance Units.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Ellcon Co.
Gen. Elec. Co.
Industrial Controller Co.
Ward Leonard Elec. Co.

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WHAT AND WHERE TO BUY

Resistance, Wire.
(See Wires, Resistance.)

Rheostats.
Biddle, James G.
Campbell Electric Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Rosettes.
National Metal Molding Co.

Sandstone (Bus and Switch Compartments)
Ohio Quarries Co.

Screw Machine Products
Hartford Machine Screw Co.
Thoner & Martens

Searchlights.
Crouse-Hinds Co.
General Electric Co.

Second-hand Apparatus.
See Searchlight Section.
Adams, Geo. Francis.
American Assn. of Engrs.
Archer & Baldwin.
Belyea Co.
Bissell Co., F.
Breu, William P.
Brown-Hunkele Corpn.
Carrell & Co., W. A.
Chuse Engine Co., H. A. & G. X.
Cleveland Armature Works
Commonwealth Edison Co.
Consolidated Gas, Elec. Light & Power Co.
Cravath, James R.
Davis, J. F.
Davis Machine & Motor Co.
Denton Engr. & Constr. Co.
Donahoo Co., J. F.
Dotterweich Co., A. J.
Duquesne Elec. & Mfg. Co.
Electric Motor & Repair Co.
Elliott Elec. Co.
Garrity, Ralph A.
Geare & Co.
General Equipment Co.
Goodman, E. W.
Goodrich Co., B. F.
Greenfield Elec. Mfg. Co.
Gregory Electric Co.
Harris Bros. Co.
Harris Pump & Supply Co.
Herfurth Eng. & Mchy. Co.
Holcomb, D. S.
Independent Elec. Mach'y Co.
Kirchner-Purcell Co.
Klein & Co., Nathan.
Loose-Wiles Biscuit Co.
MacGovern & Co., Inc.
Miller-Owen Electric Co.
Monarch Elec. Motor Co.
Motter's Sons, Geo. F.
Myerson, Joseph
Natl. Power Machy. Co.
Nelson, I. R.
Olean Elec. Light & Power Co.
Phillips, Leo A.
Power Equip. Co., Engrs.
Power Machy. Exchange.
Randle Machinery Co.
Reliable Electric Motor Co.
Rochester Elec. Supply Co.
Ross Power Equipment Co.
Sachsenmaier & Co., Geo.
Salzberg Co., Inc., H.
Scheinert Co., R.
Schwartz & Land.
Skeldon Engr. Co., Jos. L.
Standard Elec. & Elevator Co.
Stewart Elec. Co., John A.
Stewart & Co., Paul
Technical Products
Thompson, Henry P.
Tiffany, Hall & Co., Inc.
Toomey, Inc., Frank.
Venino Bros. & Co.
Vindex Elec. & Mfg. Co.
Werby & Co., A.
Wicks Machinery Co.
Wilson Machy. Co., H. R.
Zelnicker Supply Co., Walter A.

Separators, Magnetic.
Cutler-Hammer Mfg. Co.

Separators, Oil
Elliott Company
Griscom-Russell Co.

Shade Holders.
Adams-Bagnall Elec. Co.
Hubbell, Inc., Harvey.

Sheet Metal.
Am. Sheet & Tin Plate Co.
Bliss Co., E. W.

Sheets, Electrical.
Am. Sheet & Tin Plate Co.

Sockets and Receptacles.
Bryant Electric Co.
Crouse-Hinds Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hubbell, Inc., Harvey
National Metal Molding Co.
Philadelphia Elec. & Mfg. Co.

Sockets, Weatherproof
Siemon Hard Rubber Corp.

Solder
Chicago Solder Co.

Soldering Flux.
Blake Signal & Mfg. Co.

Soldering Irons
Cutler-Hammer Mfg. Co.

Solenoids.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Elec. Co.

Springs.
American Steel & Wire Co.
Cary Spring Works.
Barnes Co., W.

Sprockets, Silent Chain.
Morse Chain Co.

Stacks, Steel, Smoke.
American Bridge Co.
Condit Elec. Mfg. Co.

Stage Lighting Apparatus
Campbell Electric Co.

Staples.
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters, Motor.
Condit Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.

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American Engineering Co.
Combustion Engineering Corp.
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Stokers, Pulverized Coal
Pulverized Fuel Equipment Corp.

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Locomotive Superheater Co.

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Triumph Electric Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Automatic Time.
Anderson Mfg. Co., A. & J. M.
General Elec. Co.
Matthews & Bro., Inc., W. N.

Switches, Disconnecting.
Anderson Mfg. Co., A. & J. M.
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Electrical Engineers Equipment Co.
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Schweitzer & Conrad, Inc.
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Switches, Enclosed.
General Elec. Co.
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Switches, Float.
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Switches, Knife.
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Electric Controller & Mfg.
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Trumbull Elec. Mfg. Co.
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Switches, Oil.
Condit Elec. Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Switches, Pole Top.
Condit Elec. Mfg. Co.
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Switches, Remote Control.
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Switches, Safety.
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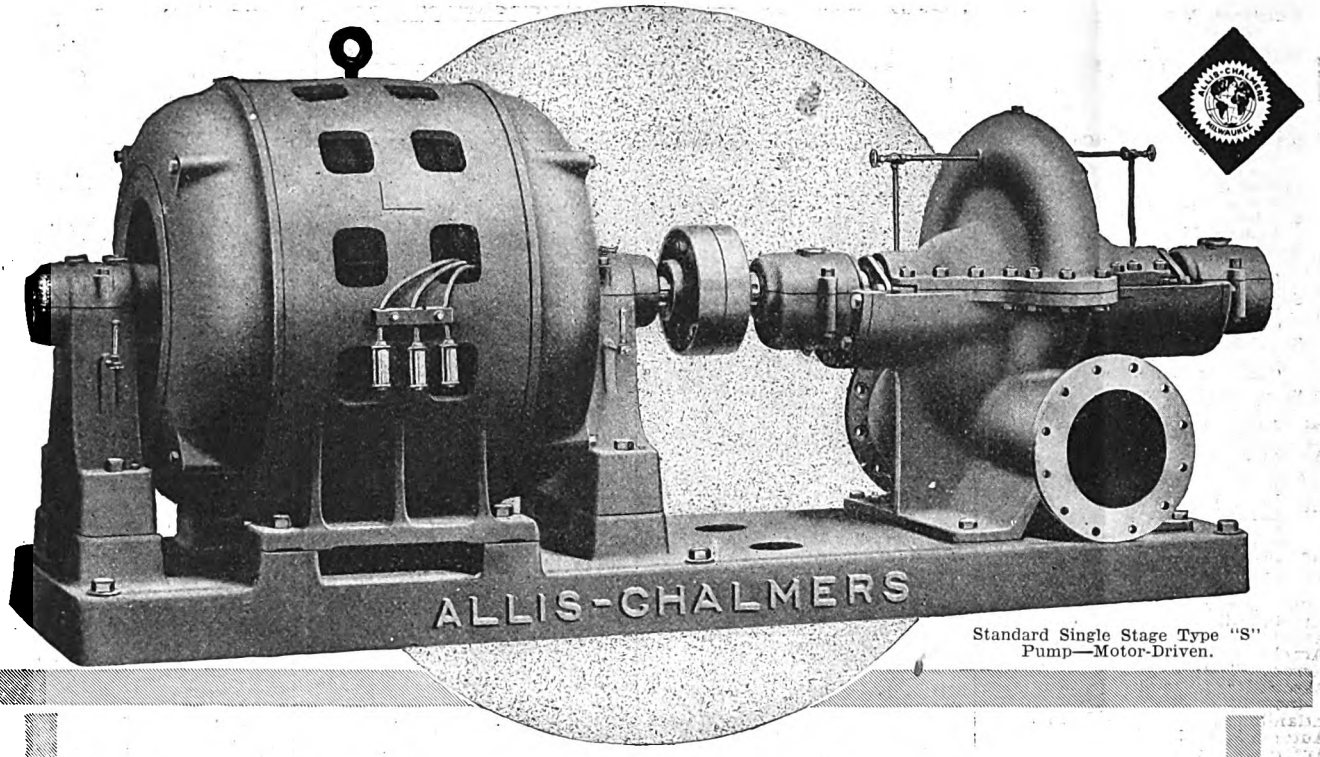

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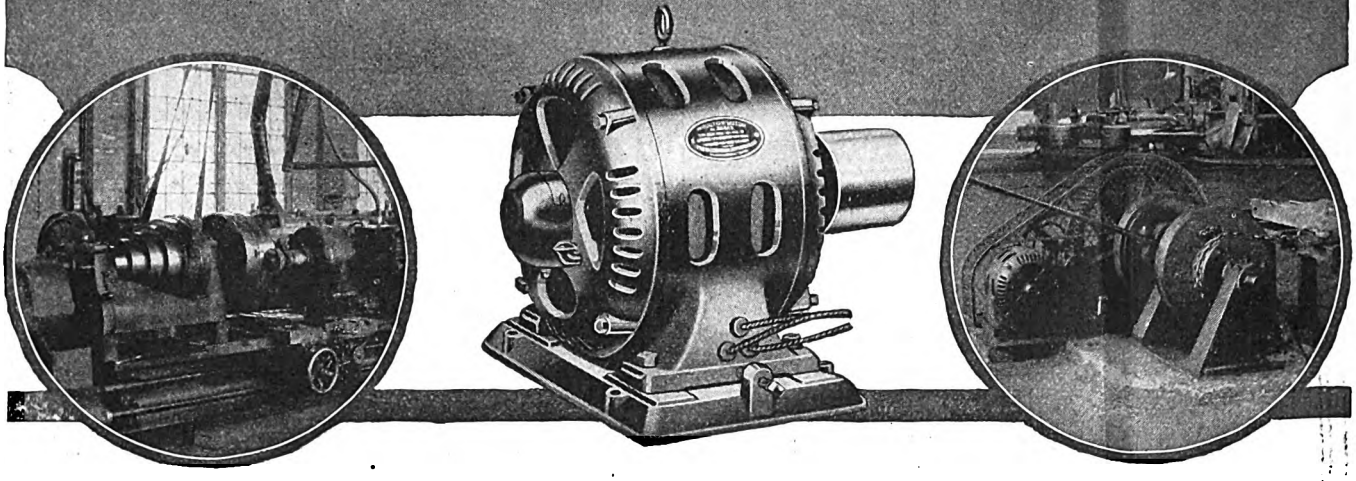

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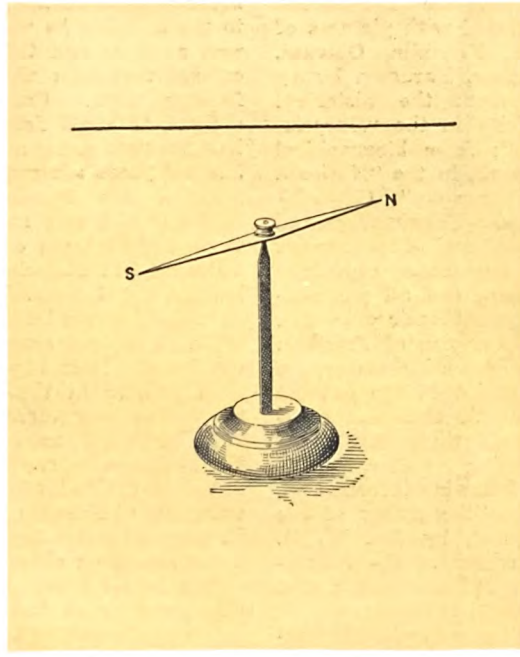

Supplement to Electrical World
JUNE 21, 1919
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THE facts and dates cited in the following pages have been gleaned from former volumes of the ELECTRICAL WORLD; from "Founders of Electrical Science," a booklet issued by the AMERICAN ELECTRICIAN previous to its amalgamation with the ELECTRICAL WORLD and illustrated with pictures of Gilbert, Guericke, Franklin, Galvani, Volta, Davy, Ampère, Faraday, Henry and Becquerel; from the historical article on electricity in the "Encyclopædia Britannica"; from biographical articles in that work, in the "National Dictionary of Biography" (British) and "La Biographie Universelle," and from various "lives" and other sources.

The portraits, reproduced especially for this supplement, are all pen-and-ink drawings from authentic originals. While, with the exception of Franklin and Kelvin, none of the likenesses can be said to be familiar to the general public or even to all electrical engineers, the rarest of them is that of Coulomb. Concerning the discovery of this portrait, the following information, kindly furnished to the writer of the text, on his request, by Mr. W. D. Weaver, former editor of the AMERICAN ELECTRICIAN and the ELECTRICAL WORLD, is of unusual interest:

"When seeking a portrait of Coulomb, I wrote to Mascart, whose course at the Collège de France I followed in 1874, for aid. In reply he said that, after inquiry in scientific circles and at the Bibliothèque Nationale, he found that no engraved portrait was known. There was, however, a medallion painting of doubtful authenticity on the ceiling of a large room in the building of the Institute of France. I commissioned a Paris photographer to make a plate of this, but after a visit to the building he wrote that the light was so poor and the portrait so discolored that he could not get a satisfactory plate. Consequently I was obliged to omit from the AMERICAN ELECTRICIAN series a Coulomb portrait. Several years afterward I happened to mention the incident to Professor Houston and was astonished to learn from him that one of his public-school colleagues in Philadelphia was a Coulomb, a lineal descendant of the French savant, of whom he had a painted portrait. I at once arranged for a reproduction of this, and the reproduction was then printed in the AMERICAN ELECTRICIAN or ELECTRICAL WORLD."

In electrical nomenclature each of the pioneers whose portraits will be found in the following pages, with the exception of Franklin, has been honored in perpetuity by the use of his name to represent an electrical unit.

The initial letter used on the opposite page shows the titlepage of Gilbert's epoch-making book, a first edition of which (1600) is included among the treasures added to the library of the United Engineering Societies at New York by the gift of Schuyler Skaats Wheeler.

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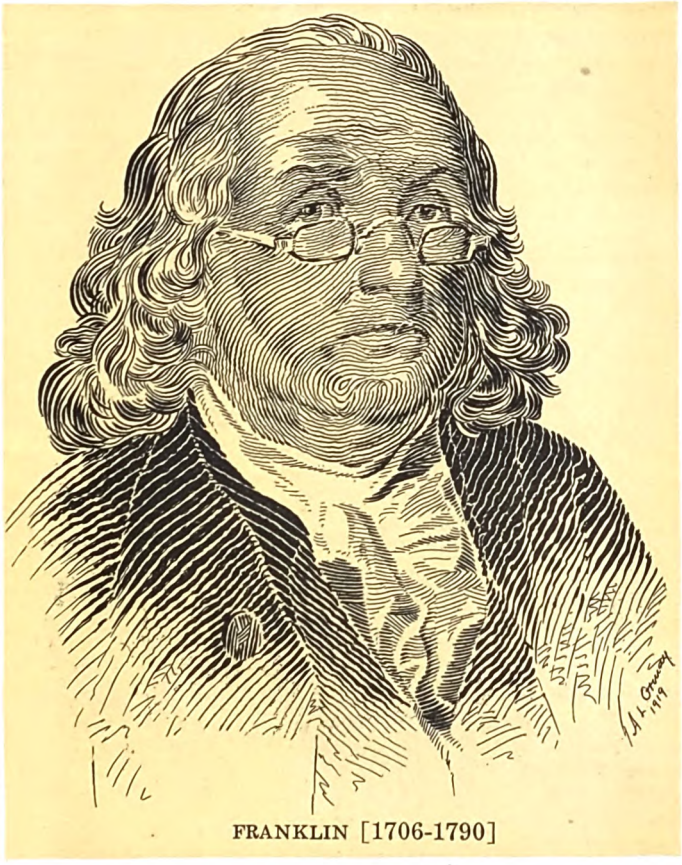
A Glance at Early Electrical Literature



FRANKLIN [1706-1790]

FROM the battle front came, just six centuries and a half ago, the first embryonic contribution to the vast library of electrical literature that exists to-day and grows larger with each passing year. For in A. D. 1269 Pierre de Maricourt (better known in his own day as Petrus Peregrinus), a soldier and Crusader, while serving at Lucera, Italy, within rude intrenchments that as a pioneer military engineer he had doubtless helped to construct, found time to investigate the mysterious properties of the lodestone and proclaimed to the scientific world in a Latin manuscript, of which contemporary copies are still intact, his discovery of the repulsion felt for each other by the simliar poles of a magnet.

For more than three hundred years magnetic research was carried little further. However, no less a man than Christopher Columbus, in 1492, while on the greatest of all historic voyages, jotted down in his logbook his observations on a phenomenon which, though probably discussed before, had never clamored for explanation until the ignorant and superstitious mariners of the "Santa Maria," "Niña" and "Pinta" saw with dread that the needle of the compass was no longer faithful to the north. Thus, in a sense, did America take a part

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in electrical discovery before she herself had loomed a reality or gained a name. Half a century after Columbus constructed his theory of magnetic declination at sea, George Hartmann, a Nuremberg vicar and the first of the German writers on electricity, made written announcement of his own corresponding discovery—that of the dip of the magnetic needle on land. Robert Norman of England subsequently but independently recorded the same discovery.

Another fifty years was to pass before the real father of electrical and magnetic science appeared. To England he owed his birth, to the medical profession his learning. William Gilbert, physician to Queen Elizabeth, probably spent little of his time prescribing for his royal patient or attending first representations of Shakespearean dramas at the Globe Theatre. He immersed himself in scientific studies, which bore full fruitage in the last year of the sixteenth century. Then appeared his epochal work, written in Latin as were virtually all learned books of that day, "De Magnete, Magneticisque Corporibus et Magno Magnete Tellure" (Concerning the Magnet, Magnetic Bodies and the Great Earth Magnet). The book, which is memorable as one of the first to employ the modern scientific method of deduction from experiment, established the distinction between electrical and magnetic attraction and demonstrated almost all the properties of the magnet.

COULOMB [1736-1806]

Dr. Gilbert made use of the Latin adjective *electrica,* as did other pioneer scientists in various lands; but it remained for another famous English physician, Sir Thomas Browne, whose "Religio Medici" and "Urn Burial" are still prime favorites with many a reading man, to introduce into the English language the noun "electricity." In his "Pseudodoxia Epidemica," or "Vulgar Errors," published in 1646, he remarked: "Crystal will calefy into electricity, that is a power to attract strawes or light bodies and convert the needle freely placed"; and in the same book he speaks of "electricities" as pertaining to certain kinds of salt. The word must rapidly have come into general use, for in 1676 "electricity" provided the subject for some observations in the "Experiments and Notes About the Mechanical Origin or Production of Particular Qualities," written by the famous Robert Boyle, alchemist, theologian, Oriental scholar and all-around man of science.

About this time appeared the "Nova Experimenta" of Otto von Guericke of Magdeburg, to whom belongs the honor of making the first electrical machine—a static generator. A generation later Francis Hauksbee of England published his "Physico - Mechanical Experiments on Various Subjects, Containing an Account of Several Surprising Phenomena Touching Light and Electricity Producible by the Attrition of Bodies," and Charles François de C. du Fay of France, as a result of experimental researches, divided electricity into two classes—vitreous and resinous: that is, positive and negative.

With the dawn of the revolutionary eighteenth century the awakened minds of men everywhere became curious concerning natural phenomena to a degree theretofore unknown. In that century lived George Graham, the London optician who in 1722 first conclusively established the daily and hourly variations of the magnetic needle; Stephen Gray, another Englishman, held by some to have laid the foundations of electricity as a science; Jean Théophile Desaguliers of France, who made important differentiations between conductors and non-conductors of electricity; John Canton, who discovered that positive and negative electricity

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could be produced at will in the same tube; the Abbé Haüy, the early French pyro-electrician; Franz U. T. Æpinus, the German savant who was one of the learned protégés of Catherine the Great and who from St. Petersburg issued a work on the single-fluid theory of electricity; Father John Baptist Beccaria and Tiberius Cavallo of Italy, the latter the inventor of a "multiplier" and a "condenser" of electricity and author of a noteworthy treatise on the embryo art; Benjamin Wilson, the painter-scientist, who was to engage Franklin in an animated controversy as to whether the tips of lightning rods should be rounded or pointed, and Joseph Priestley, the eminent preacher, reformer and philosopher, whose manifold interests included electrical research. Priestley's bones lie in the Pennsylvania of his self-chosen exile. To the great Henry Cavendish's comprehensive incursions into the realm of electricity, resulting in the promulgation of twenty-seven mathematical principles governing the action of the electric fluid, still more is due. The Leyden jar of Kleist, Watson and Bevis early in the century became a popular scientific toy, and Erastus Darwin, the learned physician and laborious poet whose grandson was to revolutionize men's ideas of creative processes, broke forth into rhymed rhapsody over the manner in which

VOLTA [1745-1827]

> "Cold from each point cerulean lustres gleam
> Or shoot in air the scintillating stream. . . .
> So from dark clouds the playful lightning springs,
> Rives the firm oak or prints the fairy rings."

All such names pale, however, before that of Benjamin Franklin, he who, in Turgot's grandiloquent phrase, "wrested lightning from the skies and the sceptre from tyranny." Franklin's three contributions to the infant science—the discovery that the electricity in a charged Leyden jar resides on the glass and not in the metal coating, the propounding of the single-fluid theory of electricity with its positive and negative varieties, and the establishment of the identity of lightning and electricity—are familiar even to laymen, and the letters and memoirs in which he set them forth are written with his characteristic lucidity and thoroughness.

Franklin's achievements excited worldwide interest, and nowhere more so than in France, where the first outstanding figure is that of Charles Augustin de Coulomb, whose "Recherches Théoriques et Expérimentales sur la Force de Torsion et sur l'Elasticité des Fils de Metal," etc., contain an account of his experimental investigation of the distribution of electricity on surfaces and of the laws of electrical and magnetic action. Of the mathematical theory of these laws Coulomb is regarded as the founder.

At the time when Franklin stood with his son in a Philadelphia doorway and manipulated his never-to-be-forgotten kite, in far-away Italy, in the beautifully situated lake town of Como, a seven-year-old boy was undergoing the formative process that was to lead to a career full of honors bestowed by his own and foreign countries for his accomplishments in science. Alessandro Volta exactly a hundred years ago returned to Como to spend his old age among the scenes of his childhood. He must have brought with him the proud prophetic conviction that when, inspired by his fellow-countryman, Aloisio Galvani, who had himself rested content with the discovery of contact electricity, he had constructed the voltaic pile, thus making possible the generation of electrical energy in appreciable quantities, he had laid the foundation of an art that was in time to revolutionize the industrial world. Volta's scientific writings are

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contained in a six-volume edition published at Florence when he was at the height of his living fame.

Thirty years later than Volta the Frenchman Ampère was born, and long before the Italian's death the Dane Oersted, the German Ohm, the Englishman Faraday and the American Henry had made their advent on the earth on which they were to leave deep and permanent impress. The international character of electrical science is thus established by a glance at the names of its great pioneers. This is surely in accordance with eternal fitness, for of the manifestations of no other art can it be said, as of electrical transmission, that space and time vanish before them.

OERSTED [1777-1851]

The great discovery —accidental though it may have been—of Hans Christian Oersted, who laid the foundation of all future electrical progress by conducting what he called, in a treatise written in Latin, "Experiments on the Effect of a Current of Electricity on the Magnetic Needle," these experiments proving that energy in the form of electricity could be converted into energy in the form of mechanical motion, is dated July 21, 1820—and here surely is a centenary anniversary worth commemorating next year. It remained, however, for André Marie Ampère to develop and extend the principles outlined by Oersted. The life of Ampère, first a precocious child, then a man of extraordinary versatility combined with childlike amiability and simplicity, affords features of dramatic interest. The guillotining of his father in the French Revolution and his own subsequent long-continued spell of dejection so extreme as almost to amount to imbecility, his recovery, his happy marriage and lifelong sorrow for a wife soon dead, and his steady rise to fame and a membership in the French Institute, make his biography as interesting from the human as from the scientific viewpoint. Ampère was the inventor of the term "electrodynamics" and the father of the science of electromagnetism. In the library of science his "Mémoires sur la Théorie Mathématique des Phénomènes Electrodynamiques" is his monument.

Volta was a college professor at Pavia, Oersted at Copenhagen, Ampère at Paris. Georg Simon Ohm, whose name is as indissolubly connected with the law for determining the magnitude of an electric current as is Newton's with the law of gravitation, taught successively at Cologne, Nuremberg and Munich. His great contribution to electrical literature is "Die galvanische Kette mathematisch bearbeitet" (The Galvanic Series Mathematically Demonstrated). A countryman and contemporary of Ohm's, Karl Friedrich Gauss of Göttingen, shares with him and others of the pioneers the honor of standing posthumous sponsor for an electrical unit. Gauss's classical memoir on the measurement of magnetic force is worthily companioned by the writings of his colleague Wilhelm Eduard Weber on the measurement of electrical quantities.

The "Contributions to Electricity and Magnetism" by another illustrious college professor, Joseph Henry of Princeton, N. J., first published in the *Transactions* of the American Philosophical Society from 1835 to 1845, constitute America's chief addition to the science at this period. Henry, whose enthusiasm as an experimenter led him to immolate his wife's silk petticoat on the altar of insulation, besides inventing the first operative telegraph and making an independent discovery of electromagnetic induction, was also the first to investigate self-induction and oscillatory discharges.

Many eminent British scientists of the early

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nineteenth century touched the electrical field in the course of varied activities—among them Sir David Brewster and Sir Humphry Davy, the latter the principal founder of electrochemical science and a man who by lectures and practical demonstrations did much to enhance popular interest in electricity. Greater than he, however, in the electrical world was to be the blacksmith's son and journeyman bookbinder whom Davy helped to his first success, who labored fifty-four years in the laboratory of the Royal Institution of Great Britain, and who, despite envy and aspersion, made good his right to stand in the forefront of early electrical scientists—whose career, in fact, covered the period between the sapling and the half-grown tree, between the fragmentary knowledge and undeveloped conceptions of the pioneers and the proved theories and demonstrated facts of the moderns. "Without experiment I am nothing," said Faraday. The work of this remarkable man, in whose character devotion to truth, kindness and energy were blended, laid the foundations upon which the industrial applications of electricity in great measure rest. The results of his experiments concerning the induction and creation of electrical currents, the laws of electrolytic action, the effect of magnetism on polarized light and the phenomena of diamagnetism are described by him in his "Experimental Researches in Electricity," papers published over a long term of years beginning with 1831.

AMPÈRE [1775-1836]

Two more illustrious Frenchmen of the earlier electrical days—Dominique François Arago, whose researches supplemented those of Ampère and who differentiated himself from nearly all of his scientific brethren by his active participation in political life, and Antoine César Becquerel, a military engineer who discovered the principles of voltaic polarization from which followed the practical primary battery—deserve mention in even the briefest of lists of electrical writers; while Joseph Louis Gay-Lussac should be included for his notable studies of terrestrial magnetism.

It is interesting to look back on the way in which great men have been viewed by those contemporaries who knew them and were best qualified to judge. Ampère, Faraday and Henry were the typical electrical scientists of their respective countries and eras. On each of them sidelights have been cast by eminent friends or successors. Arago, for instance, wrote a eulogy of Ampère from which this passage, dealing with one of the latter's signal triumphs, is taken:

"In all the magnetic experiments attempted before the discovery of Oersted the earth had acted like a large lodestone. It was to be presumed, then, that it would act like a magnet on electrical currents. Experiment, however, had not justified the conjecture. Calling to his aid the electrodynamic theory and the talent for inventing apparatus so brilliantly displayed by him, Ampère had the honor of filling the inexplicable hiatus.

"For several weeks native and foreign physicists crowded the humble study in the rue Fossée Saint-Victor to witness with amazement a connecting wire of platina take a definite direction through the action of the terrestrial globe. What would Newton, Halley, du Fay, Æpinus, Franklin and Coulomb have said if it had been announced to them that a day would come when, in default of a magnetic needle, navigators would be able to guide their vessels by observing electrical currents, electrified wires?

"The action of the earth as a conducting wire is identical in all the circumstances presented by it with that which would proceed from an assem-

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blage of currents having its seat in the depths of the earth, south of Europe, and whose movements would be like the diurnal revolution of the globe from west to east. Let it not be said, then, that, the laws of magnetic action being the same in the two theories, it is a matter of indifference which to adopt. Suppose the theory of Ampère true, and the earth, as a whole, inevitably a vast voltaic pile, creating currents moving in the direction of the diurnal revolution; then the memoir in which is found this magnificent result will take rank, without disadvantage, with the immortal works which have made of our globe a simple planet, an ellipsoid flattened at the poles, a body formerly incandescent in all its parts — incandescent still down in its depths but retaining on its surface no appreciable trace of this original heat."

OHM [1787-1854]

Among the warmest admirers of Faraday was the great scientist John Tyndall, himself a writer on electricity. He put on record accounts of a number of Faraday's experiments which show the thoroughness of the experimenter. The following extract refers to one dating back to 1831:

"Take the case of a telegraph wire with its two terminal plates dipped into the earth and suppose the wire to lie in the magnetic meridian. The ground underneath the wire is influenced, like the wire itself, by the earth's rotation; if a current from south to north be generated in the wire, a similar current from south to north would be generated in the earth under the wire; these currents would run against the same terminal plate and thus neutralize each other. The inference appears inevitable, but Faraday's profound vision perceived its possible invalidity. He saw that it was at least possible that the difference of conducting power between the earth and the wire might give one an advantage over the other and that thus a residual or differential current might be obtained. He combined wires of different materials and caused them to act in opposition to each other, but found the combination ineffectual. The more copious flow in the better conductor was exactly counterbalanced by the resistance of the worst.

"Still, though experiment was thus emphatic, he would clear his mind of all discomfort by operating on the earth itself. He went to the round lake near Kensington Palace and stretched 480 feet of copper wire, north and south, over the lake, causing plates soldered to the wire at its ends to dip into the water. The copper wire was severed at the middle and the severed ends were connected with a galvanometer. No effect whatever was observed. But though quiescent water gave no effect, moving water might. He therefore worked at Waterloo Bridge for three days during the ebb and flow of the tide, but without any satisfactory result. Still he urges: 'Theoretically it seems a necessary consequence that where water is flowing there electric currents should be found. If a line be imagined passing from Dover to Calais through the sea and returning through the land, beneath the water, to Dover, it traces out a circuit of conducting matter, one part of which, when the water moves up or down the channel, is cutting the magnetic curves of the earth, while the other is relatively at rest.' . . . This was written before the submarine cable was thought of."

When Henry died he was secretary of the Smithsonian Institution and also president of the National Academy of Sciences. Before the latter organization Simon Newcomb, the famous astronomer, in eulogizing the dead scientist, spoke appreciatively both of the handicaps under which he had labored and of his unselfish character. He said:

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"Few have any conception of the breadth of the field occupied by Professor Henry's research or of the number of scientific enterprises of which he was either the originator or the effective supporter. . . . The contributions to science of an American of the last few generations afford an entirely insufficient standard of judgment, though it is a standard which writers are prone to adopt as if it were the only one. We are apt to forget that science is a plant of cultivation which rarely or never flourishes in a state of isolation and reaches full fruition only when it can absorb into its own growth the fertile ideas of many associated minds. Leaving out a few powerful intellects who started our modern system of investigating nature, a high development of the scientific spirit has been attained only by a communion of ideas through the medium of academies, institutions and journals. . . .

"If it shall appear that Henry's contributions to electricity were less numerous and brilliant than those of Faraday, let us consider not simply the immensely wider field of his intellectual and public activity, but the different situations of the two men. The one occupied the focus of the intellectual metropolis of the world, commanding at pleasure every sort of apparatus which money could purchase or art produce, and was surrounded by an admiring crowd of the élite of society, eagerly hearing of his every discovery and listening attentively to all his utterances. The other was during his early prime an overworked instructor, almost out of the reach of the great treasures of foreign scientific literature and with none of the advantages enjoyed by his great competitor.

"Another circumstance not to be lost sight of is that Henry, in obedience to one of the great principles of his life, relinquished to others each field of investigation at the very time when he had it so far cultivated as to yield most fame and profit to himself. . . . Notwithstanding his literary productiveness, he rarely if ever wrote a paper to yield him the honorarium of a magazine contributor. . . . His principles kept him outside of all competition, jealousies and cross-purposes, and all combined gave his recommendations a force founded on assurance of their disinterestedness."

HENRY [1797-1878]

With the the dawn of modern times, electrically speaking — starting with James Clerk Maxwell's enunciation of the electromagnetic theory of light in 1865 and the invention of the self-exciting dynamo—the names multiply in ever-increasing ratio, and it is possible to mention here only a few among the most distinguished, leaving, indeed, the men of our own day—the day of alternating currents, of absolute quantitative measurements and, above all, of the application of this knowledge in electrical engineering — entirely untouched.

Savants have the habit of long life, and many electrical scientists have more than spanned one period in the art's development. Helmholtz, whose writings on electrodynamics and electrical oscillations form an important part of his work, reached seventy-three; Oersted seventy-four; Faraday seventy-six, Gauss seventy-eight, Henry eighty-one, Volta eighty-two, Franklin eighty-four, Weber eighty-seven, the famous Humboldt, whose cosmical mind touched electricity through his researches into terrestrial magnetism, ninety, while Franz Ernst Neumann, who did for electromagnetic induction what Ampère did for electrodynamics, outdid them all by reaching ninety-seven. But Clerk Maxwell, unfortunately for his chosen art, died before his time, at forty-eight, his great "Treatise on Electricity and Magnetism" having been published in 1873, six years before his death. Jean B. L.

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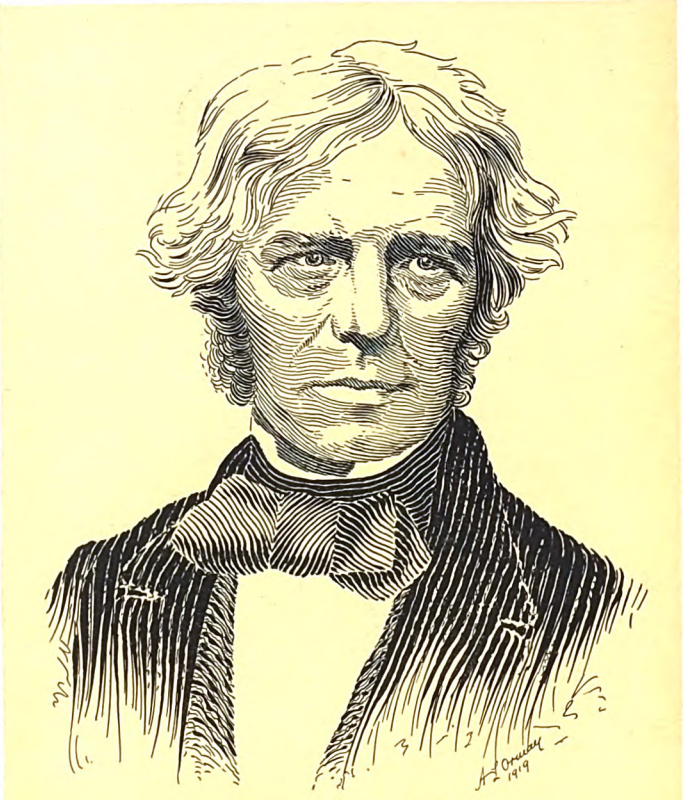
Foucault, whose papers are among the most notable in the *Comptes Rendus* of French science and the centenary of whose birth falls this year, was only forty-nine, and Heinrich Rudolf Hertz, Helmholtz's favorite pupil, who was the first to measure the length and velocity of electromagnetic waves, lived only to be thirty-seven.

Other names which cannot be omitted are those of Rudolf J. E. Clausius of Germany, chiefly famous for making thermodynamics a science, but who also advanced the molecular theory of electrolysis indorsed in our own day by Arrhenius of Sweden; the Englishman James Prescott Joule—like Maxwell honored by having a unit named after him—who published a series of valuable researches on the agency of electricity in transformations of energy and to whom the British Association committee on standards of electrical resistance intrusted the task of deducing the mechanical equivalent of heat from the thermal effects of electrical currents; Sir Charles Wheatstone, the shy genius for whom the Wheatstone bridge (invented, however, by S. H. Christie in 1833) was named and to whom is due not only a great advance in early telegraphic research but also the earliest experiments with submarine cables, and Sir Charles Siemens, a naturalized British subject, who, in a paper read before the Royal Society of England in 1867 "On the Conversion of Dynamical Into Electrical Force Without the Aid of Permanent Magnetism," announced the invention by his German brother and co-worker in electrical science, Ernst Werner Siemens, of a dynamo-electric machine.



FARADAY [1791-1867]

But the most eminent name in this transition period is surely that of William Thomson (Lord Kelvin), who died only twelve years ago, at the age of eighty-three. It was Thomson who laid the foundation of the modern knowledge of electrostatics. His work on the electrodynamic qualities of metals, thermo-electricity and galvanometry is equally great. In the "Reprint of Papers on Electrostatics and Magnetism" in 1872 and in his later "Mathematical and Physical Papers" is embodied some of the greatest electrical literature. To have been the acknowledged leader in electrical science in the days when telegraphy took great strides, when to America's lasting renown the telephone and the electric incandescent light sprang full-panoplied from the brains of Bell and Edison, when long-distance transmission at high tension became a commonplace, when electric power houses began to dot the civilized world and waterfalls everywhere to be brought into harness, is the proud distinction of Kelvin's career. He lived to see the disappearance of the horse-drawn car from city streets and the employment in medical clinics of the wonder-working X-rays due to the genius of Crookes and Röntgen.

The immense bulk which electrical literature has attained will be realized when the statement is made that in the great library of the United Engineering Societies at New York, numbering 135,000 books and pamphlets, from a fifth to a fourth of the entries pertain to electricity. The printed word has kept pace with invention—description and detailed theory following hard on practical achievement and intermingling with it. The inventor and the technician are, indeed, often merged in one individual. In former generations the reports of governments and of scientific societies, occasional brochures and long-deferred books were the only means of keeping up with the progress of the art. With the founding of electrical newspapers this ceased to be the case. The London *Electrician* was started as far back as 1861, *La Lumière Electrique* (now merged in the *Revue*

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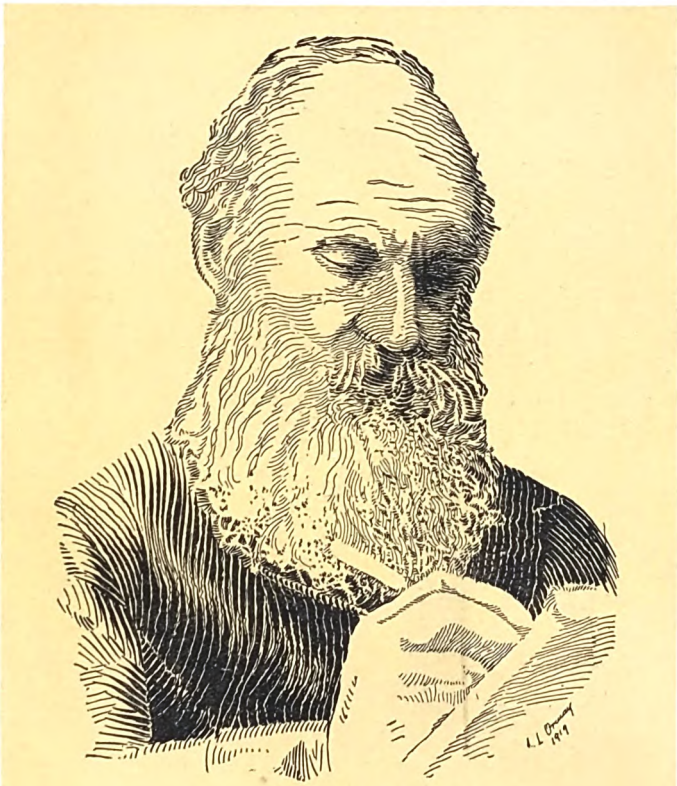
Générale de l'Electricité) in 1879, the *Elektrotechnische Zeitschrift* in 1880, and the ELECTRICAL WORLD in 1883. The ELECTRICAL WORLD was the successor of the *Operator*, founded about nine years earlier and, like the early electrical journals of other countries, devoted largely to the interests of the telegraph, which, under the spur of the genius of Samuel F. B. Morse, had revolutionized the world. These are other periodicals devoted to electricity are electrical literature in the making.

The ELECTRICAL WORLD, which covers the whole field of research abroad and at home, is indispensable to American electrical engineers. It contains every year a résumé of the developments that have taken place in electrical apparatus and an outlook into future progress in this line. It outlines regularly the problems and records the advances in the central-station field, which is the measure of the electrical industry. In the weekly department headed "Technical Theory and Practice" a digest or summary of every important article bearing on electricity which appears in the scientific and engineering press of the world is given, while once a month a summary of scientific and industrial research in the form of investigations contemplated or completed, research facilities available and suggestions for coöperative work finds space. All important papers on electrical subjects read before technical societies are abstracted, frequently with a report of any discussion that ensued, and advance announcements of meetings in all parts of the country at which such papers are to be presented appear every week.



KELVIN [1824-1907]

While the electrical scientists and engineers of America were bending all their energies to help win the terrific war for justice and democracy little research to which publicity could be given was completed. Such achievements as could be recorded and such problems as could be discussed received full treatment in the pages of the ELECTRICAL WORLD. During the war and since the signing of the armistice many subjects like those which follow have received comprehensive and careful treatment: Electric welding, factors involved in applying relays, outdoor-substation design, electrical precipitation of gases, electric propulsion of ships, multiplex telephony, radio development during the war (the first authoritative report on this subject), insulator problems and study, transmission-line computation, use of static condensers, development of self-starting synchronous motors, the Weagant method of overcoming static disturbances, a radical development in vacuum tubes, and electric furnaces in non-ferrous metallurgy. Besides the many technical articles of this description, an almost continuous account of interconnection projects and achievements in all parts of the nation and of the benefits derived has been printed; while the issue preceding the Victory convention of the National Electric Light Association at Atlantic City gave an elaborate account of central-station war problems and expedients in New England, the Middle Atlantic Coast States, the Central West, the South and the Pacific slope. The topics which relate directly to applied engineering demand more careful consideration than ever from the man who is designing new apparatus or striving to improve existing types, for in the users' problems may be found the nucleus from which future investigation must develop.

The volumes of the ELECTRICAL WORLD form, each for its own period, a microcosm of the whole electrical industry in its theoretical, inventive, operative, commercial, manufacturing and public-policy aspects. As in the past, so in the future it will leave undone nothing to prove itself worthy of the comprehensive name it bears.

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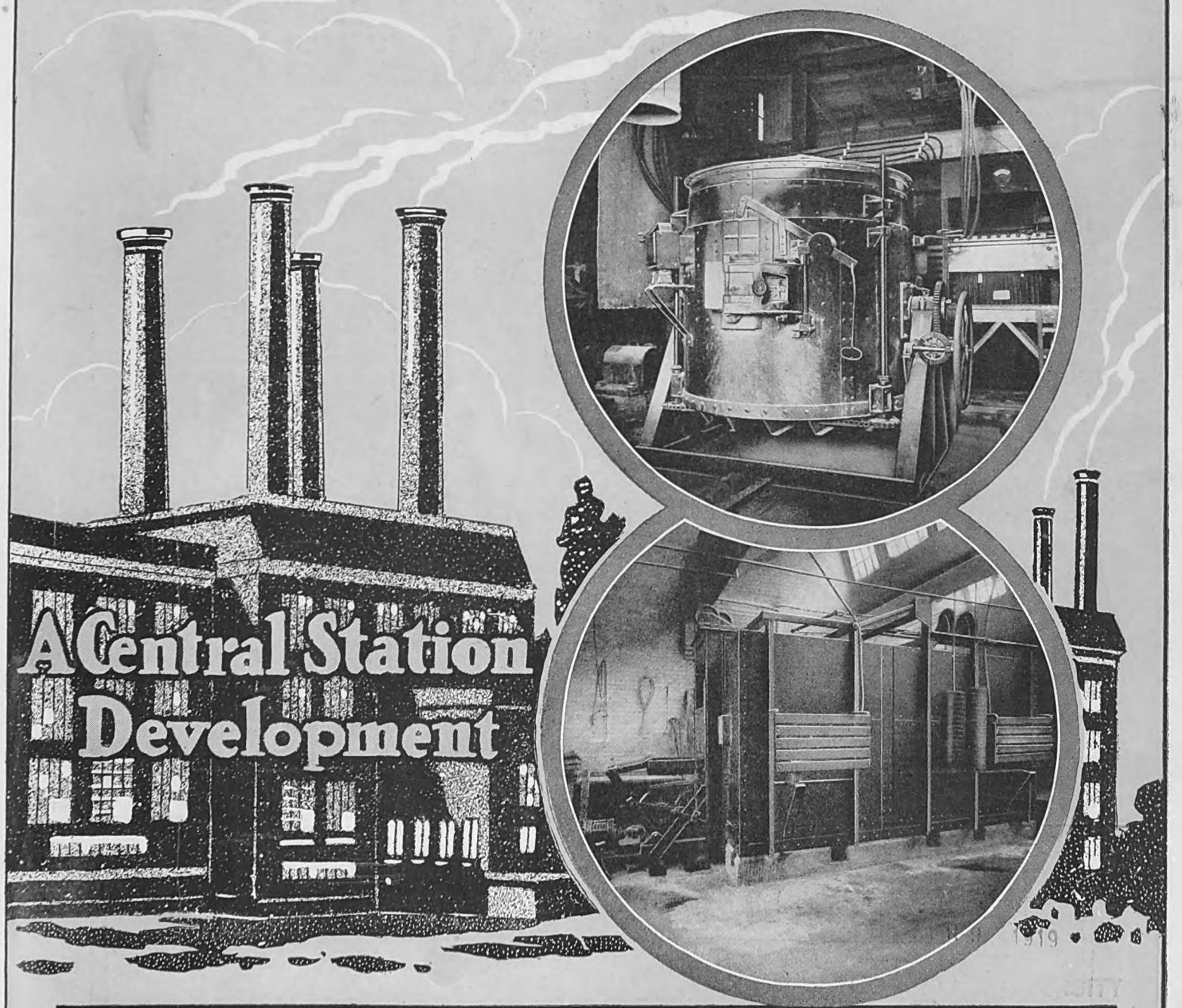
Electrical World

McGraw-Hill Company, Inc. New York, April 5, 1919 15c a copy



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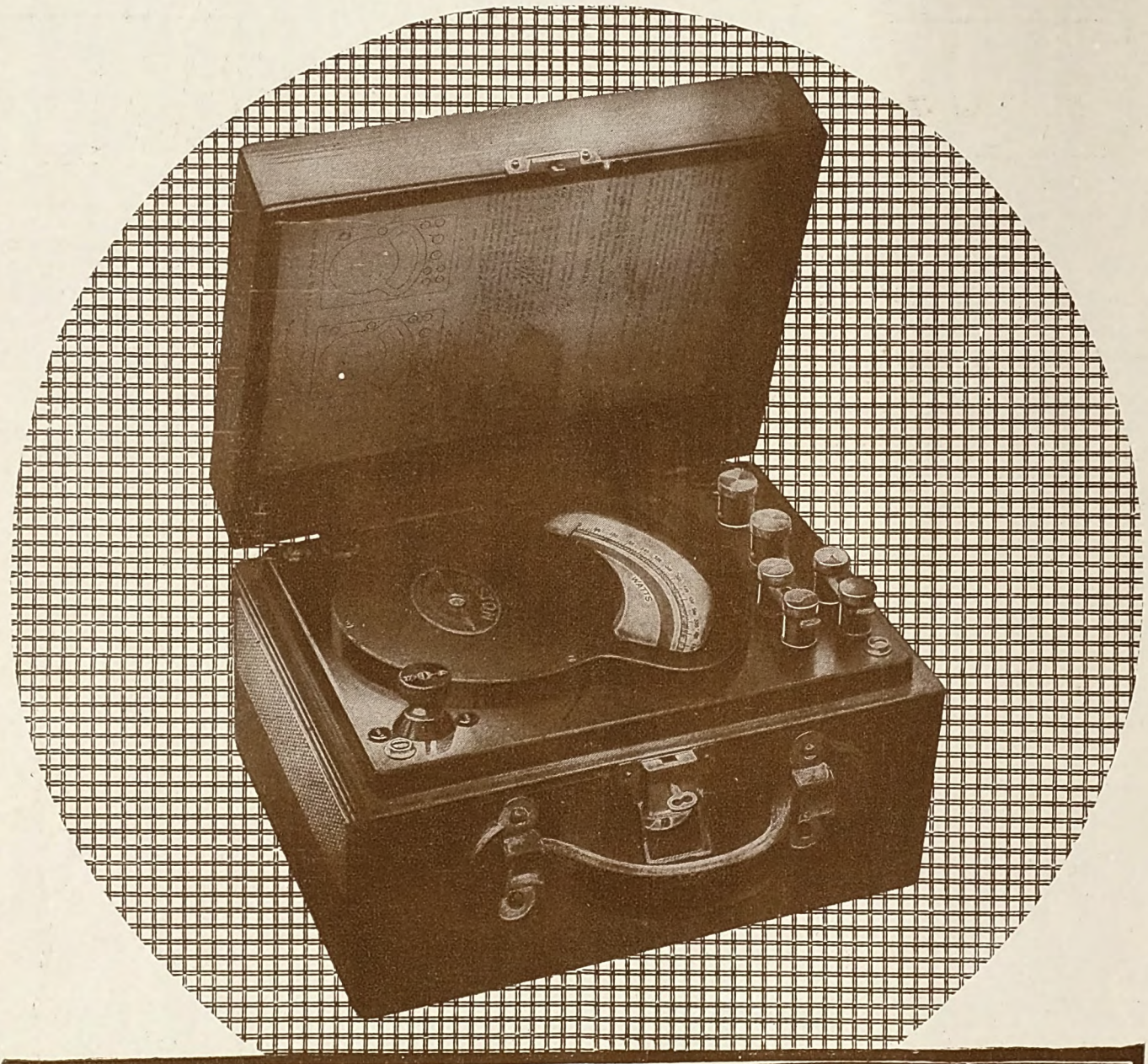

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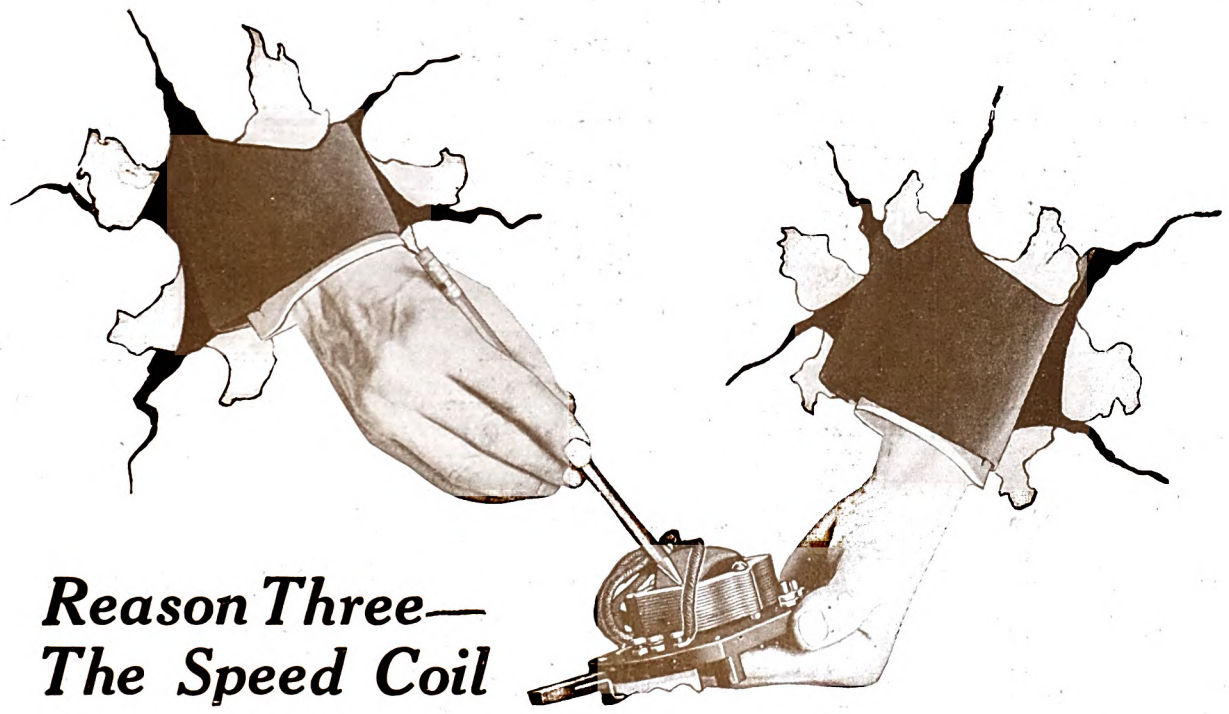

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PHILLIPSDALE, R. I.

Bare and Insulated Electric Wire
Electric Light and Line Wire
Railway Feeder and Trolley Wire
Galvanized Iron Wire and Strands

NEW YORK OFFICE, - 233 Broadway
CHICAGO OFFICE, - 112 West Adams St.
BOSTON OFFICE, - 176 Federal St.
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1870 - EUGENE F. PHILLIPS - AMERICAN ELECTRICAL WORKS - 1882

PRESSURE TEMPERATURE SPEED

FOXBORO
TRADE MARK

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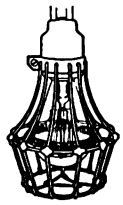
Accurate—Can be depended on for correct results.
Durable—Their rugged construction means longer service.
Simple—Both in construction and operation.
Other points are given in Bulletin AG-96.

THE FOXBORO CO., INC., FOXBORO, MASS.
New York Chicago Pittsburgh St. Louis
Birmingham San Francisco
TIME 3 FLOW



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Matthews' Holdfast Guards are each furnished with a Trap that fits across the bottom opening and which can be locked there with a pair of pliers. This Trap can be used over and over again and when worn out can be replaced at small expense. It effectually stops the troubles illustrated.

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Stocked by all jobbers

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St. Louis, U.S.A.

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ANSONIA ELECTRICAL

SHIELD BRAND

Also Annunciators, Acme, Eureka and Wizard Iron and Wood Box Bells and Buzzers, Push Buttons, Daisy Floor Treads, Etc.

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Office and Factory, Ansonia, Conn., U. S. A.

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Heat-Resisting Molded Insulation. Made by specialists exclusively devoted to solving your molding problems.

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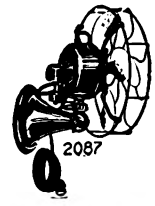
Magnet Wire helps to make a success of Liberty Motors

Massachusetts Electric Mfg. Co.
West Lynn, Mass.

Emerson



Fans—Oscillating, Ceiling, Gyrating types with 5 Year Factory-to-user Guarantee. Also Northwind Universal Fans.

Motors — Split-phase and repulsion-start types, small multiphase motors; D. C. Motors, sizes 2 hp. and less exclusively.

The Emerson Electric Mfg. Co.
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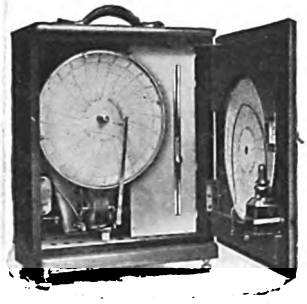

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Voltmeters, Ammeters and Watt meters can be furnished in either round chart or strip chart type and for switchboard or portable use.

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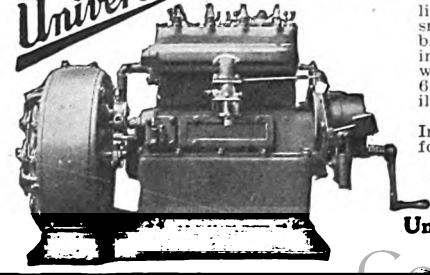
THE BRISTOL COMPANY
Waterbury, Conn.

Electric Generating Set
Flickerless Light for

Universal



lighting of residences, small towns or boats; battery charging; moving picture projection; wireless, etc.—4 K.W., 60 or 110 volt set illustrated.

In use by U. S. and foreign governments.

Ask for Bulletin 26

Universal Motor Co.
Oshkosh, Wis.

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Sibley

Electrical World

McGraw-Hill Company, Inc. New York, June 28, 1919 15c a copy

There are approximately 40,000 homes that boast an Electric Kitchen—and about 25,000 are equipped with a Hughes Range. The Hughes is the most generally sold and the most popular with Central Stations.

HUGHES RANGE ADVERTISING

This season we are running a strong campaign to tell the housewives of America about the advantages of Electric Cooking. Just look over this list. And look up some of these advertisements for your own information.

JUL 1 1919

Saturday Evening Post—full page—black and white—May 10 Saturday Evening Post—full page—black and white—June 7 Saturday Evening Post—full page—black and white—July 12 Saturday Evening Post—full page—black and white—Aug. 9	9,947,900 readers for each issue
American Magazine—full page—four colors—July American Magazine—half page—black and white—August	5,350,660 readers for each issue
Woman's Home Companion—full page—black and white—May Woman's Home Companion—full page—four colors—July	5,814,560 readers for each issue

To the Central Station national advertising such as this is a vital factor in building up a Range business. Get a copy of our Range Bulletin. Also copies of a new Range Folder for distribution to your customers.

HUGHES DIVISION
Edison Electric Appliance Co., Inc.

New York Atlanta Chicago Ontario, Calif.

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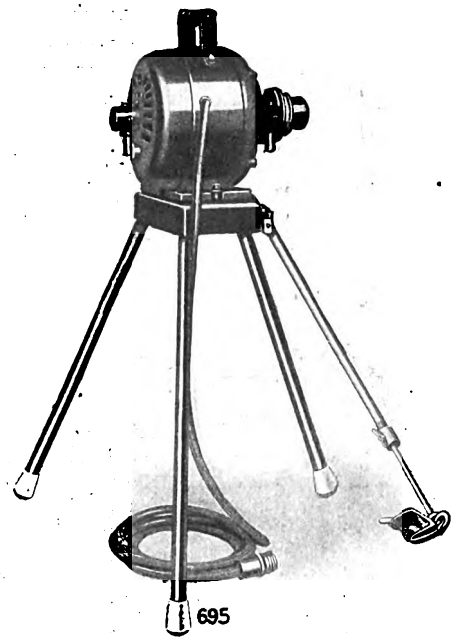
Robbins & Myers New Power Stand General Utility Motor



This new motor is especially suited for driving the many small power machines about the farm and country home. It is portable so it can be carried easily from place to place and connected up to the washing machine, churn, cream separator, grindstone, ice cream freezer or any of the other small power machines which can be equipped with a pulley.

The outfit consists of a ¼ H.P. motor, with a spiral type back gear which reduces the motor speed of 1150 r.p.m. to a speed of 285 r.p.m. at the pulley. The gears are fully enclosed and packed with grease.

A three-step pulley is supplied which consists of groove pulleys of 4 inches and 3 5/16 inches diameter for 5/16-inch round belt and a crown pulley of 2½-inch diameter and 2-inch face for flat belt.

The motor is mounted on an iron tripod base with rubber caps on the feet. A brace rod with a clamp for attachment to the driven machine is provided to maintain the belt tension. The rod is telescopic for adjustment of length and the clamp can be turned at any angle. Cord and plug are supplied with the outfit.

The motor is furnished for operation on 32-volt private lighting plant circuits and for 110-volt, 60 cycle a.c. circuits.

Descriptive circular sent on request.

THE ROBBINS & MYERS CO., SPRINGFIELD, O.

New York Boston Philadelphia Buffalo Cleveland Cincinnati Chicago St. Louis San Francisco

Robbins & Myers Motors

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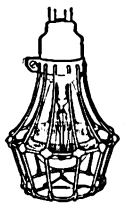

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MASSACHUSETTS MAGNET WIRE

Every Navy Yard uses Magnet Wire for field coils

Massachusetts Electric Mfg. Co.
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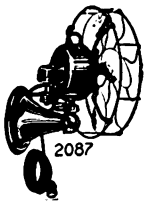

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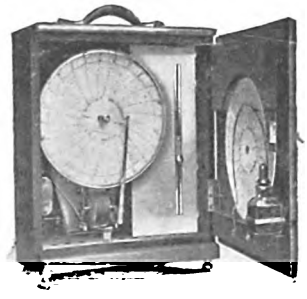

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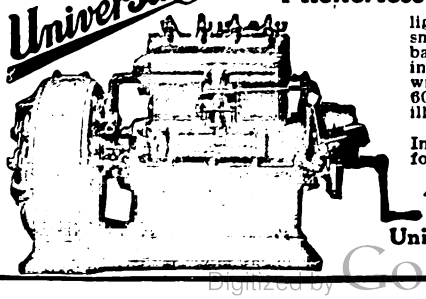

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